

# BMJ Open Prevalence of human immunodeficiency virus (HIV) among pregnant women in Nigeria: a systematic review and meta-analysis

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## ABSTRACT

**Objective** To estimate prevalence of HIV infection in Nigeria and to examine variations by geopolitical zones and study characteristics to inform policy, practice and research.

**Methods** We conducted a comprehensive search of bibliographic databases including PubMed, CINAHL, PsycINFO, Global Health, Academic Search Elite and Allied and Complementary Medicine Database (AMED) and grey sources for studies published between 1 January 2008 and 31 December 2019. Studies reporting prevalence estimates of HIV among pregnant women in Nigeria using a diagnostic test were included. Primary outcome was proportion (%) of pregnant women living with HIV infection. A review protocol was developed and registered (PROSPERO 2019 CRD42019107037).

**Results** Twenty-three studies involving 72 728 pregnant women were included. Ten studies were of high quality and the remaining were of moderate quality. Twenty-one studies used two or more diagnostic tests to identify women living with HIV. Overall pooled prevalence of HIV among pregnant women was 7.22% (95% CI 5.64 to 9.21). Studies showed high degree of heterogeneity ( $I^2=97.2%$ ) and evidence of publication bias ( $p=0.728$ ). Pooled prevalence for most individual geopolitical zones showed substantial variations compared with overall prevalence. North-Central (6.84%, 95% CI 4.73 to 9.79) and South-West zones (6.27%, 95% CI 4.75 to 8.24) had lower prevalence whereas South-East zone (17.04%, 95% CI 9.01 to 29.86) had higher prevalence.

**Conclusions** While robust national prevalence studies are sparse in Nigeria, our findings suggest 7 in every 100 pregnant women are likely to have HIV infection. These figures are consistent with reported prevalence rates in sub-Saharan African region. WHO has indicated much higher prevalence in Nigeria compared with our findings. This discrepancy could potentially be attributed to varied methodological approaches and regional focus of studies included in our review. The magnitude of the issue highlights the need for targeted efforts from local, national and international stakeholders for prevention, diagnosis, management and treatment.

## INTRODUCTION

HIV infection among pregnant women has emerged as a global public health issue

## STRENGTHS AND LIMITATIONS OF THIS STUDY

- ⇒ Our study is the first meta-analysis that estimated pooled prevalence rates of HIV among pregnant women in Nigeria and examined variations by geopolitical zones and study characteristics.
- ⇒ We followed Preferred Reporting Items for Systematic Review and Meta-Analysis guidelines and used standardised data extraction and quality assessment tools to increase the validity of our review.
- ⇒ More than half of the included studies were of moderate methodological quality with a high risk of selection and sampling bias.
- ⇒ Generalisability of our study findings may be limited as the included studies were confined to four of the six geopolitical zones in Nigeria.

with serious medical, economic and social impact.<sup>1 2</sup> Global estimates suggest that 19.2 million women were living with HIV in 2019 constituting 52% of all adults living with the infection.<sup>2</sup> HIV infection in pregnancy has become the leading cause of mortality among women of reproductive age.<sup>3</sup> While pregnancy itself has little or no contribution to the progression of HIV in women who are asymptomatic or those in the early stage of the infection,<sup>4</sup> it presents substantial risks to babies, families and healthcare workers.<sup>1</sup> The overall poor health and compromised immune capacity of women living with HIV (WLHIV), especially those in the advanced stage of the infection, may cause them to be more susceptible to increased risk of obstetrical complications and adverse perinatal outcomes, including intrauterine infections, fetal growth retardation, puerperal sepsis, ectopic pregnancy, haemorrhage, low-birth weight and preterm birth.<sup>5–11</sup> The risk of maternal death tends to increase eightfold in pregnant women living with HIV.<sup>12</sup> Perinatal transmission of HIV is a major challenge of

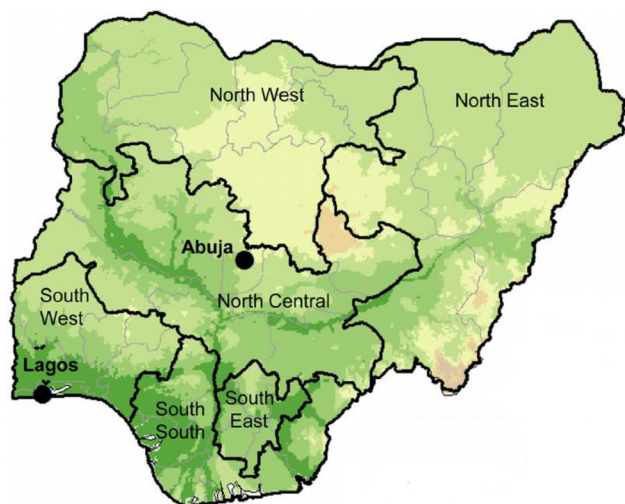
the HIV/AIDS epidemic, accounting for 90% of all paediatric HIV worldwide.<sup>13</sup>

HIV prevalence is notably higher among women in sub-Saharan Africa (SSA) with women constituting 60% of all those infected with HIV, and two-thirds of the infection occurring among 15–24 years old.<sup>3 14</sup> Although researchers have ascribed about 25% of deaths among pregnant women to HIV infection, the impact of HIV on maternal mortality in SSA is difficult to evaluate due to the lack of reliable estimates from the region.<sup>7</sup> Nigeria accounts for 10% of the HIV/AIDS burden globally,<sup>15</sup> and has the second highest incidence of new HIV infections among women globally.<sup>16</sup> In 2016, HIV prevalence among women in Nigeria was about 51% (1.6 million), compared with 42% among men (1.3 million).<sup>15</sup> Women are indicated to be more vulnerable than men to HIV/AIDS pandemic in Nigeria.<sup>17</sup>

The National HIV Sero-prevalence Sentinel Survey in Nigeria showed an increase in HIV sero-prevalence rates among pregnant women nationally from 1.8% in 1991 to 5.8% in 2001, followed by a gradual decline to 5% in 2003, 4.1% in 2010 and further to 3% in 2014.<sup>18</sup> Of an estimated 85 450 WLHIV giving birth annually (about 4.6% of all pregnancies) in Nigeria, about 56681 births are likely to be HIV positive.<sup>19 20</sup> Perinatal transmission accounts for about 10% of new HIV infections annually in Nigeria.<sup>16</sup>

Nigeria is a Federal Republic comprising 36 States and its Federal Capital Territory, Abuja. The states are grouped into six geopolitical zones, the North Central, North East, North West, South West, South East and South South as shown in figure 1.<sup>21</sup>

Variations across geopolitical zones in HIV prevalence among pregnant women is likely to occur in concurrence with the overall variations in levels of infection across the country with highest prevalence in the South-South zone (5.5%) and the lowest prevalence in the South-East zone (1.8%).<sup>22</sup>



**Figure 1** Geopolitical zones in Nigeria.<sup>21</sup>

Understanding infection prevalence rates is essential for clinicians and policymakers for the development and implementation of timely and effective interventions. While various individual studies have provided some insights about the likely prevalence of HIV among pregnant women in different parts of Nigeria, they do not provide sufficient evidence on their own to warrant appropriate action. This systematic review and meta-analysis estimated the pooled overall prevalence of HIV infection among pregnant women in Nigeria and examined variations by geo-political zones and other study characteristics.

## METHODS

### Search strategy

The review followed the ‘Preferred Reporting Items for Systematic Reviews and Meta-Analysis’ guidelines.<sup>23</sup> We conducted a comprehensive search of bibliographic databases including PubMed (Medline), CINAHL, PsycINFO, Global Health, E-Journals, Academic Search Elite and Allied and Complementary Medicine Database (AMED) for studies published between 1 January 2008 and 31 December 2019. Additional sources searched included Google Scholar, authors’ institutional libraries, reference list of identified articles and grey sources such as reports, conference abstracts, presentations and proceedings.

We used a combination of text words and MeSH (Medical Subject Headings) terms to conduct the searches as follows: (‘Human immunodeficiency virus’ OR ‘HIV’) AND (prevalen\* OR inciden\* OR epidemiolog\* OR frequen\* OR occurren\*) AND (pregnan\* OR prenatal OR antenatal OR perinatal OR maternal) AND Nigeria. See online supplemental file 1 for a full search strategy for all databases.

### Screening and selection criteria

Primary observational studies published in peer-reviewed journals since 2008 were included if they reported prevalence estimates of HIV among pregnant women in Nigeria using a diagnostic/screening test.

The screening was conducted in three stages. The first and second stages involved screening of titles and abstracts respectively of all search results for relevance along with the retrieval of the full texts of all ‘included’ and ‘may be included’ articles. In stage three, a comprehensive assessment of the full-text articles was undertaken.

### Data extraction and quality appraisal

A data extraction form was developed based on the guidance from the Centre for Reviews and Dissemination (CRD), University of York ([https://www.york.ac.uk/media/crd/Systematic\\_Reviews.pdf](https://www.york.ac.uk/media/crd/Systematic_Reviews.pdf)) and the following data were extracted and entered manually into the computer-based form: author(s), year of publication, objective of the study, study design, setting and time frame, sample definition, sampling technique and sample size, response rate, data collection methods and

**Box 1** Assessment criteria for study quality

**Sampling (maximum score=3)**

1. Was the target population clearly defined using shared characteristics such as demographic features?
2. Was probability sampling used to identify potential respondents?
3. Was there a reporting of inclusion and exclusion criteria for sample selection?

**Measurement (maximum score=4)**

1. Was the response rate higher than 80%?
2. Was the data collection method standardised, including the use of diagnostic/screening test and identical methods of assessment with all the respondents?
3. Were the data collection method reliable, in terms of reporting the names of the manufacturer's specification for testing kits and following test guidelines?
4. Were the study instruments valid by providing the names of screening and confirmation tests?

**Analysis (maximum score=1)**

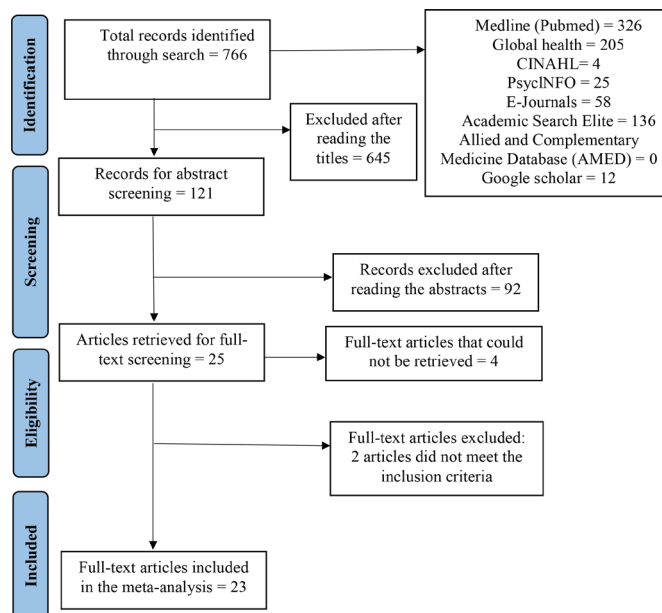
1. Was the study included CIs for statistical estimates or the information needed to calculate them?

outcome measure, particularly prevalence rate of HIV among pregnant women. Three authors (COO, RM and MA) undertook the data extraction and SP cross-checked for accuracy.

Following data extraction, the selected studies were critically assessed for methodological quality using a modified version of 'Guidelines for evaluating prevalence studies'.<sup>24</sup> Two authors (COO and RM) assessed and rated the eligible studies based on three main domains: sampling, measurement and analysis. These domains were further divided into eight criteria and for each criterion, one point was given if the answer was 'yes', and zero points if the answer was 'no' with the total score ranging from 0 to 8 (Box 1). Studies with a total score of 0–2 were considered as of 'low quality', a score of 3–5 as of 'moderate quality' and a score of 6–8 as of 'high quality'. Additionally, studies were assessed for external and internal validity using a modified risk of bias tool for prevalence studies<sup>25</sup> and were rated as of high or low risk of bias for each component in the tool.

**Data synthesis and analysis**

We conducted meta-analysis to estimate pooled prevalence and generated forest plots for Nigeria as a whole and for individual geopolitical zones with 95% CI.  $I^2$  statistics was used to assess the heterogeneity between studies, in which  $I^2$  greater than 50% indicated substantial heterogeneity.<sup>26</sup> We used a random-effects model to combine individual prevalence data, considering the variance that existed between individual studies.<sup>27</sup> We conducted subgroup analyses with respect to the following study characteristics: geopolitical zone, sampling technique and sample size, length of study, study period, study quality and risk of bias. Publication bias was assessed using funnel plot and Egger's test. The 'Meta' package 4.9–2 and 'Metafor'



**Figure 2** Preferred Reporting Items for Systematic Review and Meta-Analysis flow diagram of the study selection process.

package 2.0–0 in R statistical software and R Studio as Integrated Development Environment were used for the meta-analysis.<sup>28</sup>

A review protocol was developed and published (PROSPERO 2019 CRD42019107037).

**Public and patient involvement**

No patients or public were involved in formulating the research question, defining the outcome, analysis and interpretation or writing up of results. No data were directly collected from patients during the course of the study. Where possible, results of the study will be disseminated to the public and patient community by the authors.

**RESULTS**
**Study characteristics**

The initial search produced a total of 766 records from which 121 titles were identified following stage 1 screening. In stage 2, 92 records were excluded following abstract screening, and 29 articles were identified for full-text screening. Full texts of four articles were inaccessible. Twenty-five articles underwent stage 3 screening and 23 articles were selected<sup>29–51</sup> after excluding two studies that did not provide the details of HIV diagnostic tools (figure 2).

A total of 72 728 pregnant women from 23 studies were included in this systematic review. The women were aged 15–49 years and all the studies were conducted in health-care facilities. Ten studies were conducted in tertiary (teaching) hospitals,<sup>30–33 35 37 38 40 42 51</sup> five in general hospitals,<sup>29 34 41 46 47</sup> two in antenatal care clinics<sup>43 49</sup> and one each in the following settings: a military hospital,<sup>36</sup> a cottage hospital,<sup>44</sup> a Prevention of Mother to Child Transmission (PMTCT) centre,<sup>45</sup> maternity centres across two

**Table 1** Summary of study characteristics

Study authors	Geopolitical zone	Study setting	Study design	Duration of study	HIV screening tests used	Total participants	Number of WLHIV	Study quality
1. Egesie and Mbooh <sup>29</sup>	South-South	Amassoma General Hospital	-	Jan 2005 – Dec 2006	Capilose Determine methods	277	11	Moderate
2. Olajubu <i>et al</i> <sup>30</sup>	South-West	Olabisi Onabanjo University Teaching Hospital	-	Jan 2005 – Dec 2006	Rapid ELIZA kit and Capillus HIV 1/2	739	51	Moderate
3. Onakewhor and Okonofua <sup>31</sup>	South-South	Department of Obstetrics and Gynaecology and the Federal Government HIV laboratory in the Department of Pathology of the University of Benin Teaching Hospital	Prospective and cross-sectional	Jun – Dec 2005	Capillus HIV 1/2 and Genie 1 – HIV 1/2	269	23	High
4. Akani <i>et al</i> <sup>32</sup>	South-South	University of Port Harcourt Teaching Hospital	-	-	Second generation Genscreen and Immunocomb ELISA test	118	30	High
5. Imade <i>et al</i> <sup>33</sup>	South-South	University of Benin Teaching Hospital	-	Jan 2008 – Jun 2009	Determine HIV 1/2 and Uni-Gold HIV	3410	176	Moderate
6. Ndams <i>et al</i> <sup>34</sup>	North-Central	General Hospital, Minna	Hospital-based descriptive cross-sectional survey	Oct – Nov 2007	Enzyme Immunoassay (EIA) kit	231	18	Moderate
7. Oladeinde <i>et al</i> <sup>35</sup>	South-South	Igbinedion University Teaching Hospital	-	Sep 2009 – Aug 2010	Determine and HIV 1/2 Stat-Pak	292	30	High
8. Frank-Peterside <i>et al</i> <sup>36</sup>	South-South	Military hospital	Cross-sectional study	Apr – Jul 2011	Determine HIV 1/2 and HIV 1/2 STAT-PAK	1200	132	Moderate
9. Obi <i>et al</i> <sup>37</sup>	South-East	A tertiary health centre in Owerri	Prospective study	Mar – Aug 2010	HIV 1/2 test kit	500	115	High
10. Ibrahim <i>et al</i> <sup>38</sup>	South-South	Niger Delta University Teaching Hospital	Cross-sectional descriptive	Jul 2008 – Jun 2011	-	2437	120	Moderate
11. Oladeinde <i>et al</i> <sup>39</sup>	South-South	Traditional birth home	Cross-sectional	Nov 2010 – Jun 2012	Determine and HIV 1/2 Stat-Pak	360	26	High
12. Ikeako <i>et al</i> <sup>40</sup>	South-East	University of Nigeria Teaching Hospital	Retrospective study	May 2006 – Apr 2008	Determine and Immunocomb test	1239	154	Moderate

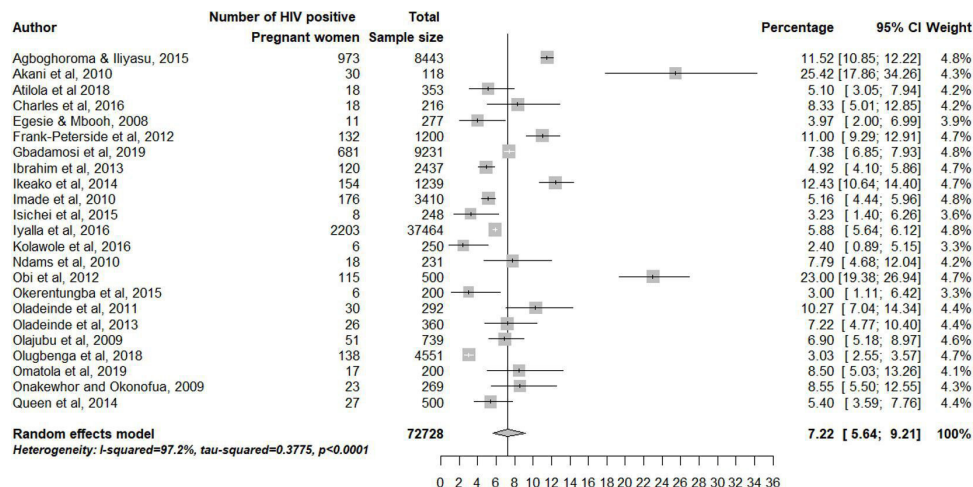
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Table 1 Continued

Study authors	Geopolitical zone	Study setting	Study design	Duration of study	HIV screening tests used	Total participants	Number of WLHIV	Study quality
13. Queen <i>et al</i> <sup>41</sup>	South-South	Braithwaite Memorial General Hospital	-	Jun – Aug 2006	Immunocomb HIV 1 and 2 and Genscreen HIV 1 and 2 kits	500	27	High
14. Agboghroma and Illiyasu <sup>42</sup>	North-Central	A public tertiary level health facility	Prospective study	Jan 2005 – Dec 2009	Capillus and Genie test kits	8443	973	High
15. Isichei <i>et al</i> <sup>43</sup>	North-Central	Antenatal clinics	Cross-sectional study	Jun – Jul 2008	Enzyme Linked Immunosorbent Assay (ELISA)	248	8	High
16. Okerentugba <i>et al</i> <sup>44</sup>	South-South	Obio Cottage hospital	Cross-sectional consecutive health-facility based study	-	Determine HIV – 1/2 and Stat-Pak HIV – 1/2	200	6	Moderate
17. Charles <i>et al</i> <sup>45</sup>	North-Central	Faith Alive Foundation and Prevention of Mother to Child Transmission Centre	Cross-sectional study	July – Dec 2014	Determine and UNIGOLD HIV test kits	216	18	Moderate
18. Caroline <i>et al</i> <sup>46</sup>	South-South	Braithwaite Memorial General Hospital	Retrospective study	2004–2013	Determine HIV 1/2 test kit and Unigold HIV 1/2	37 464	2203	Moderate
19. Kolawole <i>et al</i> <sup>47</sup>	North-Central	Federal Medical Centre (General hospital)	Hospital-based cross-sectional prospective study	-	Determine TM HIV 1/2	250	6	Moderate
20. Atilola <i>et al</i> <sup>48</sup>	South-West	Healthcare facilities for antenatal care and related services	Cross-sectional survey	Aug 2014 – May 2015	Determine presumptive diagnosis test	353	18	High
21. Olugbenga <i>et al</i> <sup>49</sup>	South-West, South-East, North-Central	Reference laboratories and 12 enrolment sites that provides ANC services	-	Feb – May 2017	Determine TM HIV – 1/2	4551	138	High
22. Gbadamosi <i>et al</i> <sup>50</sup>	North-Central	Church-organised baby shower (community-based testing centre)	-	Jul 2016 – Aug 2017	Determine rapid HIV antibody test and Uni-Gold test	9231	681	Moderate
23. Omatola <i>et al</i> <sup>51</sup>	North-Central	Kogi State University Teaching Hospital	Hospital-based cross-sectional	Sep – Nov 2007	HIV 1/2 Stat-Pak and Unigold Determine HIV 1/2 test kit	200	17	Moderate

WLHIV, women living with HIV.



**Figure 3** Pooled prevalence of HIV infection in pregnant women.

contiguous states,<sup>48</sup> community-based testing centres<sup>50</sup> and a traditional birth home.<sup>39</sup> Majority of the studies did not clearly mention the trimester in which the HIV testing was done, however, it was stated that women were tested at the time of booking.

The overall sample size in individual studies ranged from 118 to 37464. Majority of the studies were conducted in the South-South geopolitical zone,<sup>11 29 31–33 35 36 38 39 41 44 46</sup> followed by North-Central zone.<sup>7 31 42 43 45 47 50 51</sup> Few studies were conducted in South-East<sup>2 37 40</sup> and South-West<sup>2 30 48</sup> geopolitical zones. One study included participants from three zones including South-West, South-East and North-Central.<sup>49</sup> There were no studies from North-East and North-West geopolitical zones. Twelve studies were published after 2013 whereas 11 studies were published prior to 2013.

The majority (nine) were cross-sectional studies<sup>34 36 38 39 43–45 48 51</sup>; two studies each used prospective<sup>37 42</sup> and retrospective designs<sup>41 46</sup>; two studies used a combination of cross-sectional and prospective designs.<sup>31 47</sup> Among the seven studies that reported sampling methods, four used simple random sampling<sup>37 43 45 48</sup> and the remaining used convenient sampling techniques.<sup>31 41 51</sup> The study duration was less than a year in most of the studies<sup>10 31 34 36 37 41 43 45 48 49 51</sup> whereas eight studies were conducted for a period of 1–3 years.<sup>29–31 35 38–40 50</sup> Two studies were conducted for longer durations of 5 and 9 years.<sup>42 46</sup> Twenty-one studies used two or more diagnostic tests to identify participants with HIV. The diagnostic tests included: Capillus, Genie, Determine, Star-pak, Unigold, Western blot, ELISA (Immunocombo), EIA kit and Genscreen. Nearly half of the included studies (10) were rated as of high quality and the remaining were of moderate quality (table 1).

The majority (20) of the studies apart from three<sup>31 49 50</sup> examined the prevalence of HIV with respect to socio-demographic factors: age, marital status, level of education, occupation, gestational age and parity although there were variations in the way the rates were calculated. Twelve studies<sup>31–36 39 41 42 44–46 48 51</sup> used the sample size

in a particular sociodemographic variable subgroup as denominator when calculating HIV prevalence for that particular subgroup while total sample size was used in five<sup>29 30 32 37 40</sup> and total number of study participants diagnosed as HIV positive was used in three studies.<sup>38 43 47</sup>

Seventeen studies<sup>29 30 33–39 41 42 44–48 51</sup> reported HIV prevalence rates within various age groups ranging from 11 to >40 years. Thirteen studies<sup>32–34 36 38 39 43–48 51</sup> reported the level of education of the study participants when reporting HIV prevalence. Only five studies reported HIV prevalence according to pregnancy trimesters.<sup>34 45–47 51</sup> Gravidity and parity of study participants were reported in nine studies.<sup>32 36 38 39 42 45–48</sup>

### Prevalence of HIV among pregnant women in Nigeria

Among the 72 728 pregnant women included, 4981 women were diagnosed as HIV positive with prevalence rates ranging from 2.4% in North-Central zone to 25.42% in South-South geopolitical zone. The overall pooled prevalence of HIV among pregnant women was 7.22% (95% CI 5.64 to 9.21; figure 3). A high degree of heterogeneity was found in included studies (Higgins  $I^2=97.2%$ ). The funnel plot and egger test ( $p=0.728$ ) showed evidence of publication bias.

The pooled prevalence for individual geopolitical zones, except South-South (7.16%, 95% CI 5.07 to 10.02), showed substantial variations compared with the overall pooled prevalence. North-Central (6.84%, 95% CI 4.73 to 9.79) and South-West (6.27%, 95% CI 4.75 to 8.24) geopolitical zones had a lower estimate whereas the estimate for South-East zone (17.04%, 95% CI 9.01 to 29.86) was higher (table 2, figure 4).

There was no significant difference in the pooled prevalence rates between studies that used convenient sampling (7.20%) whereas studies that used simple random sampling (7.95%) showed a slightly higher prevalence rate overall (figure 5). With respect to sample size, studies that included a sample size >3297 found lower prevalence (6.07%) compared with those with a sample size <3297 (7.60%) (figure 6).

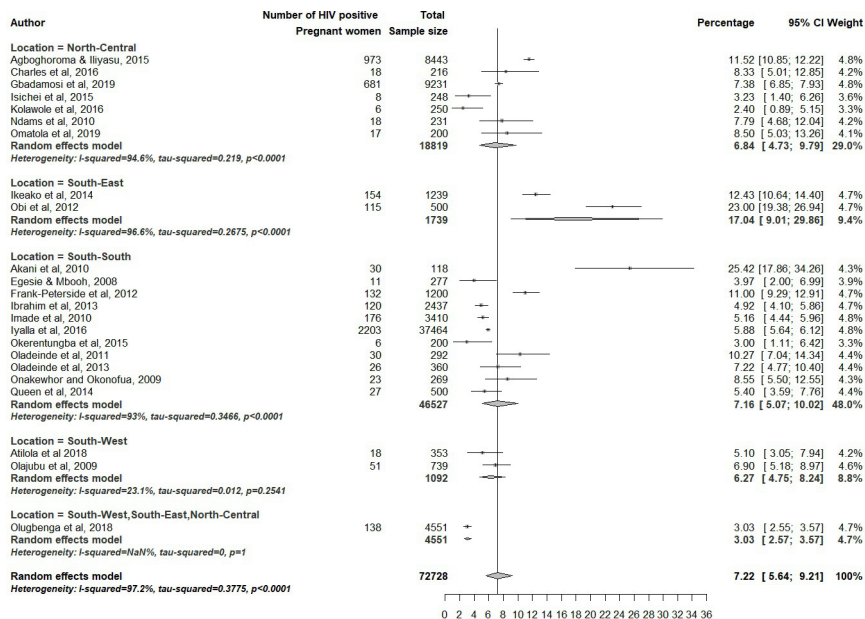
**Table 2** Subgroup analysis of the prevalence of HIV among pregnant women in Nigeria

Study characteristics	Number of pregnant women	Number of studies	Pooled prevalence (%)	95% CI
All	72 728	23	7.22	5.64 to 9.21
Geopolitical zones				
North-Central	18 819	7	6.84	4.73 to 9.79
South-East	1739	2	17.04	9.01 to 29.86
South-South	46 527	11	7.16	5.07 to 10.02
South-West	1092	2	6.27	4.75 to 8.24
South West, South-East and North-Central	4551	1	3.03	2.57 to 3.57
Sampling techniques				
Simple random sampling	1317	4	7.95	3.27 to 18.09
Convenient sampling	969	3	7.20	5.23 to 9.82
Not reported	70 442	16	6.99	5.20 to 9.32
Place of recruitment				
Antenatal care clinic	4799	2	3.04	2.59 to 3.57
General hospital	38 722	5	5.43	4.34 to 6.77
Tertiary hospital	17 647	10	10.24	7.13 to 14.50
Other hospital	1400	2	6.15	1.67 to 20.23
Other centres	10 160	4	7.33	6.84 to 7.85
Length of the study				
Greater than 11 months	63 892	10	7.25	5.75 to 9.12
Less than or equal to 11 months	8268	10	7.32	4.92 to 10.76
Not reported	568	3	6.18	1.21 to 26.10
Study period				
After April 2011	14 451	5	5.94	3.95 to 8.84
Before April 2011	16 148	11	8.07	5.75 to 11.22
Intersecting April 2011	41 461	4	6.92	4.83 to 9.82
Not reported	568	3	6.18	1.21 to 26.10
Year of publication				
After 2013	62 895	12	5.92	4.35 to 8.01
Before or in 2013	9833	11	8.95	6.20 to 12.75
Study quality				
Moderate	57 094	13	6.57	5.23 to 8.22
High	15 634	10	8.38	5.22 to 13.18
Risk of bias in sampling				
Low	1517	5	6.69	3.00 to 14.23
High	71 211	18	7.30	5.69 to 9.32
Risk of bias in reliability and validity of diagnostic tests				
Low	69 550	19	7.77	5.90 to 10.19
High	3178	4	5.02	3.50 to 7.14

The pooled prevalence for studies conducted in tertiary hospitals (10.24%) was higher compared with studies conducted in antenatal care clinics (3.04%). There was no significant difference in prevalence rates between studies that were carried out for >11 months (7.25%) and ≤11 months (7.32%) (table 2). The pooled prevalence

was higher for studies that were conducted prior to April 2011 (8.07%) compared with studies conducted after April 2011 (5.94%) or covering April 2011 (6.92%) (table 2).

The pooled prevalence from 10 high-quality studies (n = 15 634) was higher, 8.38% (95% CI 5.22 to 13.18)



**Figure 4** Pooled prevalence of HIV infection with respect to geopolitical zones.

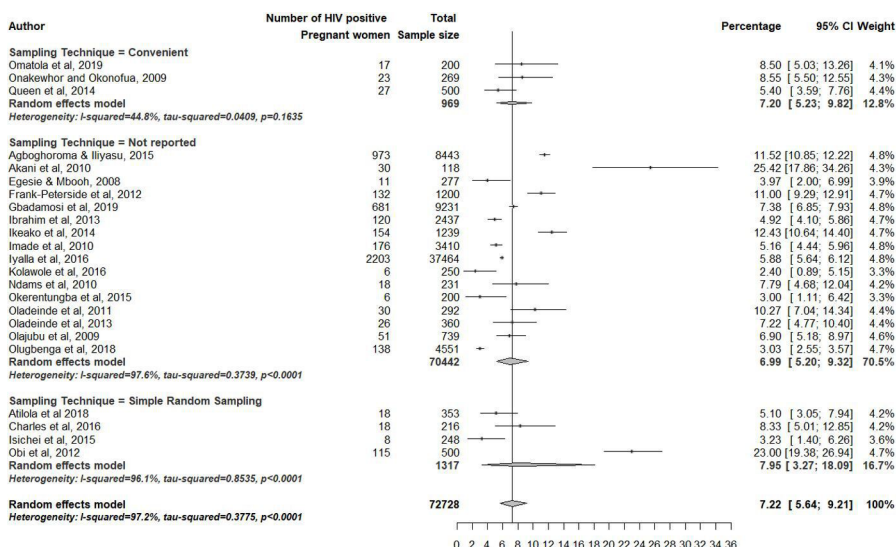
compared with pooled prevalence from 13 moderate-quality studies, 6.57% (95% CI 5.23 to 8.22) (n=57094) (figure 7). Exclusion of studies with higher risk of sampling bias lowered the prevalence estimate to 6.69% (95% CI 3.00 to 14.23). Studies with higher risk of reliability and validity of diagnostic tests reported a lower prevalence estimate of 5.02% (95% CI 3.50 to 7.14) (table 2).

### Differences in prevalence with respect to sociodemographic factors

Among studies that used the sample size in a particular sociodemographic variable subgroup as denominator when calculating HIV prevalence, the highest HIV prevalence rates were reported in the age groups of 41–45 years (100%),<sup>34</sup> 36–40 years (40%)<sup>34</sup> and 40–44 years (25%).<sup>45</sup> Among the rest, highest HIV prevalence of 6.4%

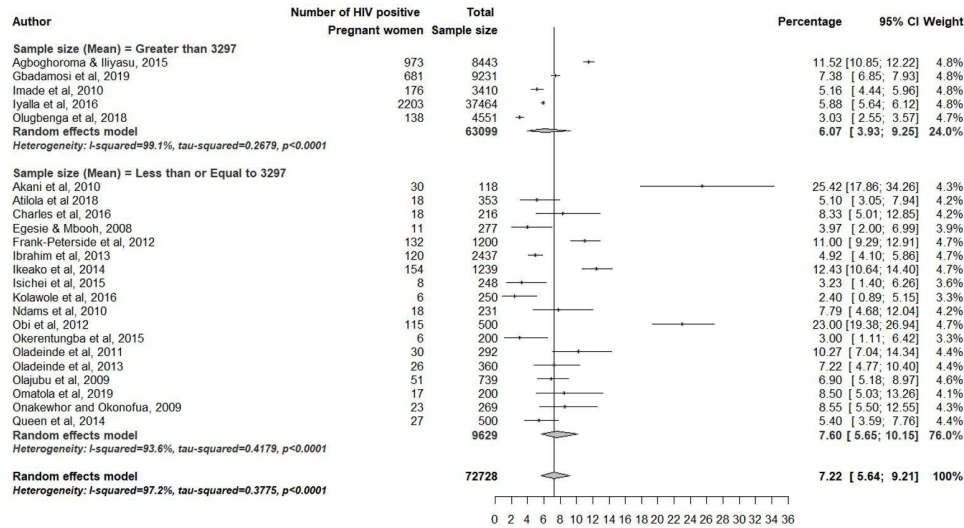
and 43.33% were reported in 29–32 years and 26–30 year groups, respectively. The lowest prevalence rates were reported in ≥30 years (1.31%),<sup>44</sup> 41–46 years (0.13%)<sup>30</sup> and ≤19 years (3.33%).<sup>38</sup> In most studies, the prevalence of HIV was higher among participants who had no formal education.<sup>32 36 39 44 45</sup> Two studies reported high prevalence rates among participants who had secondary (49.16%)<sup>38</sup> and tertiary level (50%)<sup>47</sup> education. Seven studies reported lower prevalence rates among those who completed tertiary education compared with others.<sup>32 34 36 39 46 48 51</sup>

Three studies reported higher prevalence among participants in the second trimester compared with those in the first trimester.<sup>34 47 51</sup> Two studies reported the highest prevalence among pregnant women in the first trimester and a lower prevalence among those in



**Figure 5** Pooled prevalence of HIV infection with respect to sampling methods.





**Figure 6** Pooled prevalence of HIV infection with respect to study sample size.

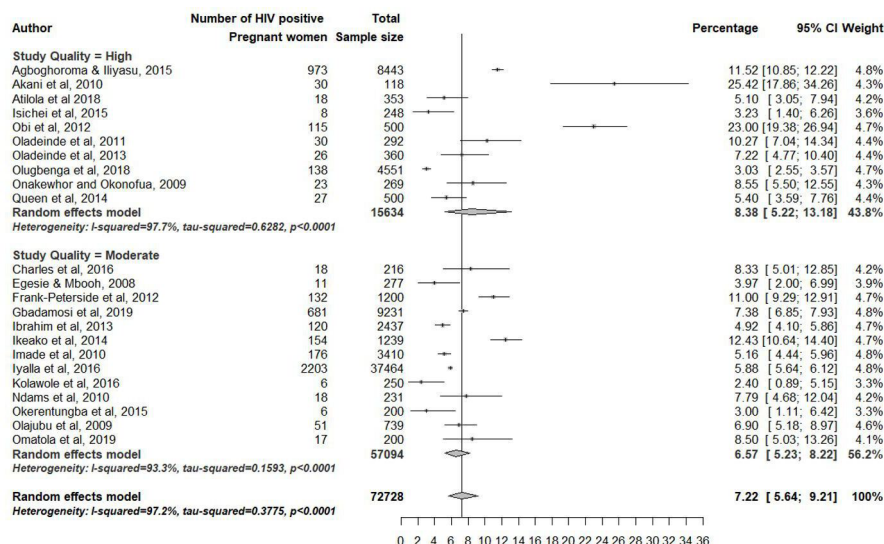
the second trimester.<sup>45 46</sup> Among nine studies that considered gravidity and parity, six studies reported higher prevalence rates among multigravida and higher parity mothers.<sup>32 36 39 42 45 48</sup>

## DISCUSSION

To the authors' knowledge, this is the first systematic review and meta-analysis conducted to estimate the prevalence of HIV among pregnant women in Nigeria. All included studies were from four geopolitical zones of Nigeria and we found an overall pooled prevalence of 7.22% (95% CI 5.64 to 9.21), with rates ranging from 2.4% in North-Central zone to 25.42% in South-South zone. While our overall prevalence rates are consistent with prevalence rates reported from SSA region as well as individual countries in the region,<sup>52</sup> there have been other reports indicating much higher prevalence rates in Nigeria. The WHO reported a 41% prevalence rate of

HIV among pregnant women in Nigeria which is six times higher than the pooled estimate found in our study.<sup>53</sup> This could be an indicator of a higher actual burden of the disease in the country as a whole. The overall high prevalence of HIV among pregnant women that we found in our review could mirror the high rates of HIV among women in general that has been attributed to some of the common cultural practices followed by Nigerian societies in certain areas, such as child marriage, levirate marriage and polygamy.<sup>54</sup> Studies have also shown that HIV prevalence among pregnant women in Nigeria is higher than the prevalence rates from other developing countries such as Brazil (0.38%),<sup>55</sup> Ethiopia (5.74%)<sup>56</sup> and Tanzania (5.6%).<sup>57</sup>

Wide variations in prevalence rates for studies conducted in different healthcare facilities could potentially be attributed to variations in the availability of adequate testing facilities. We found the highest prevalence in tertiary hospitals, which



**Figure 7** Pooled prevalence of HIV infection with respect to study quality.

could be due to the better availability of testing facilities compared with other primary and secondary care facilities. The variations in pooled prevalence rates with respect to study quality also need to be taken into consideration as more than half of the studies were of moderate methodological quality with a high risk of selection bias and sampling. There was substantial heterogeneity among studies due to the variations in methodological approaches including sample size, sampling approach and the characteristics of pregnant women although the information was not available in some studies.

The wide variations in prevalence between different geopolitical zones within Nigeria is in concurrence with findings from previous studies about significant differences in HIV prevalence both within and across countries in SSA.<sup>21 58–60</sup> This has important implications for targeted preventive as well as treatment programmes and interventions in areas with high prevalence including interventions for the prevention of perinatal transmission as well as the provision of lifelong antiretroviral drugs. Based on our findings, the South-East geopolitical zone has nearly twice the rate of HIV prevalence compared with the national average which in turn indicates the need to better target prevention efforts to these areas.

The extent of heterogeneity in a meta-analysis determines the generalisability of study findings to the entire study population. A high degree of heterogeneity (Higgins  $I^2=97.2\%$ ), both in the pooled and subgroup analyses, indicated substantial variations between included studies,<sup>26</sup> making it challenging to generalise the findings to the entire pregnant WLHIV in Nigeria. The variations in methodological approaches including differences in study settings, sampling methods, sample size and the diagnostic/screening procedures as well as the overall study quality could have all potentially contributed to the high degree of heterogeneity observed in our review.

### Strengths and limitations

The rigorous methodological approach adopted in our study makes our findings valid and reliable. However, the prevalence estimates may not be generalisable to the whole of Nigeria as included studies were from four geopolitical zones of Nigeria and there was a high degree of heterogeneity among the included studies. More than half of the included studies were of moderate methodological quality with a high risk of selection and sampling bias. We were unable to conduct a regression analysis to analyse the effect of study level factors, such as study quality and geopolitical zone, due to the lack of adequate number of studies (<10) for each category within the particular variable as well as the high level of heterogeneity found among the included studies.

### CONCLUSION

Our findings imply that HIV infection is a significantly prevalent issue among pregnant women in Nigeria. Determining an overall, synthesised accurate national

prevalence rate based on existing evidence presents a challenge due to the lack of evidence from some geopolitical zones, and the wide-ranging and, in many cases, problematic methodological approaches adopted by some studies. While new cases of HIV have gradually decreased globally since its peak in 1999, prevalence of HIV continues to be the highest in southern SSA and it has been indicated that HIV will continue to be a major threat to public health for years to come.<sup>61</sup> Our findings, therefore, have important implications for planners, policymakers, academics and researchers in medical and public health arenas both in Nigeria as well as in SSA region towards developing appropriate preventive, diagnostic and treatment interventions including the provision of lifelong antiretroviral drugs to all WLHIV as part of PMTCT services regardless of CD4 count (which indicates the level of HIV in the body) as recommended by WHO guidelines.<sup>62</sup> Future research should employ scientifically rigorous methodological approaches to derive accurate national prevalence estimates and to make comparisons with other countries in the region and internationally. The observed variations in prevalence with respect to various diagnostic tests highlights the importance of having a gold-standard diagnostic tool. There is also a need for a more in-depth understanding of the associated cultural, social and environmental factors. Qualitative studies can be of great value in this respect. Progress on all these fronts will boost the development of policies and practice guidelines to effectively tackle the issue.

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