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SYSTEMATIC REVIEW

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Epidemiology of hepatitis B virus infection among pregnant women in Africa: a systematic review and meta-analysis

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Abstract

Background Although hepatitis B infection is highly endemic in Africa, information on its epidemiology among pregnant women in the region is limited. Therefore, this systematic review provided up-to-date information on the epidemiology of hepatitis B virus (HBsAg) infection among pregnant women in Africa.

Methods A systematic review and meta-analysis was conducted according to the Preferred Reporting Items for Systematic Reviews. The Web of Science, Scopus, PubMed, Google Scholar, and African journals online were searched to identify relevant studies published between January 1, 2015, and May 21, 2024, on hepatitis B virus infection in pregnant women living in Africa. The Joanna Briggs Institute tool was used to assess the methodological qualities of the included studies. The random effects model was used to estimate the pooled prevalence of HBV infection. I^2 assessed the amount of heterogeneity. Publication bias was assessed using Egger's test and a funnel plot.

Results We included 91 studies from 28 African countries. The pooled prevalence of hepatitis B infection among pregnant women in Africa was 5.89% (95% CI: 5.26–6.51%), with significant heterogeneity between studies ($I^2 = 97.71\%$, $p < 0.001$). Family history of hepatitis B virus infection (AOR = 2.72, 95%CI: 1.53–3.9), multiple sexual partners (AOR = 2.17, 95%CI: 1.3–3.04), and sharing sharp materials were risk factors for hepatitis B infection.

Conclusion An intermediate endemic level of hepatitis B virus infection (2–7%) was observed among pregnant women in Africa. To prevent disease transmission, interventions should focus on pregnant women with a family history of hepatitis B infection, multiple sexual partners, and sharing sharp materials.

Keywords Africa, Epidemiology, Hepatitis B infection, Pregnant women

Introduction

Hepatitis B is a viral infection that affects the liver and can result in acute and chronic disease. The virus is commonly spread from mother to child during birth or in the early stages of life. Improper injection methods, exposure to sharp objects, or contact with infected blood or body fluids during intercourse can result in HBV infection [1]. Globally, chronic HBV infection is the leading cause of cirrhosis and liver cancer, affecting 296 million people [2]. Geographically, the prevalence of chronic HBV infection is categorized as low (< 2%), intermediate (2–7%), and high (> 8%) [3]. In 2019, the global prevalence of chronic HBV infection was estimated to be 4.1%, with 316 million individuals affected [4]. Hepatitis B virus (HBV) infection rates have declined in various countries due to the initiation of universal HBV vaccination programs. Nevertheless, the disease remains at an intermediate or high level in low-income countries that lack the resources to

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implement such programs [5]. In an institutional-based study in Thailand conducted between 2003 and 2022, the prevalence of HBV infection among pregnant women was 3.15% [6]. The prevalence of HBV infection among pregnant Iranian women was 1.18% [7]. In Yemen, HBV infection was 10.8% among pregnant women [8]. Hepatitis B virus is endemic in sub-Saharan Africa [9], despite the introduction of universal vaccination and effective antiviral therapy. The estimated overall seroprevalence of hepatitis B surface antigens is 6·1% [10]. Approximately 70% of all hepatitis B infections worldwide occur in Africa. About 91 million Africans have been infected with hepatitis B and C (82 million live with hepatitis B and 9 million with hepatitis C) [11]. The prevalence of hepatitis B infection was 5% among healthcare workers [12] and 6.8% among pregnant women [13] in Africa. In East Africa, the prevalence of HBV infection was 6.03% [14]. The pooled prevalence of HBV infection among pregnant women in Nigeria was 6.49% [15]. In Ethiopia, the pooled prevalence of HBV infection among pregnant women ranged from 4.7% to 5.78% [16–18].

Hepatitis B virus infection is a major burden in most developing countries because of its widespread transmission, especially in rural areas, and the high cost of prevention, management, and treatment [5]. The risk of hepatitis B seroprevalence increases with low income [19]. Blood transfusion, multiple sexual partners, and tonsillectomy were significant risk factors for HBV infection [20]. A study in Egypt indicated that a family history of HBV, previous intravenous injections, hospital admission, and surgeries were the risk factors for HBV infection [21]. Ear piercings, tattoos, and abortions are risk factors for HBV infection [22]. Women with less than 20 years of age [23] and those with a low perception of HBV risk [24] were at higher risk of infection.

Prevention of mother-to-child HBV transmission is critical for the global elimination viral hepatitis [25]. Screening pregnant women for hepatitis B surface antigen (HBsAg) is essential to reduce the risk of infection [26]. Tenofovir is a recommended drug for both vertical transmission prevention and active treatment of chronic hepatitis B during pregnancy [27]. Engagement with sub-Saharan African patients with chronic hepatitis B is challenging because of the stigma associated with the diagnosis, the lack of routine screening programs, and difficulties in accessing healthcare systems [28]. Introduction of hepatitis B birth doses, improvement of 3 doses of hepatitis B vaccine and hepatitis B-birth dose coverage, and monitoring and implementation of elimination of mother-to-child transmission interventions are essential to accelerate progress toward hepatitis B control and elimination in Africa [19, 26]. Despite the availability of effective vaccines for more than 40 years in Africa, immunization for hepatitis B and antenatal tenofovir prophylaxis for highly viraemic women are still not widely used, leading to 990,000 new infections annually [29].

Although HBV is endemic in Africa [29], there is limited information about the burden of the disease among pregnant women on this continent using robust evidence from systematic reviews and meta-analyses. Up-to-date

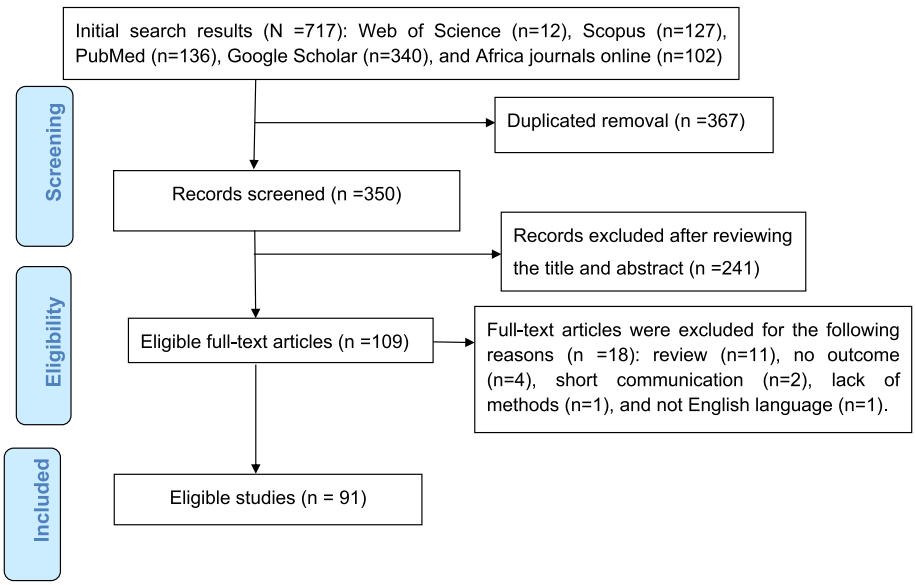

Fig. 1 The PRISMA flow chart for selecting studies for systematic review

Table 1 Characteristics of the included studies

ID	Authors	References	Study country	Study design	Sample size	Cases	Prevalence
1	H Brahimi, et al. 2021	[37]	Algeria	cohort	2165	39	1.8%
2	Vueba AN, et al. 2021	[38]	Angola	cross-sectional	878	226	25.7%
3	Mbangiwa T, et al. 2018	[39]	Botswana	cohort	752	16	2.1%
4	Yelemkoure ET, et al. 2018	[40]	Burkina Faso	cross-sectional	237	22	9.3%
5	Ouoba S, et al. 2023	[41]	Burkina Faso	cross-sectional	1622	106	6.5%
6	Eyong EM, et al. 2019	[42]	Cameroon	cross-sectional	2647	175	6.6%
7	Fouelifack FY, et al. 2018	[43]	Cameroon	cross-sectional	360	34	9.4%
8	Noubiap JJ, et al. 2015	[44]	Cameroon	cross-sectional	325	33	10.2%
9	Dionne-Odom J, et al. 2016	[45]	Cameroon	cross-sectional	7069	308	4.4%
10	Nlinwe NO, et al. 2021	[46]	Cameroon	cross-sectional	221	11	4.98%
11	Habkreo M, et al. 2022	[47]	Chad	cross-sectional	138	14	10.1%
12	Debsikréo N, et al. 2023	[48]	Chad	cross-sectional	458	33	7.2%
13	Clausina AA, et al. 2019	[49]	Congo	cross-sectional	150	4	2.67%
14	Kabamba A, et al. 2022	[50]	Congo	cross-sectional	1711	76	4.4%
15	Angounda BM, et al. 2016	[51]	Congo	cross-sectional	437	38	8.7%
16	Mpody C, et al. 2019	[52]	Congo	cross-sectional	1377	65	4.7%
17	JM Kabinda, et al. 2015	[53]	Congo	cross-sectional	460	27	5.9%
18	Mudji J, et al. 2021	[54]	Congo	cross-sectional	457	18	3.9%
19	Thompson P, et al. 2021	[55]	Congo	cross-sectional	4016	109	2.7%
20	Dirir SD, et al. 2023	[56]	Djibouti	cross-sectional	882	82	9.3%
21	Abdulkadhim SM, et al. 2022	[57]	Egypt	cross-sectional	1000	13	1.3%
22	Abdelkader AH, et al. 2020	[58]	Egypt	cross-sectional	563	1	0.17%
23	Elkadeem M, et al. 2021	[59]	Egypt	cross-sectional	1918	30	1.54%
24	Fekry MM, et al. 2019	[60]	Egypt	cross-sectional	354	12	3.39%
25	Dawud MM, et al. 2021	[61]	Egypt	cross-sectional	456	8	1.8%
26	Eletreby R, et al. 2021	[62]	Egypt	cross-sectional	399	30	7.52%
27	Elkhateeb RR, et al. 2018	[63]	Egypt	cohort	11,250	41	0.364%
28	Fessehaye N, et al. 2018	[64]	Eritrea	cross-sectional	5009	163	3.2%
29	Tanga AT, et al. 2019	[65]	Ethiopia	cross-sectional	253	20	7.9%
30	Umer A, et al. 2023	[66]	Ethiopia	cross-sectional	300	24	8%
31	Umare A, et al. 2016	[67]	Ethiopia	cross-sectional	318	22	6.9%
32	Kampe A, et al. 2023	[68]	Ethiopia	cross-sectional	368	21	5.7%
33	Atalay AA, et al. 2021	[69]	Ethiopia	cross-sectional	215	11	5.1%
34	Mamuye B, et al. 2020	[70]	Ethiopia	cross-sectional	363	22	6.1%
35	Demeke G, et al. 2021	[71]	Ethiopia	cross-sectional	338	28	8.3%
36	Tesfu MA, et al. 2023	[72]	Ethiopia	cross-sectional	12,138	369	3.04%
37	Wakjira M, et al. 2022	[73]	Ethiopia	cross-sectional	361	18	4.99%
38	Tadesse M, et al. 2022	[74]	Ethiopia	cross-sectional	252	19	7.5%
39	Dabsu R, et al. 2018	[75]	Ethiopia	cross-sectional	421	10	2.4%
40	Asaye Z, et al. 2021	[76]	Ethiopia	cross-sectional	375	22	5.9%
41	Kassaw B, et al. 2022	[77]	Ethiopia	cross-sectional	381	25	6.6%
42	Mavoungou K DS, et al. 2023	[78]	Gabon	cross-sectional	901	35	3.9%
43	Bittaye M, et al. 2019	[79]	Gambia	cross-sectional	424	39	9.2%
44	Eduku A, et al. 2024	[80]	Ghana	cross-sectional	225	18	8%
45	Luuse A, et al. 2017	[81]	Ghana	cross-sectional	208	5	2.4%
46	Antuamwine BB, et al. 2022	[82]	Ghana	cross-sectional	2634	158	6%
47	Dortey BA, et al. 2020	[83]	Ghana	cross-sectional	221	17	7.7%
48	Boachie J, et al. 2024	[84]	Ghana	cross-sectional	135	6	4.4%
49	Kwadzokpui P, et al. 2020	[85]	Ghana	cross-sectional	213	7	3.3%

Table 1 (continued)

ID	Authors	References	Study country	Study design	Sample size	Cases	Prevalence
50	Ephraim R, et al. 2015	[86]	Ghana	cross-sectional	168	16	9.5%
51	Bobie SA, et el. 2022	[87]	Ghana	cross-sectional	260	12	4.6%
52	Anabire NG, et al. 2019	[88]	Ghana	cross-sectional	2070	155	7.5%
53	Ngaira JA, et al. 2016	[89]	Kenya	cross-sectional	287	11	3.8%
54	Gatheru Z, et al. 2018	[90]	Kenya	cross-sectional	2196	205	9.3%
55	Randriamahazo TR, et al. 2015	[91]	Madagascar	cross-sectional	1050	20	1.9%
56	A.El Farouki, et al. 2019	[92]	Morocco	cross-sectional	483	6	1.2%
57	Loarec A, et al. 2022	[93]	Mozambique	cross-sectional	6775	270	4%
58	Idowu A, et al. 2019	[94]	Nigeria	cross-sectional	168	21	12%
59	Amaike C, et al. 2023	[95]	Nigeria	cross-sectional	706	82	11.6%
60	Anaedobe CG, et al. 2015	[96]	Nigeria	cross-sectional	180	15	8.3%
61	Fowotade A, et al. 2021	[97]	Nigeria	cross-sectional	172	18	10.5%
62	Magaji FA, et al. 2021	[98]	Nigeria	cross-sectional	3238	241	7.4%
63	Mustapha GU, et al. 2020	[99]	Nigeria	cross-sectional	210	14	6.7%
64	Aba HO, et al. 2016	[100]	Nigeria	cross-sectional	800	31	3.9%
65	Anejo O J, et al. 2023	[101]	Nigeria	cohort	301	17	5.6%
66	Adegbesan OM, et al. 2015	[102]	Nigeria	cross-sectional	150	11	7.3%
67	Talla C, et al. 2021	[103]	Nigeria	cross-sectional	10,167	1032	10.2%
68	Omatola CA, et al. 2021	[104]	Nigeria	cross-sectional	200	5	2.5%
69	Nyamusi MM, et al. 2016	[105]	Rwanda	cross-sectional	385	12	3.1%
70	Mutagoma M, et al. 2017	[106]	Rwanda	cross-sectional	13,121	486	3.7%
71	Ghazzawi M, et al. 2022	[107]	Sierra Leone	cross-sectional	394	31	7.9%
72	Nour HM, et al. 2022	[108]	Somalia	cross-sectional	251	11	4.4%
73	Davey DJ, et al. 2022	[109]	South Africa	cross-sectional	1194	8	0.67%
74	Chotun N, et al. 2017	[110]	South Africa	cohort	134	6	4.5%
75	Mudardum AH, et al. 2019	[111]	Sudan	cross-sectional	165	14	8.5%
76	Suliman EB, et al. 2024	[112]	Sudan	cross-sectional	226	11	4.9%
77	Abuelgasim MH, et al. 2015	[113]	Sudan	cross-sectional	160	12	7.5%
78	Gasim R, et al. 2019	[114]	Sudan	cross-sectional	900	162	18%
79	Kirbak ALS, et al. 2017	[115]	South Sudan	cross-sectional	280	31	11%
80	Jok TA, et al. 2023	[116]	South Sudan	cross-sectional	200	17	8.5%
81	Chibwe E, et al. 2019	[117]	Tanzania	cross-sectional	339	85	25.07%
82	Manyahi J, et al. 2017	[118]	Tanzania	cross-sectional	249	20	8.03%
83	Geffert K, et al. 2020	[119]	Tanzania	cross-sectional	743	22	3%
84	Shedura VJ, et al. 2023	[120]	Tanzania	cross-sectional	220	23	10.5%
85	Derick M,et al. 2018	[121]	Uganda	cross-sectional	160	4	2.5%
86	Mugabiirwe N, et al. 2022	[122]	Uganda	cross-sectional	384	8	2.1%
87	Kayondo SP, et al. 2020	[123]	Uganda	cross-sectional	340	10	2.9%
88	Duri K,et al. 2023	[124]	Zimbabwe	cohort	1208	32	2.65%
89	Hassan SA, et al. 2024	[125]	Somalia	cross-sectional	384	43	11.2%
90	Mazen AEl Z, et al. 2023	[126]	Egypt	cross-sectional	1200	58	4.83%
91	Torimiro JNE, et al. 2024	[25]	Cameroon	cross-sectional	1992	115	5.8%
92	Torimiro JNE, et al. 2024	[25]	Zimbabwe	cross-sectional	1200	32	2.7%

evidence on the epidemiology of HBV among pregnant women in Africa is important to eliminate and control vertical transmission of the disease. Such data are mandatory for healthcare planners and providers to design and implement evidence-based interventions. Thus, this systematic review and meta-analysis provides up-to-date information about the epidemiology of HBV among pregnant women in Africa.

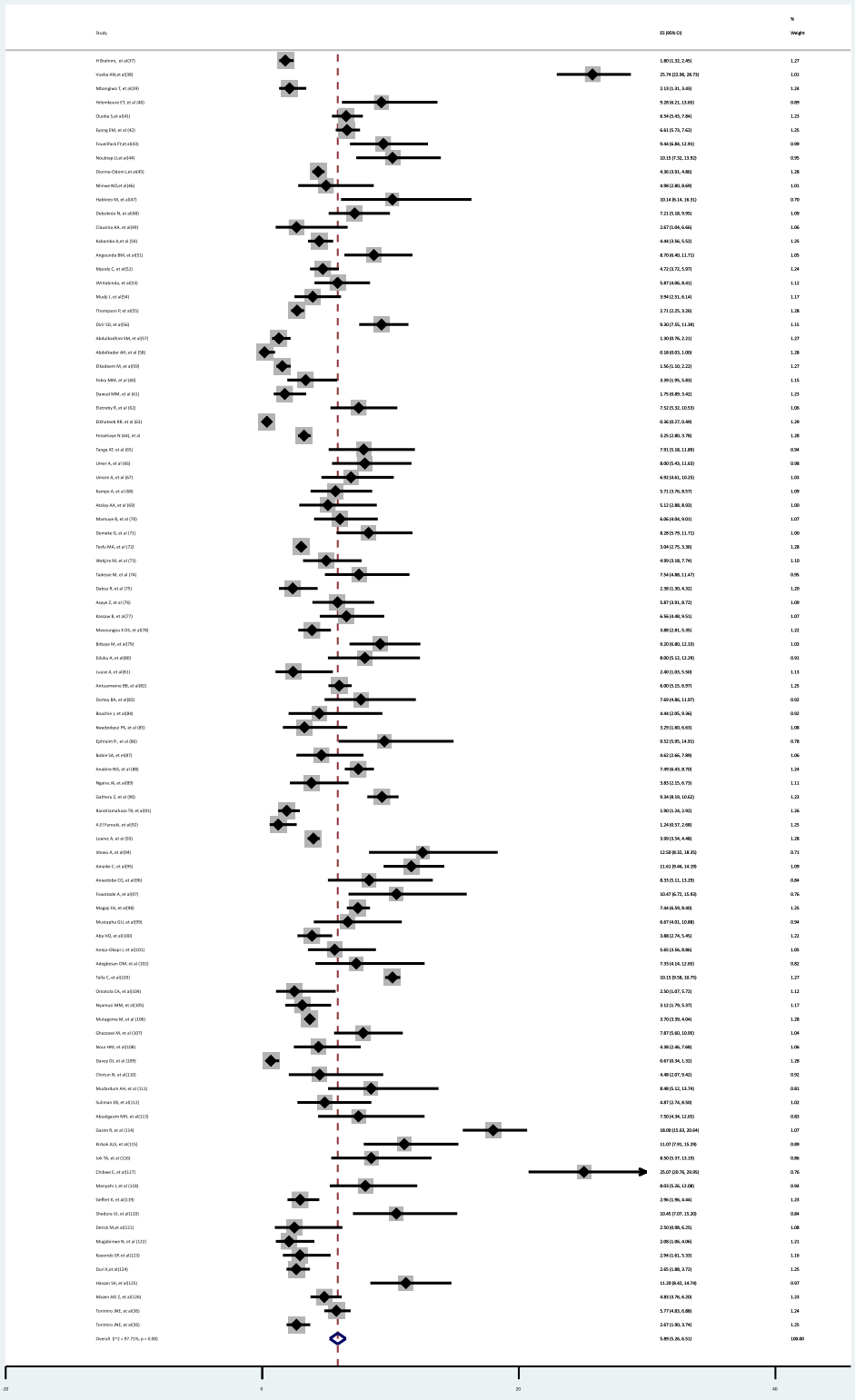

Fig. 2 Pooled prevalence of Hepatitis B infection among pregnant women in Africa

Table 2 Subgroup analysis

Variables	Name of countries	Prevalence (95%CI)	I^2, *p*-value	df
Region	East Africa	5.38% (4.71–6.05%)	91.1%, < 0.001	33
	West Africa	6.98% (5.85–8.1%)	88.8%, < 0.001	23
	Southern Africa	1.78% (0.24–3.31%)	-	2
	North Africa	3.57% (2.61–4.53%)	96.4%, < 0.001	13
	Middle Africa	6.77% (5.41–8.14%)	95.1%, < 0.001	16
Countries	Algeria	1.8% (1.32–2.34%)	-	0
	Angola	25.7% (23–28.7%)	-	0
	Botswana	2.1% (1.3–3.43%)	-	0
	Burkina Faso	6.8% (5.7–7.9%)	-	1
	Cameroon	6.4% (5.0–7.9%)	86.80%, < 0.001	5
	Chad	7.7% (5.6–9.9%)	-	1
	Congo	4.5% (3.3–5.8%)	84.08%, < 0.001	6
	Djibouti	9.3% (7.6% -11.4%)	-	0
	Egypt	2.1% (1.24- 2.9%)	94.08%, < 0.001	7
	Eritrea	3.3% (2.8%-3.8%)	-	0
	Ethiopia	5.8% (4.5–7.1%)	82.23%, < 0.001	12
	Gabon	3.9% (2.8–5.4%)	-	0
	Gambia	9.2% (6.8–12.3%)	-	0
	Ghana	5.7% (4.3–7.1%)	72.84%, < 0.001	8
	Kenya	8.1% (7.0–9.1%)	-	1
	Madagascar	1.9% (1.24- 2.9%)		0
	Morocco	1.24% (0.57–2.7%)	-	0
	Mozambique	4% (3.5–4.5%)	-	0
	Nigeria	7.6% (5.7–9.6%)	92.12%, < 0.001	10
	Rwanda	3.7% (3.4–4.0%)	-	1
	Sierra Leone	7.9% (5.6–11%)	-	0
	Somalia	7.1% (5.1–9.0%)		1
	South Africa	0.74% (0.28–1.19%)	-	1
	Sudan	9.8% (2.9–16.6%)	94.27%, < 0.001	3
	South Sudan	9.9% (7.2–12.5%)	-	1
	Tanzania	11.4% (3.0–19.9%)	96.79%, < 0.001	3
	Uganda	2.4% (1.4–3.5%)	-	2
	Zimbabwe	2.7% (2.02–3.3%)	-	1
Study design	Cohort	2.4% (1.1–3.6%)	93.54%, < 0.001	5
	Cross-sectional	6.1% (5.5–6.8%)	96.33%, < 0.001	85
Publication year	2015–2019	6.3% (5.3–7.4%)	97.89%, < 0.001	37
	2020–2024	5.6% (4.8–6.5%)	96.96%, < 0.001	53
Sample size	< 422	6.6% (5.7–7.4%)	80.54%, < 0.001	50
	≥ 422	5.2% (4.4–6.1%)	98.83%, < 0.001	40

Dash (-) indicates no heterogeneity

Methods

Reporting and registration

The Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) guidelines, which cover all parts of the article items, including the title, abstract, introduction, method, results, discussion, and funding, were used to report this systematic review [30] (S1 File). The International Prospective Register of Systematic

Table 3 Univariate meta-regression analysis according to sample size and publication year

Variables	Coefficient (95%CI)	*P*-value
Publication year	0.0003622 (-0.0029988–0.0037232)	0.831
Sample size	-1.41e-06 (-3.48e-06 -6.55e-07)	0.178

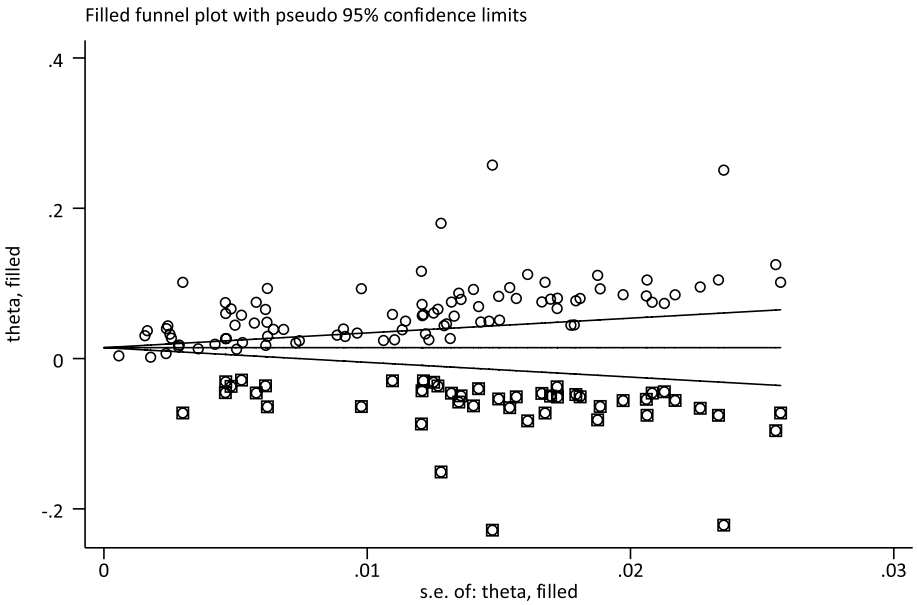

Fig. 3 Funnel plot of imputed and observed studies

Reviews (PROSPERO) registered this review protocol (ID = CRD42024518328).

Research questions

1. What is the pooled prevalence of the hepatitis B virus infection among pregnant women in Africa?
2. What are the risk factors for hepatitis B virus infection among pregnant women in Africa?

Searching strategies

The Web of Science, Scopus, PubMed, Google Scholar, and African journals online databases were searched to identify relevant articles published from January 1, 2015, to May 21, 2024, with an English language restriction. The search was limited to the last ten years to identify the most recent data on the epidemiology of hepatitis B infection among pregnant women in Africa. The references to all relevant studies were also searched to identify

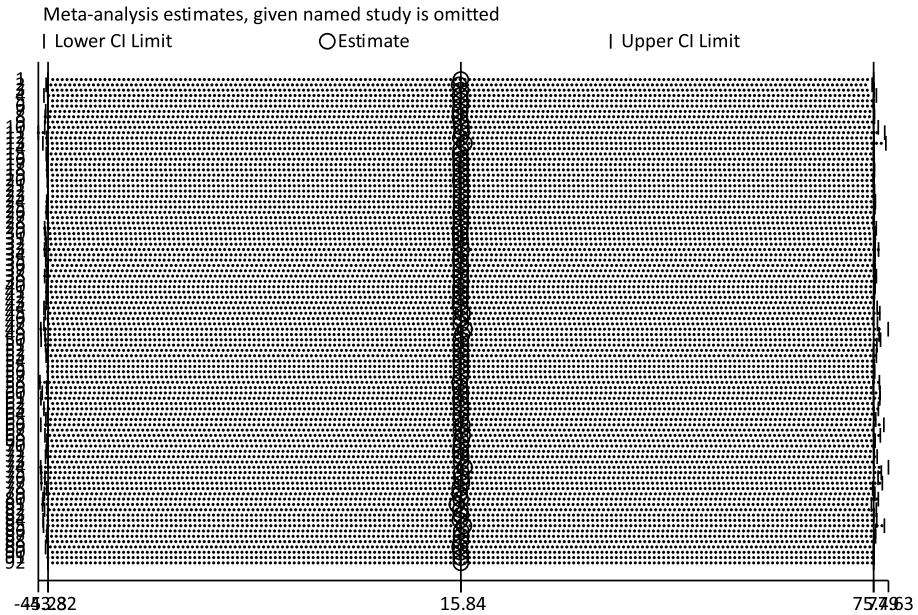

Fig. 4 Sensitivity analyses for the pooled prevalence of HBV infection among pregnant women in Africa

additional studies that could supplement these database searches. The search was conducted in all electronic databases from April 27 to May 21, 2024. The MeSH terms used for searching were “hepatitis B," “pregnant women," and "Africa," which were connected by the “AND” Boolean operator. The Boolean operator "OR" was used to connect synonyms for each MeSH term. The literature search was conducted by two authors (T.G.W. and A.T.M.) through a detailed examination of various databases. The search strategy details are provided in the supplemental file (S2 File).

Study selection

The EndNote X8.1 software was used to remove duplicate articles. The titles and abstracts of the articles were independently screened by two authors (TGW and ATM). The full-text articles were obtained, and the authors further assessed the eligibility of the full articles for final inclusion. Disagreements were resolved through discussions and scientific consensus between the authors (TGW and ATM).

Eligible criteria

Inclusion criteria according to population, outcome, and context (POCo):

Population: pregnant women, regardless of their trimesters.
Outcome: prevalence of HBV infection (HBsAg).
Context: Africa.
Study design: both descriptive and observational studies reported the prevalence or magnitude of HBV infection based on HBsAg diagnosis.
Publication language: studies published in English.
Study period: studies conducted from January 1, 2015, to May 21, 2024.
Publication type: both published and unpublished.
Exclusion criteria: Qualitative studies, reviews, editorials, commentaries, and case reports were excluded.

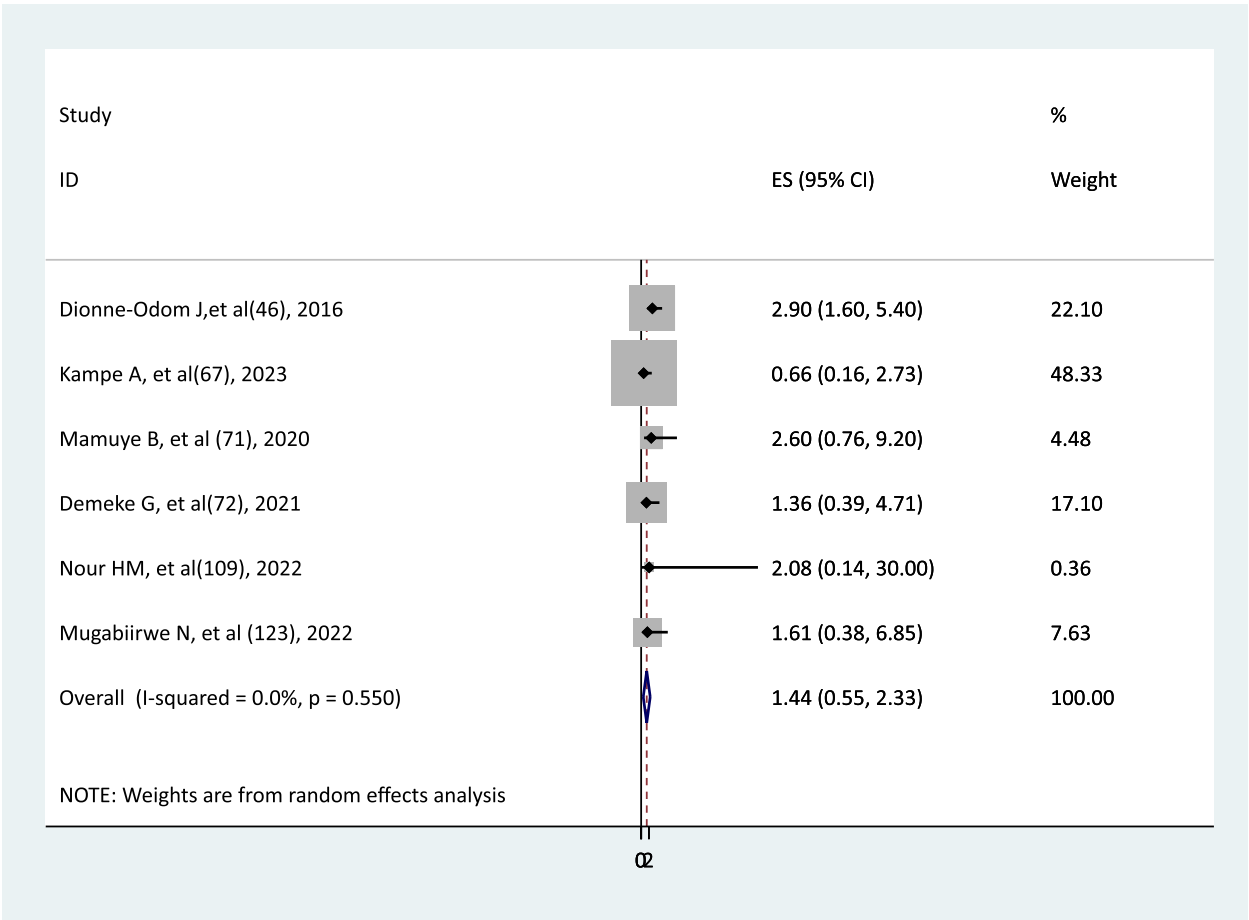

Fig. 5 The association between urban residence and HBV infection

Measurements

Outcome measurement

This systematic review and meta-analysis determined the regional pooled prevalence of hepatitis B infection among pregnant women using the magnitudes of outcomes from primary studies.

Effect measurement

This systematic review and meta-analysis estimated the pooled effect size for associated factors using the factors (AOR) from the included primary studies. Variables identified as risk factors for HBV in at least three studies were considered.

Data extraction

Two authors (TGW and ATM) independently extracted pertinent data using a pretested data extraction form created using Microsoft Excel. This data included the first author's name, publication year, study country, study design, sample size, number of pregnant women with hepatitis B infection, and prevalence of the infection.

Quality assessment

The quality of the included studies was assessed by two authors using the Joanna Briggs Institute Critical Appraisal Checklist for Studies Reporting Prevalence studies [31]. The checklist evaluated the methodological quality of prevalence studies based on the nine questions. Yes, no, unknown, and not applicable were possible responses available on the tool: 1 indicates yes, and 0 indicates other options. The scores were added up with a possible minimum sum score of 0 and a maximum sum score of 9. The total score was converted to percentages. The final meta-analysis included studies that scored at least 50% of the total score. During the critical appraisal, scientific consensus and discussion were used to settle the disagreements between the authors.

Data synthesis and statistical analysis

The data entered in the Microsoft Excel spreadsheet were imported in to STATA version 15 software for analysis. The random-effects model was used to estimate the pooled prevalence of HBV infection and its determinants

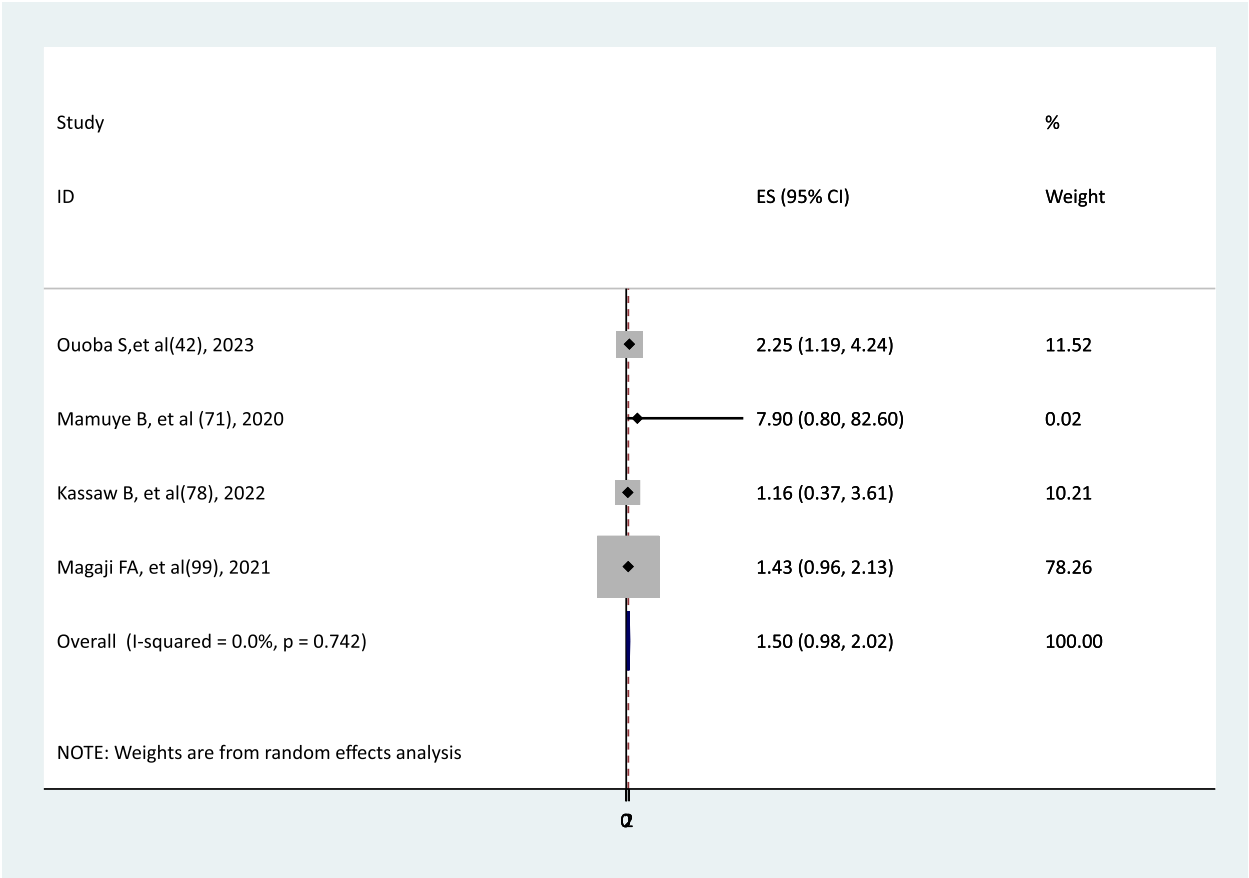

Fig. 6 The association between circumcision and HBV infection

due to heterogeneity among study regions or countries and study design. I^2 statistics of 0, 25, 50, and 75% were used to declare no, low, moderate, and high heterogeneity, respectively [32]. I^2 statistic values of 50% or more were considered significant heterogeneity [33]. Subgroup analysis by African subdivision, study country, publication year, study design, and sample size was conducted. Publication bias was assessed using Egger's test and a funnel plot [34, 35]. The effect of a single study on the overall pooled prevalence was computed by sensitivity analysis [36]. Figures and tables were used to summarize and describe the results of the meta-analysis.

Results

Search results

The initial searches identified 717 articles; 367 duplicated articles were removed. The titles and abstracts of 350 articles were reviewed, and 241 irrelevant articles were excluded. One hundred nine full-text articles were reviewed, and 18 were excluded for a variety of reasons: 11 were reviewed, 4 did not have outcomes, 2 were short communications, one article lacked methods, and the other was published in a language other than English. Finally, 91 eligible articles were included (Fig. 1).

Study characteristics

Overall, 91 studies from 28 African countries were included. In the eastern, northern, southern, western, and middle African countries, 34, 24, 17, 14, and 3 studies were conducted, respectively. The highest numbers of studies were conducted in Ethiopia and Nigeria, at 14.1% (13/92) and 12.1% (11/92), respectively. About 93.5% (86/92) of the studies were cross-sectional. The majority (58.7%, 54/92) of the studies were published after 2020. One article was conducted simultaneously in Zimbabwe and Cameroon [25]. The prevalence of HBV infection ranged from 0.17% in Egypt to 25.7% in Angola (Table 1).

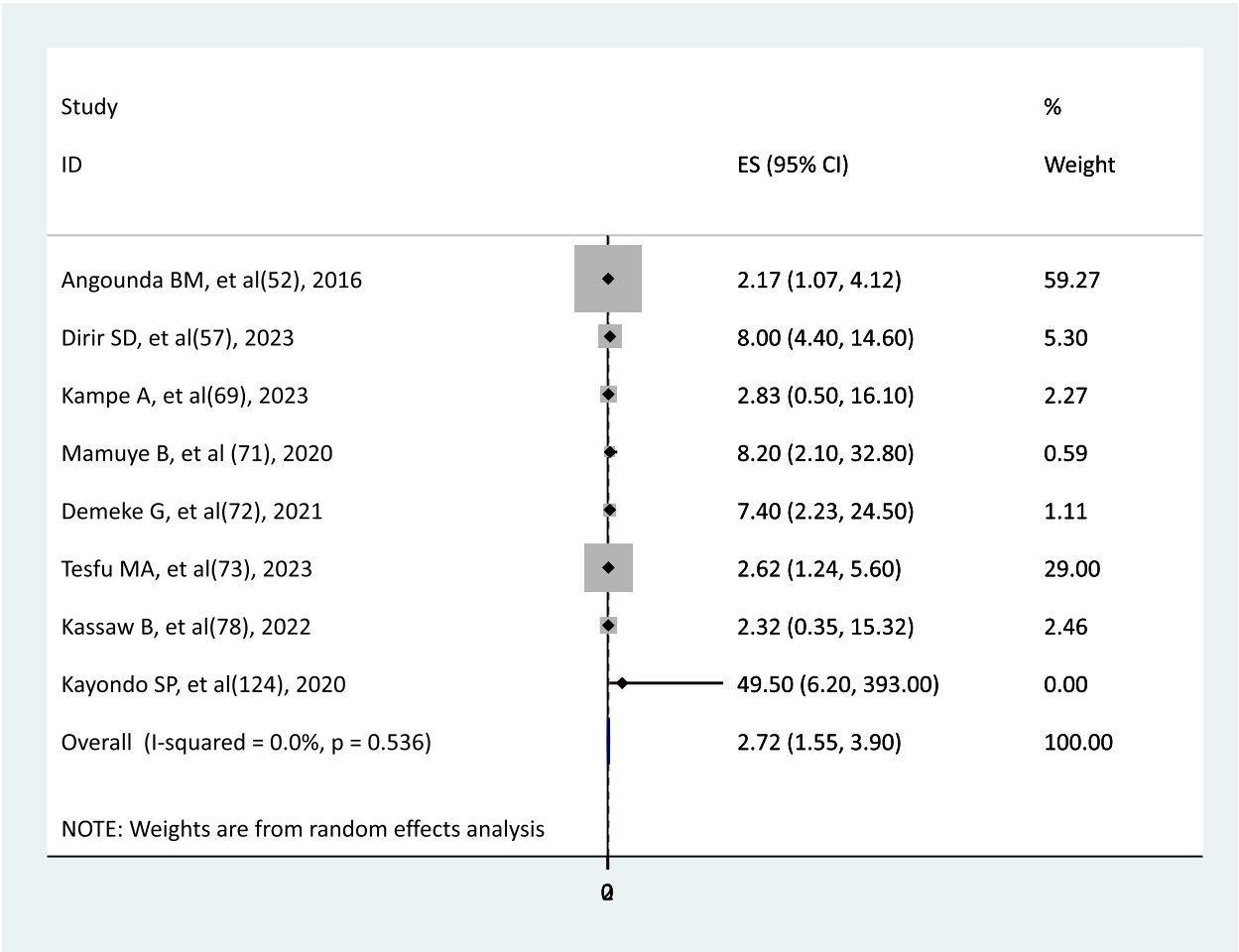

Fig. 7 The association between HBV infection and family history of this disease

Quality of the included studies

The quality of the included studies was assessed using the Joanna Briggs Institute Critical Appraisal Checklist for Studies reporting prevalence. The total scores of the included studies ranged from 5 to 9. Eleven, 13, 18, and 22 studies scored 55.6% (5/9), 66.7% (6/9), 77.8% (7/9), and 88.9% (8/9), respectively. Twenty-eight studies scored 100% (9/9). Details regarding the quality assessment of the included studies are provided in the S4 File.

Pooled prevalence of hepatitis B infection among pregnant women in Africa

There were 123,765 pregnant women, and 6065 of them had hepatitis B virus infection (HBsAg). Using a random-effect model meta-analysis, the pooled prevalence of hepatitis B infection among pregnant women in Africa was 5.89% (95%CI: 5.26–6.51%), with significant heterogeneity across studies ($I^2 = 97.71\%$, $p < 0.001$) (Fig. 2).

Subgroup analysis

The regions with the highest nearly equivalent prevalence of hepatitis B infection among pregnant women were West Africa, Middle Africa, and East Africa, at 6.98% (95%CI:5.85–8.1%), 6.77% (95%CI:5.41–8.14%), and 5.38% (95%CI:4.71–6.05%), respectively. The prevalence of hepatitis B infection among pregnant women in African countries ranged from 0.74% (95%CI: 0.28–1.19%) in South Africa to 25.7% (95%CI: 23–28.7%) in Angola. In the cross-sectional and cohort studies, the rates of hepatitis B infection were 6.1% (95% CI: 5.5–6.7%) and 2.4% (95% CI: 1.1–3.6%), respectively. In publication years between 2015 and 2019, the prevalence rate was 6.3% (95% CI: 5.3–7.4%) and 5.6% (95% CI: 4.8–6.5%) in publication years between 2020 and 2024. In a sample size of less than 422, the prevalence of hepatitis B infection among pregnant women was 6.6% (95% CI: 5.7–7.4%) (Table 2).

Furthermore, a univariate meta-regression analysis was conducted with sample size and publication year

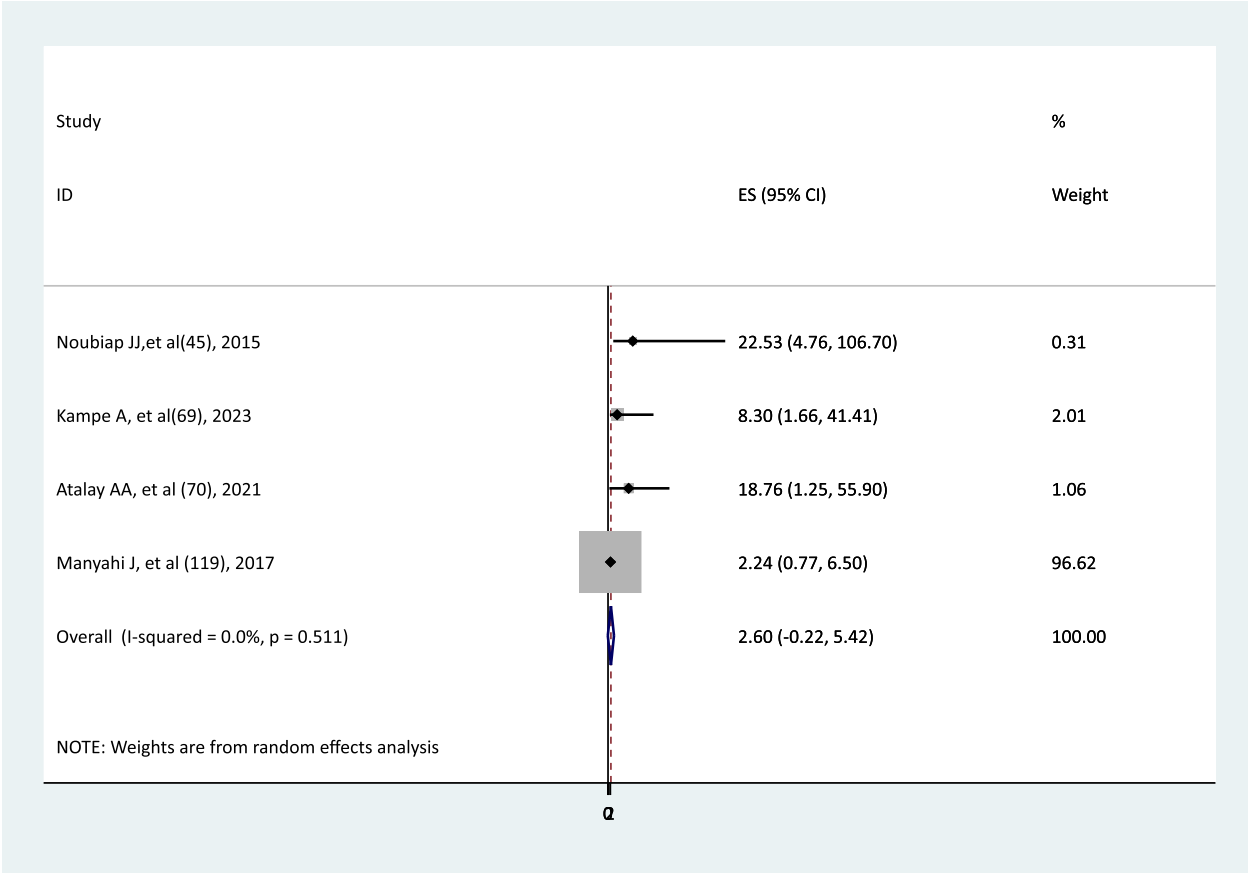

Fig. 8 The association between HIV infection and HBV infection

as covariates to determine the source of heterogeneity; however, neither sample size nor publication years showed any statistically significant association (Table 3).

Publication *bias*

Publication bias was assessed using a funnel plots and Egger's test. A funnel plot was constructed from the study prevalence with a 95% CI against the standard error of the prevalence. The asymmetry of the funnel plot visual inspection indicated publication bias in the pooled prevalence of hepatitis B infection. Egger's test also confirmed this evidence of publication bias (intercept = 5.5, 95% CI: 4.2–6.7). As a result, a trim-and-fill meta-analysis was conducted. The trim-and-fill meta-analysis identified 46 missing studies. Imputing the omitted studies and combining the imputed and observed studies yielded 138 studies. Using random trim-and-fill meta-analysis, the pooled prevalence of hepatitis B infection among pregnant women was 5.9% (95% CI: 5.3–6.5%) for observed studies; for combined observed and imputed studies, the pooled prevalence of hepatitis B infection was 2.1% (95% CI: 1.4–2.7%). The imputed studies reduced the prevalence of hepatitis B infection from 5.9% to 2.1% by 3.8%. The symmetrical funnel plot resulting from the imputed studies is shown in Fig. 3 (Fig. 3).

Sensitivity analysis

By omitting each study one by one, a leave-out-one sensitivity analysis was carried out to estimate the effect of a single study on the overall pooled prevalence of hepatitis B infection among pregnant women in Africa. According to the sensitivity analysis, no single study had a significant effect on the overall pooled prevalence of HBV infection among pregnant women in Africa (Fig. 4).

Determinants of hepatitis B infection among pregnant women

Individual determinants

The association between residence and HBV infection

The association between residence and HBV infection was estimated using six studies [45, 66, 70, 71, 108, 122] involving 2029 pregnant women. The meta-analysis revealed no significant association between urban residence and HBV infection (AOR = 1.44, 95% CI: 0.55–2.33) with no heterogeneity ($I^2 = 0$, $p = 0.55$) (Fig. 5).

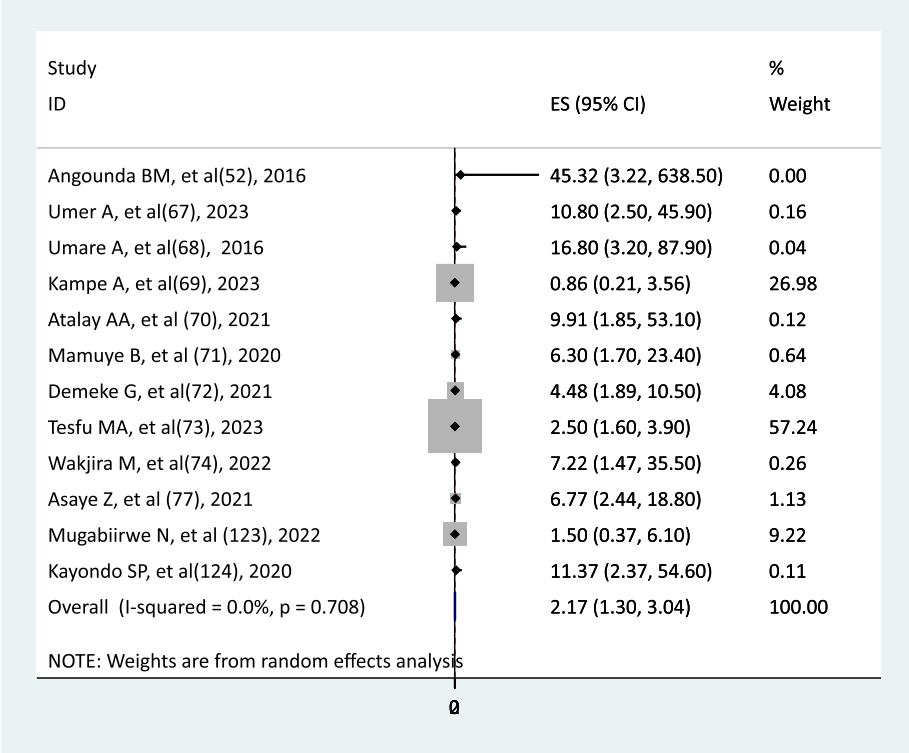

Fig. 9 The association between multiple sexual partners and HBV infection

The association between circumcision and HBV infection

In four studies [41, 70, 77, 98] involving 5604 pregnant women**,** the relationship between circumcision and HBV infection was determined. The study did not find a significant association between circumcision and HBV infection (AOR = 1.5, 95% CI: 0.98–2.02), without heterogeneity among the studies ($I^2 = 0$, $p = 0.742$) (Fig. 6).

The association between a family history of HBV infection and development of hepatitis B infection among pregnant women

Eight studies [51, 56, 68, 70–72, 77, 123] with the involvement of 14,884 pregnant women were conducted to determine the association between a family history of HBV infection and pregnancy with this disease. The results of the meta-analysis showed that pregnant women with a family history of HBV infection were 2.72 times more likely to have HBV infection than those without a family history of HBV infection (AOR = 2.72, 95% CI: 1.53–3.9) with no heterogeneity (Fig. 7).

The association between HIV infection and HBV infection

Four studies [44, 68, 69, 118] with a sample size of 1157 were used to identify the association between HIV infection and HBV infection. There was no relationship between HIV infection and HBV infection (AOR = 2.6, 95%CI:-0.22–5.4) with no heterogeneity (Fig. 8).

History of multiple sexual partners and HBV infection

Twelve studies [51, 66–73, 76, 122, 123], with a sample size of 15,937, estimated the association between a history of multiple sexual partners and HBV infection. This meta-analysis indicated that pregnant women with a history of multiple sexual partners were 2.17 times more likely to have HBV infection than pregnant women without a history of multiple sexual partners (AOR = 2.17, 95% CI: 1.3–3.04) without heterogeneity (Fig. 9).

The association between STI and HBV infection

Four studies [67, 68, 72, 80] with 13,049 pregnant women assessed the association between STIs and HBV

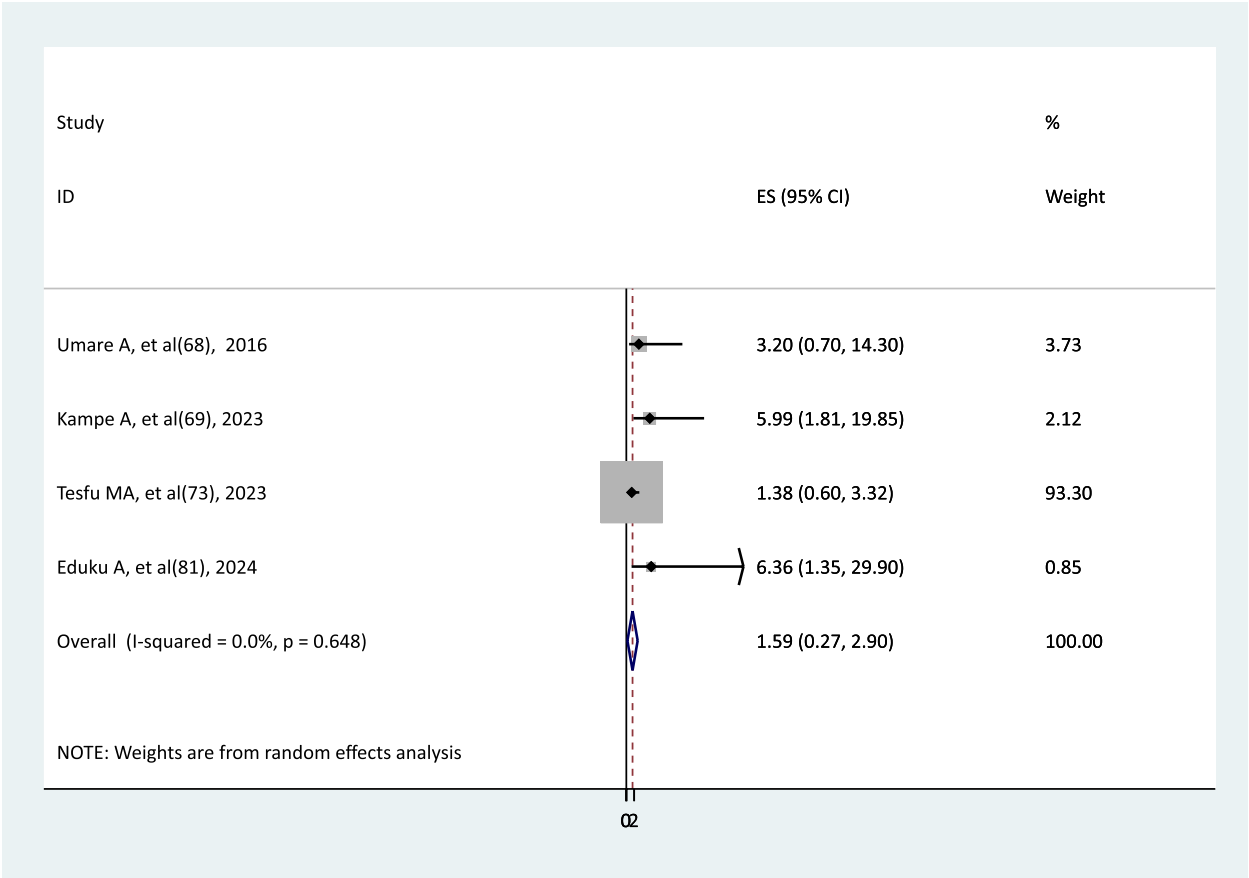

Fig. 10 The association between STI and HBV infection

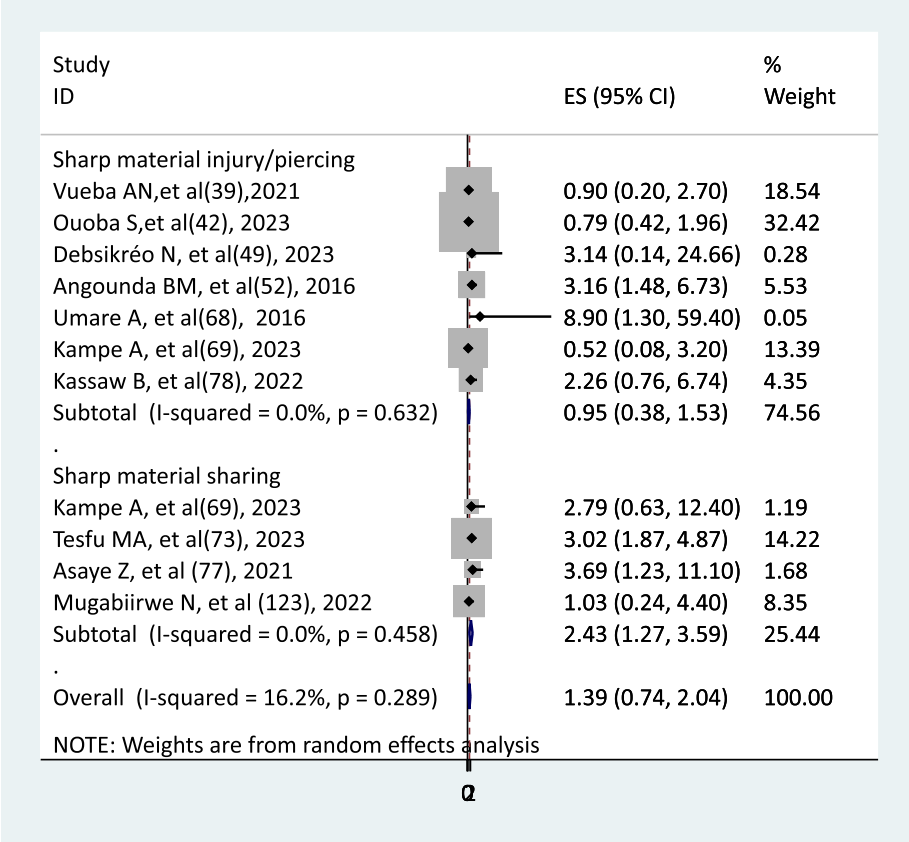

Fig. 11 The association of sharp material piercing/ injury and sharing with HBV infection

infection. The results of the meta-analysis indicated that there was no association between STI and HBV infection (AOR = 1.59, 95% CI: 0.27–2.9) in the absence of heterogeneity (Fig. 10).

The association of piercing/injury and sharing sharp materials with HBV infection

The association between sharp material piercing or injury and HBV infection was determined in seven studies [38, 41, 48, 51, 67, 68, 77] with a sample size of 4462, whereas the association between sharp material sharing and HBV infection was determined by four studies [67, 71, 75, 121] with a sample size of 13,265. This meta-analysis showed that there was no statistically significant association between sharp material piercing or injury and HBV infection (AOR = 0.95, 95% CI: 0.38–1.53), but pregnant women who shared sharp materials were 2.43 times more likely to develop HBV infection than pregnant women who did not share sharp materials (AOR = 2.43, 95% CI: 1.27–3.59), with the absence of heterogeneity (Fig. 11).

The association between histories of contact with HBV-infected/ jaundiced patients and developing HBV infection

Three studies [66, 72, 76] with a sample size of 12,813 were found to determine the association between a history of contact with HBV infection/jaundice patients and subsequent development of HBV infection. The pooled adjusted odd ratio of these studies showed that there was no significant association between having contact with HBV-infected or jaundiced patients and the development of HBV infection (AOR = 0.86, 95% CI: 0.09–1.64) with no heterogeneity (Fig. 12).

The association between scarification and HBV infection

The association between scarification and HBV infection was determined in three studies [41, 48, 51], with a sample size of 2517. In this meta-analysis, scarification was not associated with HBV infection (AOR = 1.26, 95% CI: 0.41–2.11). Low heterogeneity was observed between the studies ($I^2 = 9.7\%$, $p = 0.331$) (Fig. 13).

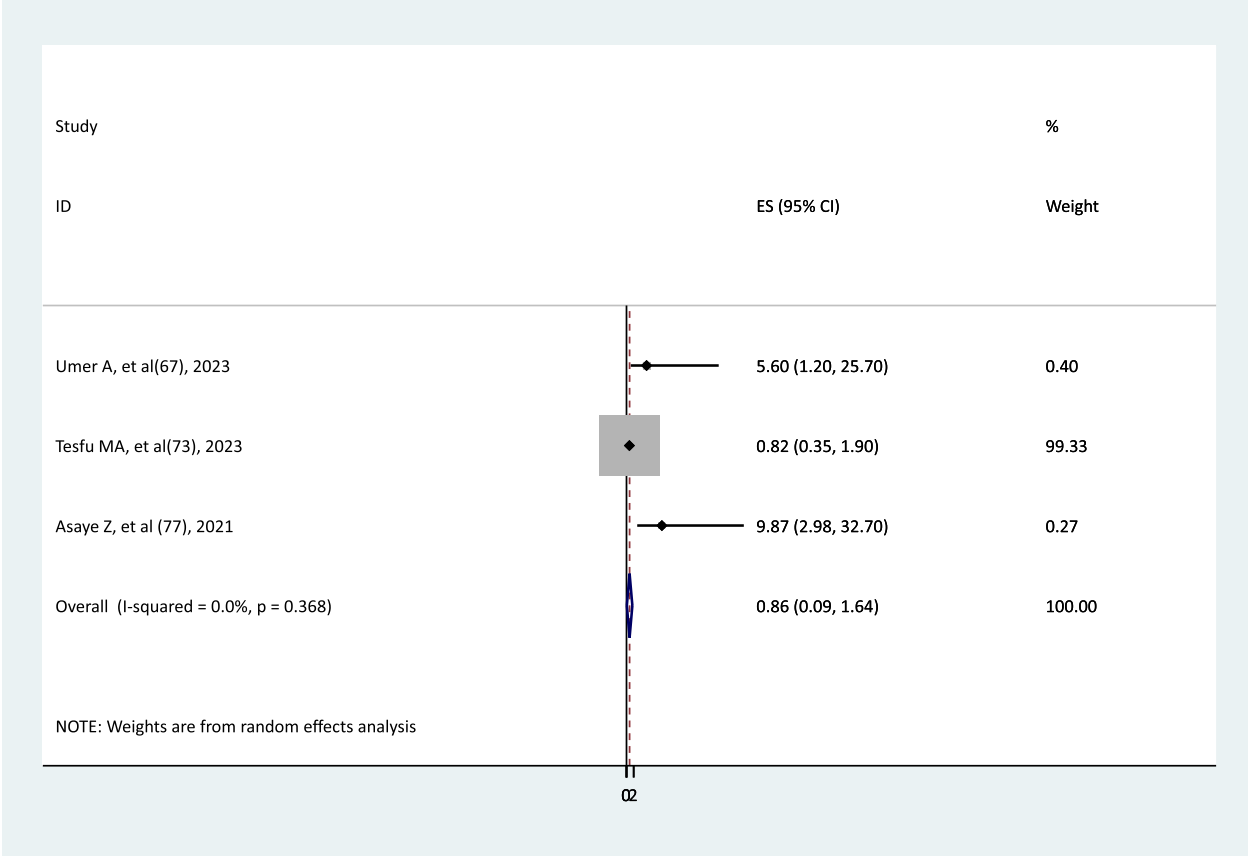

Fig. 12 The association between histories of contact with HBV-infected patients and the development of HBV infection

The association between tattoos and HBV infection

Ten studies [51, 67–73, 77, 98] including 18,157 pregnant women, were examined to determine the relationship between tattoos and HBV infection. The pooled effect size of these studies did not indicate a statistically significant association between tattoos and HBV infection (AOR = 1.12, 95% CI: 0.77–1.47), with no heterogeneity (Fig. 14).

The association between tooth extraction and hepatitis B infection

Using five studies [66–68, 108, 122] that included 1621 pregnant women, the association between tooth extraction and HBV infection was determined. The findings of the meta-analysis indicated that tooth extraction was not significantly associated with HBV infection (AOR = 2.57, 95% CI: -0.08–5.22) without heterogeneity (Fig. 15).

The association between tonsillectomy and HBV infection

The association between tonsillectomy and HBV infection was assessed in five studies [66–68, 70, 77], with 1730 pregnant women. The findings of the meta-analysis indicated that tonsillectomy was not significantly associated with HBV infection (AOR = 3.09, 95%CI: 0.49–5.69) in the absence of heterogeneity (Fig. 16).

Health-related determinants

The association between abortion and HBV infection

Ten studies [38, 51, 56, 66, 67, 70, 73, 77, 108, 122] involving 4555 pregnant women were found to determine the relationship between abortion and HBV infection. The current meta-analysis did not find a statistically significant relationship between pregnant women with a history of abortion and HBV infection (AOR = 1.08, 95% CI: 0.69–1.46), with no heterogeneity (Fig. 17).

The association between blood transfusion and HBV infection

Fifteen studies [41, 44, 48, 51, 56, 66, 68, 72, 76, 80, 98, 108, 120, 122, 125] with 21,607 pregnant women were

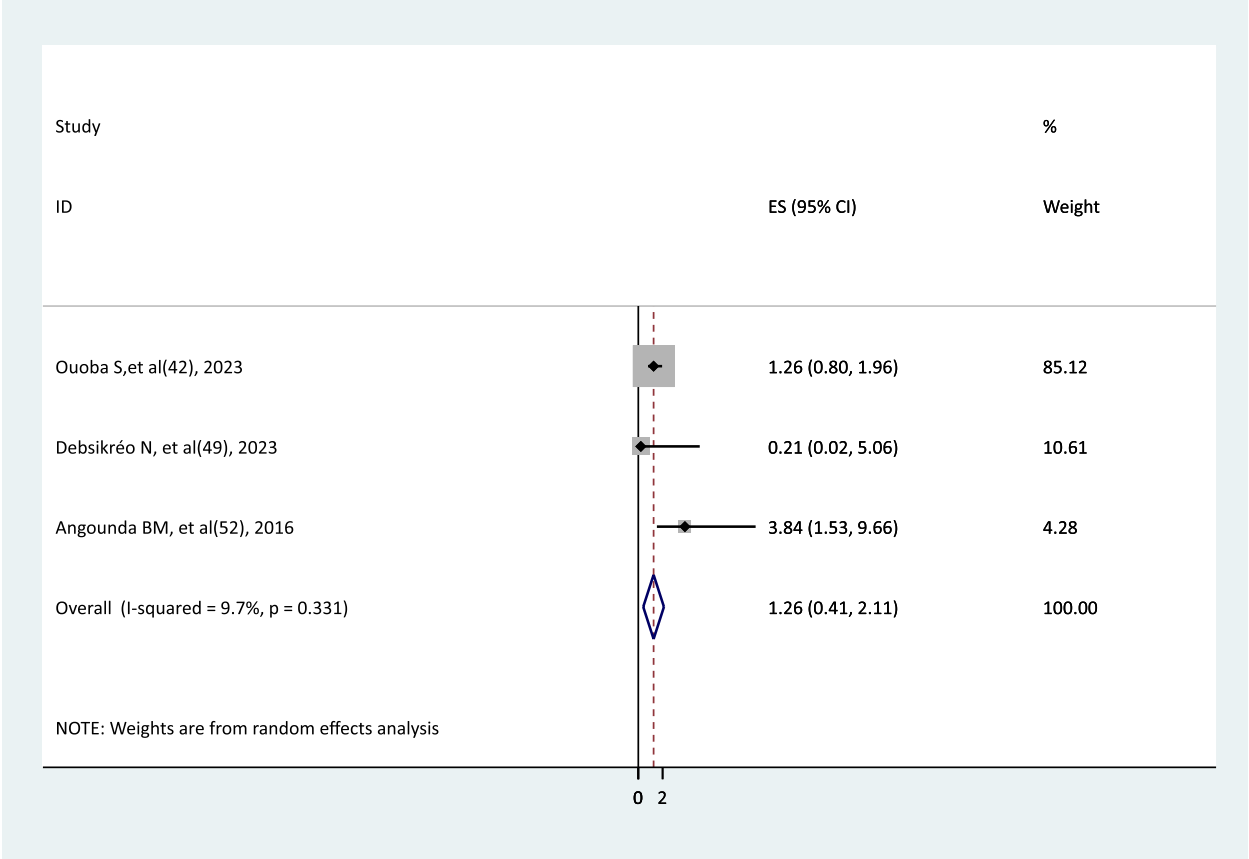

Fig. 13 The association between scarification and HBV infection

conducted to examine the association between blood transfusion and HBV infection. The meta-analysis findings did not reveal any significant association between blood transfusion and HBV infection (AOR = 1.2, 95%CI: 0.73–1.66). There was no heterogeneity between studies (Fig. 18).

The association between hospital admission and HBV infection

The association between hospital admission and hepatitis B infection was determined in nine studies [48, 67, 68, 70, 72, 73, 77, 80, 122], with 14,996 pregnant women. The results of this meta-analysis showed that no statistically significant association was noted between history of hospital admission and having hepatitis B infection (AOR = 1.4, 95% CI: 0.8–2.0) with the absence of heterogeneity (Fig. 19).

The association between surgical procedure and HBV infection

The relationship between surgical procedures and HBV infection was determined in 10 studies [41, 51, 66–68, 70, 77, 98, 108, 120] in which 7498 pregnant women were involved. The findings of the meta-analysis showed that surgical procedures were not associated with HBV infection (AOR = 1.07, 95% CI: 0.73–1.41). There was no heterogeneity among the studies (Fig. 20).

Discussion

HBV causes acute and chronic infections [1]. It is the most common serious liver infection globally, resulting in high morbidity and mortality [2], particularly in Africa [11]. Therefore, awareness of HBV infection in pregnant women is essential because it will enable them to take great care of their babies before, during, and after delivery, thereby preventing or reducing the risk of chronic hepatitis. Prevention of mother-to-child HBV transmission is critical for the global elimination of viral hepatitis [25]. The information obtained from this systematic review could improve knowledge on the epidemiology of HBV infection among pregnant women in Africa. Therefore, the present systematic review and meta-analysis estimated the pooled prevalence of HBV infection among pregnant women in Africa.

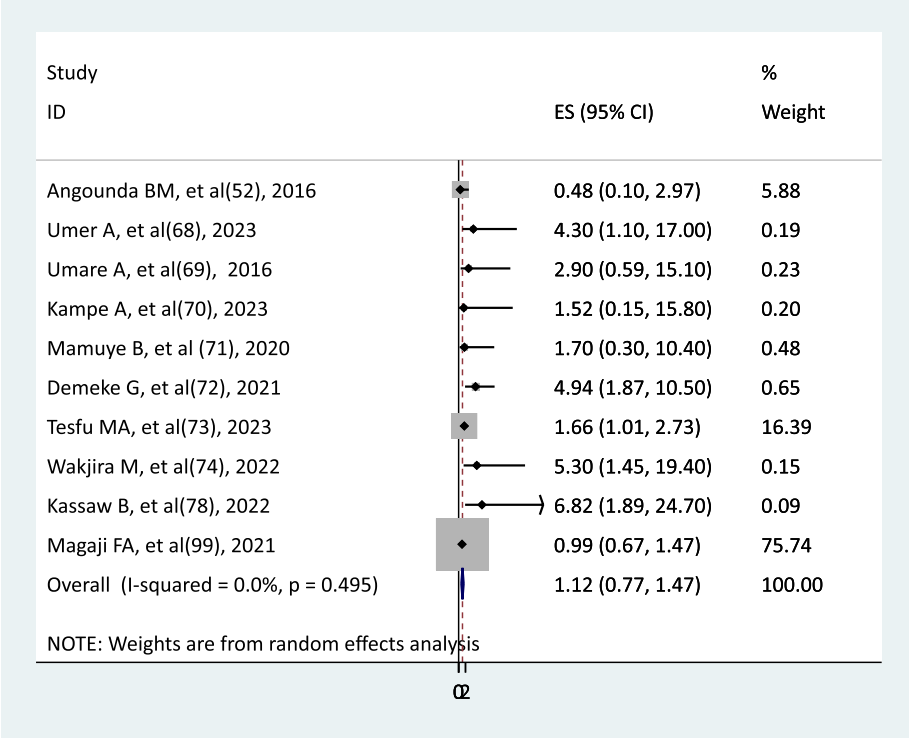

Fig. 14 The association between tattoo and HBV infection

In this review, the pooled prevalence of HBV infection among pregnant women in Africa was 5.89% (95% CI: 5.26–6.51%). This indicated that HBV infection among pregnant women in Africa occurred at an intermediate level (2–7%) [3]. This finding is consistence with previous studies conducted in low-income countries, which reported that HBV infection is at an intermediate or high endemic level [5, 10]. The magnitude of HBV infection in the current study among pregnant women in Africa was higher than that in a previous study conducted in the general population at the global level [4], as well as prior studies conducted among pregnant women in Thailand [6] and Iran [7]. Variations in economic levels [19], high expenses for care, prevention, and treatment, disease's widespread transmission in developing countries, and difficulty in implementing screening programs [5] could be contributing factors. The stigma associated with the diagnosis, the absence of regular screening programs, and difficulties in obtaining access to healthcare systems could also pose other challenges for patients with chronic hepatitis in sub-Saharan Africa [28]. The other explanation could be that there is variation in the diagnostic test of HBsAg. This suggests that the implementation of HBV prevention programs [5, 19, 26, 27] in Africa is still not widely practiced [29]. However, the current study's prevalence of HBV infection was lower than that in a previous study in Yemen [8]. The high prevalence of hepatitis B virus in Yemen may be caused by the country's instability (civil war), which has resulted in the inaccessibility of health services and a lack of medication and vaccination. A single cross-sectional study with a small sample size in Yemen may have also failed to accurately detect the outcome. The pooled prevalence of HBV infection among pregnant women was comparable to that in previous studies conducted in Africa [12, 13], East Africa [14], Nigeria [15], and Ethiopia [16–18]. This finding validated a true reflection of the prevalence of HBV infection in the region as reported in previous studies. The comparable socioeconomic development and the adoption of analogous HBV prevention programs among African countries may account for this comparability. West and Middle Africa had comparable higher prevalence rates of HBV infection at 6.98% and 6.77%, respectively, followed by East Africa (5.38%). The prevalence of HBV infection was 1.785 and 3.75% in Southern and Northern Africa, respectively. In the country-level subgroup analysis, the prevalence of HBV infection among pregnant women in African countries ranged from 0.74% in South Africa to 25.7% in Angola. This discrepancy may be caused by variations in pregnant women's perceptions about the risk of HBV and age differences among the study participants. Research by Bayo P et al. [23] and Nankya-Mutyoba J

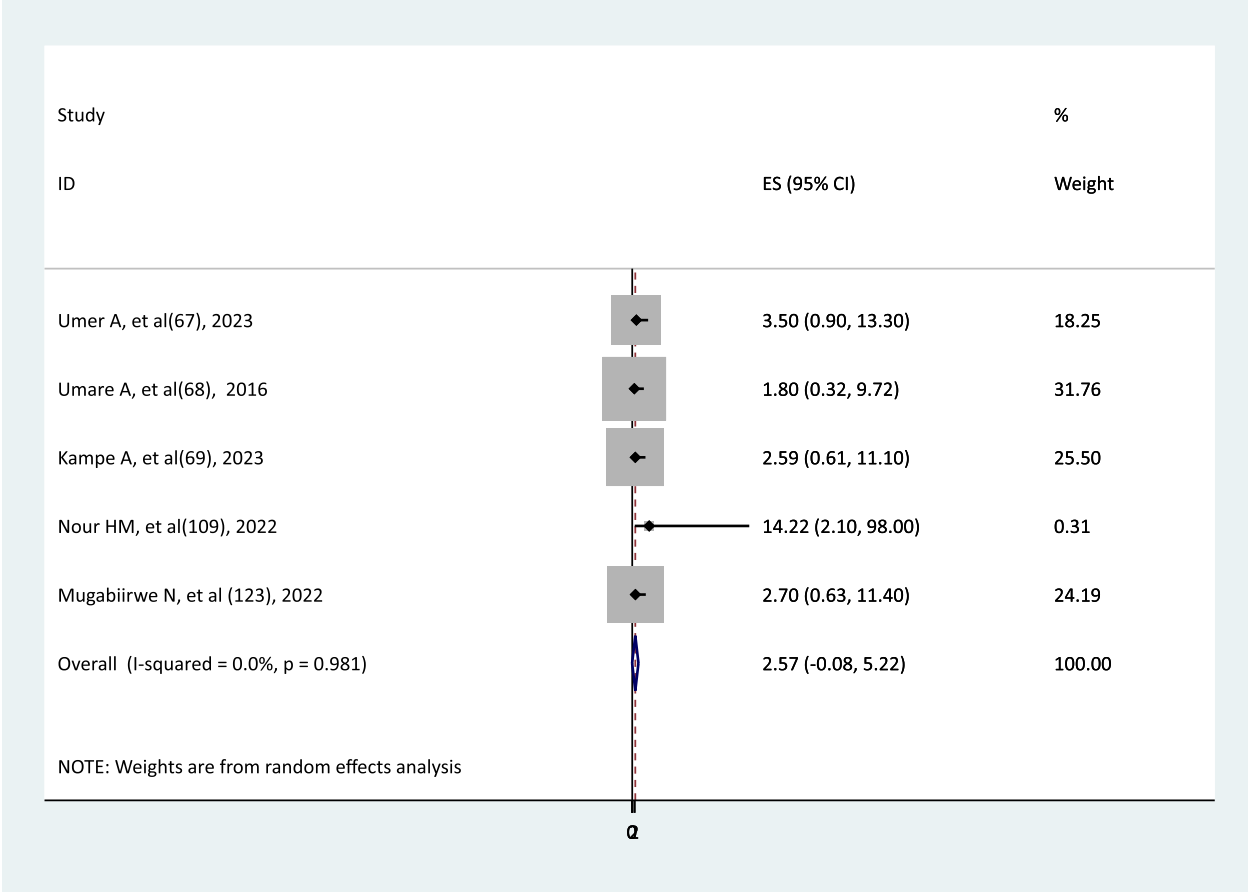

Fig. 15 The association between tooth extraction and HBV infection

et al. [24], respectively, postulated that women under the age of 20 years and those with a low perception of HBV risk were at higher risk of infection. The reasons could be variations in the way HBV prevention is implemented internationally, such as the failure of some countries to provide pregnant women with HBV with tenofovir [27] or to administer three doses of the hepatitis B vaccine [19, 26] to such women. Another reason for this variation would be that small studies were included in the subgroup analysis, which could impact the outcome. In the publication years between 2015 and 2019 and after 2020, the prevalence rates of HBV infection among pregnant women in Africa were comparable, at 6.3% and 5.6%, respectively. This indicates that the virus has not reduced. In this way, the strategies of the WHO, which were a 90% reduction in incidence and a 65% reduction in mortality for hepatitis B and C from 2015 to 2030 [127], may not be achieved. There were also nearly similar magnitudes of HBV infection among pregnant women in the sample sizes less than 422 and greater/equal to 422. The prevalence of HBV infection among pregnant women was 6.1% in cross-sectional studies and 2.4% in cohort studies. This difference could be due to the small number of included studies in the cohort studies, which may have resulted in inaccurate detection of the outcome.

Risk factors found to have a significant association with HBV infection were family history of HBV, multiple sexual partners, and sharp materials sharing. Pregnant women with a family history of HBV infection were nearly three times more likely to develop HBV infection than pregnant women without such a family history of HBV infection. This finding is in line with a previous study in Egypt [21]. More research is necessary to find the relationship between the onset of this disease and a family history of hepatitis B infection. Pregnant women with multiple sexual partners were nearly two times more likely to have an HBV infection than pregnant women without multiple sexual partners. This evidence is consistent with a previous study [20]. The potential exchange of infected fluids (blood, semen, and vaginal fluids) during sexual intercourse could cause disease transmission. Pregnant women who shared sharp materials were 2.4 times more likely to develop HBV infection than those who did not share

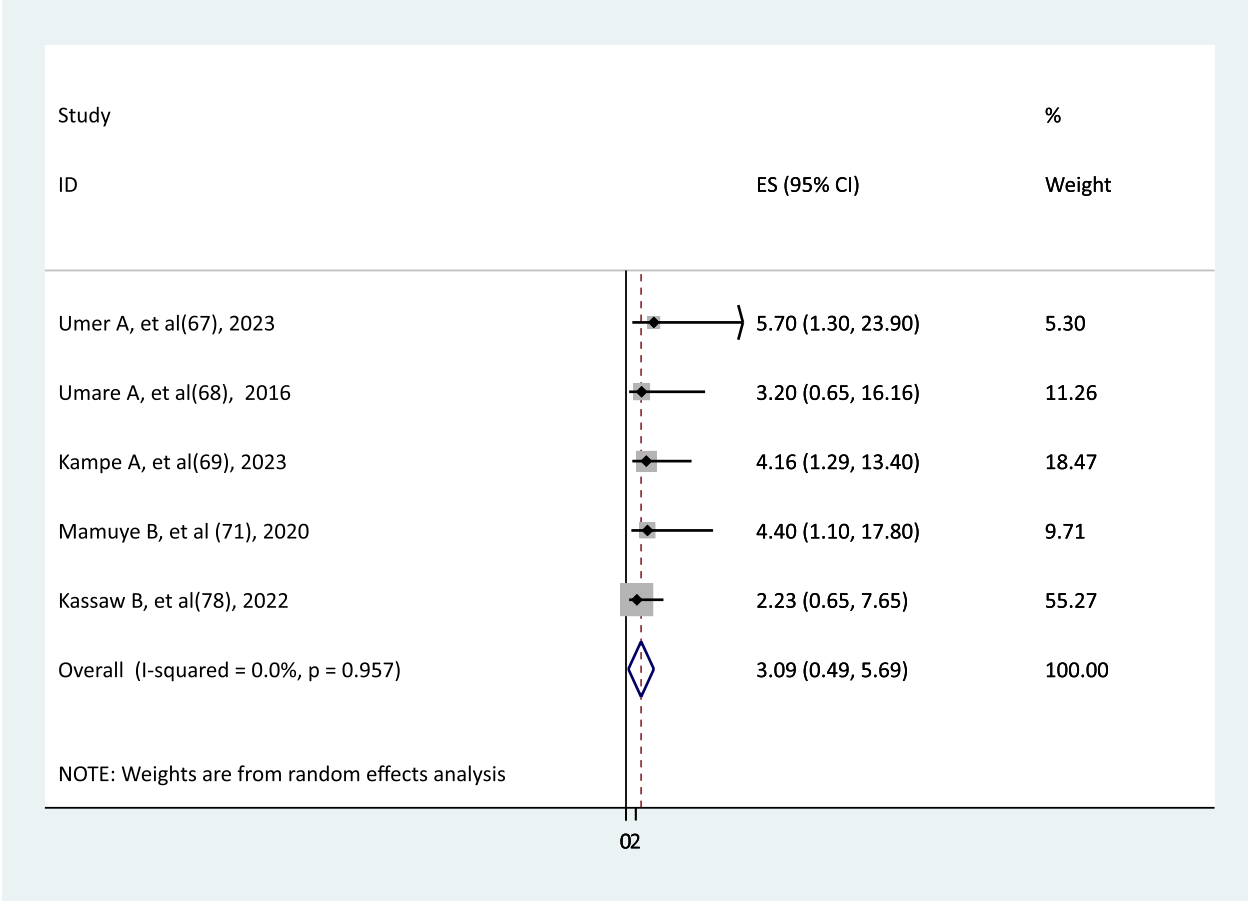

Fig. 16 The association between tonsillectomy and HBV infection

sharp materials. This was also explained in a previous study, which stated that exposure to sharp objects is a mechanism for the transmission of HBV [1]. In this study, an extremely wide confidence interval (CI) was observed for the factors of HIV and tooth extraction, indicating that the sample size for determining the outcome was inadequate. In previous studies, blood transfusion, tonsillectomy [20], hospital admission, surgery [21], abortion, piercing, and tattooing [22] were significant risk factors for HBV infection. However, in this study, abortion, blood transfusion, circumcision, tonsillectomy, hospital admission, piercing, scarification, tattoos, and surgical procedures had no statistically significant association with HBV infection. The variation in the relationship between these factors and HBV infection could be attributed to differences between hospitals or practitioners in the proper use of surgical instruments, proper cleaning of bedrooms, and safe blood transfusions.

The drawback of this study is that African countries and subdivisions were not uniformly represented. This limits the generalizability of the findings to all African countries and their subdivisions. Only studies published in English were included. Most of the included studies were cross-sectional and could not ascertain temporal relationships between risk factors and HBV infection among pregnant women. Significant heterogeneity was observed across the studies. Although we identified some sources of heterogeneity by subgroup analysis, there may still be others not investigated, such as participants' socio-demographic characteristics, may still have been overlooked in the included studies. These factors were unable to be assessed because they were not fully reported or because of different categorizations and descriptions of some variables in the primary studies. The other limitation was the existence of publication bias in the analyses, suggesting that studies with low sample sizes could have altered the overall pooled prevalence of HBV infection. However, to the best of our knowledge, this study is among the systematic reviews and meta-analyses of studies on the prevalence of HBV infection among pregnant women in Africa. Most of the

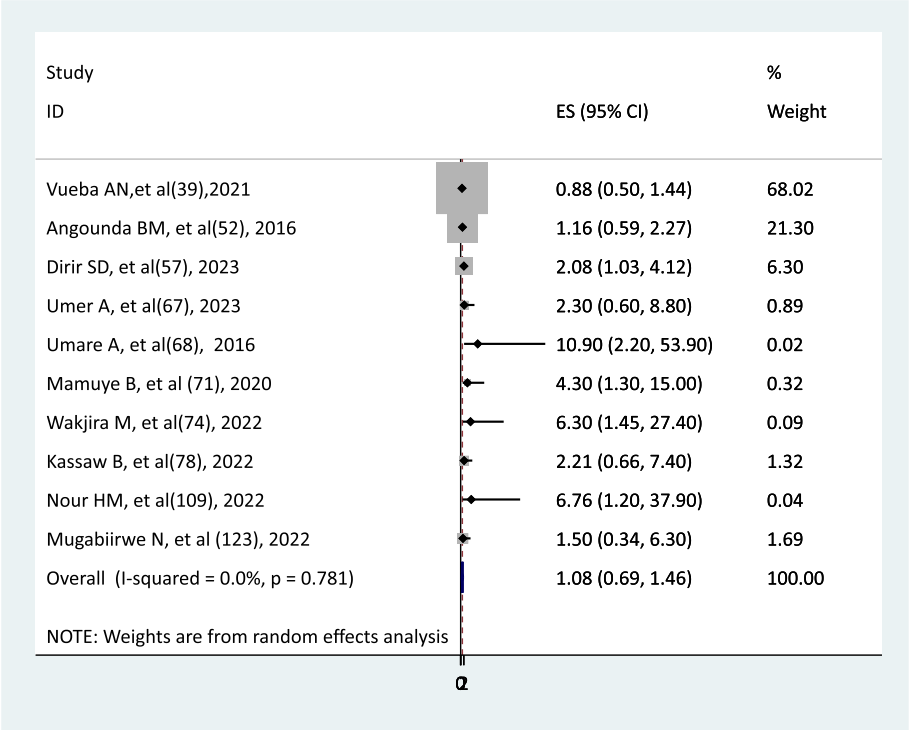

Fig. 17 The association between abortion and HBV infection

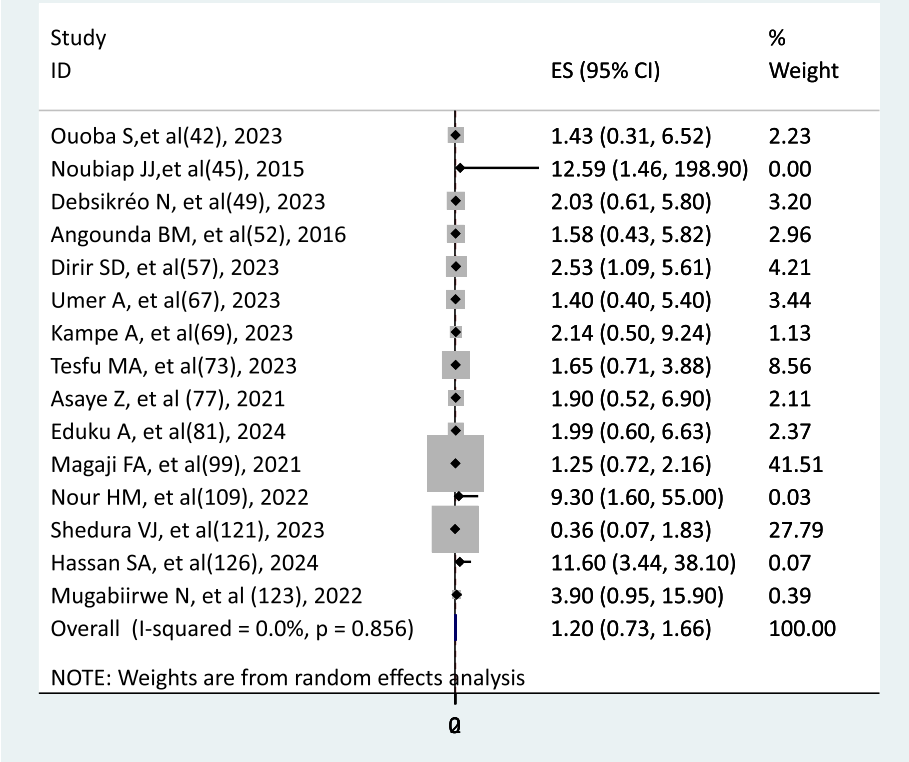

Fig. 18 The association between blood transfusion and HBV infection

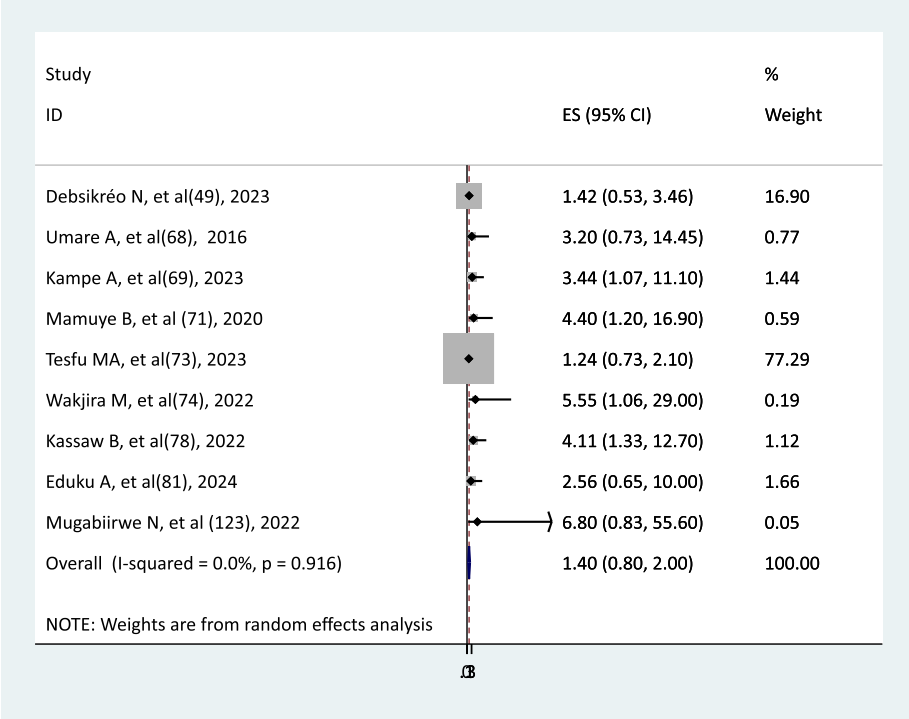

Fig. 19 The association between hospital admissions and HBV infection

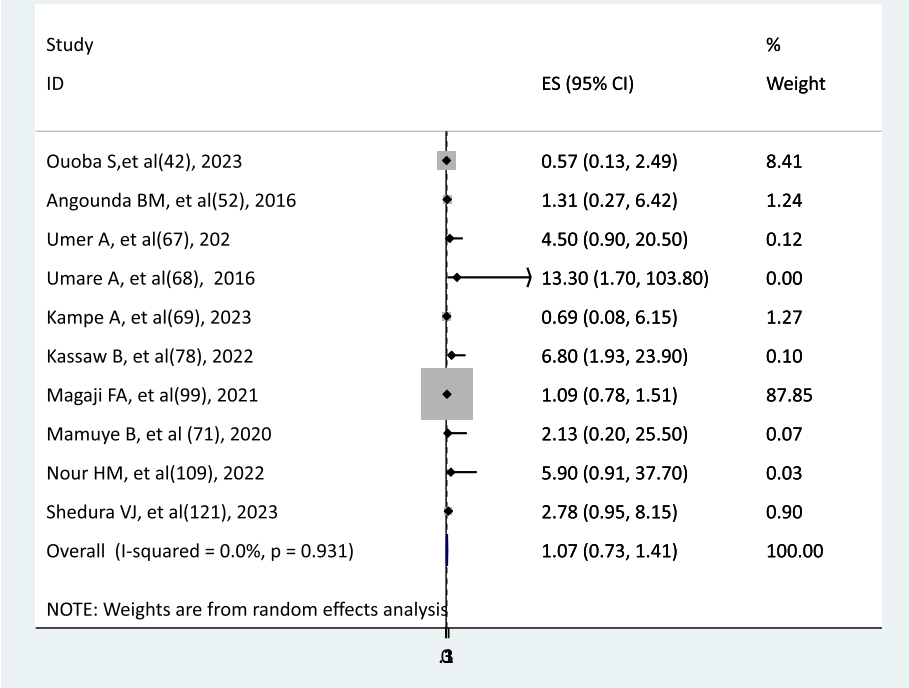

Fig. 20 The association between surgical procedure and HBV infection

included studies were conducted in recent years; therefore, the estimated pooled prevalence of HBV infection in this meta-analysis is more likely to reflect the current situation of the disease burden among pregnant women in Africa. A comprehensive search strategy was conducted with the involvement of a pair of independent investigators at all stages of the review process.

Conclusion

This systematic review and meta-analysis revealed an intermediate level of HBV endemicity among pregnant women in Africa. The highest rates of HBV infection among pregnant women were observed in West and Middle Africa, followed by East Africa. To prevent the spread of HBV among pregnant women in Africa, it is necessary to educate pregnant women about the risks associated with sharing sharp objects, having multiple sexual partners, and having a family history of HBV infection. Leaders of African nations and other governmental and non-governmental organizations should also collaborate to increase access to antiviral therapy, especially for pregnant women infected with HBV.

Abbreviations

HBV	Hepatitis B virus
HBsAg	Hepatitis B surface antigen
STI	Sexually transmitted disease
HIV	Human immunodeficiency virus
Fig	Figure
AOR	Adjusted odd ratio
CI	Confidence interval
S	Supplementary

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s12879-024-09839-3.

Additional file 1: S1 File. Checklist of Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA 2020).

Additional file 2: S2 File. Comprehensive search strategy for Epidemiology of HBV infection among pregnant women in Africa.

Additional file 3: S3 File. Extracted data for the epidemiology of HBV infection among pregnant women in Africa.

Additional file 4: S4 File. The quality of included studies was checked using the Joanna Briggs Institute Critical Appraisal Checklist.

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Authors' contributions

Temesgen Gebeyehu Wondmeneh (TGW) and Ayal Tsegaye Mekonnen (ATM) originated the idea and were fully involved in the identification, article review, data extraction, quality assessment, analysis, draft writing, and manuscript revision. TGW was heavily involved in the analysis, draft preparation, and revision of the manuscript. The final version of the manuscript to be considered for publication was read and approved by both authors. Both authors also agreed to share equal responsibility for all aspects of this research project.

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Availability of data and materials

All data generated or analyzed during this study are included in this article.

Declarations

Ethics approval and consent to participate

Not applicable.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

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