

Systematic Review

Prevalence of Group B *Streptococcus* Colonization and Invasive Infection in Nigeria: A Systematic Review and Meta-Analysis

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Abstract

Objective: This study provides the first systematic synthesis of the burden of Group B *Streptococcus* (GBS) colonization and invasive disease in Nigeria, with emphasis on prevalence, serotypes, and sequence types (STs). **Method:** This systematic review and meta-analysis were conducted in accordance with the PRISMA guidelines and was registered on PROSPERO (CRD420251155310). Searches were conducted across multiple databases, including Scopus, ScienceDirect, Web of Science, PubMed, Dimensions, and African Journals Online, as well as in Google Scholar and Google to identify relevant articles. In total, 426 records were retrieved, of which 43 studies met the inclusion criteria. A random-effects model was applied to estimate the pooled prevalence. **Result:** The pooled prevalence of GBS colonization in Nigeria was 12.0% (95% CI: 9.0–15.0%). Higher colonization rates were observed in Southern Nigeria (13.0%) than in Northern Nigeria (9.0%). The neonatal colonization rate was 16.0%. Colonization rates were 13.0% in pregnant women and 8.0% in non-pregnant individuals. Human immunodeficiency virus status showed no significant association with GBS colonization among pregnant women (OR = 1.47, $p = 0.17$). Invasive GBS disease was uncommon (3.0%) and occurred only in neonates. Across included studies, serotypes V and II were the most frequently reported, with ST19, ST182, and ST28 being the predominant STs. **Conclusions:** GBS colonization is common in Nigeria, with marked regional variation and heightened neonatal vulnerability to invasive GBS infections. Notably, nineteen states lacked surveillance data, highlighting substantial gaps in national monitoring. These findings highlight the importance of strengthening prevention strategies, expanding surveillance coverage, and implementing maternal screening and immunization programs to mitigate the burden of GBS.

Keywords: *Streptococcus agalactiae*; maternal carriage; invasive GBS infection; neonatal sepsis; Nigeria; systematic review; epidemiology



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1. Introduction

Streptococcus agalactiae (Group B *Streptococcus*; GBS) is a Gram-positive bacterium that occupies a unique niche at the interface of commensalism and invasive disease [1]. It commonly colonizes the gastrointestinal and genitourinary tracts of humans without symptoms, yet under certain circumstances, it can cause severe infections [1,2]. The clinical impact of GBS varies across populations, ranging from neonatal sepsis, pneumonia, and meningitis to maternal puerperal infections, chorioamnionitis, and invasive disease in non-pregnant adults, particularly the elderly and immunocompromised [2–6]. A 2020 global estimate attributed nearly 20 million maternal colonizations to GBS, resulting in approximately 394,000 infant infections, 58,000–92,000 neonatal deaths, 37,000 cases of long-term disability, more than 40,000 maternal infections, and 46,000 stillbirths [2].

GBS is heterogeneous. Isolates are classified into ten capsular polysaccharide serotypes (Ia–IX) [7–9] and by sequence types (STs) using multilocus sequence typing (MLST) [9–11]. Serotype and lineage distributions vary by region, host population, and clinical syndrome [3,7,9,12]. Globally, serotypes Ia, III, and V are predominant, associated with ST23, ST17, and ST1, respectively [6,8,11]. These differences are critical as they influence vaccine design, disease risk, and interpretation of surveillance data [11].

Maternal colonization prevalence also varies widely [13]. Multicountry studies report rates of 10–30%, though with heterogeneity by country and sampling methods [7,14–16]. In sub-Saharan Africa, prevalence estimates remain fragmentary due to limited surveillance and laboratory capacity [8]. Local prevalence data are essential since maternal colonization is the primary upstream risk factor for neonatal exposure and early-onset disease (EOD), making colonization, serotype distribution, and ST data vital for informing intrapartum antibiotic prophylaxis (IAP) policies and maternal vaccine strategies [13,17,18].

Nigeria, home to over 221 million people and one of the world's highest birth rates, records 34.3 neonatal deaths per 1000 live births, ranking fifth globally [19]. This population growth significantly impacts public health [20]. Despite this, GBS data remain fragmented, with variable colonization and invasive estimates and limited serotype/ST characterization [12,18,21–24]. Weak surveillance systems, uneven laboratory capacity, and limited intrapartum screening further constrain detection [7,12,14–16]. This study represents the first systematic review and meta-analysis of the burden of GBS in Nigeria. We aimed to synthesize evidence on colonization and invasive disease, determine pooled prevalence across populations, serotype and ST distributions, and identify knowledge gaps to inform prevention strategies.

2. Methods

2.1. Protocol Registration and Reporting Standards

The review protocol was registered with the International Prospective Register of Systematic Reviews (PROSPERO) on 30 September 2025 under the registration number CRD420251155310. This systematic review and meta-analysis were conducted in accordance with the PRISMA 2020 guidelines (Supplementary Table S1), focusing on the prevalence of GBS colonization and invasive disease among neonates, pregnant women, and non-pregnant populations in Nigeria [25].

2.2. Eligibility Criteria

Original studies that described the study population and design and reported the prevalence (or sufficient data to calculate prevalence) of GBS colonization or invasive disease among neonates, pregnant women or non-pregnant populations in Nigeria and/or study which conducted serotyping or MLST for GBS isolates were included while exclusion criteria include studies of GBS in other hosts, human GBS studies with unclear

results, reviews, letters, commentaries, editorials, and studies that did not provide proportion/prevalence data among human participants are excluded.

2.3. Information Sources

We systematically searched literature published between 1 January 1984, and 31 December 2024, in Scopus, ScienceDirect, Web of Science, PubMed, Dimensions, Africa Journals Online, Google Scholar, and Google.

2.4. Search Strategy

Search terms combined “*Streptococcus agalactiae*” OR “Group B *Streptococcus*” OR “Group B streptococci” OR “Group B streptococcal” AND “Nigeria”. Detailed search strings for each database are provided in Supplementary Table S2.

2.5. Selection Process

All 426 records were imported into Rayyan software, and 80 duplicates were removed using a combination of exact matching criteria (title and author) and fuzzy logic [26]. After deduplication, 346 unique records remained. Two reviewers (AA and BHG) independently screened the titles, abstracts, and full texts of the articles. Of these, 281 articles were excluded at the title and abstract screening stage because they were not related to GBS in Nigeria. Sixty-five articles were sought for retrieval, of which four could not be retrieved. The remaining 61 articles underwent full-text screening, resulting in the exclusion of 19 studies. These excluded studies included review articles, letter to editors, commentaries, studies conducted in other countries, studies involving non-classified *Streptococcus* species, GBS studies in animals, non-GBS studies, studies with unclear sample sizes and results, and studies conducted outside the period 1984 to 2024 (Supplementary Table S3). Finally, 42 articles met the inclusion criteria and were included in the study. Any disagreements were resolved through discussion or, when necessary, by consultation with a third reviewer (VAA). The PRISMA 2020 flow diagram (Figure 1) illustrates the study selection process and the reasons for exclusion at the full-text stage.

2.6. Data Collection Process

Data were extracted into an Excel spreadsheet by two independent reviewers (AA and VAA) and cross-checked; disagreements were resolved by consensus. Extracted items included: first author (or first and second author where two authors were listed), publication year, state and geopolitical zone, study population (neonates, pregnant women, non-pregnant), sample size, number of GBS identified, specimen type, serotype distribution, and ST data (if performed) (Table 1).

2.7. Study Risk of Bias Assessment

AA and VAA independently assessed methodological quality using an adapted Joanna Briggs Institute (JBI) critical appraisal checklist [27]. A composite quality score (0–10) was assigned to each study using an adapted JBI checklist for prevalence studies. We prespecified $\geq 6/10$ as moderate to high quality to reflect adequate sampling, an appropriate case definition, valid measurement, and acceptable response rates. Studies with scores < 6 were classified as lower quality (Supplementary Table S4). BHG adjudicated any disagreements.

2.8. Synthesis Methods

The data were synthesized using an online meta-analysis software available at <https://metaanalysisonline.com> (4 October 2025) [28]. In view of the substantial heterogeneity across studies, pooled prevalence estimates of GBS colonization and invasive infection in Nigeria were calculated using a random-effects model with 95% confidence intervals as well

as meta-regression. The analyses were stratified by geographical region and by population groups, including neonates, pregnant women, and non-pregnant women. Serotype and ST distributions were summarized descriptively. We calculated pooled odds ratios and 95% confidence intervals. Results will be presented as tables and graphical displays, including forest plots and a map.

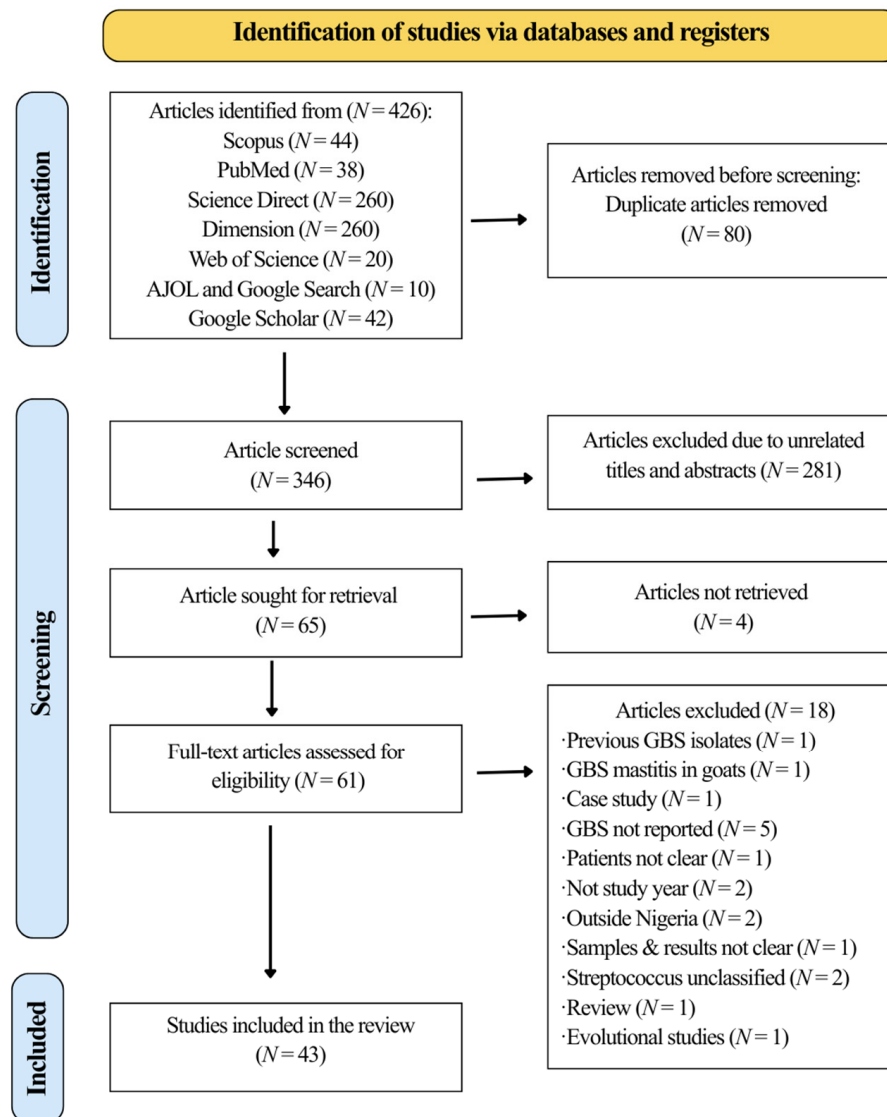


Figure 1. The study flow diagram demonstrates the study selection process.

Table 1. Summary of the characteristics of the included studies.

S/N	Author	Year	State	Zone	Population	Specimen	Isolation	Sample Size	No. of GBS Isolates	Prevalence (%)	Serotype Identified	ST Identified
1.	Akadri et al. [21]	2019	Osun	SW	Pregnant women	Vaginal and rectal swabs	Colonizing	184	51	28	NR	NR
2.	Akinlolu et al. [29]	2018	Osun	SW	Pregnant women and neonates	Vaginal, rectal, and umbilical cord	Colonizing	340	98	29	NR	NR
3.	Akinniyi et al. [30]	2017	Kaduna	NW	Pregnant women	Vaginal and rectal swabs	Colonizing	220	19	9	NR	NR
4.	Anosike et al. [23]	2017	Cross river	SS	Pregnant and non-pregnant women	High vaginal swab	Colonizing	122	26	21	NR	NR
5.	Bamidele et al. [31]	2022	Ekiti	SW	Pregnant women and neonates	Vaginal and rectal swabs	Colonizing	252	45	18	NR	NR
6.	Bello et al. [22]	2016	Oyo	SW	Pregnant women	Vaginal and rectal swabs	Colonizing	240	23	10	NR	NR
7.	Biobaku et al. [32]	2017	Osun	SW	HIV (+ and –) pregnant women	Vaginal and rectal swabs	Colonizing	198	36	18	NR	NR
8.	Bob-Manuel et al. [33]	2021	Rivers	SS	Pregnant women	Vaginal and rectal swabs	Colonizing	185	35	19	Ia (10 isolates), Ib (1), II (8), III (8), IV (4), and V (15).	NR
9.	Bob-Manuel et al. [34]	2021	Rivers	SS	Pregnant women	Isolates from the previous study by Bob-Manuel et al. [33]						ST1 (1), ST2 (2), ST8 (1), ST17 (1), ST19 (9), ST23 (1), ST24 (4), ST26 (1), ST28 (3), ST182 (3), ST486 (5), ST1336 (2)

Table 1. Cont.

S/N	Author	Year	State	Zone	Population	Specimen	Isolation	Sample Size	No. of GBS Isolates	Prevalence (%)	Serotype Identified	ST Identified
10.	Dozie-Nwakile et al. [35]	2022	Enugu	SE	Pregnant and non-pregnant women, neonates, couples with an infertility condition.	Vaginal, endocervical swabs, semen, urethral swabs, and neonate (not mentioned)	Colonizing	300	61	20	NR	NR
11.	Egbule et al. [36]	2024	Delta	SS	Pregnant women	Vaginal and rectal swabs	Colonizing	87	38	44	NR	NR
12.	Elikwu et al. [37]	2016	Lagos	SW	pregnant women and neonates	Vaginal and rectal	Colonizing	353	70	20	Ia (11 isolates), Ib (9), II (8), III (10), V (7), and VI (1).	NR
13.	Elikwu et al. [38]	2016	Lagos	SW	Pregnant women	Vaginal and rectal	Colonizing	300	59	20	NR	NR
14.	Ella et al. [39]	2008	Kaduna	NW	Neonate	Blood	Invasive	50	1	2	NR	NR
15.	Emembolu [40]	1989	Kaduna	NW	Infertile women	uterine curettage	Colonizing	114	10	9	NR	NR
16.	Ezeonu and Agbo [41]	2014	Enugu	SE	Pregnant and non-pregnant women	Vaginal and rectal swabs	Colonizing	400	47	12	NR	NR
17.	Gambo et al. [42]	2024	Sokoto	NW	Pregnant women	Vaginal and rectal swabs	Colonizing	152	7	5	NR	NR
18.	Hoppe et al. [43]	1986	Ogun	SW	Neonates	Pharyngeal aspirate, the nose, ear, and anus	Colonizing	200	38	19	Reported but not clearly grouped	NR
19.	Ibrahim et al. [44]	2021	Sokoto	NW	Pregnant women	Vaginal/rectal	Colonizing	185	7	4	NR	NR
20.	Idih et al. [45]	2019	Imo	SE	Pregnant women and neonates	Vaginal and rectal swabs	Colonizing	360	17	5	NR	NR
21.	Kwatra et al. [12]	2024	Abuja	NC	Mothers and neonates	Vaginal, urine, rectal swabs, umbilicus, outer ear, axillary fold, rectum, and throat	Colonizing	1759	405	23	Reported but not clearly grouped	NR

Table 1. Cont.

S/N	Author	Year	State	Zone	Population	Specimen	Isolation	Sample Size	No. of GBS Isolates	Prevalence (%)	Serotype Identified	ST Identified
22.	Makinde et al. [18]	2022	Lagos	SW	HIV (+ and –) pregnant women	Vaginal and rectal swabs	Colonizing	244	8	3	NR	NR
23.	Medugu et al. [17]	2017	Abuja	NC	Mothers and neonates	Rectal and vaginal samples and the external auditory meatus for neonates	Colonizing	1000	266	27	V (112); II (60), Ia (34), III (29), IV (3), and NT (7)	ST19 (9), ST182 (7), ST1 (4), ST28 (3), ST17 (3), ST23 (3), ST2 (1), ST196 (1), ST8 (1), ST26 (1), ST24 (1), ST762 (1)
24.	Nanbol et al. [46]	2021	Plateau	NC	Pregnant and non-pregnant HIV (+ and –) pregnant women	Vaginal and rectal swabs	Colonizing	300	9	3	NR	NR
25.	Njoku et al. [47]	2018	Cross River	SS	Pregnant and non-pregnant women	Vaginal and rectal swabs	Colonizing	168	18	11	NR	NR
26.	Nsagha et al. [48]	2000	Plateau	NC	Non-pregnant women	endocervical and anorectal swabs	Colonizing	162	11	7	NR	NR
27.	Nsagha et al. [24]	2012	Plateau	NC	Pregnant women	Vaginal and rectal swabs	Colonizing	56	2	4	NR	NR
28.	Nwachukwu et al. [49]	2007	Cross River	SS	Pregnant women	Vaginal and rectal swabs	Colonizing	200	18	9	NR	NR
29.	Ojo et al. [50]	2019	Lagos	SW	Pregnant women	Vaginal and rectal swabs	Colonizing	140	6	4	NR	NR
30.	Ojukwu et al. [51]	2006	Ebonyi	SE	Neonates	Blood	Invasive	138	1	1	NR	NR
31.	Okolo et al. [52]	1985	Edo	SS	Neonates	Blood	Invasive	177	1	1	NR	NR
32.	Okon et al. [53]	2013	Borno	NE	Pregnant women	Vaginal and rectal swabs	Colonizing	133	13	10	NR	NR

Table 1. Cont.

S/N	Author	Year	State	Zone	Population	Specimen	Isolation	Sample Size	No. of GBS Isolates	Prevalence (%)	Serotype Identified	ST Identified
33.	Okon et al. [54]	2023	Akwa Ibom	SE	HIV (+) patients	Sputum	Colonizing	61	5	8	NR	NR
34.	Olanisebe and Adetosoye [55]	1986	Oyo	SW	Pregnant women	Vaginal and rectal swabs	Colonizing	500	8	2	NR	NR
35.	Onipede et al. [56]	2012	Osun	SW	Pregnant women	Vaginal and rectal swabs	Colonizing	150	17	11	NR	NR
36.	Onwuezobe and Effiom [57]	2016	Akwa Ibom	SE	Pregnant women	Vaginal and rectal swabs	Colonizing	150	2	1	NR	NR
37.	Orji et al. [58]	2011	Rivers	SS	Neonate	Cerebrospinal fluid and blood	Invasive	145	21	14	NR	NR
38.	Patrick et al. [59]	2024	Bayelsa	SS		Swabs sample	Colonizing	185	11	6	NR	NR
39.	Rotimi et al. [60]	1985	Lagos	SW	Neonates	Umbilical cord swab	Colonizing	23	6	26	NR	NR
40.	Samuel et al. [61]	2019	Plateau	NC	Pregnant and non-pregnant women	Vaginal and rectal swabs	Colonizing	300	19	6	Ia (8), III (6), V (3), and II (2)	NR
41.	Uhiara [62]	1993	Kaduna	NW	Pregnant women and neonates	Vaginal and perineal swabs	Colonizing	200	27	14	Not clear	NR
42.	Wonodi [63]	2020	Rivers	SS	Children	Throat swab	Colonizing	456	23	5	NR	NR
43.	Yerumoh et al. [64]	2017	Edo	SS	Pregnant Women	Vaginal and rectal swabs	Colonizing	234	23	10	NR	NR

Keys: NC = North Central; NE = North East; NW = North West; SE = South East; SS = South South; SW = South West; NT = Non-typeable; NR = Not reported.

2.9. Reporting Bias Assessment

Publication bias was assessed visually using funnel plots, tables, and formally with trim-and-fill analysis and Egger's regression tests; a p -value ≤ 0.05 was considered evidence of small-study effects.

3. Results

3.1. Study Selection and Study Characteristics

Of the 426 records retrieved, 43 met the inclusion criteria after screening (Figure 1). The characteristics of these forty-two studies are summarized in Table 1.

3.2. Prevalence of Group B *Streptococcus* Colonization in Nigeria

Of the 43 included studies, 38 reported GBS colonization, resulting in 1584 GBS-positive cases among 10,613 individuals, which translates to an overall prevalence of 12.0% (95% CI: 9.0–15.0%) (Figure 2). Evidence of publication bias was suggested by funnel plot asymmetry and Egger's test (intercept: -4.22 , $p = 0.034$) (Figure 3, Supplementary Table S5). To further assess the impact of potential publication bias, a trim-and-fill analysis was conducted under a random-effects model. No potentially missing studies were imputed ($k_0 = 0$), and the adjusted pooled prevalence remained unchanged, indicating that the overall estimate was robust to the influence of publication bias. In addition, sensitivity analysis excluding two large studies [12,17] and one small study [60] yielded a prevalence of 11.0% (95% CI: 8.0–14.0%), while heterogeneity remained high ($I^2 = 93.6\%$) and no evidence of publication bias (Egger's intercept: 2.47 , $p = 0.401$), confirming the robustness of estimates. To explore sources of heterogeneity, a meta-regression was conducted using study years (in decades) as a moderator, with the 1980s as the reference category. The baseline prevalence in the 1980s was 11.0% (95% CI: 2.0–22.0%). No statistically significant differences were observed across subsequent decades (1990s–2020s), as reflected by overlapping confidence intervals, indicating the absence of a clear temporal trend (Figure 4). Substantial residual heterogeneity remained after adjustment.

Prevalence was higher in the South (13.0% [95% CI: 9.0–17.0%]) than in the North (9.0% [95% CI: 5.0–15.0%]). Across geopolitical zones, the South West recorded the highest prevalence (14.0% [95% CI: 9.0–21.0%]; 13 studies [18,21,22,29,31,32,37,38,43,50,55,56,60]), followed by the South South (12.0% [95% CI: 7.0–18.0%]; 10 studies [23,33,36,47,49,54,57,59,63,64]). The South East showed 11.0% (95% CI: 4.0–21.0%; 3 studies [33,45,63]), the North Central 10.0% (95% CI: 4.0–19.0%; 6 studies [12,17,24,46,48,61]), and the North East 10.0% (95% CI: 5.0–16.0%; 1 study [53]). The lowest prevalence was in the North West (8.0% [95% CI: 4.0–11.0%]; 5 studies [30,40,42,44,62]).

No data were available for 18 states, including Ondo, Abia, Anambra, Ebonyi, Benue, Kogi, Kwara, Nasarawa, Adamawa, Bauchi, Gombe, Taraba, Yobe, Jigawa, Kano, Katsina, Kebbi, and Zamfara (Figure 5).

3.3. Prevalence of Group B *Streptococcus* Colonization in the Neonate

Nine of the 38 included studies reported on GBS colonization in neonates, involving a total of 2166 neonates across nine states of Nigeria [12,17,29,31,35,43,45,60,62]. Among these, 416 cases of GBS were identified, yielding a pooled prevalence of 16.0% (95% CI: 12.0–22.0%) (Figure 6).

Regionally, the northern part of the country reported the highest number of neonatal GBS cases, with 312 cases out of 1485 neonates, corresponding to a prevalence of 19.0% (95% CI: 15.0–24.0%) [12,17,62]. In contrast, the southern region reported 104 cases out of 681 neonates, with a prevalence of 16.0% (95% CI: 8.0–25.0%) [18,29,31,43,45].

3.4. Prevalence of Group B Streptococcus Colonization in Pregnant Women

Thirty-one of the 38 included articles reported maternal colonization in Nigeria, involving a total of 6,940 women, of whom 1,045 were colonized, resulting in an overall prevalence of 13% (95% CI: 9.0–16.0%) (Figure 7). Prevalence was higher in the southern region of Nigeria (14.0% [95% CI: 9.0–18.0%]) compared to the northern region (11.0% [95% CI: 5.0–18.0%]).

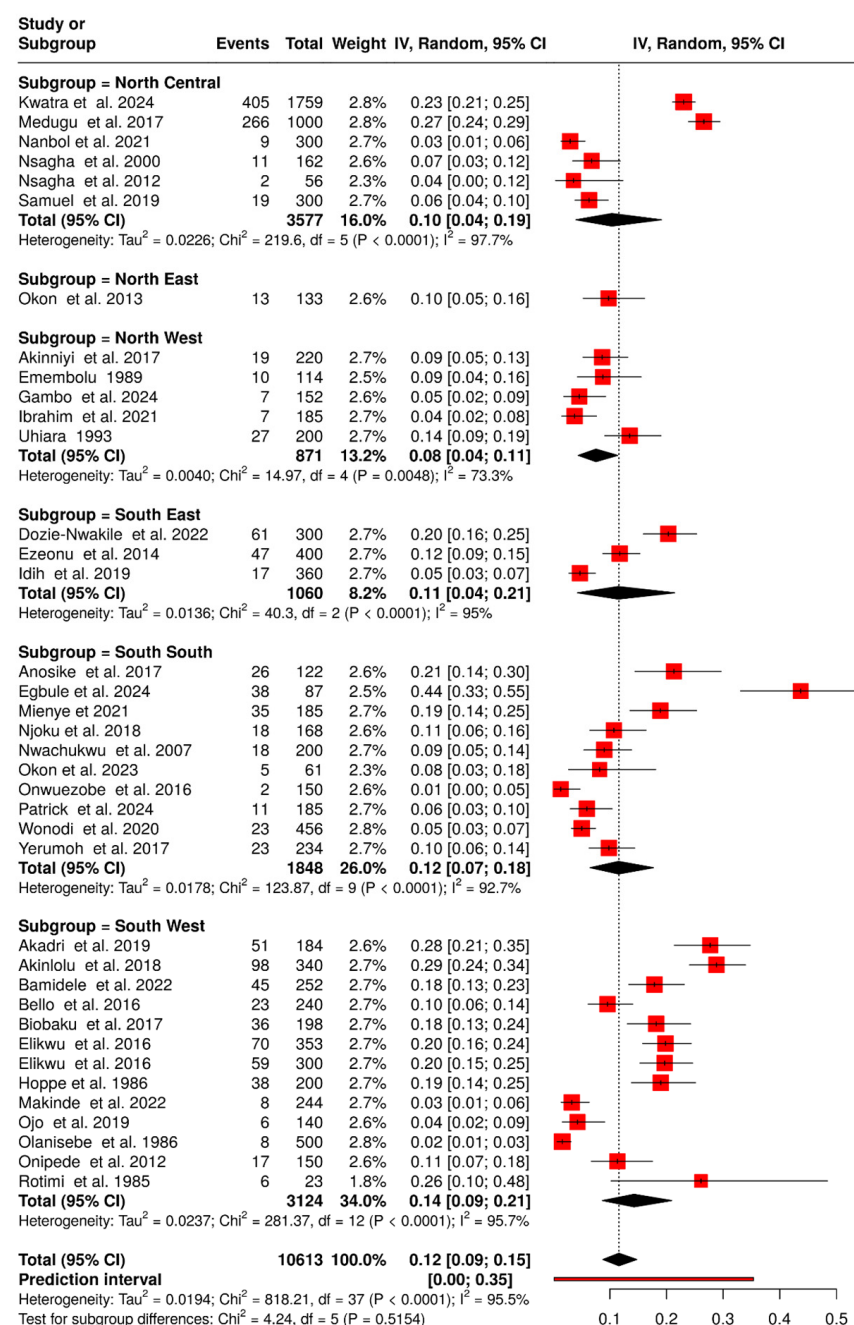


Figure 2. Forest plot of GBS colonization prevalence in Nigeria and geopolitical zones (1984–2024). The pooled prevalence was estimated using random-effects models [12,17,18,21–24,29–33,35–38,40–50,53–57,59–64]. Each black horizontal line represents a study's 95% confidence interval, with red squares indicating point estimates and weights. Black diamonds denote comparisons, while dotted or dashed lines show subgroup analyses. The red horizontal line represents the prediction interval.

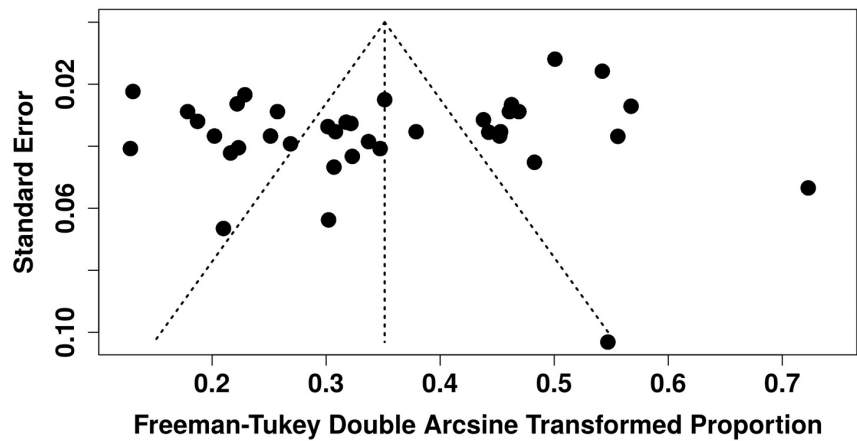


Figure 3. The funnel plot of studies conducted on Group B *Streptococcus* colonization rates in Nigeria between 1984 and 2024 demonstrates an asymmetrical distribution.

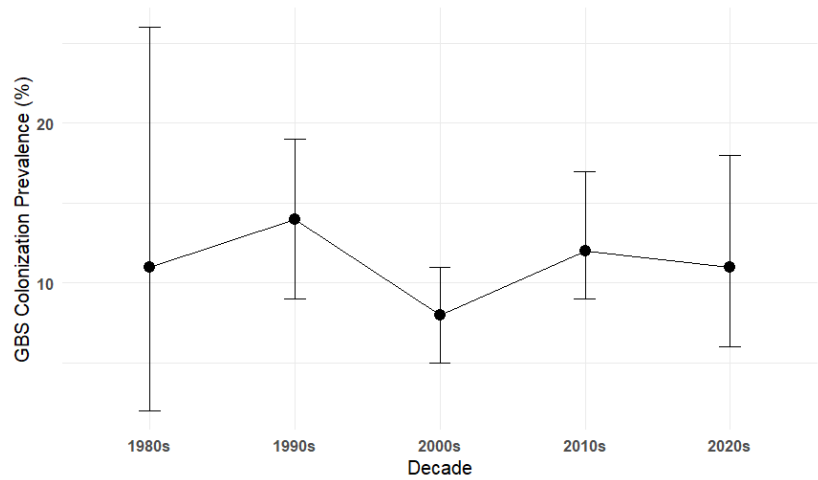


Figure 4. Colonization prevalence of Group B *Streptococcus* by decade with 95% confidence intervals. Black circles show the estimated GBS prevalence per decade, with vertical black lines represent 95% confidence intervals.

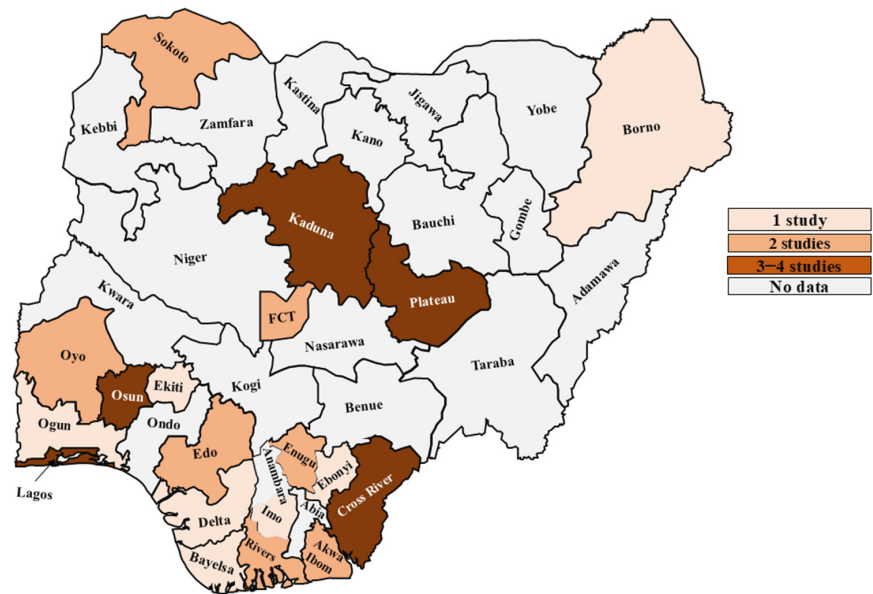


Figure 5. Distribution of studies across Nigerian states from 1984 to 2024, highlighting the range of data available per state.

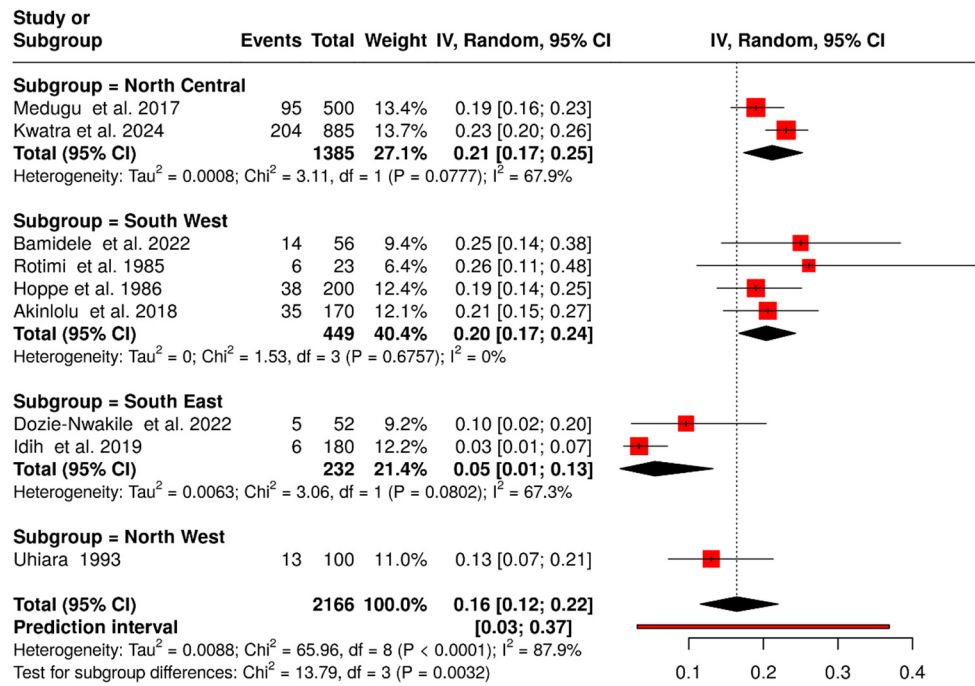


Figure 6. Forest plot of Neonatal GBS colonization prevalence in Nigeria and per geographical zones (1984–2024). The pooled prevalence was estimated using random-effects models [12,17,29,31,35,43,45,60,62]. Each black horizontal line represents a study’s 95% confidence interval, with red squares indicating point estimates and weights. Black diamonds denote comparisons, while dotted or dashed lines show subgroup analyses. The red horizontal line represents the prediction interval.

Regional analysis showed that prevalence was highest in the North Central (14.0% [95% CI: 5.0–26.0%]; 5 studies [12,17,46,48,61] and lowest in the North West (7.0% [95% CI: 4.0–12.0%]; 4 studies [30,42,44,62]). The North East (10.0% [95% CI: 5.0–16.0%]; 1 study [53]) had intermediate prevalence. In the southern regions, South South (14.0% [95% CI: 7.0–24.0%]; 7 studies [23,33,36,47,49,57,64]), South East (12.0% [95% CI: 5.0–20.0%]; 3 studies [35,41,45]), and South West (14.0% [95% CI: 7.0–21.0%]; 11 studies showed similar prevalence across regions [18,21,22,29,31,32,37,38,50,55,56].

3.5. Prevalence of Maternal Group B Streptococcus Colonization in HIV Pregnant Women

Three studies assessed GBS colonization among HIV-positive pregnant women [18,32,47]. The individual studies reported prevalence estimates of 3.0% [18], 15.0% [47], and 19.0% [32], respectively, reflecting variability across study populations and settings. When the data were pooled, the overall prevalence of GBS colonization in this subgroup was estimated at 11.0% (95% CI: 3.0–25.0%), suggesting that HIV-positive women may have a moderate burden of GBS colonization. However, the wide confidence interval indicates uncertainty in the estimate and highlights the need for further studies with larger sample sizes to provide more precise prevalence data.

3.6. Impact of HIV on Maternal Group B Streptococcus Colonization

Three studies assessed maternal GBS colonization in HIV-positive and HIV-negative pregnant women [18,32,47]. The odds ratios from individual studies ranged from 1.00 to 2.89. A pooled Mantel–Haenszel meta-analysis showed no statistically significant association between HIV status and GBS colonization (OR = 1.47, 95% CI: 0.85–2.54, $p = 0.17$) (Table S5).

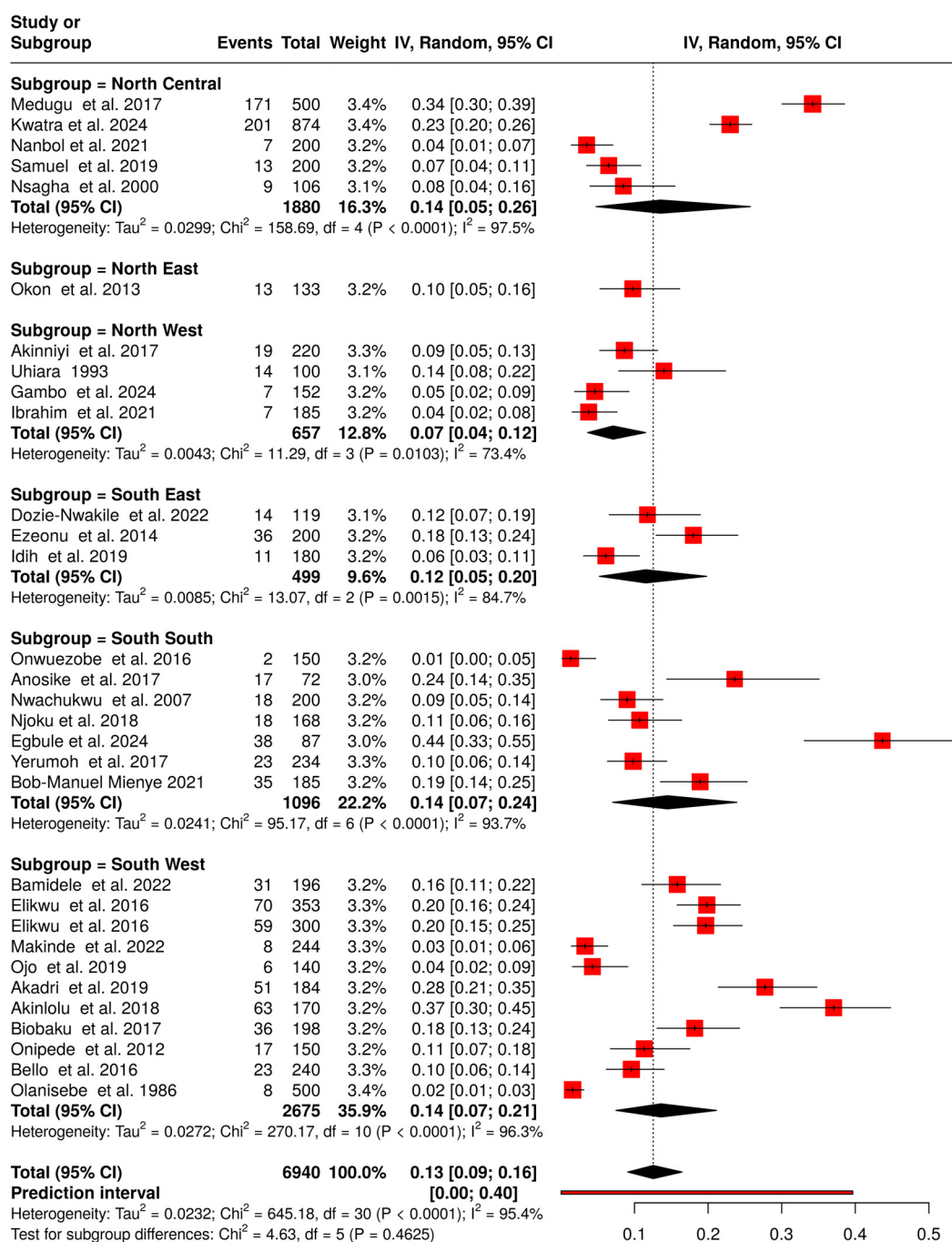


Figure 7. Forest plot of Maternal GBS colonization prevalence in Nigeria and geopolitical zones (1984–2024). The pooled prevalence was estimated using random-effects models [12,17,18,21–23,29–33,35–38,41,42,44–50,53,55–57,61,62,64]. Each black horizontal line represents a study's 95% confidence interval, with red squares indicating point estimates and weights. Black diamonds denote comparisons, while dotted or dashed lines show subgroup analyses. The red horizontal line represents the prediction interval.

3.7. Prevalence of Group B Streptococcus Colonization in Non-Pregnant Individuals

In addition to neonates and pregnant women, 11 studies reported GBS colonization among non-pregnant women, men, and school children [23,24,35,40,41,46,48,54,59,61,63], with a pooled prevalence of 8.0% (95% CI: 4.0–13.0%) (Figure 8). Of these, five studies were conducted in the northern region, involving 426 individuals, among whom 22 GBS isolates were identified, corresponding to a prevalence of 5.0% (95% CI: 3.0–8.0%) [24,40,46,48,61].

In contrast, studies from the southern region reported 103 GBS isolates out of 1081 individuals, yielding a prevalence of 11.0% (95% CI: 4.0–20.0%) [23,35,41,54,59,63].

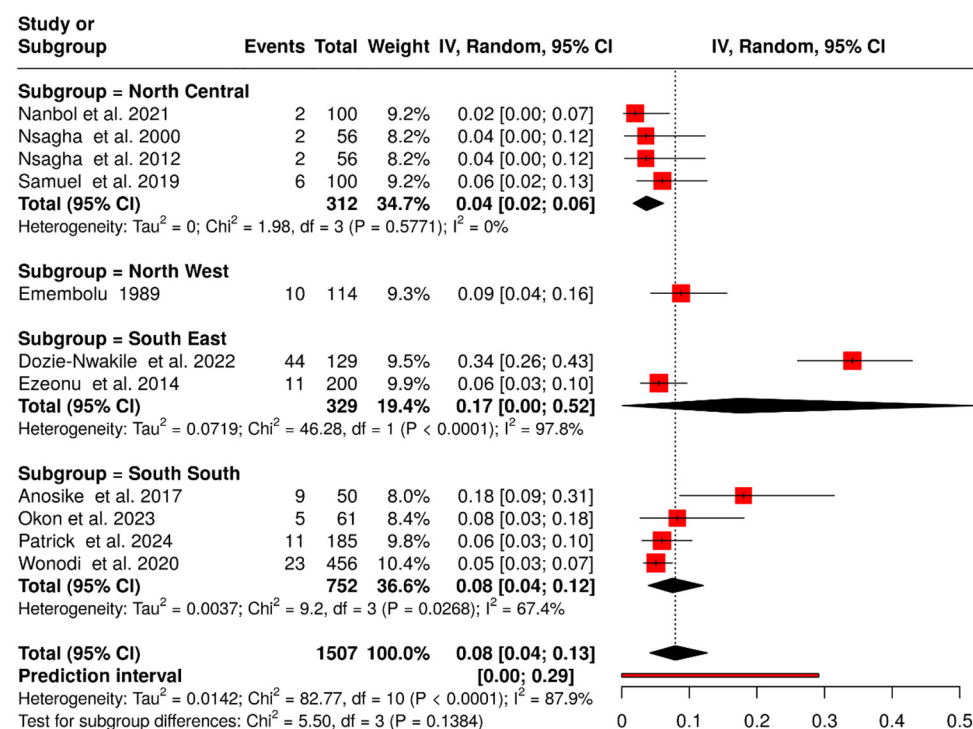


Figure 8. Forest plot of prevalence of colonization of GBS in non-pregnant, non-neonate in Nigeria and per geographical zones (1984–2024). The pooled prevalence was estimated using random-effects models [23,24,35,40,41,46,48,53,59,61,63]. Each black horizontal line represents a study's 95% confidence interval, with red squares indicating point estimates and weights. Black diamonds denote comparisons, while dotted or dashed lines show subgroup analyses. The red horizontal line represents the prediction interval.

3.8. Prevalence of Invasive Group B Streptococcus Cases

Four studies out of the 43 included studies in this review reported invasive GBS in Nigeria, with an overall pooled prevalence of 3.0% (95% CI: 0.0–11.0%) (Figure 9) [39,51,52,58]. Interestingly, all occurred in neonates. In Kaduna, GBS was isolated from 1 of 50 neonates with sepsis (7.69%) [39]. Ojukwu et al. [51] and Okolo and Omene [52] each identified one case of neonatal septicaemia, with overall incidences of 7.98 and 5.6 per 1000 live births, respectively. In Rivers State, GBS was detected in 21 of 145 infant blood or cerebrospinal fluid samples (14.5%) [58].

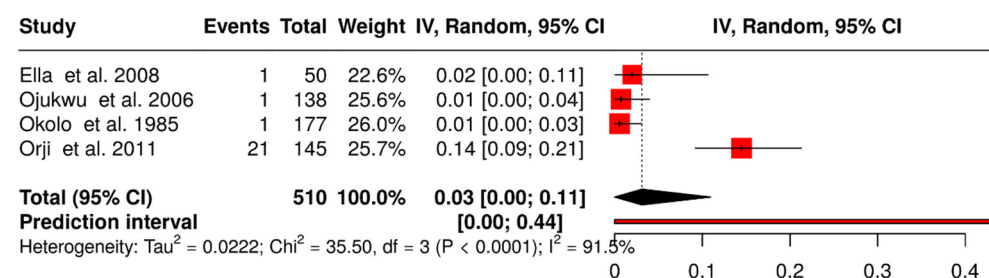


Figure 9. Forest plot of prevalence of invasive GBS infection in Nigeria (1984–2024). The pooled prevalence was estimated using random-effects models [39,51,52,58]. Each black horizontal line represents a study's 95% confidence interval, with red squares indicating point estimates and weights. Black diamonds denote comparisons, while dotted or dashed lines show subgroup analyses. The red horizontal line represents the prediction interval.

3.9. Capsular Serotype Distribution of Group B *Streptococcus* in Nigeria

Of the 43 included studies, seven reported capsular serotype distribution [12,17,33,34,37,43,61]. Of these, four studies were included in the analysis, while three were excluded: two (Hoppe et al. [43] and Kwatra et al. [12]) had unclear serotype data, and one (Bob-Manuel et al. [34]) performed serotyping on isolates that had already been classified. Across the four studies, 356 GBS isolates were serotyped. The most common identified serotype was serotype V (137, 38.5%). Others include serotype II (78, 21.9%), serotype Ia (63, 17.7%), serotype III (53, 14.9%), serotype Ib (10, 2.8%), serotype IV (7, 2.0%), serotype VI (1, 0.3%), and non-typeable (NT) isolates (7, 2.0%).

Individual studies showed variable distributions. Samuel et al. [61] observed serotype Ia (42.1%), III (31.6%), V (15.8%), and II (10.5%). Elikwu et al. [37] reported serotype Ia (23.9%) predominating in maternal isolates and serotype II (71.4%) in neonates. Bob-Manuel et al. [33] identified serotype V (32.6%) and serotype Ia (21.7%) as most common among pregnant women, while Medugu et al. [17] reported serotype V (45.7%), II (24.5%), Ia (13.9%), III (11.8%), NT (2.9%), and IV (1.2%).

3.10. Sequence Type Distribution of Group B *Streptococcus*

Two studies reported MLST data in Nigeria [17,34], identifying 14 STs. The combined STs from both studies included ST19 ($N = 18$, 26.5%), ST182 ($N = 10$, 14.7%), ST28 ($n = 6$, 8.8%), ST1, ST24, and ST486 ($N = 5$ each, 7.4%), ST17 and ST23 ($N = 4$ each, 5.9%), ST2 ($N = 3$, 4.4%), ST8, ST26, and ST1336 ($N = 2$ each, 2.9%), and ST196 and ST762 ($N = 1$ each, 1.5%).

Individually, Medugu et al. in 2017 reported STs included ST19 ($N = 9$, 25.7%), ST182 ($N = 7$, 20.0%), ST1 ($N = 4$, 11.4%), ST28, ST17, and ST23 ($N = 3$ each, 8.6%), and ST2, ST196, ST8, ST26, ST24, and ST762 ($N = 1$ each, 2.9%) [17]. Similarly, Bob-Manuel et al. (2021) reported 12 STs: ST19 ($N = 9$, 27.3%), ST486 ($N = 5$, 15.2%), ST24 ($N = 4$, 12.1%), ST28 and ST182 ($N = 3$ each, 9.1%), ST2 and ST1336 ($N = 2$ each, 6.1%), and ST1, ST8, ST17, ST23, and ST26 ($N = 1$ each, 3.0%) [34].

4. Discussion

GBS is a significant pathogen of public health importance, widely recognized as both a neonatal and maternal pathogen. Globally, colonization varies by geography and socioeconomic context [2,6,7,16,65]. Our meta-analysis found an overall prevalence of 12.0% (95% CI: 9.0–15.0%) in Nigeria, with neonatal colonization at 16.0% (95% CI: 12.0–22.0%), maternal colonization at 13.0% (95% CI: 9.0–16.0%), and 8.0% (95% CI: 4.0–13.0%) in non-pregnant populations. These figures highlight Nigeria's contribution to the global GBS burden and illustrate regional variation that requires contextual interpretation.

The 16.0% neonatal colonization rate is concerning compared with global and African estimates [2,66–68]. A higher prevalence in northern Nigeria (19.0%) compared to the south (16.0%), this may suggest differences in the dynamics of vertical transmission. Invasive neonatal disease was detected in 3.0% (95% CI: 0.0–11.0%), consistent with global trends [2,66]. Although neonatal GBS is under-documented in Nigeria, our findings support its role in early-onset sepsis [45,65,69]. Africa bears the highest global incidence (1.12 per 1000 live births vs. 0.49 per 1000 globally) [67], and Nigerian data align with this pattern [12,17,39,51,52,58,67].

The maternal prevalence in Nigeria was 13.0%, which is lower than the global estimate of 18% (95% CI: 17–19%) [6] and lower than the average rates in other African countries (16–22%) [7,14,15,65]. Methodological variation, such as swab site, timing, culture techniques, and sample size, likely contributed to this lower pooled prevalence [7,62]. Regionally, rates were higher in the south (14%) compared to the north (11%), mirroring the broader continental heterogeneity [9,16,70,71]. GBS colonization in HIV-positive pregnant women has

been examined in multiple studies from different countries [71–73]. Among HIV-positive pregnant women, prevalence was 11.0% (95% CI: 3.0–25.0%) with no significant association between HIV and colonization (OR = 1.47, 95% CI: 0.66–3.24). This aligns with findings from Malawi (19.4% vs. 21.7%), Brazil (19.8% vs. 14.15%), Belgium (29.6% vs. 24.2%), and the United States (41.3% vs. 30.6%) [74–77], although data from Tanzania suggest an increased risk (63.1% vs. 18.9%) [73]. Given the wide confidence intervals and few Nigerian studies, larger, prospective cohorts are needed to clarify this relationship [18,32,47].

Beyond neonates and pregnant women, GBS is also an important pathogen on the broader population [4,8,78–80]. Globally, it has been reported in different forms of infection, including throat infections in school-aged children and young adults [63,81,82], urinary tract infections in men and women, and even infertility [40,83–85] and sepsis and cellulitis [79,80]. Our pooled prevalence among this population was 8.0%, comparable to global estimates (9–32%) [4,78,86–88]. Nigerian data fall within the lower range of global values, although regional differences were evident, with a higher prevalence in the south (11%) compared to the north (5%).

The serotype distribution in Nigeria reflects the global epidemiology. Across the five studies that conducted serotyping, serotype V was predominant [12,17,33,37,43]. These, along with serotypes Ia, Ib, II, and III, account for over 90% of invasive cases globally and are targets of candidate maternal vaccines [7,14,67]. There is considerable variation in GBS serotype distribution across countries. Kwatra et al. reported serotype Ia as the most prevalent in Bangladesh, India, Ethiopia, Kenya, and South Africa, serotype V in Mali, and serotype III in Mozambique [12]. In Southeast Asian countries, Muthanna and colleagues identified serotype III as the predominant serotype, followed by serotypes V, II, VI, and Ia [6]. In Europe, North America, and Southern Africa, serotype IV was more commonly reported, whereas serotype V predominated in West Africa [11].

Like other African countries, there are limited GBS MLST data in Nigeria. Two studies, Medugu et al. and Bob-Manuel et al., conducted MLST, reporting 14 GBS STs with ST19 (26.5%), ST182 (14.7%), and ST28 (8.8%) predominated [17,34]. In Kenya, ST17 and ST23 were the most reported, followed by ST10 and ST1. In Senegal, ST1, ST26, and ST28 were the most common [89,90]. Outside Africa, studies from Malaysia and Thailand indicate ST1 as the most prevalent STs, followed by ST17 and ST283 [6,91,92]. A Canadian study similarly reported ST1 as the most common, followed by ST23 [93]. Unlike regions where hypervirulent ST17 dominates, Medugu et al. and Bob-Manuel et al. reported low (5.9%). The availability of only two MLST studies in Nigeria highlights the need for expanded molecular epidemiology. Without additional data, it is difficult to track the circulation and evolution of GBS strains or assess their potential virulence in Nigeria. Expanded surveillance, including MLST or whole-genome sequencing, would provide critical information on STs, clonal complexes and virulence factors, helping to guide vaccine implementation and public health strategies in Nigeria [11,17,94].

Nigeria's 13% maternal colonization prevalence suggests opportunities for prevention. In high-income countries, universal screening and IAP have reduced EOD [1,5]. While universal screening may be impractical in Nigeria, risk-based or culture-limited approaches could be introduced in tertiary centers [17,95]. The cost of implementing screening (₦300,000/500 women) is substantially lower than treating neonatal sepsis or its sequelae [17]. Standardized rectovaginal swabs, improved culture capacity, and national perinatal pathogen surveillance are essential. Antenatal care should be updated to clarify and include IAP. Preparations for maternal GBS vaccines should include monitoring of serotype and lineage, particularly in under-studied northern and rural states.

This study addresses an important question and represents the first systematic review and meta-analysis of GBS in Nigeria. By pooling data from pregnant women, neonates,

non-pregnant adults, and HIV-positive populations, it provides a broad national overview. Methodological rigor, adherence to PRISMA, and sensitivity analyses further strengthen the reliability of findings. However, high heterogeneity ($I^2 > 90\%$) across studies, reflecting differences in methods, swab sites, and culture techniques, limits comparability. Study quality was assessed using the JBI checklists; however, a formal GRADE assessment was not conducted. Similarly, differences in rates may reflect variation in surveillance, screening, and research coverage rather than true biological differences, as only 19 of 37 states contributed data, leaving significant geographical gaps. Most data came from urban hospital settings, which may have led to an underestimation of rural prevalence.

Overall, the findings suggest that GBS colonization and disease are underrecognized in Nigeria, and the prevalence should be interpreted with caution, as it does not reflect uniform national coverage. They emphasize the need to enhance standardized GBS screening and diagnostic capabilities in maternal and neonatal care, supported by national guidelines and coordinated surveillance, to address existing geographical disparities. Future research should focus on multi-state, population-based studies and greater inclusion of rural populations to better inform prevention and control strategies.

5. Conclusions

This systematic review synthesizes four decades of GBS data in Nigeria, revealing an overall prevalence of 12%, higher in neonates (16%) than in pregnant women (13%) or other populations (8%). Findings align with global trends in serotypes and STs although hypervirulent ST17 appears to be less prevalent. Expanding surveillance, introducing feasible prevention measures, and preparing for maternal vaccines are vital steps to address neonatal invasive infections and strengthen maternal–child health outcomes.

Supplementary Materials: The following supporting information can be downloaded at: <https://www.mdpi.com/article/10.3390/medsci14010093/s1>, Table S1: PRISMA Checklist; Table S2: Search Queries; Table S3: Excluded Articles with Reasons [69,96–116]; Table S4: Quality Assessment of Included Studies; Table S5: Publication Bias Assessment Result; Table S6: Odds ratios (OR) of GBS colonization by maternal HIV status in Nigeria.

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Abbreviations

The following abbreviations are used in this manuscript:

GBS	Group B <i>Streptococcus</i>
PROSPERO	International Prospective Register of Systematic Reviews
PRISMA	Preferred Reporting Items for Systematic reviews and Meta-Analyses
MLST	Multilocus Sequence Typing
ST	Sequence Type
HIV	Human Immunodeficiency Virus
IAP	Intrapartum Antibiotic Prophylaxis
EOD	Early-Onset Disease
OR	Odd Ratio
CI	Confidence Interval

References

1. World Health Organization. Group B Streptococcus Vaccine: Full Value Vaccine Assessment. Available online: <https://www.who.int/publications/i/item/9789240037526> (accessed on 6 January 2025).
2. Gonçalves, B.P.; Procter, S.R.; Paul, P.; Chandna, J.; Lewin, A.; Seedat, F.; Koukounari, A.; Dangor, Z.; Leahy, S.; Santhanam, S.; et al. Group B Streptococcus Infection during Pregnancy and Infancy: Estimates of Regional and Global Burden. *Lancet Glob. Health* **2022**, *10*, e807–e819. [\[CrossRef\]](#)
3. Francois Watkins, L.K.; McGee, L.; Schrag, S.J.; Beall, B.; Jain, J.H.; Pondo, T.; Farley, M.M.; Harrison, L.H.; Zansky, S.M.; Baumbach, J.; et al. Epidemiology of Invasive Group B Streptococcal Infections Among Nonpregnant Adults in the United States, 2008–2016. *JAMA Intern. Med.* **2019**, *179*, 479. [\[CrossRef\]](#) [\[PubMed\]](#)
4. Bliss, S.J.; Manning, S.D.; Tallman, P.; Baker, C.J.; Pearlman, M.D.; Marrs, C.F.; Foxman, B. Group B *Streptococcus* Colonization in Male and Nonpregnant Female University Students: A Cross-Sectional Prevalence Study. *Clin. Infect. Dis.* **2002**, *34*, 184–190. [\[CrossRef\]](#)
5. Behjati, S.; Prentice, P.; Rennie, J. Management of Group B Streptococcal Sepsis Risk in Well, Term Newborns. *Acta Paediatr.* **2012**, *101*, 128–131. [\[CrossRef\]](#)
6. Muthanna, A.; Sulaiman, N.; Dzaraly, N.D.; Al-Obaidi, M.M.J.; Amin-Nordin, S.; Azmai, M.N.A.; Desa, M.N.M. Distribution of Group B *Streptococcus* Isolated from Humans in Southeast Asia: A Systematic Review and Meta-Analysis. *Asian Pac. J. Trop. Med.* **2025**, *18*, 289–301. [\[CrossRef\]](#)
7. Russell, N.J.; Seale, A.C.; O'Driscoll, M.; O'Sullivan, C.; Bianchi-Jassir, F.; Gonzalez-Guarin, J.; Lawn, J.E.; Baker, C.J.; Bartlett, L.; Cutland, C.; et al. Maternal Colonization with Group B *Streptococcus* and Serotype Distribution Worldwide: Systematic Review and Meta-Analyses. *Clin. Infect. Dis. Off. Publ. Infect. Dis. Soc. Am.* **2017**, *65*, S100–S111. [\[CrossRef\]](#) [\[PubMed\]](#)
8. Navarro-Torné, A.; Curcio, D.; Moisi, J.C.; Jodar, L. Burden of Invasive Group B Streptococcus Disease in Non-Pregnant Adults: A Systematic Review and Meta-Analysis. *PLoS ONE* **2021**, *16*, e0258030. [\[CrossRef\]](#)
9. Wang, J.; Zhang, Y.; Lin, M.; Bao, J.; Wang, G.; Dong, R.; Zou, P.; Chen, Y.; Li, N.; Zhang, T.; et al. Maternal Colonization with Group B *Streptococcus* and Antibiotic Resistance in China: Systematic Review and Meta-Analyses. *Ann. Clin. Microbiol. Antimicrob.* **2023**, *22*, 5. [\[CrossRef\]](#)
10. Kao, Y.; Tsai, M.-H.; Lai, M.-Y.; Chu, S.-M.; Huang, H.-R.; Chiang, M.-C.; Fu, R.-H.; Lu, J.-J.; Hsu, J.-F. Emerging Serotype III Sequence Type 17 Group B Streptococcus Invasive Infection in Infants: The Clinical Characteristics and Impacts on Outcomes. *BMC Infect. Dis.* **2019**, *19*, 538. [\[CrossRef\]](#)
11. Bianchi-Jassir, F.; Paul, P.; To, K.-N.; Carreras-Abad, C.; Seale, A.C.; Jauneikaite, E.; Madhi, S.A.; Russell, N.J.; Hall, J.; Madrid, L.; et al. Systematic Review of Group B Streptococcal Capsular Types, Sequence Types and Surface Proteins as Potential Vaccine Candidates. *Vaccine* **2020**, *38*, 6682–6694. [\[CrossRef\]](#)
12. Kwatra, G.; Izu, A.; Cutland, C.; Akaba, G.; Ali, M.M.; Ahmed, Z.; Beck, M.M.; Barsosio, H.C.; Berkley, J.A.; Chaka, T.E.; et al. Prevalence of Group B *Streptococcus* Colonisation in Mother–Newborn Dyads in Low-Income and Middle-Income South Asian and African Countries: A Prospective, Observational Study. *Lancet Microbe* **2024**, *5*, 100897. [\[CrossRef\]](#)
13. Lee, K.W.; Yap, S.F.; Murdan, S.; Zainudin, Z.; Abdul Hamid, H.; Emamjomeh, M.; Mohd Desa, M.N.; Sither Joseph, N.M.; Azmai Amal, M.N.; Amin-Nordin, S. Maternal and Neonatal Group B Streptococcus Colonisation: A Systematic Review and the Meta-analysis of Matched-pair Studies. *Acta Paediatr.* **2024**, *113*, 892–911. [\[CrossRef\]](#)
14. Gizachew, M.; Tiruneh, M.; Moges, F.; Tessema, B. *Streptococcus agalactiae* Maternal Colonization, Antibiotic Resistance and Serotype Profiles in Africa: A Meta-Analysis. *Ann. Clin. Microbiol. Antimicrob.* **2019**, *18*, 14. [\[CrossRef\]](#) [\[PubMed\]](#)

15. Wadilo, F.; Hailemeskel, E.; Kedir, K.; El-Khatib, Z.; Asogba, P.C.; Seyoum, T.; Landis, F.C.; Howe, R.; Boltana, M.T. Prevalence of Group B Streptococcus Maternal Colonization, Serotype Distribution, and Antimicrobial Resistance in Sub-Saharan Africa: A Systematic Review and Meta-Analysis. *J. Glob. Antimicrob. Resist.* **2023**, *32*, 134–144. [CrossRef] [PubMed]
16. Kyohere, M.; Davies, H.G.; Karampatsas, K.; Cantrell, L.; Musoke, P.; Nakimuli, A.; Tusubira, V.; Nsimire, J.S.; Jamrozy, D.; Khan, U.B.; et al. Epidemiology of Group B *Streptococcus*: Maternal Colonization and Infant Disease in Kampala, Uganda. *Open Forum Infect. Dis.* **2025**, *12*, ofaf167. [CrossRef]
17. Medugu, N.; Iregbu, K.C.; Parker, R.E.; Plemmons, J.; Singh, P.; Audu, L.I.; Efetie, E.; Davies, H.D.; Manning, S.D. Group B Streptococcal Colonization and Transmission Dynamics in Pregnant Women and Their Newborns in Nigeria: Implications for Prevention Strategies. *Clin. Microbiol. Infect.* **2017**, *23*, 673.e9–673.e16. [CrossRef]
18. Makinde, O.; Okusanya, B.O.; Osanyin, G. Group B Streptococcus Vaginal Colonization in Pregnant Women Living with HIV Infection: Prevalence and Antibiotic Susceptibility at HIV Referral Centers in Lagos, Nigeria. *J. Matern. Fetal Neonatal Med.* **2022**, *35*, 9098–9104. [CrossRef]
19. Healthy Newborn Network—Nigeria. Available online: <https://healthynewbornnetwork.org/country/nigeria/> (accessed on 25 October 2025).
20. Adesola, R.O.; Opuni, E.; Idris, I.; Okesanya, O.J.; Igwe, O.; Abdulazeez, M.D.; Lucero-Prisno, D.E. Navigating Nigeria's Health Landscape: Population Growth and Its Health Implications. *Environ. Health Insights* **2024**, *18*, 11786302241250211. [CrossRef] [PubMed]
21. Akadri, A.A.; Osuolale, B.D.; Shorunmu, T.O.; Odelola, O.I. Group B Streptococcus Colonization in Pregnancy: Prevalence, Determinants and Antibacterial Susceptibility Pattern in Sagamu, Nigeria. *J. Adv. Med. Med. Res.* **2019**, *29*, 1–8. [CrossRef]
22. Bello, O.; Kehinde, A.; Oluwasola, T.; Olakogbe, A. Prevalence of Rectovaginal Group B Streptococcus (GBS) among Pregnant Women at University College Hospital, Ibadan, Nigeria. *Trop. J. Obstet. Gynaecol.* **2016**, *33*, 21–26.
23. Anosike, I.; Ebana, R.; Edet, U.; Egbomuche, R.; Victory, A. Prevalence of Streptococcus agalactiae among Women Resident in Calabar, Cross River State, Nigeria. *Asian J. Res. Med. Pharm. Sci.* **2017**, *2*, 1–7. [CrossRef]
24. Nsagha, D.S.; Kamga, H.L.F.; Assob, J.C.N.; Njunda, A.L.; Bello, C.S.S.; Kandakai-Olukemi, Y.T. Epidemiological Significance of the Colonization of *Streptococcus agalactiae* in the Anorectum and Endocervix of Non-Parturients in Jos, Nigeria. *Afr. J. Clin. Exp. Microbiol.* **2012**, *13*, 144–149. [CrossRef]
25. Page, M.J.; McKenzie, J.E.; Bossuyt, P.M.; Boutron, I.; Hoffmann, T.C.; Mulrow, C.D.; Shamseer, L.; Tetzlaff, J.M.; Akl, E.A.; Brennan, S.E.; et al. The PRISMA 2020 Statement: An Updated Guideline for Reporting Systematic Reviews. *BMJ* **2021**, *372*, n71. [CrossRef]
26. Ouzzani, M.; Hammady, H.; Fedorowicz, Z.; Elmagarmid, A. Rayyan—A Web and Mobile App for Systematic Reviews. *Syst. Rev.* **2016**, *5*, 210. [CrossRef]
27. Hilton, M. JBI Critical Appraisal Checklist for Systematic Reviews and Research Syntheses (Product Review). *J. Can. Health Libr. Assoc. J. Assoc. Bibl. Santé Can.* **2024**, *45*, 180–183. [CrossRef]
28. Fekete, J.T.; Györfy, B. MetaAnalysisOnline.Com: Web-Based Tool for the Rapid Meta-Analysis of Clinical and Epidemiological Studies. *J. Med. Internet Res.* **2025**, *27*, e64016. [CrossRef]
29. Akinlolu, J.; Omololu, A.J.; Owolabi, A.; Omololu, A.O. Molecular Epidemiological Status of Group B Streptococcus in Ile Ife South Western Nigeria. *Arch. Med.* **2018**, *10*, 4. [CrossRef]
30. Akinniyi, A.; Adesiyun, A.; Kolawole, A.; Giwa, F.; Randawa, A. The Prevalence of Asymptomatic Group B Streptococcal Infection and Antimicrobial Sensitivity Pattern among Parturients at Ahmadu Bello University Teaching Hospital, Zaria, Nigeria. *Trop. J. Obstet. Gynaecol.* **2017**, *34*, 182. [CrossRef]
31. Bamidele, A.O.; Adebayo, A.A.; Victoria, A.F.; Timothy, O.O.; Emmanuel, A.O.; Sunday, A.B.; Oluseyi, A.I.; Adewumi, B.; Olabisi, A.T.; Olumide, A.M. Correlates of Group B Streptococcal Colonization in Pregnancy at A Tertiary Hospital in South West Nigeria. *Microbiol. Infect. Dis.* **2022**, *6*, 1–7. [CrossRef]
32. Biobaku, R.O.; Olaleye, A.O.; Adefusi, O.F.; Adeyemi, B.A.; Onipede, A.O.; Loto, O.M.; Imaralu, J.O. Group B Streptococcus Colonization and HIV in Pregnancy: A Cohort Study in Nigeria. *J. Neonatal Perinat. Med.* **2017**, *10*, 91–97. [CrossRef]
33. Bob-Manuel, M.; Stephenson, D.L.; Terhemmen, K.; Ibinabo, L.O.; Orikomaba, K.O.; Kennedy, T.W. Epidemiology and Capsular Typing of Group B Streptococcus in Pregnant Women in Port Harcourt, Nigeria. *Ann. Microbiol. Infect. Dis.* **2021**, *4*, 1–6. [CrossRef]
34. Bob-Manuel, M.; McGee, L.; Igunma, J.A.; Alex-Wele, M.A.; Obunge, O.K.; Wariso, K.T. Whole Genome Sequence Based Capsular Typing and Antimicrobial Resistance Prediction of Group B Streptococcal Isolates from Colonized Pregnant Women in Nigeria. *BMC Genom.* **2021**, *22*, 627. [CrossRef]
35. Dozie-Nwakile, O.C.; Nwakile, C.D.; Uchendu, I.K.; Okoroiwu, H.U.; Onyemelukwe, N.F. Prevalence, Characterization, Antimicrobial Susceptibility Pattern and Factors Associated with Group B Streptococci (*Streptococcus agalactiae*) from Clinical and Non-Clinical Sources in South-East Nigeria. *J. Biol. Res. Boll. Della Soc. Ital. Biol. Sper.* **2022**, *95*, 9922. [CrossRef]
36. Egbule, O.S.; Enwa, O.F.; Omenogor, P.K.; Odum, E.I.; Iweriebor, B.C.; Obi, C.L. Multidrug Resistant Group B *Streptococcus* Isolates from Pregnant Women in Delta State, Nigeria. *Pak. J. Biol. Sci.* **2024**, *27*, 447–454. [CrossRef] [PubMed]

37. Elikwu, C.J.; Oduyebo, O.; Ogunisola, F.T.; Anorlu, R.I.; Okoromah, C.N.; König, B. High Group B Streptococcus Carriage Rates in Pregnant Women in a Tertiary Institution in Nigeria. *Pan Afr. Med. J.* **2016**, *25*, 249. [\[CrossRef\]](#)
38. Elikwu, C.; Oduyebo, O.; Anorlu, R.; Konig, B. Antibiotic Susceptibility/Resistant Gene Profiles of Group B Streptococci Isolates from Pregnant Women in a Tertiary Institution in Nigeria. *J. Clin. Sci.* **2016**, *13*, 132. [\[CrossRef\]](#)
39. Ella, E.; Ahmad, A.; Ogala, W.; Umoh, V.; Aliyu-Zubair, R. Bacteriology and Sensitivity Profile Bacterial Agents Responsible for Neonatal Septicaemia in a Tertiary Hospital of Kaduna Metropolis. *J. Pure Appl. Microbiol.* **2008**, *2*, 103–108.
40. Emembolu, J.O. Endometrial Flora of Infertile Women in Zaria, Northern Nigeria. *Int. J. Gynaecol. Obstet. Off. Organ Int. Fed. Gynaecol. Obstet.* **1989**, *30*, 155–159. [\[CrossRef\]](#)
41. Ezeonu, I.M.; Agbo, M.C. Incidence and Anti-Microbial Resistance Profile of Group B Streptococcus (GBS) Infection in Pregnant Women in Nsukka, Enugu State, Nigeria. *Afr. J. Microbiol. Res.* **2014**, *8*, 91–95. [\[CrossRef\]](#)
42. Gambo, A.U.; Mohammed, Y.; Abubakar, J.; Dada, K.M.; Shehu, I.M.; Bello, S.; Olasunmbro, Y. Asymptomatic Group B Streptococcal Infection, Antibiotic Sensitivity, Risk Factors and Pregnancy Outcome among Pregnant Women at the Usmanu Danfodiyo University Teaching Hospital, Sokoto, Nigeria. *Int. J. Adv. Multidiscip. Res. Stud.* **2024**, *4*, 698–703. [\[CrossRef\]](#)
43. Hoppe, J.E.; Grieshaber, J.; Höfler, W. Colonization of Nigerian Neonates with Group B Streptococci and Its Rapid Detection. *Infection* **1986**, *14*, 74–78. [\[CrossRef\]](#)
44. Ibrahim, U.A.; Panti, A.A.; Mohammed, Y.; Tunau, K.A.; Asma'u, A.; Abubakar, J.G.; Ladan, A.A. Risk Factors for Group B Streptococcus Colonization and Drugs Sensitivity Pattern in a Nigerian Obstetric Population. *Open J. Obstet. Gynecol.* **2021**, *11*, 804–814. [\[CrossRef\]](#)
45. Idih, E.; Ezem, B.; Onyegbule, O.; Ododo, N.; Onumajuru, C. Prevalence of Vaginal Group-B-Streptococcus, Antibiotic and Antigen Sensitivity amongst Parturients at the Federal Medical Center Owerri, Nigeria. *Niger. J. Med.* **2019**, *28*, 5. [\[CrossRef\]](#)
46. Nanbol, H.D.; Listick, N.D.; Binshak, N.; Olukemi-Kandakai, Y.T.; Samuel, D.A.; Dangana, A.; Issaoui, R.; Abdullahi, I.N. Streptococcus agalactiae Carriage, Serotype Distribution and Associated Antibigram among Pregnant and Non-Pregnant Women in Jos City, Nigeria. *Niger. Med. J.* **2021**, *62*, 249–259. [\[CrossRef\]](#)
47. Njoku, C.; Emechebe, C.; Agbakwuru, A. Prevalence and Determinants of Anogenital Colonization by Group B Streptococcus Infection Among HIV Positive and Negative Women in Calabar, Nigeria. *Int. J. Women's Health Reprod. Sci.* **2018**, *6*, 11–17. [\[CrossRef\]](#)
48. Nsagha, D.; Bello, C.; Kandakai-Olukemi, Y. Hippurate Hydrolysis and Christie, Atkins, Munch-Peterson Tests Epidemiological Diagnostic Tools for Streptococcus agalactiae Carriage in Pregnancy. *East Afr. Med. J.* **2000**, *77*, 34–36. [\[CrossRef\]](#) [\[PubMed\]](#)
49. Nwachukwu, N.; Utsalo, S.; Kanu, I.; Anyanwu, E. Genital Colonization of Group B Streptococcus at Term Pregnancy in Calabar, Nigeria. *Internet J. Pediatr. Neonatol.* **2007**, *7*, 2. [\[CrossRef\]](#)
50. Ojo, O.O.; Awonuga, D.O.; Dedeke, I.O.F.; Nwadike, V.U.; Adenaya, O.R.; Odelola, O.I. Prevalence of Group B Streptococcus Colonisation and Antimicrobial Susceptibility Pattern among Pregnant Women Attending a Tertiary Health Facility in Ogun State, Southwest Nigeria. *J. West Afr. Coll. Surg.* **2019**, *9*, 8–14. [\[CrossRef\]](#)
51. Ojukwu, J.U.; Abonyi, L.E.; Ugwu, J.; Orji, I.K. Neonatal Septicemia in High Risk Babies in South-Eastern Nigeria. *J. Perinat. Med.* **2006**, *34*, 166–172. [\[CrossRef\]](#) [\[PubMed\]](#)
52. Okolo, A.A.; Omene, J.A. Changing Pattern of Neonatal Septicaemia in an African City. *Ann. Trop. Paediatr.* **1985**, *5*, 123–126. [\[CrossRef\]](#) [\[PubMed\]](#)
53. Okon, K.; Usman, H.; Usman, Z.; Balogun, S. Prevalence of Group B Streptococcus (GBS) Colonization among Pregnant Women Attending Antenatal Clinic of a Tertiary Hospital in Northeastern, Nigeria. *Am. J. Res. Commun.* **2013**, *1*, 54–66.
54. Okon, R.-S.; Onwuezobe, I.; Edem, E.-N.; Akereuke, U.-E.; Bonne, S.; Bawonda, E.-O. Bacterial Aetiologic Profile and Antibiotic Response Patterns of Lower Respiratory Tract Infection (LRTI) among HIV/AIDS Patients on Highly Active Antiretroviral Therapy (HAART) in Uyo, South-South Nigeria. *Acta Microbiol. Hell.* **2023**, *68*, 185–195. [\[CrossRef\]](#)
55. Olanisebe, S.B.; Adetosoye, A.I. Determination of Asymptomatic Carrier Rate of Beta-Haemolytic Group B Streptococcus in Vaginas of Pregnant Women in Ibadan, Nigeria. *Zentralbl. Bakterirol. Mikrobiol. Hyg. A* **1986**, *261*, 248–253. [\[CrossRef\]](#)
56. Onipede, A.; Adefusi, O.; Adeyemi, A.; Adejuyigbe, E.; Oyelese, A.; Ogunniyi, T. Group B Streptococcus Carriage during Late Pregnancy in Ile-Ife, Nigeria. *Afr. J. Clin. Exp. Microbiol.* **2012**, *13*, 135–143. [\[CrossRef\]](#)
57. Onwuezobe, I.; Effiom, R. Prevalence and Associated Risk Factors of Group B Streptococcus in Pregnant Women Attending Antenatal Care in a Nigerian Urban Hospital. *Ibom Med. J.* **2016**, *9*, 1–7. [\[CrossRef\]](#)
58. Orji, F.; Nwachukwu, N.; Iheukwumere, I.; Emeana, U. Group B Streptococcal (GBS) Infections among Infants in Port Harcourt City, Nigeria. *Aust. J. Basic Appl. Sci.* **2011**, *5*, 1114–1118.
59. Patrick, E.E.; Kenneth, I.E.P.; Ifeoma, A.V.; Akpomede, S. Prevalence of Group B Streptococcus among Individuals in Yenagoa, Bayelsa State, South South, Nigeria. *Afr. J. Med. Surg. Public Health Res.* **2024**, *1*, 54–65. [\[CrossRef\]](#)
60. Rotimi, V.O.; Olowe, S.A.; Ahmed, I. The Development of Bacterial Flora of Premature Neonates. *J. Hyg.* **1985**, *94*, 309–318. [\[CrossRef\]](#) [\[PubMed\]](#)

61. Samuel, D.A.; Egah, D.Z.; Yvonne, K.-O.T. Prevalence of *Streptococcus agalactiae* Serotypes Associated with Anogenital Colonization among Pregnant Women in Jos. *J. Adv. Med. Med. Res.* **2019**, *29*, 1–7. [\[CrossRef\]](#)
62. Uhiara, J.E. Group B Streptococcal Carriage among Parturients and Their Neonates in Zaria, Nigeria. *Afr. J. Med. Med. Sci.* **1993**, *22*, 79–83. [\[PubMed\]](#)
63. Wonodi, W. Prevalence and Pattern of Beta-Haemolytic Streptococcal Throat Infections among Primary School Children in a Rural Community in Rivers State. *Port Harcourt Med. J.* **2020**, *14*, 23–30. [\[CrossRef\]](#)
64. Yerumoh, S.; Alenoghena, I.; Isabu, P.; Adewusi, G. Risk Factors for Group B Streptococcal Infection among Women Attending Antenatal Clinic in a Tertiary Health Institution in Edo State, Nigeria. *Sub Sahar. Afr. J. Med.* **2017**, *4*, 79. [\[CrossRef\]](#)
65. Kwatra, G.; Cunningham, M.C.; Merrall, E.; Adrian, P.V.; Ip, M.; Klugman, K.P.; Tam, W.H.; Madhi, S.A. Prevalence of Maternal Colonisation with Group B Streptococcus: A Systematic Review and Meta-Analysis. *Lancet Infect. Dis.* **2016**, *16*, 1076–1084. [\[CrossRef\]](#) [\[PubMed\]](#)
66. Ding, Y.; Wang, Y.; Hsia, Y.; Russell, N.; Heath, P.T. Systematic Review and Meta-Analyses of Incidence for Group B *Streptococcus* Disease in Infants and Antimicrobial Resistance, China. *Emerg. Infect. Dis.* **2020**, *26*, 2651–2659. [\[CrossRef\]](#) [\[PubMed\]](#)
67. Madrid, L.; Seale, A.C.; Kohli-Lynch, M.; Edmond, K.M.; Lawn, J.E.; Heath, P.T.; Madhi, S.A.; Baker, C.J.; Bartlett, L.; Cutland, C.; et al. Infant Group B Streptococcal Disease Incidence and Serotypes Worldwide: Systematic Review and Meta-Analyses. *Clin. Infect. Dis.* **2017**, *65*, S160–S172. [\[CrossRef\]](#)
68. Were, L.M.; Otieno, J.A.; Miheso, B.; Mayieka, L.M.; Alobo, M.; Caleb, S.K.; Ochodo, E. Group B Streptococcus in Pregnant Women and Neonates in Africa: A Scoping Review. *BMJ Public Health* **2025**, *3*, e002263. [\[CrossRef\]](#)
69. Medugu, N.; Iregbu, K.; Iroh Tam, P.-Y.; Obaro, S. Aetiology of Neonatal Sepsis in Nigeria, and Relevance of Group B *Streptococcus*: A Systematic Review. *PLoS ONE* **2018**, *13*, e0200350. [\[CrossRef\]](#)
70. Sahuquillo-Arce, J.M.; Hernández-Cabezas, A.; Castaño-Aroca, M.J.; Chouman-Arcas, R.; Díaz-Aguirre, E.; Acosta-Boga, B.; López-Hontangas, J.L. *Streptococcus agalactiae* in Childbearing Age Immigrant Women in Comunitat Valenciana (Spain). *Sci. Rep.* **2020**, *10*, 9904. [\[CrossRef\]](#)
71. Tsoia, M.; Psoma, M.; Gavrilis, S.; Petrochilou, V.; Michalas, S.; Legakis, N.; Karpathios, T. Group B Streptococcus Colonization of Greek Pregnant Women and Neonates: Prevalence, Risk Factors and Serotypes. *Clin. Microbiol. Infect.* **2003**, *9*, 832–838. [\[CrossRef\]](#)
72. Mavengengwa, R.T.; Moyo, S.R.; Nordbø, S.A. *Streptococcus agalactiae* Colonization and Correlation with HIV-1 and HBV Seroprevalence in Pregnant Women from Zimbabwe. *Eur. J. Obstet. Gynecol. Reprod. Biol.* **2010**, *150*, 34–38. [\[CrossRef\]](#)
73. Ngayomela, P.H.; Kiritta, R.; Remi, B.A.; Mboya, S.T.; Moremi, N.; Matovelo, D.; Mujuni, F.; Mshana, S.E.; Daubenberger, C.; Zadoks, R.N.; et al. *Streptococcus agalactiae* Colonization Is Common among Pregnant Women with HIV Infection and Is Neither Predicted by Hospital Tier nor Trimester in Mwanza, Tanzania. *BMC Pregnancy Childbirth* **2025**, *25*, 478. [\[CrossRef\]](#)
74. Dauby, N.; Adler, C.; Miendje Deyi, V.Y.; Sacheli, R.; Busson, L.; Chamekh, M.; Marchant, A.; Barlow, P.; De Wit, S.; Levy, J.; et al. Prevalence, Risk Factors, and Serotype Distribution of Group B Streptococcus Colonization in HIV-Infected Pregnant Women Living in Belgium: A Prospective Cohort Study. *Open Forum Infect. Dis.* **2018**, *5*, ofy320. [\[CrossRef\]](#) [\[PubMed\]](#)
75. Gray, K.J.; Kafulafula, G.; Matamba, M.; Kamdolozi, M.; Membe, G.; French, N. Group B Streptococcus and HIV Infection in Pregnant Women, Malawi, 2008–2010. *Emerg. Infect. Dis.* **2011**, *17*, 1932–1935. [\[CrossRef\]](#) [\[PubMed\]](#)
76. El Beitune, P.; Duarte, G.; Maffei, C.M.L.; Quintana, S.M.; De Sá Rosa E Silva, A.C.J.; Nogueira, A.A. Group B *Streptococcus* Carriers among HIV-1 Infected Pregnant Women: Prevalence and Risk Factors. *Eur. J. Obstet. Gynecol. Reprod. Biol.* **2006**, *128*, 54–58. [\[CrossRef\]](#)
77. Morgan, J.A.; Hankins, M.E.; Callais, N.A.; Albritton, C.W.; Vanchiere, J.A.; Betcher, R.E.; Lewis, D.F. Group B *Streptococcus* Rectovaginal Colonization and Resistance Patterns in HIV-Positive Compared to HIV-Negative Pregnant Patients. *Am. J. Perinatol.* **2023**, *40*, 1573–1578. [\[CrossRef\]](#)
78. Van Kassel, M.N.; Janssen, S.W.C.M.; Kofman, S.; Brouwer, M.C.; Van De Beek, D.; Bijlsma, M.W. Prevalence of Group B Streptococcal Colonization in the Healthy Non-Pregnant Population: A Systematic Review and Meta-Analysis. *Clin. Microbiol. Infect.* **2021**, *27*, 968–980. [\[CrossRef\]](#) [\[PubMed\]](#)
79. Barkham, T.; Sheppard, A.; Jones, N.; Chen, S.L. *Streptococcus agalactiae* That Caused Meningitis in Healthy Adults in 1998 Are ST283, the Same Type That Caused a Food-Borne Outbreak of Invasive Sepsis in 2015: An Observational Molecular Epidemiology Study. *Clin. Microbiol. Infect.* **2018**, *24*, 923–925. [\[CrossRef\]](#)
80. Muthanna, A.; Desa, M.N.M.; Rahman, N.A.A.; Dzaraly, N.D.; Baharin, N.H.Z.; Aziz, N.A.; Shan, C.H.; Ismail, Z.; Nor, L.A.M.; Ali, M.M.; et al. Epidemiological Observations of Invasive Group B *Streptococcus* Infections in Six Major Hospitals in Peninsular Malaysia. *Asian Pac. J. Trop. Med.* **2024**, *17*, 384–391. [\[CrossRef\]](#)
81. Luiz, F.B.D.O.; Alves, K.B.; Barros, R.R. Prevalence and Long-Term Persistence of Beta-Haemolytic Streptococci Throat Carriage among Children and Young Adults. *J. Med. Microbiol.* **2019**, *68*, 1526–1533. [\[CrossRef\]](#)
82. Navaneeth, B.V.; Nimananda, R.; Chawda, S.; Selvarani, P.; Bhaskar, M.; Suganthi, N. Prevalence of Beta Hemolytic Streptococci Carrier Rate among Schoolchildren in Salem. *Indian J. Pediatr.* **2001**, *68*, 985–986. [\[CrossRef\]](#)

83. Ghiasi, M.; Fazaeli, H.; Kalhor, N.; Sheykh-Hasan, M.; Tabatabaei-Qomi, R. Assessing the Prevalence of Bacterial Vaginosis among Infertile Women of Qom City. *Iran. J. Microbiol.* **2014**, *6*, 404–408.
84. Manning, S.D.; Tallman, P.; Baker, C.J.; Gillespie, B.; Marrs, C.F.; Foxman, B. Determinants of Co-Colonization with Group B *Streptococcus* among Heterosexual College Couples. *Epidemiol. Camb. Mass* **2002**, *13*, 533–539. [\[CrossRef\]](#)
85. Swain, B.; Rakshit, A.; Sahu, K.K.; Sahoo, N.; Otta, S. Group B *Streptococcus*: An Unusual Cause for Urinary Tract Infection. *J. Clin. Diagn. Res. JCDR* **2017**, *11*, DL05–DL06. [\[CrossRef\]](#) [\[PubMed\]](#)
86. Baldan, R.; Droz, S.; Casanova, C.; Knabben, L.; Huang, D.J.; Brülisauer, C.; Kind, A.B.; Krause, E.; Mauerer, S.; Spellerberg, B.; et al. Group B Streptococcal Colonization in Elderly Women. *BMC Infect. Dis.* **2021**, *21*, 408. [\[CrossRef\]](#)
87. Martins, E.R.; Nascimento Do Ó, D.; Marques Costa, A.L.; Melo-Cristino, J.; Ramirez, M. Characteristics of *Streptococcus agalactiae* Colonizing Nonpregnant Adults Support the Opportunistic Nature of Invasive Infections. *Microbiol. Spectr.* **2022**, *10*, e01082-22. [\[CrossRef\]](#)
88. Neves, F.P.G.; Marlow, M.A.; Rezende-Pereira, G.; Pinheiro, M.G.; Dos Santos, A.F.M.; De Fátima Nogueira De Freitas, M.; Barros, R.R.; Aguiar-Alves, F.; Cardoso, C.A.A.; Riley, L.W. Differences in Gram-Positive Bacterial Colonization and Antimicrobial Resistance among Children in a High Income Inequality Setting. *BMC Infect. Dis.* **2019**, *19*, 478. [\[CrossRef\]](#)
89. Seale, A.C.; Koech, A.C.; Sheppard, A.E.; Barsosio, H.C.; Langat, J.; Anyango, E.; Mwakio, S.; Mwarumba, S.; Morpeth, S.C.; Anampiu, K.; et al. Maternal Colonization with *Streptococcus agalactiae* and Associated Stillbirth and Neonatal Disease in Coastal Kenya. *Nat. Microbiol.* **2016**, *1*, 16067. [\[CrossRef\]](#) [\[PubMed\]](#)
90. Brochet, M.; Couvé, E.; Bercion, R.; Sire, J.-M.; Glaser, P. Population Structure of Human Isolates of *Streptococcus agalactiae* from Dakar and Bangui. *J. Clin. Microbiol.* **2009**, *47*, 800–803. [\[CrossRef\]](#)
91. Tulyaprawat, O.; Pharkjaksu, S.; Shrestha, R.K.; Ngamskulrungron, P. Emergence of Multi-Drug Resistance and Its Association with Uncommon Serotypes of *Streptococcus agalactiae* Isolated from Non-Neonatal Patients in Thailand. *Front. Microbiol.* **2021**, *12*, 719353. [\[CrossRef\]](#) [\[PubMed\]](#)
92. Muthanna, A.; Desa, M.N.M.; Alsalemi, W.; Liyana Abd Aziz, N.A.; Dzaraly, N.D.; Baharin, N.H.Z.; Aziz, N.A.; Ali, M.M.; Nor, L.A.M.; Ismail, Z.; et al. Phenotypic and Genotypic Comparison of Pathogenic Group B *Streptococcus* Isolated from Human and Cultured Tilapia (*Oreochromis* Species) in Malaysia. *Comp. Immunol. Microbiol. Infect. Dis.* **2023**, *97*, 101993. [\[CrossRef\]](#)
93. Teatero, S.; Ferrieri, P.; Martin, I.; Demczuk, W.; McGeer, A.; Fittipaldi, N. Serotype Distribution, Population Structure, and Antimicrobial Resistance of Group B *Streptococcus* Strains Recovered from Colonized Pregnant Women. *J. Clin. Microbiol.* **2017**, *55*, 412–422. [\[CrossRef\]](#)
94. Creti, R.; Imperi, M.; Berardi, A.; Lindh, E.; Alfarone, G.; Pataracchia, M.; Recchia, S. The Italian Network on Neonatal and Infant GBS Infections. Invasive Group B Streptococcal Disease in Neonates and Infants, Italy, Years 2015–2019. *Microorganisms* **2021**, *9*, 2579. [\[CrossRef\]](#)
95. Lawn, J.E.; Chandna, J.; Paul, P.; Jit, M.; Trotter, C.; Lambach, P.; Ter-Meulen, A.S. Every Country, Every Family: Time to Act for Group B Streptococcal Disease Worldwide. *Clin. Infect. Dis. Off. Publ. Infect. Dis. Soc. Am.* **2022**, *74*, S1–S4. [\[CrossRef\]](#)
96. Onile, B.A. Group B Streptococcal Neonatal and Infant Infections in Nigeria: A Review and Update. *East Afr. Med. J.* **1984**, *61*, 591–595. [\[PubMed\]](#)
97. Danmallam, F.A.; Pimenov, N.V. Study on Prevalence, Clinical Presentation, and Associated Bacterial Pathogens of Goat Mastitis in Bauchi, Plateau, and Edo States, Nigeria. *Vet. World* **2019**, *12*, 638–645. [\[CrossRef\]](#) [\[PubMed\]](#)
98. Airede, K.I.; Adeyemi, O.; Ibrahim, T. Neonatal Bacterial Meningitis and Dexamethasone Adjunctive Usage in Nigeria. *Niger. J. Clin. Pract.* **2008**, *11*, 235–245.
99. Ako-Nai, K. The Bacteriology of Neonatal Septicaemia in Ile-Ife, Nigeria. *J. Trop. Pediatr.* **1999**, *45*, 146–151. [\[CrossRef\]](#) [\[PubMed\]](#)
100. Obadare, T.O.; Adejuyigbe, E.A.; Adeyemo, A.T.; Amupitan, A.A.; Ugowe, O.J.; Anyabolu, C.H.; Aboderin, A.O. Clinical and Bacteriological Profiles of Neonatal Sepsis in a Tertiary Hospital, South-Western Nigeria. *Germes* **2023**, *13*, 137. [\[CrossRef\]](#)
101. Airede, A.I. Neonatal Bacterial Meningitis in the Middle Belt of Nigeria. *Dev. Med. Child Neurol.* **1993**, *35*, 424–430. [\[CrossRef\]](#)
102. Longe, A.C.; Omene, J.A.; Okolo, A.A. Neonatal Meningitis in Nigerian Infants. *Acta Paediatr.* **1984**, *73*, 477–481. [\[CrossRef\]](#)
103. Lawal, S.F.; Odugbemi, T. Antibigram of Lagos Strains of Beta-Haemolytic Streptococci. *J. Chemother.* **1989**, *1*, 285–286.
104. Nwachukwu, I. Antibacterial Resistance Patterns of Group B Streptococcus Infections in Pregnant Women Attending St John's Hospital, Owerri, Nigeria. *Multidiscip. Res. Dev. J. Int'l* **2024**, *5*, 1–7.
105. Nwankwu, E.O.; Njoku-Obi, A.N. Serogroups of Beta-Haemolytic Streptococci Isolated from Clinical Specimens in Parts of Eastern Nigeria. *J. Commun. Dis.* **1990**, *22*, 269–273.
106. Omololu-Aso, J. Group B Streptococcus in Pregnancy and Neonatal Colonization at Primary Health Care Institution Nigeria. *Am. J. Trop. Med. Hyg.* **2018**, *99*, 164.
107. Nwadioha, S.I.; Nwokedi, E.O.P.; Onwuezube, I.; Egesie, J.O.; Kashibu, E. Bacterial Isolates from Cerebrospinal Fluid of Children with Suspected Acute Meningitis in a Nigerian Tertiary Hospital. *Niger. Postgrad. Med. J.* **2013**, *20*, 9–13. [\[CrossRef\]](#)
108. Onile, B.A. Group B Streptococcal Carriage in Nigeria. *Trans. R. Soc. Trop. Med. Hyg.* **1980**, *74*, 367–370. [\[CrossRef\]](#) [\[PubMed\]](#)

109. Onile, B.A.; Osinusi, B.O.; Montefiore, D.; Sogbetun, A.O. Neonatal Septicemia Resulting from Group B Streptococci: A Case Report. *Int. J. Gynecol. Obstet.* **1980**, *17*, 393–395. [[CrossRef](#)]
110. Manning, S.D. Correlates of Antibiotic-Resistant Group B Streptococcus Isolated from Pregnant Women. *Obstet. Gynecol.* **2003**, *101*, 74–79. [[CrossRef](#)]
111. Mueller, M.; Henle, A.; Droz, S.; Kind, A.B.; Rohner, S.; Baumann, M.; Surbek, D. Intrapartum Detection of Group B Streptococci Colonization by Rapid PCR-Test on Labor Ward. *Eur. J. Obstet. Gynecol. Reprod. Biol.* **2014**, *176*, 137–141. [[CrossRef](#)] [[PubMed](#)]
112. Elikwu, C.J.; Oduyebo, O.; König, B. Antibiotic Susceptibility Profiles of Group B Streptococci (GBS) Isolates from Pregnant Mothers in a Tertiary Institution in Nigeria. *Int. J. Infect. Dis.* **2014**, *21*, 348. [[CrossRef](#)]
113. Omololu-Aso, J.; Omololu-Aso, O.O.; Akinlolu, J.T.; Grace, A.B.; Tunde, A.M. A Case Study of Group B Streptococcus Associated with Women in Antepartum Period and Their Neonates, Ile Ife South-Western Nigeria. *Arch. Clin. Microbiol.* **2017**, *8*, 68.
114. Adewumi, O. Microbiological Pattern in Preterm Prelabour Rupture of the Fetal Membranes in South-Western Nigeria. *Obstet. Gynecol. Int. J.* **2017**, *6*, 101–105. [[CrossRef](#)]
115. Onalo, R.; Adeleke, S.I.; Nwalorzie, C.; Njoku, R. Rate of Isolation of Streptococcus Species from Children with Bacterial Infections: An Indication for Introduction of Streptococcal Vaccines. *Niger. J. Paediatr.* **2011**, *38*, 136–141. [[CrossRef](#)]
116. Le Bris, J.E.; Pell, M.E.; Medugu, N.; Manning, S.D. Investigating Group B Streptococcus (GBS) Genetic Factors Associated with Vertical Transmission and Invasive Neonatal Disease in Nigeria. *Spartan Med. Res. J.* **2024**, *9*, 91. [[CrossRef](#)]

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