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**Systematic review and meta-analysis of seroprevalence of human immunodeficiency virus serological markers among pregnant women in Africa, 1984-2020**

Ebogo-Belobo JT *et al*. HIV in pregnant women in Africa

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**Abstract**

BACKGROUND

Human immunodeficiency virus (HIV) is a major public health concern, particularly in Africa where HIV rates remain substantial. Pregnant women are at an increased risk of acquiring HIV, which has a significant impact on both maternal and child health.

AIM

To review summarizes HIV seroprevalence among pregnant women in Africa. It also identifies regional and clinical characteristics that contribute to study-specific estimates variation.

METHODS

The study included pregnant women from any African country or region, irrespective of their symptoms, and any study design conducted in any setting. Using electronic literature searches, articles published until February 2023 were reviewed. The quality of the included studies was evaluated. The DerSimonian and Laird random-effects model was applied to determine HIV pooled seroprevalence among pregnant women in Africa. Subgroup and sensitivity analyses were conducted to identify potential sources of heterogeneity. Heterogeneity was assessed with Cochran's Q test and I2 statistics, and publication bias was assessed with Egger's test.

RESULTS

A total of 248 studies conducted between 1984 and 2020 were included in the quantitative synthesis (meta-analysis). Out of the total studies, 146 (58.9%) had a low risk of bias and 102 (41.1%) had a moderate risk of bias. No HIV-positive pregnant women died in the included studies. The overall HIV seroprevalence in pregnant women was estimated to be 9.3% [95% confidence interval (CI): 8.3-10.3]. The subgroup analysis showed statistically significant heterogeneity across subgroups (*P* < 0.001), with the highest seroprevalence observed in Southern Africa (29.4%, 95%CI: 26.5-32.4) and the lowest seroprevalence observed in Northern Africa (0.7%, 95%CI: 0.3-1.3).

CONCLUSION

The review found that HIV seroprevalence among pregnant women in African countries remains significant, particularly in Southern African countries. This review can inform the development of targeted public health interventions to address high HIV seroprevalence in pregnant women in African countries.

**Key Words:** Human immunodeficiency virus; Pregnant women; Africa; Prevalence; Review; Meta-analysis

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**Core Tip:** A meta-analysis reveals a 9.3% Human immunodeficiency virus (HIV) seroprevalence among pregnant women in Africa, with regional variations. Southern Africa reports the highest rates at 29.4%, whereas Northern Africa shows the lowest at 0.7%. These findings underscore the need for targeted public health interventions to tackle high HIV seroprevalence in pregnant women, especially in Southern African countries.

**INTRODUCTION**

Human immunodeficiency virus (HIV) treatment guidelines, increased use of testing and counselling have resulted in a significant decrease in HIV rates in the general population during the 2010s, including in Africa[1-4]. Unfortunately, the impact of these interventions on pregnant women is less clear. According to the UNAIDS report (2023), 39 million people globally were living with HIV in 2022, and around 65% of these people lived in sub-Saharan Africa[5]. According to the same report, women and girls accounted for 63% of all new HIV infections in sub-Saharan Africa. A meta-analysis of participants recruited from 1984 to 2012 showed that HIV acquisition during pregnancy and postpartum was estimated at 3.8 [95% confidence interval (CI): 3.0, 4.6] per 100 person-years[6]. HIV incidence was higher during pregnancy and in Africa. A more recent meta-analysis revealed HIV incidence among pregnant women in sub-Saharan Africa remained significant at 3.6 (95%CI: 1.2-11.1)[7]. HIV causes maternal deaths between 5.9% and 17.9%[8-10]. HIV-positive pregnant and postpartum women are more likely to die than those without HIV. Moreover, the study estimated that 994 deaths per 100000 were caused by HIV in pregnant and postpartum women[11]. A more rapid progression of HIV-related illness or obstetric complications may contribute to this higher morbidity in HIV-positive pregnant women[12,13]. Besides health risks for mothers, HIV infection also increases the risks of mother-to-child transmission. HIV transmission from mother to child is also increased during pregnancy and after delivery[6,7]. A study has shown that the risk of mother-to-child HIV transmission during pregnancy is higher than that of chronic infections during pregnancy and postpartum[6]. A separate study found that mothers infected with HIV who don't receive antiretroviral therapy have an increased chance of having a preterm birth, a low birth weight, a small for gestational age, and a stillbirth in sub-Saharan Africa[14]. Several studies have explored the HIV seroprevalence among pregnant women in Africa, but a comprehensive review is needed. A meta-analysis of 15 studies found that 5.74% (95%CI: 3.96-7.53%) of pregnant women in Ethiopia had HIV with a high level of regional heterogeneity[15]. To guide future research and policy, it is essential to better understand the characteristics contributing to variations in HIV estimates among pregnant women. Furthermore, it is vital to develop effective strategies to reduce horizontal and vertical transmission of HIV during pregnancy and breastfeeding. We have summarized estimates of HIV seroprevalence among pregnant women in Africa and identified regional and clinical characteristics that contribute to variation in study-specific estimates.

**MATERIALS AND METHODS**

***Study design***

This study complied with the Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA) guidelines[16]. Study protocol was registered in PROSPERO (CRD42021272440). The registered protocol specifies objectives, inclusion and exclusion criteria, search strategy, data extraction, and statistical analysis plan.

***Eligibility criteria***

This systematic review and meta-analysis assessed the seroprevalence of HIV serological markers among pregnant women in 54 African countries up to February 2023. The study included pregnant women from any African country or region, irrespective of their symptoms, and any study design (cross-sectional, cohort, clinical trial, or case-control) conducted in any setting (hospital-based, antenatal clinics, or community-based). All laboratory diagnostic methods using any sample type to detect HIV serological markers were eligible. Studies with a sample size greater than 10, with enough data available, written in English and French were included. We chose studies with more than 10 samples for statistical robustness and reliability. When overlapping data appeared in different articles, the most recent or complete study was used. Review articles, comments, case reports, and studies with inaccessible full-text or abstracts were excluded from the study.

***Article search strategy***

Using Pubmed and Web of Science, African Index Medicus, and African Journal online, we reviewed the electronic bibliography for articles published till February 2023. Search terms related to HIV, pregnant women, and Africa were used (Supplementary Table 1). The reference lists of all relevant articles were reviewed to complete searches in the bibliographic database and identify possible additional data sources.

***Article selection***

Two investigators (Ebogo-Belobo JT and Kenmoe S) independently screened titles and abstracts of articles retrieved from electronic literature searches, and full texts of those eligible were obtained and assessed further for final inclusion. A PRISMA flow diagram was used to document the screening process. Consensus was reached between reviewers to resolve disagreements.

***Data extraction from the included articles***

Data extraction for this systematic review was conducted using a Google form by 14 study authors and verified by Ebogo-Belobo JT. The extracted data included information on the first author's name, year of publication, and participants' inclusion period. We also collected information about the study design and countries. A number of websites were used to obtain the WHO region, United Nations region, and World Bank Income Group from country information[17,18]. Other extracted information included single HIV diagnostic methods or algorithms of diagnostic methods, parity, gravidity, gestational age, educational level, sample size, HIV positive number, and type of HIV. In studies reporting results with undetermined HIV status, we excluded these patients from our estimations. In cases where detection algorithms were used, we considered the number of positives from the group of detection methods constituting the algorithm, not the results of the individual detection methods. Discrepancies encountered during data extraction were resolved through discussion and consensus among the authors.

***Assessment of study quality***

The risk of bias assessment was conducted using the Hoy *et al*[19], tool, which is designed to assess the risk of bias in prevalence studies (Supplementary Table 2). This tool includes ten items related to the study’s external and internal validity. Each item is scored as either low risk, high risk, or unclear risk of bias. Scores range from 0 to 10, with higher scores indicating lower bias risk. Each study included in the review was assessed for bias using the tool, with disagreements resolved through discussion and consensus.

***Statistical analysis***

This meta-analysis used the DerSimonian and Laird random-effects model to determine pooled HIV seroprevalence among pregnant women in Africa[20]. This was done by inputting numerators (HIV positive) and denominators (HIV tested) extracted from selected studies. Using the Clopper-Pearson method, we calculated 95%CI for individual studies. The results of individual studies were summarized using forest plots. The analysis was conducted with the ‘meta’ package in R v4.0.3 (R Foundation for Statistical Computing, Vienna, Austria), and the ‘metaprop’ function was applied to conduct the meta-analysis of single proportions to obtain HIV pooled seroprevalence[21,22].

***Sub-group, metaregression, and sensitivity analyses***

A subgroup meta-analysis and metaregression analysis were conducted to identify potential sources of heterogeneity. Several covariates were considered, including: (1) Regional characteristics such as countries, United Nations regions, WHO regions, and World Bank Income Groups; (2) HIV characteristics such as type of HIV and HIV diagnostic method; (3) participant characteristics such as gestational age, parity, gravidity and educational level; and (4) studies characteristics such as sample size, risk of bias, and study period. Only covariates with at least three data points were considered in the subgroup analyses. We included only cross-sectional studies and those with low bias risks in the sensitivity analyses.

***Heterogeneity and publication bias***

Heterogeneity was assessed using Cochran's Q test and I2 statistics[23]. A statistically significant Cochran's Q test (*P* < 0.05) was indicative of true heterogeneity of effect sizes between studies. The I2 statistic was calculated as an estimate of between-studies variance using the maximum likelihood method. I2 values of 50% or higher indicate substantial heterogeneity. Publication bias was assessed with Egger's test, with a statistically significance (*P* < 0.05) suggesting evidence of funnel plot asymmetry[24].

**RESULTS**

***Selection of included articles***

We conducted a comprehensive search of relevant databases for studies on HIV seroprevalence and case fatality rates in pregnant women. After deduplication and initial screening, 619 full-text articles were evaluated. Ultimately, 248 articles met our inclusion criteria and were incorporated into the meta-analysis (Figure 1)[25-272].

***Included article characteristics***

We conducted a systematic review of studies published from 1987 to 2023 and reviewed 248 studies. The selected studies encompassed a total of 1374392 participants, with individual studies ranging from 11 to 243302 participants. There were no cases reported of HIV-positive pregnant women dying in the included studies, which only reported HIV seroprevalence among pregnant women. Included studies recruited participants between 1984 and 2020, with unclear inclusion periods in 25 studies (Supplementary Table 3). The studies were conducted in 37 African countries, with the majority being from Nigeria (23.0%), followed by Tanzania (8.5%), Ethiopia (7.3%), and South Africa (7.3%). The studies were mostly conducted in lower-middle-income countries (58.5%), followed by low-income countries (32.3%) and upper-middle-income countries (8.9%). Most studies were hospital-based (99.2%), with only one community-based study. The HIV diagnostic methods used in the studies varied, with the most common methods being algorithm of rapid antibody tests (29.0%), single rapid antibody test (14.9%), and indirect enzyme-linked immunosorbent assay (ELISA) (11.7%).

***Risk of bias in the included studies***

Out of the total number of studies included in the review (248), 146 (58.9%) were deemed to have a low risk of bias, while 102 (41.1%) were categorized as having a moderate risk of bias (Supplementary Table 4).

***Meta-analysis***

A meta-analysis was performed to estimate the overall HIV seroprevalence in pregnant women, as well as the seroprevalence among cross-sectional studies, among studies with sample size ≥ 100 and those with a low risk of bias. The overall HIV seroprevalence in pregnant women was estimated to be 9.3% (95%CI: 8.3-10.3). The seroprevalence among cross-sectional studies and among studies with a low risk of bias were slightly lower at 8.8% (95%CI: 7.7-9.8) and .8% (95%CI: 7.5-10.2) respectively, while the seroprevalence among studies with sample size ≥ 100 was 9.1% (95%CI: 8.1-10.2). All three analyses exhibited high heterogeneity (*P* < 0.001). The analysis of publication bias using the Egger test indicated evidence of significant publication bias (*P* < 0.001) in the meta-analysis (Supplementary Figure 1).

***Metanalysis by United Nation regions***

Subgroup analysis was conducted to explore the difference in seroprevalence among different United Nation regions (Figure 2). The results showed statistically significant heterogeneity across subgroups (*P* < 0.001). The seroprevalence of the disease varied across different regions with the highest observed in Southern Africa (29.4%, 95%CI: 26.5-32.4) and the lowest in Northern Africa (0.7%, 95%CI: 0.3-1.3). Eastern Africa had a relatively high seroprevalence (11.7%, 95%CI: 10.2-13.2), while that in Western Africa was relatively low (6.2%, 95%CI: 5.2-7.3). Middle Africa had a moderate seroprevalence (4.8%, 95%CI: 4-5.8). The difference in seroprevalence between United Nation regions was statistically significant (*P* < 0.001).

***Meta-analysis of other regional categories***

HIV seroprevalence in pregnant women varied among different countries (Table 1). The highest seroprevalence was reported in South Africa (29.9%, 95%CI: 26.7-33.2), followed by Zimbabwe (25.7%, 95%CI: 16.4-36.3) and Malawi (18.7%, 95%CI: 14.2-23.8) (Figure 3). The lowest seroprevalence was reported in Sudan (1.0%, 95%CI: 0.4-1.7) and Senegal (0.7%, 95%CI: 0.5-0.9). The difference was statistically significant (*P* < 0.001). HIV seroprevalence in pregnant women varied significantly among WHO regions (*P* < 0.001) (9.5%, 95%CI: 8.4-10.6 in Africa *vs* 1.4%, 95%CI: 0.6-2.4 in Eastern Mediterranean) (Table 1). HIV seroprevalence during pregnancy was significantly different among World Bank Income Groups (*P* < 0.001) (Table 1). The highest seroprevalence was observed in upper-middle-income countries (24%, 95%CI: 19.9-28.3), followed by low-income countries (8.4%, 95%CI: 6.9-10.1) and lower-middle-income countries (8.1%, 95%CI: 7.2-9.1).

***Meta-analysis by HIV characteristics***

The HIV-1 seroprevalence was 8.7% (95%CI: 7.5-10) with a 95% prediction interval of 0.5-25.4%, while the HIV-2 seroprevalence was 1.2% (95%CI: 0.7-1.9) with a 95% prediction interval of 0-5.2% (Table 1). HIV-1 seroprevalence was significantly higher than HIV-2 (*P* < 0.001) (Figure 3). Regarding the HIV diagnostic method, the highest seroprevalence was found in the combination of rapid antibody test and indirect ELISA subgroup (15.9%; 95%CI: 1.3-42.1) (Table 1). The lowest seroprevalence was found in the algorithm (rapid antibody test, indirect ELISA, and enzyme immunoassay) subgroup (3.3%; 95%CI: 1.9-4.9). There was a statistically significant difference between subgroups (*P* < 0.001).

***Meta-analysis by pregnant women’s characteristics***

The subgroup analysis by gestational age included 17 studies involving 36935 participants (Table 1). The HIV seroprevalence was highest in the second trimester with 9.6% (95%CI: 5.2-15), followed by the third trimester with 8.7% (95%CI: 5.2-13.1) and the least during the first trimester with a prevalence of 7.3% (95%CI: 3.5-12.2) but without statistical significance (*P* = 0.902). Ten studies were included in the parity subgroup analysis, involving 18015 participants. HIV seroprevalence was 6.7% (95%CI: 4-10) among nulliparous women, 6.5% (95%CI: 4.5-8.8) among multiparous women, and 5% (95%CI: 2.8-7.8) among primiparous women. There was no statistically significant difference between the different categories (*P* = 0.690). The subgroup analysis by gravidity included 17 studies with 53860 participants. HIV seroprevalence was 9.2% (95%CI: 5.5-13.7) among multigravidae and 6.5% (95%CI: 4.2-9.2) among primigravidae. HIV seroprevalence was not significantly higher among multigravidae than among primigravidae (*P* = 0.276).

The metaregression analysis revealed an association between different factors and HIV seropositivity, with an overall variability of 63.07% observed in our multivariate model (Supplementary table 5).

**DISCUSSION**

Participants were recruited in 248 studies between 1984 and 2020 from 39 African countries, with 1374392 participants in total. The overall HIV seroprevalence among pregnant women in Africa was estimated to be 9.3% (95%CI: 8.3-10.3), which suggests that a significant proportion of pregnant women in the region live with HIV. However, it is worth noting that no HIV-positive pregnant women died in any of the included studies. The study also found significant differences in HIV seroprevalence by United Nation region, WHO region, World Bank Income Groups, and individual countries. United Nation regions showed Southern Africa had the highest seroprevalence, followed by Eastern Africa, Western Africa, Middle Africa, and Northern Africa. The WHO region with the greatest seroprevalence was Africa compared to the Eastern Mediterranean. There were significant differences in HIV seroprevalence among World Bank Income Groups, with upper-middle-income countries having the highest seroprevalence, followed by low-income countries, and lower-middle-income countries. The analysis presented data on HIV seroprevalence in different African countries, with South Africa having the highest seroprevalence, followed by Zimbabwe, Malawi, Zambia, and Rwanda. The lowest seroprevalence was observed in Senegal and Sudan. The study found significantly higher HIV-1 seroprevalence (8.2%) than HIV-2 (1.2%). No significant differences were observed in seroprevalence based on gestational age, parity, and gravidity.

It is concerning to find that the overall HIV seroprevalence among pregnant women in Africa was estimated to be 9.3% (95%CI: 8.3-10.3), which indicates that the HIV epidemic continues to have a high impact on the continent. Previous studies show pregnant women in Africa are at higher risk of HIV infection[6,7]. There have been previous reports of death in African pregnant and postpartum women, primarily in longitudinal studies[11,13,273]. It is noteworthy that none of the included studies reported the death of HIV-positive pregnant women. As previously reported[274,275], Southern Africa had the highest HIV seroprevalence among pregnant women, followed by Eastern Africa, Western Africa, Middle Africa, and Northern Africa. This highlights the urgent need for continued efforts to prevent HIV transmission and provide effective care and treatment to HIV-positive pregnant women in these regions. The high HIV seroprevalence in Southern Africa is well documented, with countries like South Africa being among the highest HIV seroprevalence in the world[276,277]. This can be attributed to a range of factors, including data availability, poverty, violence against women, cultural restrictions promoting intergenerational sex, unprotected sex, multiple sexual partners, political barriers, recreational drug use, stigma, and discrimination[276,277]. Eastern and Western Africa also have high HIV seroprevalence, with countries like Zimbabwe, Malawi, Zambia, Rwanda, Uganda, and Kenya reporting significant numbers of HIV infections each year[278]. These findings suggest that efforts to prevent HIV transmission and provide care and treatment to HIV-positive pregnant women need to be targeted towards these high-prevalent regions. This may include scaling up prevention interventions such as condom use and pre-exposure prophylaxis (PrEP), as well as increasing access to HIV testing and treatment services[279-281]. In addition, addressing social and economic factors that contribute to HIV transmission, such as poverty, gender inequality, and stigma, is crucial to reducing HIV seroprevalence in these regions.

HIV-1 seroprevalence was significantly higher than HIV-2 seroprevalence, which has implications for HIV prevention and treatment. HIV-1 and HIV-2 are two distinct types of the virus that cause HIV infection, and they differ in their transmission, clinical presentation, and response to treatment[282-284]. HIV-1 is more prevalent globally and is the predominant HIV type in sub-Saharan Africa, where the HIV burden is highest. In contrast, HIV-2 is primarily found in West Africa and is less prevalent globally[282,283]. This has significant implications for prevention efforts, as HIV-1 is more easily transmitted than HIV-2 and associated with faster AIDS progression. Prevention efforts must therefore focus on reducing HIV-1 transmission through strategies such as condom use, pre-exposure PrEP, and promoting HIV testing and treatment for people living with HIV. Antiretroviral therapy is the cornerstone of HIV treatment, and it suppresses both HIV-1 and HIV-2. However, HIV-2 is less responsive to some antiretroviral therapy regimens and may require different treatment strategies[282,283,285]. The high HIV-1 seroprevalence in the study population suggests that healthcare providers should know the HIV-1 predominance and tailor treatment accordingly.

There was no significant difference in seroprevalence based on gestational age, parity, or gravidity, indicating that HIV infection does not discriminate against these demographic characteristics. This finding is consistent with previous research that shows that HIV can affect anyone, regardless of their age, parity, or gravidity[286-288].

This systematic review and meta-analysis of HIV seroprevalence among pregnant women in Africa has some limitations. We acknowledge that not searching the grey literature might introduce a potential limitation to our review. The lack of uniformity in testing methods and cutoffs used in included studies may have affected the results comparability. However, this systematic review and meta-analysis of HIV seroprevalence among pregnant women in Africa has several strengths. The comprehensive search strategy and pre-defined inclusion and exclusion criteria minimized the risk of missing relevant studies and ensured that only appropriate studies were considered. The large sample size and broad time frame of the review increased generalizability. Finally, meta-analysis allowed for the estimation of overall seroprevalence rates and identification of factors associated with HIV seroprevalence among pregnant women in Africa, providing significant insights for clinicians, researchers, and policymakers.

**CONCLUSION**

This study reports that HIV seroprevalence in pregnant African women was estimated to be 9.3%, highlighting the substantial burden of HIV in Africa. Southern Africa had the highest HIV seroprevalence among pregnant women, followed by Eastern, Western, Middle, and Northern Africa, emphasizing the need for targeted efforts to prevent transmission and provide care and treatment in these regions. HIV-1 seroprevalence was considerably higher than HIV-2, underscoring the need for tailored prevention and treatment strategies.

**ARTICLE HIGHLIGHTS**

***Research background***

An extensive literature review was carried out in various databases up until February 2023, using key terms such as Human immunodeficiency virus (HIV), pregnancy, and Africa. Through this literature search, we noted a significant body of evidence detailing HIV infection prevalence among pregnant women in Africa.

***Research motivation***

Given the continued high incidence and impact of HIV among pregnant women in Africa, there is a critical need to enhance our understanding of the specific factors that contribute to this high prevalence and the variations in these proportions. There is also an urgent need to examine strategies that could effectively mitigate both horizontal (person-to-person) and vertical (mother-to-child) HIV transmission during pregnancy and breastfeeding.

***Research objectives***

This research aims to provide a comprehensive understanding of HIV prevalence among pregnant women in Africa by identifying and analyzing the regional and clinical characteristics that contribute to variations in study-specific estimates.

***Research methods***

This systematic review and meta-analysis, compliant with Preferred Reporting Items for Systematic Reviews and Meta-analyses guidelines and registered in PROSPERO, assessed the seroprevalence of HIV serological markers among pregnant women in Africa up to 2023. All types of study designs from any African region were eligible if the sample size was greater than 10 and published in English or French. A literature search was conducted in databases such as Pubmed, Web of Science, African Index Medicus, and African Journal online, with relevant search terms. The quality of the included studies was assessed using the appropriate tool. The DerSimonian and Laird random-effects model was used to determine pooled HIV seroprevalence.

***Research results***

This systematic review analyzed data from 248 studies investigating HIV seroprevalence in pregnant women across various African countries from 1984 to 2020. The overall HIV seroprevalence was estimated at 9.3% [95% confidence interval (CI): 8.3-10.3]. The highest seroprevalence was found in Southern Africa (29.4%, 95%CI: 26.5-32.4), while Northern Africa had the lowest (0.7%, 95%CI: 0.3-1.3). Among the different types of HIV, HIV-1 seroprevalence was significantly higher than HIV-2 (*P* < 0.001).

***Research conclusions***

This comprehensive analysis identified a high HIV seroprevalence among pregnant women in Africa at an estimated 9.3%, highlighting the significant burden of HIV in the region.

***Research perspectives***

Considering the substantial HIV seroprevalence among pregnant women in Africa, this analysis underlines the need for sustained efforts to prevent HIV transmission and provide effective care and treatment for HIV-positive pregnant women, especially in regions with high seroprevalence. Future research should aim to elucidate the factors contributing to high seroprevalence, especially in Southern Africa, and devise effective preventive and therapeutic strategies tailored to the region's needs.

**REFERENCES**

1 **WHO**. WHO Guidelines Approved by the Guidelines Review Committee. Guideline on When to Start Antiretroviral Therapy and on Pre-Exposure Prophylaxis for HIV. Geneva: World Health Organization. 2015. Available from: https://iris.who.int/bitstream/handle/10665/186275/9789241509565\_eng.pdf?sequence=1

2 **Hampanda KM**, Pelowich K, Freeborn K, Graybill LA, Mutale W, Jones KR, Saidi F, Kumwenda A, Kasaro M, Rosenberg NE, Chi BH. Strategies to increase couples HIV testing and counselling in sub-Saharan Africa: a systematic review. *J Int AIDS Soc* 2023; **26**: e26075 [PMID: 36929284 DOI: 10.1002/jia2.26075]

3 **Suthar AB**, Ford N, Bachanas PJ, Wong VJ, Rajan JS, Saltzman AK, Ajose O, Fakoya AO, Granich RM, Negussie EK, Baggaley RC. Towards universal voluntary HIV testing and counselling: a systematic review and meta-analysis of community-based approaches. *PLoS Med* 2013; **10**: e1001496 [PMID: 23966838 DOI: 10.1371/journal.pmed.1001496]

4 **Vandormael A**, Akullian A, Siedner M, de Oliveira T, Bärnighausen T, Tanser F. Declines in HIV incidence among men and women in a South African population-based cohort. *Nat Commun* 2019; **10**: 5482 [PMID: 31792217 DOI: 10.1038/s41467-019-13473-y]

5 **UNAIDS.** Global HIV & AIDS statistics-Fact sheet. 2023. Available from: https://www.unaids.org/sites/default/files/media\_asset/UNAIDS\_FactSheet\_en.pdf

6 **Drake AL**, Wagner A, Richardson B, John-Stewart G. Incident HIV during pregnancy and postpartum and risk of mother-to-child HIV transmission: a systematic review and meta-analysis. *PLoS Med* 2014; **11**: e1001608 [PMID: 24586123 DOI: 10.1371/journal.pmed.1001608]

7 **Graybill LA**, Kasaro M, Freeborn K, Walker JS, Poole C, Powers KA, Mollan KR, Rosenberg NE, Vermund SH, Mutale W, Chi BH. Incident HIV among pregnant and breast-feeding women in sub-Saharan Africa: a systematic review and meta-analysis. *AIDS* 2020; **34**: 761-776 [PMID: 32167990 DOI: 10.1097/QAD.0000000000002487]

8 **Khan KS**, Wojdyla D, Say L, Gülmezoglu AM, Van Look PF. WHO analysis of causes of maternal death: a systematic review. *Lancet* 2006; **367**: 1066-1074 [PMID: 16581405 DOI: 10.1016/S0140-6736(06)68397-9]

9 **Hogan MC**, Foreman KJ, Naghavi M, Ahn SY, Wang M, Makela SM, Lopez AD, Lozano R, Murray CJ. Maternal mortality for 181 countries, 1980-2008: a systematic analysis of progress towards Millennium Development Goal 5. *Lancet* 2010; **375**: 1609-1623 [PMID: 20382417 DOI: 10.1016/S0140-6736(10)60518-1]

10 **Organization WH**. Trends in maternal mortality: 1990 to 2008. 2010. Available from: https://iris.who.int/bitstream/handle/10665/44423/9789241500265\_eng.pdf?sequence=1

11 **Calvert C**, Ronsmans C. The contribution of HIV to pregnancy-related mortality: a systematic review and meta-analysis. *AIDS* 2013; **27**: 1631-1639 [PMID: 23435296 DOI: 10.1097/QAD.0b013e32835fd940]

12 **French R**, Brocklehurst P. The effect of pregnancy on survival in women infected with HIV: a systematic review of the literature and meta-analysis. *Br J Obstet Gynaecol* 1998; **105**: 827-835 [PMID: 9746374 DOI: 10.1111/j.1471-0528.1998.tb10226.x]

13 **Calvert C**, Ronsmans C. Pregnancy and HIV disease progression: a systematic review and meta-analysis. *Trop Med Int Health* 2015; **20**: 122-145 [PMID: 25358498 DOI: 10.1111/tmi.12412]

14 **Wedi CO**, Kirtley S, Hopewell S, Corrigan R, Kennedy SH, Hemelaar J. Perinatal outcomes associated with maternal HIV infection: a systematic review and meta-analysis. *Lancet HIV* 2016; **3**: e33-e48 [PMID: 26762992 DOI: 10.1016/S2352-3018(15)00207-6]

15 **Geremew D**, Tajebe F, Ambachew S, Endalamaw A, Eshetie S. Seroprevalence of HIV among pregnant women in Ethiopia: a systematic review and meta-analysis. *BMC Res Notes* 2018; **11**: 908 [PMID: 30567589 DOI: 10.1186/s13104-018-4022-1]

16 **Moher D**, Liberati A, Tetzlaff J, Altman DG; PRISMA Group. Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. *BMJ* 2009; **339**: b2535 [PMID: 19622551 DOI: 10.1136/bmj.b2535]

17 **Who**. Countries overview. World Health Organization. Available from: https://www.who.int/countries

18 **World Bank**. World Bank Country and Lending Groups-World Bank Data Help Desk. Available from: https://datahelpdesk.worldbank.org/knowledgebase/articles/906519-world-bank-country-and-lending-groups

19 **Hoy D**, Brooks P, Woolf A, Blyth F, March L, Bain C, Baker P, Smith E, Buchbinder R. Assessing risk of bias in prevalence studies: modification of an existing tool and evidence of interrater agreement. *J Clin Epidemiol* 2012; **65**: 934-939 [PMID: 22742910 DOI: 10.1016/j.jclinepi.2011.11.014]

20 **DerSimonian R**, Laird N. Meta-analysis in clinical trials. *Control Clin Trials* 1986; **7**: 177-188 [PMID: 3802833 DOI: 10.1016/0197-2456(86)90046-2]

21 **Borenstein M**, Hedges LV, Higgins JP, Rothstein HR. A basic introduction to fixed-effect and random-effects models for meta-analysis. *Res Synth Methods* 2010; **1**: 97-111 [PMID: 26061376 DOI: 10.1002/jrsm.12]

22 **Schwarzer G**. meta: An R Package for Meta-Analysis. 2007; **7**: 40-45

23 **Higgins JP**, Thompson SG, Deeks JJ, Altman DG. Measuring inconsistency in meta-analyses. *BMJ* 2003; **327**: 557-560 [PMID: 12958120 DOI: 10.1136/bmj.327.7414.557]

24 **Egger M**, Davey Smith G, Schneider M, Minder C. Bias in meta-analysis detected by a simple, graphical test. *BMJ* 1997; **315**: 629-634 [PMID: 9310563 DOI: 10.1136/bmj.315.7109.629]

25 **Abbott RC**, NDour-Sarr A, Diouf A, NDoye T, Bâ D, Tall N, MBaye N, Kébé F, Diadhiou F, Essex ME. Risk factors for HIV-1 and HIV-2 infection in pregnant women in Dakar, Senegal. *J Acquir Immune Defic Syndr (1988)* 1994; **7**: 711-717 [PMID: 8207649]

26 **Abuku VG**, Allotey EA, Akonde M. Clinical and laboratory presentation of first-time antenatal care visits of pregnant women in Ghana, a hospital-based study. *PLoS One* 2023; **18**: e0280031 [PMID: 36598908 DOI: 10.1371/journal.pone.0280031]

27 **Agboghoroma CO**, Ukaire BC. Prevalence and Risk Factors of Human Immunodeficiency Virus and Hepatitis C Virus Infection among Pregnant Women Attending Antenatal Care at a Tertiary Hospital in Abuja, Nigeria. *Niger Med J* 2020; **61**: 245-251 [PMID: 33487847 DOI: 10.4103/nmj.NMJ\_241\_19]

28 **Agida ET**, Abu P, Echikwonye M, Hwande TS, Ayeni HA, Swende TZ. HIV prevalence amongst clients attending antenatal clinic at the Federal Medical Centre, Makurdi. *Niger J Med* 2010; **19**: 295-297 [PMID: 20845634 DOI: 10.4314/njm.v19i3.62570]

29 **Ahmed SD**, Cuevas LE, Brabin BJ, Kazembe P, Broadhead R, Verhoeff FH, Hart CA. Seroprevalence of hepatitis B and C and HIV in Malawian pregnant women. *J Infect* 1998; **37**: 248-251 [PMID: 9892528 DOI: 10.1016/s0163-4453(98)91983-1]

30 **Aidaoui M**, Bouzbid S, Laouar M. [Seroprevalence of HIV infection in pregnant women in the Annaba region (Algeria)]. *Rev Epidemiol Sante Publique* 2008; **56**: 261-266 [PMID: 18687541 DOI: 10.1016/j.respe.2008.05.023]

31 **Ajoge HO,** Ahmad AA, Olonitola OS, Abdulsalam A, Onujabe MI, Muktar HM, Shittu SO.. The Prevalence of Human Immunodeficiency Virus Infection among Pregnant Women in Rural Settlements of Ebira-Land. *International Journal of Biological and Chemical Sciences* 2008; **2:** 123-127 [DOI: 10.4314/ijbcs.v2i1.39730]

32 **Ajoge HO**, Yende-Zuma N, Jatau ED, Ibrahim S, Olonitola SO, Shittu OS. Community-based intervention is necessary for the control of HIV in North-Central Nigeria. *Int J Infect Dis* 2013; **17**: e234-e239 [PMID: 23237969 DOI: 10.1016/j.ijid.2012.09.020]

33 **Akani CI**, Ojule AC, Opurum HC, John CT. Sero-prevalence of HIV antibodies in pregnant women in Port Harcourt, Nigeria. *Niger J Med* 2006; **15**: 44-48 [PMID: 16649450 DOI: 10.4314/njm.v15i1.37114]

34 **Akani CI**, Osaro E, Allagoa DO. Human immunodeficiency virus prevalence in an unbooked obstetric population in the Niger Delta. *HIV AIDS (Auckl)* 2010; **2**: 179-184 [PMID: 22096396 DOI: 10.2147/HIV.S9630]

35 **Anaedobe CG**, Ajani TA. Co-infection of Herpes Simplex Virus Type 2 and HIV Infections among Pregnant Women in Ibadan, Nigeria. *J Glob Infect Dis* 2019; **11**: 19-24 [PMID: 30814831 DOI: 10.4103/jgid.jgid\_56\_18]

36 **Anoubissi JD**, Gabriel EL, Kengne Nde C, Fokam J, Tseuko DG, Messeh A, Moussa Y, Nkenfou CN, Bonono L, Billong SC, Nfetam JE. Factors associated with risk of HIV-infection among pregnant women in Cameroon: Evidence from the 2016 national sentinel surveillance survey of HIV and syphilis. *PLoS One* 2019; **14**: e0208963 [PMID: 30978189 DOI: 10.1371/journal.pone.0208963]

37 **Assefa T**, Davey G, Dukers N, Wolday D, Worku A, Messele T, Tegbaru B, Dorigo W, Sanders EJ. Overall HIV-1 prevalence in pregnant women over-estimates HIV-1 in the predominantly rural population of Afar Region. *Ethiop Med J* 2003; **41 Suppl 1**: 43-49 [PMID: 15227880]

38 **Atewogbola GO**, Olufemi BT, Babawale AA, Taiwo MA, Tadese SA, Olaniyan AA, Sule WF. Multiple Sexual Partners as Major Predictor of Human Immunodeficiency Virus Seropositivity Among Pregnant Women, Osun State, Nigeria. *Viral Immunol* 2021; **34**: 632-638 [PMID: 34403606 DOI: 10.1089/vim.2021.0029]

39 **Atilola G**, Randle T, Obadara T, Komolafe IO, Odutolu G, Olomu J, Adenuga L. Epidemiology of HIV and Tuberculosis in pregnant women, South West Nigeria. *J Infect Public Health* 2018; **11**: 826-833 [PMID: 30392526 DOI: 10.1016/j.jiph.2018.06.004]

40 **Awobode HO**, Olubi IC. Prevalence of Toxoplasma gondii and HIV infection among pregnant women in Ibadan North Local Government, Oyo State. *Afr J Med Med Sci* 2014; **43 Suppl**: 39-45 [PMID: 26949779]

41 **Awolude OA**, Adesina OA, Oladokun A, Adewole IF. Emergency obstetric patients in developing countries and prevalence of HIV infection. *Afr J Med Med Sci* 2009; **38**: 39-43 [PMID: 19722427]

42 **Ayisi JG**, van Eijk AM, ter Kuile FO, Kolczak MS, Otieno JA, Misore AO, Kager PA, Steketee RW, Nahlen BL. Risk factors for HIV infection among asymptomatic pregnant women attending an antenatal clinic in western Kenya. *Int J STD AIDS* 2000; **11**: 393-401 [PMID: 10872913 DOI: 10.1258/0956462001916119]

43 **Bafa TA**, Egata AD. Seroepidemiological patterns and predictors of hepatitis B, C and HIV viruses among pregnant women attending antenatal care clinic of Atat Hospital, Southern Ethiopia. *SAGE Open Med* 2020; **8**: 2050312119900870 [PMID: 32002184 DOI: 10.1177/2050312119900870]

44 **Bayo P**, Ochola E, Oleo C, Mwaka AD. High prevalence of hepatitis B virus infection among pregnant women attending antenatal care: a cross-sectional study in two hospitals in northern Uganda. *BMJ Open* 2014; **4**: e005889 [PMID: 25387757 DOI: 10.1136/bmjopen-2014-005889]

45 **Becker S**, Mlay R, Schwandt HM, Lyamuya E. Comparing couples' and individual voluntary counseling and testing for HIV at antenatal clinics in Tanzania: a randomized trial. *AIDS Behav* 2010; **14**: 558-566 [PMID: 19763813 DOI: 10.1007/s10461-009-9607-1]

46 **Bello FA**, Ogunbode OO, Adesina OA, Olayemi O, Awonuga OM, Adewole IF. Acceptability of counselling and testing for HIV infection in women in labour at the University College Hospital, Ibadan, Nigeria. *Afr Health Sci* 2011; **11**: 30-35 [PMID: 21572854]

47 **Bello G**, Kagoli M, Chipeta S, Auld A, Chang JC, DeVos JR, Kim E, Mkungudza J, Payne D, Eliya M, Nyirenda R, Jahn A, Mzumara T, Mvula B, Dadabhai S, Namakhoma I, Babaye Y, Giron A, Jordan MR, Bertagnolio S, O'Malley G, Wadonda-Kabondo N. Resistance levels to non-nucleoside reverse transcriptase inhibitors among pregnant women with recent HIV infection in Malawi. *Antivir Ther* 2022; **27**: 13596535221121225 [PMID: 35976773 DOI: 10.1177/13596535221121225]

48 **Biadgo B**, Hassen A, Getaneh M, Tesfa H, Jaleta KN, Eshetu T, Kasew D, Melku M. Syphilis and human immunodeficiency virus infections among pregnant women attending antenatal care clinic of Gondar family guidance association, Northwest Ethiopia: implication for prevention of mother to child transmission. *Reprod Health* 2019; **16**: 27 [PMID: 30832694 DOI: 10.1186/s12978-019-0691-z]

49 **Billong SC**, Fokam J, Anoubissi JD, Kengne Nde C, Toukam Fodjo R, Ngo Nemb M, Moussa Y, Lienou Messeh A, Ndjolo A, Nfetam Elat JB; National HIV Drug Resistance Working Group. The declining trend of HIV-Infection among pregnant women in Cameroon infers an epidemic decline in the general population. *Heliyon* 2020; **6**: e04118 [PMID: 32566779 DOI: 10.1016/j.heliyon.2020.e04118]

50 **Billong SC**, Fokam J, Billong EJ, Nguefack-Tsague G, Essi MJ, Fodjo R, Sosso SM, Gomba A, Mosoko-Jembia J, Loni-Ekali G, Colizzi V, Bissek AC, Monebenimp F, Nfetam JB. [Epidemiological distribution of HIV infection among pregnant women in the ten regions of Cameroon and strategic implications for prevention programs]. *Pan Afr Med J* 2015; **20**: 79 [PMID: 26090037 DOI: 10.11604/pamj.2015.20.79.4216]

51 **Bruzzone B**, Bisio F, Ventura A, Nigro N, Miguel LM, Mayinda Mboungou FA, Nzagou AC, Mayembo P, Uberti F, De Maria A, Icardi G, Viscoli C. HIV serological screening in a population of pregnant women in the Republic of Congo: suitability of different assays. *Trop Med Int Health* 2008; **13**: 900-903 [PMID: 18482195 DOI: 10.1111/j.1365-3156.2008.02090.x]

52 **Buseri F**, Seiyaboh E, Jeremiah Z. Surveying Infections among Pregnant Women in the Niger Delta, Nigeria. *J Glob Infect Dis* 2010; **2**: 203-211 [PMID: 20927278 DOI: 10.4103/0974-777X.68525]

53 **Byamugisha R**, Tylleskär T, Kagawa MN, Onyango S, Karamagi CA, Tumwine JK. Dramatic and sustained increase in HIV-testing rates among antenatal attendees in Eastern Uganda after a policy change from voluntary counselling and testing to routine counselling and testing for HIV: a retrospective analysis of hospital records, 2002-2009. *BMC Health Serv Res* 2010; **10**: 290 [PMID: 20946632 DOI: 10.1186/1472-6963-10-290]

54 **Cartoux M**, Msellati P, Meda N, Welffens-Ekra C, Mandelbrot L, Leroy V, Van de Perre P, Dabis F. Attitude of pregnant women towards HIV testing in Abidjan, Côte d'Ivoire and Bobo-Dioulasso, Burkina Faso. DITRAME Study Group (ANRS 049 Clinical Trial). Diminution de la Transmission Mère Enfant du VIH. Agence Nationale de Recherches sur le SIDA. *AIDS* 1998; **12**: 2337-2344 [PMID: 9863877 DOI: 10.1097/00002030-199817000-00016]

55 **Chandisarewa W**, Stranix-Chibanda L, Chirapa E, Miller A, Simoyi M, Mahomva A, Maldonado Y, Shetty AK. Routine offer of antenatal HIV testing ("opt-out" approach) to prevent mother-to-child transmission of HIV in urban Zimbabwe. *Bull World Health Organ* 2007; **85**: 843-850 [PMID: 18038074 DOI: 10.2471/blt.06.035188]

56 **Changalucha J**, Grosskurth H, Mwita W, Todd J, Ross D, Mayaud P, Mahamoud A, Klokke A, Mosha F, Hayes R, Mabey D. Comparison of HIV prevalences in community-based and antenatal clinic surveys in rural Mwanza, Tanzania. *AIDS* 2002; **16**: 661-665 [PMID: 11873011 DOI: 10.1097/00002030-200203080-00019]

57 **Chetty V**, Moodley D, Chuturgoon A. Evaluation of a 4th generation rapid HIV test for earlier and reliable detection of HIV infection in pregnancy. *J Clin Virol* 2012; **54**: 180-184 [PMID: 22445263 DOI: 10.1016/j.jcv.2012.02.021]

58 **Chukwuali L,** Eke N, Bassey MS. Trends In The Prevalence Of Human Immunodeficiency Virus Among Pregnant Women In Keffi, North Central Nigeria. *Tropical journal of obstetrics and gynaecology* 2014; **31**: 16-2131 [DOI: 10.4314/tjog.v31i2]

59 **Cissé CAT**, Inzale MA, Wade NF, Niang MM, Diallo D, Ndiaye Seye N. Screening and management of HIV infection in pregnant women in Dakar. *Med Sante Trop* 2018; **28**: 186-192 [PMID: 29997078 DOI: 10.1684/mst.2018.0794]

60 **Collenberg E**, Ouedraogo T, Ganamé J, Fickenscher H, Kynast-Wolf G, Becher H, Kouyaté B, Kräusslich HG, Sangaré L, Tebit DM. Seroprevalence of six different viruses among pregnant women and blood donors in rural and urban Burkina Faso: A comparative analysis. *J Med Virol* 2006; **78**: 683-692 [PMID: 16555290 DOI: 10.1002/jmv.20593]

61 **Cossa HA**, Gloyd S, Vaz RG, Folgosa E, Simbine E, Diniz M, Kreiss JK. Syphilis and HIV infection among displaced pregnant women in rural Mozambique. *Int J STD AIDS* 1994; **5**: 117-123 [PMID: 8031913 DOI: 10.1177/095646249400500208]

62 **Crampin AC**, Jahn A, Kondowe M, Ngwira BM, Hemmings J, Glynn JR, Floyd S, Fine PE, Zaba B. Use of antenatal clinic surveillance to assess the effect of sexual behavior on HIV prevalence in young women in Karonga district, Malawi. *J Acquir Immune Defic Syndr* 2008; **48**: 196-202 [PMID: 18520678 DOI: 10.1097/QAI.0b013e31817236c4]

63 **Dao B**, Nacro B, Dahourou H, Meda N, Van De Perre P. [HIV infection and hepatitis B co-infection: survey of prevalence in pregnant women in Bobo Dioulasso, Burkina Faso]. *Rev Med Brux* 2001; **22**: 83-86 [PMID: 11388027]

64 **Datiko DG**, Yassin MA, Chekol LT, Kabeto LE, Lindtjørn B. The rate of TB-HIV co-infection depends on the prevalence of HIV infection in a community. *BMC Public Health* 2008; **8**: 266 [PMID: 18667068 DOI: 10.1186/1471-2458-8-266]

65 **de Beer S**, Kalk E, Kroon M, Boulle A, Osler M, Euvrard J, Timmerman V, Davies MA. A longitudinal analysis of the completeness of maternal HIV testing, including repeat testing in Cape Town, South Africa. *J Int AIDS Soc* 2020; **23**: e25441 [PMID: 31997583 DOI: 10.1002/jia2.25441]

66 **De Paschale M**, Ceriani C, Cerulli T, Cagnin D, Cavallari S, Ndayaké J, Zaongo D, Priuli G, Viganò P, Clerici P. Prevalence of HBV, HDV, HCV, and HIV infection during pregnancy in northern Benin. *J Med Virol* 2014; **86**: 1281-1287 [PMID: 24777580 DOI: 10.1002/jmv.23951]

67 **Delaporte E**, Janssens W, Peeters M, Buvé A, Dibanga G, Perret JL, Ditsambou V, Mba JR, Courbot MC, Georges A, Bourgeois A, Samb B, Henzel D, Heyndrickx L, Fransen K, van der Groen G, Larouzé B. Epidemiological and molecular characteristics of HIV infection in Gabon, 1986-1994. *AIDS* 1996; **10**: 903-910 [PMID: 8828748 DOI: 10.1097/00002030-199607000-00014]

68 **Deme C**, Edao B, Jaya G, Tisiano G, Fano H, Alegria I, Reyes F, Gorgolas M, Ramos JM. PREVALENCE OF HYPERTENSION, ANEMIA, ASYMPTOMATIC URINARY TRACT INFECTION, SYPHILIS, HIV AND HEPATITIS B VIRUS INFECTION AMONG PREGNANT WOMEN ATTENDING AN ANTENATAL CLINIC AT A RURAL HOSPITAL IN SOUTHERN ETHIOPIA. *Southeast Asian J Trop Med Public Health* 2016; **47**: 1032-1039 [PMID: 29620811]

69 **Desalegn Z**, Wassie L, Beyene HB, Mihret A, Ebstie YA. Hepatitis B and human immunodeficiency virus co-infection among pregnant women in resource-limited high endemic setting, Addis Ababa, Ethiopia: implications for prevention and control measures. *Eur J Med Res* 2016; **21**: 16 [PMID: 27075475 DOI: 10.1186/s40001-016-0211-3]

70 **Desgrées du Loû A**, Msellati P, Ramon R, Noba V, Viho I, Dabis F, Mandelbrot L, Welffens-Ekra C. HIV-1 infection and reproductive history: a retrospective study among pregnant women, Abidjan, Côte d'Ivoire, 1995-1996. Ditrame Project. *Int J STD AIDS* 1998; **9**: 452-456 [PMID: 9702593 DOI: 10.1258/0956462981922610]

71 **Diallo MO**, Ettiègne-Traoré V, Maran M, Kouadio J, Brattegaard K, Makke A, Van Dyck E, Laga M, De Cock KM. Sexually transmitted diseases and human immunodeficiency virus infections in women attending an antenatal clinic in Abidjan, Côte d'Ivoire. *Int J STD AIDS* 1997; **8**: 636-638 [PMID: 9310223 DOI: 10.1258/0956462971918904]

72 **Dionne-Odom J**, Mbah R, Rembert NJ, Tancho S, Halle-Ekane GE, Enah C, Welty TK, Tih PM, Tita AT. Hepatitis B, HIV, and Syphilis Seroprevalence in Pregnant Women and Blood Donors in Cameroon. *Infect Dis Obstet Gynecol* 2016; **2016**: 4359401 [PMID: 27578957 DOI: 10.1155/2016/4359401]

73 **Diouf A,** Kebe F, Faye EO, Diallo D, Ndour Sarr A, Mboup S, Diadhiou F. [HIV infection in pregnant women in Dakar (Senegal)]. J *Gynecol Obstet Biol Reprod (Paris)* 1996; **25**: 283-287 [PMID: 8767227]

74 **Dolmans WM**, van Loon AM, van den Akker R, Mulder DW, Shao JF, Mbena E, Mtey P. Prevalence of HIV-1 antibody among groups of patients and healthy subjects from a rural and urban population in the Mwanza region, Tanzania. *AIDS* 1989; **3**: 297-299 [PMID: 2504234 DOI: 10.1097/00002030-198905000-00008]

75 **Dunkle KL**, Jewkes RK, Brown HC, Gray GE, McIntryre JA, Harlow SD. Gender-based violence, relationship power, and risk of HIV infection in women attending antenatal clinics in South Africa. *Lancet* 2004; **363**: 1415-1421 [PMID: 15121402 DOI: 10.1016/S0140-6736(04)16098-4]

76 **Duru MU**, Aluyi HS, Anukam KC. Rapid screening for co-infection of HIV and HCV in pregnant women in Benin City, Edo State, Nigeria. *Afr Health Sci* 2009; **9**: 137-142 [PMID: 20589140]

77 **Egbe TO**, Tazinya RM, Halle-Ekane GE, Egbe EN, Achidi EA. Estimating HIV Incidence during Pregnancy and Knowledge of Prevention of Mother-to-Child Transmission with an Ad Hoc Analysis of Potential Cofactors. *J Pregnancy* 2016; **2016**: 7397695 [PMID: 27127653 DOI: 10.1155/2016/7397695]

78 **Egesie UG,** Mbooh T. Seroprevalence of human immunodeficiency virus (hiv) infection in pregnant women in amassoma, nigeria. *African Journal of Biomedical Research* 2008; **11** [DOI: 10.4314/ajbr.v11i1.50676]

79 **Ejeta E**, Dabsu R. Prevalence of Hepatitis C Virus and HIV Infection Among Pregnant Women Attending Antenatal Care Clinic in Western Ethiopia. *Front Med (Lausanne)* 2018; **5**: 366 [PMID: 30729110 DOI: 10.3389/fmed.2018.00366]

80 **Ekouevi DK**, Kariyiare BG, Coffie PA, Jutand MA, Akpadza K, Lawson-Evi A, Tatagan A, Dabis F, Sibe M, Pitche VP, Becquet R, David M. Feasibility and acceptability of rapid HIV screening in a labour ward in Togo. *J Int AIDS Soc* 2012; **15**: 17380 [PMID: 22905362 DOI: 10.7448/ias.15.2.17380]

81 **Ekouevi DK**, Leroy V, Viho A, Bequet L, Horo A, Rouet F, Sakarovitch C, Welffens-Ekra C, Dabis F; ANRS 1201/1202 Ditrame Plus Study Group. Acceptability and uptake of a package to prevent mother-to-child transmission using rapid HIV testing in Abidjan, Côte d'Ivoire. *AIDS* 2004; **18**: 697-700 [PMID: 15090779 DOI: 10.1097/00002030-200403050-00018]

82 **Elkheir SM**, Babiker ZO, Elamin SK, Yassin MI, Awadalla KE, Bealy MA, Agab Eldour AA, Alloba FE, Atabani SF, Osman HK, Babiker AG, Herieka EA. Seroprevalence of maternal HIV, hepatitis B, and syphilis in a major maternity hospital in North Kordofan, Sudan. *Int J STD AIDS* 2018; **29**: 1330-1336 [PMID: 30049254 DOI: 10.1177/0956462418784687]

83 **Endris M**, Deressa T, Belyhun Y, Moges F. Seroprevalence of syphilis and human immunodeficiency virus infections among pregnant women who attend the University of Gondar teaching hospital, Northwest Ethiopia: a cross sectional study. *BMC Infect Dis* 2015; **15**: 111 [PMID: 25887081 DOI: 10.1186/s12879-015-0848-5]

84 **Esu-Williams E**, Mulanga-Kabeya C, Takena H, Zwandor A, Aminu K, Adamu I, Yetunde O, Akinsete I, Patrel D, Peeters M, Delaporte E. Seroprevalence of HIV-1, HIV-2, and HIV-1 group O in Nigeria: evidence for a growing increase of HIV infection. *J Acquir Immune Defic Syndr Hum Retrovirol* 1997; **16**: 204-210 [PMID: 9390573 DOI: 10.1097/00042560-199711010-00010]

85 **Etukumana EA**, Thacher TD, Sagay AS. HIV prevalence in pregnant women attending a rural hospital in Nigeria. *Int J Gynaecol Obstet* 2008; **100**: 181-182 [PMID: 17904560 DOI: 10.1016/j.ijgo.2007.07.007]

86 **Ezeoru VC,** Enweani IB, Ochiabuto O, Nwachukwu AC, Ogbonna US, Obeagu EI. Prevalence of Malaria with Anaemia and HIV Status in Women of Reproductive Age in Onitsha, Nigeria. *Journal of Pharmaceutical Research International* 2021; **33**: 10-19 [DOI: 10.9734/JPRI/2021/v33i431166]

87 **Ezugwu EC**, Agu P, Ohayi SA, Okeke TC, Dim CC, Obi SN. HIV sero-prevalence among pregnant women in a resource constrained setting, South East Nigeria. *Niger J Med* 2012; **21**: 338-342 [PMID: 23304933]

88 **Fall-Malick FZ**, Bara AO, Lam M, Mint Beibacar M, Ba K, Ba H, Ould Ghady I, Ould Horma A, Toure-Kane NC, Mboup S, Lo B. [HIV sentinel surveillance of pregnant women in Mauritania from 2001 to 2007]. *Bull Soc Pathol Exot* 2010; **103**: 243-245 [PMID: 20213323 DOI: 10.1007/s13149-010-0042-3]

89 **Fielding-Miller R**, Dunkle KL, Hadley C, Cooper HL, Windle M. Agency as a mediator in the pathway from transactional sex to HIV among pregnant women in Swaziland: a multigroup path analysis. *J Int AIDS Soc* 2017; **20**: 21554 [PMID: 28692210 DOI: 10.7448/IAS.20.1.21554]

90 **Fonck K**, Kidula N, Kirui P, Ndinya-Achola J, Bwayo J, Claeys P, Temmerman M. Pattern of sexually transmitted diseases and risk factors among women attending an STD referral clinic in Nairobi, Kenya. *Sex Transm Dis* 2000; **27**: 417-423 [PMID: 10949433 DOI: 10.1097/00007435-200008000-00007]

91 **Frickmann H**, Schwarz NG, Girmann M, Hagen RM, Poppert S, Crusius S, Podbielski A, Heriniaina JN, Razafindrabe T, Rakotondrainiarivelo JP, May J, Rakotozandrindrainy R. Serological survey of HIV and syphilis in pregnant women in Madagascar. *Trop Med Int Health* 2013; **18**: 35-39 [PMID: 23094758 DOI: 10.1111/tmi.12007]

92 **Friis H**, Gomo E, Koestel P, Ndhlovu P, Nyazema N, Krarup H, Michaelsen KF. HIV and other predictors of serum beta-carotene and retinol in pregnancy: a cross-sectional study in Zimbabwe. *Am J Clin Nutr* 2001; **73**: 1058-1065 [PMID: 11382660 DOI: 10.1093/ajcn/73.6.1058]

93 **Galadanci HS**, Iliyasu Z, Tukur J, Muktar-Yola M, Adeleke SI. Uptake of voluntary counselling and testing for HIV by pregnant women in a prevention-of-mother-to-child-transmission programme at Aminu Kano Teaching Hospital, Nigeria. *Afr J AIDS Res* 2008; **7**: 143-148 [PMID: 25871279 DOI: 10.2989/AJAR.2008.7.1.14.442]

94 **Gamba EP**, Nambei WS, Kamandji L. [Integrated screening for HIV, syphilis, and toxoplasmosis among pregnant women in the Central African Republic]. *Med Sante Trop* 2013; **23**: 421-426 [PMID: 24334440 DOI: 10.1684/mst.2013.0256]

95 **Gassmelseed DE**, Nasr AM, Homeida SM, Elsheikh MA, Adam I. Prevalence of HIV infection among pregnant women of the central Sudan. *J Med Virol* 2006; **78**: 1269-1270 [PMID: 16927279 DOI: 10.1002/jmv.20694]

96 **Gay CL**, Mwapasa V, Murdoch DM, Kwiek JJ, Fiscus SA, Meshnick SR, Cohen MS. Acute HIV infection among pregnant women in Malawi. *Diagn Microbiol Infect Dis* 2010; **66**: 356-360 [PMID: 20226326 DOI: 10.1016/j.diagmicrobio.2009.12.001]

97 **Gianelli E**, Riva A, Rankin Bravo FA, Da Silva Te D, Mariani E, Casazza G, Scalamogna C, Bosisio O, Adorni F, Rusconi S, Galli M. Prevalence and risk determinants of HIV-1 and HIV-2 infections in pregnant women in Bissau. *J Infect* 2010; **61**: 391-398 [PMID: 20831880 DOI: 10.1016/j.jinf.2010.08.012]

98 **Gill MM**, Machekano R, Isavwa A, Ahimsibwe A, Oyebanji O, Akintade OL, Tiam A. The association between HIV status and antenatal care attendance among pregnant women in rural hospitals in Lesotho. *J Acquir Immune Defic Syndr* 2015; **68**: e33-e38 [PMID: 25501608 DOI: 10.1097/QAI.0000000000000481]

99 **Glynn JR**, Buvé A, Caraël M, Musonda RM, Kahindo M, Macauley I, Tembo F, Zekeng L; Study Group on Heterogeneity of HIV Epidemics in African Cities. Factors influencing the difference in HIV prevalence between antenatal clinic and general population in sub-Saharan Africa. *AIDS* 2001; **15**: 1717-1725 [PMID: 11546948 DOI: 10.1097/00002030-200109070-00016]

100 **Gray KJ**, Kafulafula G, Matemba 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 [PMID: 22000375 DOI: 10.3201/eid1710.102008]

101 **Green SD**, Cutting WA, Mokili JL, Nganzi M, Hargreaves FD, Davies AG, Bopopi JM, Elton RE, Hardy IR, Jackson DJ. Stable seroprevalence of HIV-1 in antenatal women in rural Bas-Zaïre, 1988-1993. *AIDS* 1994; **8**: 397-398 [PMID: 8031527 DOI: 10.1097/00002030-199403000-00024]

102 **Gregson S**, Moorhouse L, Dadirai T, Sheppard H, Mayini J, Beckmann N, Skovdal M, Dzangare J, Moyo B, Maswera R, Pinsky BA, Mharakurwa S, Francis I, Mugurungi O, Nyamukapa C. Comprehensive investigation of sources of misclassification errors in routine HIV testing in Zimbabwe. *J Int AIDS Soc* 2021; **24**: e25700 [PMID: 33882190 DOI: 10.1002/jia2.25700]

103 **Gumede-Moyo S**, Todd J, Schaap A, Mee P, Filteau S. Increasing Proportion of HIV-Infected Pregnant Zambian Women Attending Antenatal Care Are Already on Antiretroviral Therapy (2010-2015). *Front Public Health* 2019; **7**: 155 [PMID: 31249826 DOI: 10.3389/fpubh.2019.00155]

104 **Hamda SG**, Tshikuka JG, Joel D, Monamodi G, Masupe T, Setlhare V. Sociodemographic Predictors of HIV Infection among Pregnant Women in Botswana: Cross-Sectional Study at 7 Health Facilities. *J Int Assoc Provid AIDS Care* 2020; **19**: 2325958220925659 [PMID: 32618484 DOI: 10.1177/2325958220925659]

105 **Handema R**, Terunuma H, Kasolo F, Kasai H, Sichone M, Mulundu G, Deng X, Ichiyama K, Mitarai S, Honda M, Yamamoto N, Ito M. Emergence of new HIV-1 subtypes other than Subtype C among antenatal women in Lusaka, Zambia. *AIDS Res Hum Retroviruses* 2001; **17**: 759-763 [PMID: 11429116 DOI: 10.1089/088922201750237031]

106 **Harry TO**, Bukbuk DN, Idrisa A, Akoma MB. HIV infection among pregnant women. A worsening situation in Maiduguri, Nigeria. *Trop Geogr Med* 1994; **46**: 46-47 [PMID: 8165740]

107 **Harry TO**, Ekenna O, Chikwem JO, Mohammed I, Sakwa M, Adeyera SA, Zacchariah R, Moses AE, Ola TO, Williams EE. Seroepidemiology of human immunodeficiency virus infection in Borno State of Nigeria by sentinel surveillance. *J Acquir Immune Defic Syndr (1988)* 1993; **6**: 99-103 [PMID: 8417183]

108 **Harry TO**, Kyari O, Mohammed I. Prevalence of human immunodeficiency virus-infection among pregnant women attending ante-natal clinic in Maiduguri, north-eastern Nigeria. *Trop Geogr Med* 1992; **44**: 238-241 [PMID: 1455529]

109 **Haukenes G**, Shao J, Mhalu F, Nome S, Sam NE. The AIDS epidemic in Tanzania: rate of spread of HIV in blood donors and pregnant women in Dar es Salaam. *Scand J Infect Dis* 1992; **24**: 701-706 [PMID: 1287803 DOI: 10.3109/00365549209062454]

110 **Heemelaar S**, Habets N, Makukula Z, van Roosmalen J, van den Akker T. Repeat HIV testing during pregnancy and delivery: missed opportunities in a rural district hospital in Zambia. *Trop Med Int Health* 2015; **20**: 277-283 [PMID: 25418130 DOI: 10.1111/tmi.12432]

111 **Helegbe GK**, Aryee PA, Mohammed BS, Wemakor A, Kolbila D, Abubakari AW, Askanda S, Alhassan R, Barnie C, Donkoh AA, Ofosu E. Seroprevalence of Malaria and Hepatitis B Coinfection among Pregnant Women in Tamale Metropolis of Ghana: A Cross-Sectional Study. *Can J Infect Dis Med Microbiol* 2018; **2018**: 5610981 [PMID: 30344800 DOI: 10.1155/2018/5610981]

112 **Hinderaker SG**, Krüger C, Olsen BE, Naman N, Bergsjø P, Olsen OH. Low HIV-seroprevalence in pregnant women in a rural area in Tanzania. *Acta Obstet Gynecol Scand* 2001; **80**: 1152-1153 [PMID: 11846719 DOI: 10.1034/j.1600-0412.2001.801218.x]

113 **Hokororo A**, Kihunrwa A, Hoekstra P, Kalluvya SE, Changalucha JM, Fitzgerald DW, Downs JA. High prevalence of sexually transmitted infections in pregnant adolescent girls in Tanzania: a multi-community cross-sectional study. *Sex Transm Infect* 2015; **91**: 473-478 [PMID: 25834122 DOI: 10.1136/sextrans-2014-051952]

114 **Holmes C**, Preko P, Bolds R, Baidoo J, Jolly P. Acceptance of Voluntary Counselling, Testing and Treatment for HIV Among Pregnant Women in Kumasi, Ghana. *Ghana Med J* 2008; **42**: 8-15 [PMID: 18560557]

115 **Hoque M**, Hoque ME, van Hal G, Buckus S. Prevalence, incidence and seroconversion of HIV and Syphilis infections among pregnant women of South Africa. *S Afr J Infect Dis* 2021; **36**: 296 [PMID: 34917677 DOI: 10.4102/sajid.v36i1.296]

116 **Ibrahim IA**, Owoeye GI, Obilahi A. The burden of HIV infection among women attending antenatal clinic in a semi-urban Nigerian town. *West Indian Med J* 2013; **62**: 323-328 [PMID: 24756593 DOI: 10.7727/wimj.2012.228]

117 **Ikeako L**, Ezegwui H, Ajah L, Dim C, Okeke T. Seroprevalence of Human Immunodeficiency Virus, Hepatitis B, Hepatitis C, Syphilis and Co-infections among Antenatal Women in a Tertiary Institution in South-East Nigeria. *Ann Med Health Sci Res* 2014; **4**: S259-S263 [PMID: 25364599 DOI: 10.4103/2141-9248.141969]

118 **Ilboudo D,** Sawadogo A, Simpore J. Hepatitis C and HIV co-infection in pregnant women, Ouagadougou (Burkina Faso). *Medecine et maladies infectieuses* 2003; **33:** 278-279 [DOI: 10.1016/S0399-077X(02)00004-5]

119 **Imade GE**, Musa J, Sagay AS, Kapiga SH, Sankale JL, Idoko J, Kanki P. Association of Bacterial vaginosis and other Sexually Transmitted Infections with HIV among pregnant women in Nigeria. *Afr J Med Med Sci* 2014; **43**: 23-28 [PMID: 26681823]

120 **Imade GE**, Sagay AS, Musa J, Ocheke AN, Adeniyi DS, Idighri M, Powl R, Sendeht A, Ogwuche JP, Elujoba M, Egbodo CO, Oyebode T, Daru PH, Agbaji O, Pam IC, Meloni ST, Okonkwo P, Kanki PJ. Declining rate of infection with maternal human immunodeficiency virus at delivery units in north-central Nigeria. *Afr J Reprod Health* 2013; **17**: 138-145 [PMID: 24689325]

121 **Isara A**, Baldeh AK. Prevalence of sexually transmitted infections among pregnant women attending antenatal clinics in West Coast Region of The Gambia. *Afr Health Sci* 2021; **21**: 585-592 [PMID: 34795711 DOI: 10.4314/ahs.v21i2.13]

122 **Jackson DJ**, Ngugi EN, Plummer FA, Kirui P, Kariuki C, Ndinya-Achola JO, Bwayo JJ, Moses S. Stable antenatal HIV-1 seroprevalence with high population mobility and marked seroprevalence variation among sentinel sites within Nairobi, Kenya. *AIDS* 1999; **13**: 583-589 [PMID: 10203383 DOI: 10.1097/00002030-199904010-00007]

123 **Jervasea AC**. HIV Prevalence in South Sudan: Data from the ANC Sentinel Surveillance 2009. *South Sudan med j* 2010; **4**: 49-56

124 **Jimoh AA.** Prevalence of HIV antibodies amongst apparently healthy pregnant women in Mongomo, Guinea Equatoria. *Niger J Med* 2004; **13**: 114-117 [PMID: 15293827]

125 **Kania D**, Fao P, Valéa D, Gouem C, Kagoné T, Hien H, Somda P, Ouédraogo P, Drabo A, Gampini S, Méda N, Diagbouga S, Van de Perre P, Rouet F; WHO/ANRS 1289 Kesho Bora Study Group in Burkina Faso. Low prevalence rate of indeterminate serological human immunodeficiency virus results among pregnant women from Burkina Faso, West Africa. *J Clin Microbiol* 2010; **48**: 1333-1336 [PMID: 20129958 DOI: 10.1128/JCM.01734-09]

126 **Kasaro MP**, Bosomprah S, Taylor MM, Sindano N, Phiri C, Tambatamba B, Malumo S, Freeman B, Chibwe B, Laverty M, Owiredu MN, Newman L, Sikazwe I. Field performance evaluation of dual rapid HIV and syphilis tests in three antenatal care clinics in Zambia. *Int J STD AIDS* 2019; **30**: 323-328 [PMID: 30472926 DOI: 10.1177/0956462418800872]

127 **Kayibanda JF**, Alary M, Bitera R, Kabeja A, Hinda R, Munyakazi L, Chitou B, Gatarayiha JP. HIV Prevalence Comparison Between Antenatal Sentinel Surveillance and Demographic and Health Survey in Rwanda. *Open AIDS J* 2011; **5**: 29-36 [PMID: 21643421 DOI: 10.2174/1874613601105010029]

128 **Françoise Kayibanda J**, Alary M, Bitera R, Mutagoma M, Kabeja A, Hinda R, Asiimwe A. Use of routine data collected by the prevention of mother-to-child transmission program for HIV surveillance among pregnant women in Rwanda: opportunities and limitations. *AIDS Care* 2011; **23**: 1570-1577 [PMID: 21732899 DOI: 10.1080/09540121.2011.579941]

129 **Keating MA**, Hamela G, Miller WC, Moses A, Hoffman IF, Hosseinipour MC. High HIV incidence and sexual behavior change among pregnant women in Lilongwe, Malawi: implications for the risk of HIV acquisition. *PLoS One* 2012; **7**: e39109 [PMID: 22768063 DOI: 10.1371/journal.pone.0039109]

130 **Keogh SC**, Urassa M, Kumogola Y, Mngara J, Zaba B. Reproductive behaviour and HIV status of antenatal clients in northern Tanzania: opportunities for family planning and preventing mother-to-child transmission integration. *AIDS* 2009; **23 Suppl 1**: S27-S35 [PMID: 20081386 DOI: 10.1097/01.aids.0000363775.68505.f1]

131 **Mbopi Kéou FX**, Mbu R, Mauclère P, Andela A, Tetanye E, Léké R, Chaouat G, Barré-Sinoussi F, Martin P, Bélec L. Antenatal HIV prevalence in Yaounde, Cameroon. *Int J STD AIDS* 1998; **9**: 400-402 [PMID: 9696195 DOI: 10.1258/0956462981922485]

132 **Kharsany AB**, Frohlich JA, Yende-Zuma N, Mahlase G, Samsunder N, Dellar RC, Zuma-Mkhonza M, Abdool Karim SS, Abdool Karim Q. Trends in HIV Prevalence in Pregnant Women in Rural South Africa. *J Acquir Immune Defic Syndr* 2015; **70**: 289-295 [PMID: 26186507 DOI: 10.1097/QAI.0000000000000761]

133 **Kharsany AB**, Hancock N, Frohlich JA, Humphries HR, Abdool Karim SS, Abdool Karim Q. Screening for 'window-period' acute HIV infection among pregnant women in rural South Africa. *HIV Med* 2010; **11**: 661-665 [PMID: 20497252 DOI: 10.1111/j.1468-1293.2010.00838.x]

134 **Kiarie J**, Nduati R, Koigi K, Musia J, John G. HIV-1 testing in pregnancy: acceptability and correlates of return for test results. *AIDS* 2000; **14**: 1468-1470 [PMID: 10930172 DOI: 10.1097/00002030-200007070-00030]

135 **Kidan KG**, Fantahun M, Azeze B. Seroprevalence of human immunodeficiency virus infection and its association with syphilis seropositivity among antenatal clinic attenders at Debretabor Rural Hospital, Ethiopia. *East Afr Med J* 1995; **72**: 579-583 [PMID: 7498045]

136 **Kigadye RM**, Klokke A, Nicoll A, Nyamuryekung'e KM, Borgdorff M, Barongo L, Laukamm-Josten U, Lisekie F, Grosskurth H, Kigadye F. Sentinel surveillance for HIV-1 among pregnant women in a developing country: 3 years' experience and comparison with a population serosurvey. *AIDS* 1993; **7**: 849-855 [PMID: 8363761 DOI: 10.1097/00002030-199306000-00014]

137 **Kilian AH**, Gregson S, Ndyanabangi B, Walusaga K, Kipp W, Sahlmüller G, Garnett GP, Asiimwe-Okiror G, Kabagambe G, Weis P, von Sonnenburg F. Reductions in risk behaviour provide the most consistent explanation for declining HIV-1 prevalence in Uganda. *AIDS* 1999; **13**: 391-398 [PMID: 10199230 DOI: 10.1097/00002030-199902250-00012]

138 **Kinoshita-Moleka R**, Smith JS, Atibu J, Tshefu A, Hemingway-Foday J, Hobbs M, Bartz J, Koch MA, Rimoin AW, Ryder RW. Low prevalence of HIV and other selected sexually transmitted infections in 2004 in pregnant women from Kinshasa, the Democratic Republic of the Congo. *Epidemiol Infect* 2008; **136**: 1290-1296 [PMID: 18028581 DOI: 10.1017/S0950268807009818]

139 **Kipp W**, Chapman E, Jhangri GS, Veugelers P, Kilian A, Rubaale T, Kabagambe G. Fourteen years of surveillance of HIV-1 prevalence among pregnant women attending antenatal care clinics in western Uganda. *Int J STD AIDS* 2009; **20**: 499-502 [PMID: 19541894 DOI: 10.1258/ijsa.2008.008404]

140 **Kiptoo M**, Mpoke S, Ng'ang'a Z, Mueke J, Okoth F, Songok E. Survey on prevalence and risk factors on HIV-1 among pregnant women in North-Rift, Kenya: a hospital based cross-sectional study conducted between 2005 and 2006. *BMC Int Health Hum Rights* 2009; **9**: 10 [PMID: 19405971 DOI: 10.1186/1472-698X-9-10]

141 **Koblavi-Dème S**, Maurice C, Yavo D, Sibailly TS, N'guessan K, Kamelan-Tano Y, Wiktor SZ, Roels TH, Chorba T, Nkengasong JN. Sensitivity and specificity of human immunodeficiency virus rapid serologic assays and testing algorithms in an antenatal clinic in Abidjan, Ivory Coast. *J Clin Microbiol* 2001; **39**: 1808-1812 [PMID: 11325995 DOI: 10.1128/JCM.39.5.1808-1812.2001]

142 **Kolawole OM**, Amuda OO, Nzurumike C, Suleiman MM, Ikhevha Ogah J. Seroprevalence and Co-Infection of Human Immunodeficiency Virus (HIV) and Herpes Simplex Virus (HSV) Among Pregnant Women in Lokoja, North-Central Nigeria. *Iran Red Crescent Med J* 2016; **18**: e25284 [PMID: 28180012 DOI: 10.5812/ircmj.25284]

143 **Kuate S**, Mikolajczyk RT, Forgwei GW, Tih PM, Welty TK, Kretzschmar M. Time trends and regional differences in the prevalence of HIV infection among women attending antenatal clinics in 2 provinces in Cameroon. *J Acquir Immune Defic Syndr* 2009; **52**: 258-264 [PMID: 19546813 DOI: 10.1097/QAI.0b013e3181ab6d2e]

144 **Kwiek JJ**, Mwapasa V, Alker AP, Muula AS, Misiri HE, Molyneux ME, Rogerson SJ, Behets FM, Meshnick SR. Socio-demographic characteristics associated with HIV and syphilis seroreactivity among pregnant women in Blantyre, Malawi, 2000-2004. *Malawi Med J* 2008; **20**: 80-85 [PMID: 19537404 DOI: 10.4314/mmj.v20i3.10965]

145 **Laktabai J**, Mobley VL, Prudhomme-O'Meara W, Taylor SM. Associations between Antenatal Syphilis Test Results and Adverse Pregnancy Outcomes in Western Kenya. *Am J Trop Med Hyg* 2022; **107**: 401-406 [PMID: 35895406 DOI: 10.4269/ajtmh.22-0083]

146 **Lallemant M**, Lallemant-Le Coeur S, Cheynier D, Nzingoula S, Jourdain G, Sinet M, Dazza MC, Larouzé B. Characteristics associated with HIV-1 infection in pregnant women in Brazzaville, Congo. *J Acquir Immune Defic Syndr (1988)* 1992; **5**: 279-285 [PMID: 1740754]

147 **Lawi JD**, Mirambo MM, Magoma M, Mushi MF, Jaka HM, Gumodoka B, Mshana SE. Sero-conversion rate of Syphilis and HIV among pregnant women attending antenatal clinic in Tanzania: a need for re-screening at delivery. *BMC Pregnancy Childbirth* 2015; **15**: 3 [PMID: 25613487 DOI: 10.1186/s12884-015-0434-2]

148 **Leroy V**, Ladner J, Nyiraziraje M, De Clercq A, Bazubagira A, Van de Perre P, Karita E, Dabis F. Effect of HIV-1 infection on pregnancy outcome in women in Kigali, Rwanda, 1992-1994. Pregnancy and HIV Study Group. *AIDS* 1998; **12**: 643-650 [PMID: 9583605 DOI: 10.1097/00002030-199806000-00014]

149 **Leroy V**, Ntawiniga P, Nziyumvira A, Kagubare J, Salamon R. HIV prevalence among pregnant women in Kigali, Rwanda. *Lancet* 1995; **346**: 1488-1489 [PMID: 7491008 DOI: 10.1016/s0140-6736(95)92504-x]

150 **Liotta G**, Chimbwandira F, Wouters K, Nielsen-Saines K, Jere H, Mancinelli S, Ceffa S, Erba F, Palombi L, Marazzi MC. Impact of Extended Combination Antiretroviral Therapy on the Decline of HIV Prevalence in Pregnant Women in Malawi. *J Int Assoc Provid AIDS Care* 2016; **15**: 172-177 [PMID: 26512040 DOI: 10.1177/2325957415614643]

151 **Lodiongo DK**, K Bior B, W Dumo G, S Katoro J, Mogga JJH, Lokore ML, G Abias A, Y Carter J, L Deng L. Field evaluation of SD BIOLINE HIV/Syphilis Duo assay among pregnant women attending routine antenatal care in Juba, South Sudan. *PLoS One* 2018; **13**: e0205383 [PMID: 30304043 DOI: 10.1371/journal.pone.0205383]

152 **Mabunda SA**, Sigovana K, Chitha W, Apalata T, Nomatshila S. Socio-demographic associations of HIV among women attending antenatal care in selected rural primary care facilities in South Africa's Eastern Cape province. *BMC Infect Dis* 2021; **21**: 61 [PMID: 33435863 DOI: 10.1186/s12879-020-05744-7]

153 **Magazani K**, Laleman G, Perriëns JH, Kizonde K, Mukendi K, Mpungu M, Badibanga N, Piot P. Low and stable HIV seroprevalence in pregnant women in Shaba province, Zaire. *J Acquir Immune Defic Syndr (1988)* 1993; **6**: 419-423 [PMID: 8455147]

154 **Mahomed K**, Kasule J, Makuyana D, Moyo S, Mbidzo M, Tswana S. Seroprevalence of HIV infection amongst antenatal women in greater Harare, Zimbabwe. *Cent Afr J Med* 1991; **37**: 322-325 [PMID: 1813126]

155 **Makuwa M**, Taty E, Beuzit Y, Loemba H, Miehakanda J. [Retrospective study of infection by the human immunodeficiency virus in pregnant women. Future of the child and the mother]. *Med Trop (Mars)* 1992; **52**: 125-129 [PMID: 1406211]

156 **Mamadou S**, Ide M, Maazou AR, Aoula B, Labo S, Bozari M. HIV infection and hepatitis B seroprevalence among antenatal clinic attendees in Niger, West Africa. *HIV AIDS (Auckl)* 2012; **4**: 1-4 [PMID: 22347805 DOI: 10.2147/HIV.S27881]

157 **Mandala J**, Kasonde P, Badru T, Dirks R, Torpey K. HIV Retesting of HIV-Negative Pregnant Women in the Context of Prevention of Mother-to-Child Transmission of HIV in Primary Health Centers in Rural Zambia: What Did We Learn? *J Int Assoc Provid AIDS Care* 2019; **18**: 2325958218823530 [PMID: 30798664 DOI: 10.1177/2325958218823530]

158 **Manyahi J**, Jullu BS, Abuya MI, Juma J, Ndayongeje J, Kilama B, Sambu V, Nondi J, Rabiel B, Somi G, Matee MI. Prevalence of HIV and syphilis infections among pregnant women attending antenatal clinics in Tanzania, 2011. *BMC Public Health* 2015; **15**: 501 [PMID: 25994129 DOI: 10.1186/s12889-015-1848-5]

159 **Manyahi J**, Msigwa Y, Mhimbira F, Majigo M. High sero-prevalence of hepatitis B virus and human immunodeficiency virus infections among pregnant women attending antenatal clinic at Temeke municipal health facilities, Dar es Salaam, Tanzania: a cross sectional study. *BMC Pregnancy Childbirth* 2017; **17**: 109 [PMID: 28388879 DOI: 10.1186/s12884-017-1299-3]

160 **Martin-Herz SP**, Shetty AK, Bassett MT, Ley C, Mhazo M, Moyo S, Herz AM, Katzenstein D. Perceived risks and benefits of HIV testing, and predictors of acceptance of HIV counselling and testing among pregnant women in Zimbabwe. *Int J STD AIDS* 2006; **17**: 835-841 [PMID: 17212862 DOI: 10.1258/095646206779307630]

161 **Mashamba-Thompson TP,** Moodley P, Sartorius B, Drain PK. Evaluation of antenatal rapid human immunodeficiency virus testing in rural South Africa. *Southern African Journal of HIV Medicine* 2018; **19** [DOI: 10.4102/sajhivmed.v19i1.771]

162 **Matambo JA**, Moodley D, Moodley J. HIV seroprevalence and rapid testing in unbooked pregnant African women. *Int J Gynaecol Obstet* 1999; **66**: 289-290 [PMID: 10580679 DOI: 10.1016/s0020-7292(99)00087-9]

163 **Mathe MK**, Rigo J, Sontag D, Gerard C. [Prevalence of HIV infection among pregnant women. A study in rural Africa]. *Rev Epidemiol Sante Publique* 2008; **56**: 407-413 [PMID: 19019602 DOI: 10.1016/j.respe.2008.08.005]

164 **Mayaphi SH**, Martin DJ, Quinn TC, Stoltz AC. Field performance of the INSTI HIV-1/-2 antibody test in two South African antenatal clinics. *J Med Virol* 2019; **91**: 1355-1359 [PMID: 30840772 DOI: 10.1002/jmv.25447]

165 **Mbachu II**, Udigwe G, Joseph I, John O, Samuel UO, Joseph U, Ngozi MC. The evaluation of accuracy of serial rapid HIV test algorithm in the diagnosis of HIV antibodies among pregnant women in south east Nigeria. *BMC Res Notes* 2015; **8**: 557 [PMID: 26459010 DOI: 10.1186/s13104-015-1454-8]

166 **Mbizvo MT**, Mashu A, Chipato T, Makura E, Bopoto R, Fottrell PF. Trends in HIV-1 and HIV-2 prevalence and risk factors in pregnant women in Harare, Zimbabwe. *Cent Afr J Med* 1996; **42**: 14-21 [PMID: 8868380]

167 **Meda N**, Mandelbrot L, Cartoux M, Dao B, Ouangré A, Dabis F. Anaemia during pregnancy in Burkina Faso, west Africa, 1995-96: prevalence and associated factors. DITRAME Study Group. *Bull World Health Organ* 1999; **77**: 916-922 [PMID: 10612887]

168 **Meda N**, Zoundi-Guigui MT, van de Perre P, Alary M, Ouangré A, Cartoux M, Mandelbrot L, Viens P, Dabis F. HIV infection among pregnant women in Bobo-Dioulasso, Burkina Faso: comparison of voluntary and blinded seroprevalence estimates. *Int J STD AIDS* 1999; **10**: 738-740 [PMID: 10563562 DOI: 10.1258/0956462991913277]

169 **Melku M**, Kebede A, Addis Z. Magnitude of HIV and syphilis seroprevalence among pregnant women in Gondar, Northwest Ethiopia: a cross-sectional study. *HIV AIDS (Auckl)* 2015; **7**: 175-182 [PMID: 26082663 DOI: 10.2147/HIV.S81481]

170 **Metaferia Y**, Dessie W, Ali I, Amsalu A. Seroprevalence and associated risk factors of hepatitis B virus among pregnant women in southern Ethiopia: a hospital-based cross-sectional study. *Epidemiol Health* 2016; **38**: e2016027 [PMID: 27336446 DOI: 10.4178/epih.e2016027]

171 **Mhalu F**, Bredberg-Rådén U, Mbena E, Pallangyo K, Kiango J, Mbise R, Nyamuryekunge K, Biberfeld G. Prevalence of HIV infection in healthy subjects and groups of patients in Tanzania. *AIDS* 1987; **1**: 217-221 [PMID: 3126768]

172 **Miotti PG**, Dallabetta G, Ndovi E, Liomba G, Saah AJ, Chiphangwi J. HIV-1 and pregnant women: associated factors, prevalence, estimate of incidence and role in fetal wastage in central Africa. *AIDS* 1990; **4**: 733-736 [PMID: 2261131]

173 **Pegha Moukandja I**, Ngoungou EB, Lemamy GJ, Bisvigou U, Gessain A, Toure Ndouo FS, Kazanji M, Lekana-Douki JB. Non-malarial infectious diseases of antenatal care in pregnant women in Franceville, Gabon. *BMC Pregnancy Childbirth* 2017; **17**: 185 [PMID: 28606185 DOI: 10.1186/s12884-017-1362-0]

174 **Mphatswe W**, Maise H, Sebitloane M. Prevalence of repeat pregnancies and associated factors among teenagers in KwaZulu-Natal, South Africa. *Int J Gynaecol Obstet* 2016; **133**: 152-155 [PMID: 26948340 DOI: 10.1016/j.ijgo.2015.09.028]

175 **Msamanga G**, Fawzi W, Hertzmark E, McGrath N, Kapiga S, Kagoma C, Spiegelman D, Hunter D. Socio-economic and demographic factors associated with prevalence of HIV infection among pregnant women in Dar es Salaam, Tanzania. *East Afr Med J* 2006; **83**: 311-321 [PMID: 16989376 DOI: 10.4314/eamj.v83i6.9438]

176 **Mseleku M**, Smith TH, Guidozzi F. HIV seropositive in pregnant South African women who initially refuse routine antenatal HIV screening. *BJOG* 2005; **112**: 370-371 [PMID: 15713157 DOI: 10.1111/j.1471-0528.2004.00424.x]

177 **Msellati P**, Hingst G, Kaba F, Viho I, Welffens-Ekra C, Dabis F. Operational issues in preventing mother-to-child transmission of HIV-1 in Abidjan, Côte d'Ivoire, 1998-99. *Bull World Health Organ* 2001; **79**: 641-647 [PMID: 11477967]

178 **Msellati P**, Sakarovitch C, Bequet L, Atta H, Alioum A, Viho I, Timothée O, Leroy V, Welffens-Ekra C, Dabis F; ANRS Ditrame Study Group; Ditrame Plus Study Group. Decrease of human immunodeficiency virus prevalence in antenatal clinics in Abidjan, Côte d'Ivoire, 1995-2002. *Int J STD AIDS* 2006; **17**: 57-60 [PMID: 16409681 DOI: 10.1258/095646206775220559]

179 **Msuya SE**, Mbizvo E, Hussain A, Uriyo J, Sam NE, Stray-Pedersen B. HIV among pregnant women in Moshi Tanzania: the role of sexual behavior, male partner characteristics and sexually transmitted infections. *AIDS Res Ther* 2006; **3**: 27 [PMID: 17044932 DOI: 10.1186/1742-6405-3-27]

180 **Mulanga-Kabeya C**, Nzilambi N, Edidi B, Minlangu M, Tshimpaka T, Kambembo L, Atibu L, Mama N, Ilunga W, Sema H, Tshimanga K, Bongo B, Peeters M, Delaporte E. Evidence of stable HIV seroprevalences in selected populations in the Democratic Republic of the Congo. *AIDS* 1998; **12**: 905-910 [PMID: 9631144 DOI: 10.1097/00002030-199808000-00013]

181 **Mulu A**, Kassu A, Tessema B, Yismaw G, Tiruneh M, Moges F, Wondmikun Y, Nishikawa T, Ota F. Seroprevalence of syphilis and HIV-1 during pregnancy in a teaching hospital in northwest Ethiopia. *Jpn J Infect Dis* 2007; **60**: 193-195 [PMID: 17642529]

182 **Munjoma MW**, Mapingure MP, Stray-Pedersen B. Risk factors for herpes simplex virus type 2 and its association with HIV among pregnant teenagers in Zimbabwe. *Sex Health* 2010; **7**: 87-89 [PMID: 20152103 DOI: 10.1071/SH09106]

183 **Muzyka BC**, Kamwendo L, Mbweza E, Lopez NB, Glick M, Matheson PB, Kershbaumer R, Nyrienda T, Malamud D, Constantine NT, Thompson J, Nyasulu Y, Saville R, Berthold P. Prevalence of HIV-1 and oral lesions in pregnant women in rural Malawi. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 2001; **92**: 56-61 [PMID: 11458246 DOI: 10.1067/moe.2001.112542]

184 **Mwandagalirwa K**, Jackson EF, McClamroch K, Bollinger R, Ryder RW, Weir SS. Local differences in human immunodeficiency virus prevalence: a comparison of social venue patrons, antenatal patients, and sexually transmitted infection patients in eastern kinshasa. *Sex Transm Dis* 2009; **36**: 406-412 [PMID: 19525891 DOI: 10.1097/OLQ.0b013e3181a2a80e]

185 **Mwembo-Tambwe AN**, Kalenga MK, Donnen P, Humblet P, Chenge M, Dramaix M, Buekens P. [HIV testing among women in delivery rooms in Lubumbashi, Democratic Republic of the Congo: a catch-up strategy for prevention of mother-to-child transmission]. *Rev Epidemiol Sante Publique* 2013; **61**: 21-27 [PMID: 23337841 DOI: 10.1016/j.respe.2012.05.008]

186 **Ndege S**, Washington S, Kaaria A, Prudhomme-O'Meara W, Were E, Nyambura M, Keter AK, Wachira J, Braitstein P. HIV Prevalence and Antenatal Care Attendance among Pregnant Women in a Large Home-Based HIV Counseling and Testing Program in Western Kenya. *PLoS One* 2016; **11**: e0144618 [PMID: 26784957 DOI: 10.1371/journal.pone.0144618]

187 **Ndumbe PM**, Skalsky J, Joller-Jemelka HI. Seroprevalence of hepatitis and HIV infection among rural pregnant women in Cameroon. *APMIS* 1994; **102**: 662-666 [PMID: 7524547 DOI: 10.1111/j.1699-0463.1994.tb05217.x]

188 **Ngounouh C,** Nguwoh P, Pouanse Bazu A, Ewoele E, Egoume L, Wouambo R, Assam Assam J, Okomo AssoumouM, Moyou R, Fokam J. Infection of Pregnant Women with Human Immunodeficiency Virus, Hepatitis B Virus and Associated Risk Factors in Semi-rural Health District, Cameroon. *Journal of Gynecology and Women Healthcare* 2020; **2:** 209

189 **Ng'wamkai G**, Msigwa KV, Chengula D, Mgaya F, Chuma C, Msemwa B, Silago V, Majigo M, Mshana SE, Mirambo MM. Treponema pallidum infection predicts sexually transmitted viral infections (hepatitis B virus, herpes simplex virus-2, and human immunodeficiency virus) among pregnant women from rural areas of Mwanza region, Tanzania. *BMC Pregnancy Childbirth* 2019; **19**: 392 [PMID: 31664945 DOI: 10.1186/s12884-019-2567-1]

190 **Niama RF**, Loukabou Bongolo NC, Bayonne Kombo ES, Yengo R, Mayengue PI, Mandingha Kosso EB, Louzolo I, Macosso L, Dzeret G, Dzabatou Babeaux ASP, Puruehnce MF, Parra HJ. Syphilis and HIV infections among pregnant women attending antenatal clinics in Republic of Congo. *Pan Afr Med J* 2017; **28**: 8 [PMID: 29138654 DOI: 10.11604/pamj.2017.28.8.13097]

191 **Nnatu SN**, Anyiwo CE, Obi CL, Karpas A. Prevalence of human immunodeficiency virus (HIV) antibody among apparently healthy pregnant women in Nigeria. *Int J Gynaecol Obstet* 1993; **40**: 105-107 [PMID: 8094677 DOI: 10.1016/0020-7292(93)90367-6]

192 **Nyawanda BO**, Otieno NA, Otieno MO, Emukule GO, Bigogo G, Onyango CO, Lidechi S, Nyaundi J, Langley GE, Widdowson MA, Chaves SS. The Impact of Maternal Human Immunodeficiency Virus Infection on the Burden of Respiratory Syncytial Virus Among Pregnant Women and Their Infants, Western Kenya. *J Infect Dis* 2022; **225**: 2097-2105 [PMID: 32777041 DOI: 10.1093/infdis/jiaa490]

193 **Obi CL**, McAdoo HP, Murray M, Tswana SA, Moyo SR. HIV infection and HIV-1 clades among pregnant women in Harare, Zimbabwe. *Cent Afr J Med* 1997; **43**: 188-192 [PMID: 9431751]

194 **Obi CL**, McAdoo HP, Onigbinde AO, Murray M, Tswana SA, Moyo SR. Subtypes of HIV-1 and the impact of dual infections of HIV-1 and measles virus on micronutrient levels of pregnant women in Harare, Zimbabwe. *Cent Afr J Med* 1997; **43**: 165-172 [PMID: 9431744]

195 **Obi RK,** Iroagba II, Ojiako OA. Prevalence of human immunodeficiency virus (HIV) infection among pregnant women in an antenatal clinic in Port-Harcourt, Nigeria. *African Journal of Biotechnology* 2007; [DOI: 10.4314/AJB.V6I3.56175]

196 **Obisesan KA**, Olaleye OD, Adeyemo AA. The increasing prevalence of HIV-1 and HIV-2 infections in a low risk antenatal population in south west Nigeria. *Int J Gynaecol Obstet* 1997; **56**: 271-273 [PMID: 9127161 DOI: 10.1016/s0020-7292(96)02821-4]

197 **Odehouri K**, De Cock KM, Krebs JW, Moreau J, Rayfield M, McCormick JB, Schochetman G, Bretton R, Bretton G, Ouattara D. HIV-1 and HIV-2 infection associated with AIDS in Abidjan, Côte d'Ivoire. *AIDS* 1989; **3**: 509-512 [PMID: 2508711 DOI: 10.1097/00002030-198908000-00004]

198 **O'Farrell N**, Hoosen AA, Kharsany AB, van den Ende J. Sexually transmitted pathogens in pregnant women in a rural South African community. *Genitourin Med* 1989; **65**: 276-280 [PMID: 2807289 DOI: 10.1136/sti.65.4.276]

199 **Offor E**, Okolo AA. HIV seroprevalence in women of childbearing age in Benin City, Nigeria. *Afr J Reprod Health* 1997; **1**: 36-40 [PMID: 10214413]

200 **Okeudo C**, Ezem BU, Ojiyi EC. Human immuno-deficiency virus antibody seroprevalence among pregnant women at booking at a university teaching hospital in South-Eastern Nigeria. *Niger J Med* 2012; **21**: 227-230 [PMID: 23311197]

201 **Okonko IO**, Okoli EM. Determination of antibodies to human immunodeficiency virus type 1&2&O and P24 - antigen in pregnant women in port harcourt Nigeria. *J Immunoassay Immunochem* 2020; **41**: 208-218 [PMID: 31885351 DOI: 10.1080/15321819.2019.1708387]

202 **Oladeinde BH**, Phil RO, Olley M, Anunibe JA. Prevalence of HIV and anemia among pregnant women. *N Am J Med Sci* 2011; **3**: 548-551 [PMID: 22363076 DOI: 10.4297/najms.2011.3548]

203 **Olajubu FA**, Osinupebi OA, Deji-Agboola M, Jagun EO. Seroprevalence of HIV among blood donors, antenatal women and other patients in a tertiary hospital in Nigeria. *Braz J Infect Dis* 2009; **13**: 280-283 [PMID: 20231991 DOI: 10.1590/s1413-86702009000400008]

204 **Olaleye DO**, Ekweozor CC, Sheng Z, Rasheed S. Evidence of serological cross-reactivities with human immunodeficiency virus types 1 and 2 and human T-lymphotropic virus types I and II in sera of pregnant women in Ibadan, Nigeria. *Int J Epidemiol* 1995; **24**: 198-203 [PMID: 7797344 DOI: 10.1093/ije/24.1.198]

205 **Olatunbosun OA**, Abasiattai AM, Bassey EA, James RS, Ibanga G, Morgan A. Prevalence of anaemia among pregnant women at booking in the University of Uyo Teaching Hospital, Uyo, Nigeria. *Biomed Res Int* 2014; **2014**: 849080 [PMID: 24982910 DOI: 10.1155/2014/849080]

206 **Olugbenga I**, Taiwo O, Laverty M, Ngige E, Anyaike C, Bakare R, Ogunleye V, Peterson Maddox BL, Newman DR, Gliddon HD, Ofondu E, Nurse-Findlay S, Taylor MM. Clinic-based evaluation study of the diagnostic accuracy of a dual rapid test for the screening of HIV and syphilis in pregnant women in Nigeria. *PLoS One* 2018; **13**: e0198698 [PMID: 29990336 DOI: 10.1371/journal.pone.0198698]

207 **Omatola CA**, Lawal C, Omosayin DO, Okolo MO, Adaji DM, Mofolorunsho CK, Bello KE. Seroprevalence of HBV, HCV, and HIV and Associated Risk Factors Among Apparently Healthy Pregnant Women in Anyigba, Nigeria. *Viral Immunol* 2019; **32**: 186-191 [PMID: 31021251 DOI: 10.1089/vim.2018.0140]

208 **Omoding D**, Katawera V, Siedner M, Boum Y 2nd. Evaluation of the SD Bioline HIV/Syphilis Duo assay at a rural health center in Southwestern Uganda. *BMC Res Notes* 2014; **7**: 746 [PMID: 25339379 DOI: 10.1186/1756-0500-7-746]

209 **Onakewhor JU**, Okonofua FE. The prevalence of dual human immunodeficiency virus/hepatitis C virus (HIV/HCV) infection in asymptomatic pregnant women in Benin City, Nigeria. *Afr J Reprod Health* 2009; **13**: 97-108 [PMID: 20690253]

210 **Onuminya D,** Isabu P, Eifediyi R, Eigbeifoh J, Okogbo F, Sule-Odu A. Seroprevalence of human immunodeficiency virus, hepatitis b virus, and syphilis infections among pregnant women booked for antenatal care at kogi state specialist hospital, Lokoja, Nigeria. *Nigerian Journal of Medicine 2021*; **30:** 329 [DOI: 10.4103/NJM.NJM\_193\_20]

211 **Opaleye OO**, Igboama MC, Ojo JA, Odewale G. Seroprevalence of HIV, HBV, HCV, and HTLV among Pregnant Women in Southwestern Nigeria. *J Immunoassay Immunochem* 2016; **37**: 29-42 [PMID: 25879258 DOI: 10.1080/15321819.2015.1040160]

212 **Orish VN**, Onyeabor OS, Boampong JN, Acquah S, Sanyaolu AO, Iriemenam NC. The effects of malaria and HIV co-infection on hemoglobin levels among pregnant women in Sekondi-Takoradi, Ghana. *Int J Gynaecol Obstet* 2013; **120**: 236-239 [PMID: 23219288 DOI: 10.1016/j.ijgo.2012.09.021]

213 **Ortashi OM**, El Khidir I, Herieka E. Prevalence of HIV, syphilis, Chlamydia trachomatis, Neisseria gonorrhoea, Trichomonas vaginalis and candidiasis among pregnant women attending an antenatal clinic in Khartoum, Sudan. *J Obstet Gynaecol* 2004; **24**: 513-515 [PMID: 15369929 DOI: 10.1080/01443610410001722536]

214 **Osman AMM,** Mirghani OA, Gasim GI, Adam I. Hepatitis B Virus, Hepatitis C Virus and Human Immunodeficiency Virus Infections among Pregnant Women in Central Sudan. *Sudan Journal of Medical Sciences* 2014; **9**: 91-96

215 **Price JT**, Vwalika B, Edwards JK, Cole SR, Kasaro MP, Rittenhouse KJ, Kumwenda A, Lubeya MK, Stringer JSA. Maternal HIV Infection and Spontaneous Versus Provider-Initiated Preterm Birth in an Urban Zambian Cohort. *J Acquir Immune Defic Syndr* 2021; **87**: 860-868 [PMID: 33587508 DOI: 10.1097/QAI.0000000000002654]

216 **Ramon R**, Sawadogo D, Koko FS, Noba V, Likikouët R, Gourvellec G, Viho I, Mandelbrot L, Dabis F, Ekra CW, Msellati P. Haematological characteristics and HIV status of pregnant women in Abidjan, Côte d'Ivoire, 1995-96. *Trans R Soc Trop Med Hyg* 1999; **93**: 419-422 [PMID: 10674094 DOI: 10.1016/s0035-9203(99)90143-8]

217 **Ramos JM**, Toro C, Reyes F, Amor A, Gutiérrez F. Seroprevalence of HIV-1, HBV, HTLV-1 and Treponema pallidum among pregnant women in a rural hospital in Southern Ethiopia. *J Clin Virol* 2011; **51**: 83-85 [PMID: 21330196 DOI: 10.1016/j.jcv.2011.01.010]

218 **Rashid S**, Kilewo C, Aboud S. Seroprevalence of hepatitis B virus infection among antenatal clinic attendees at a tertiary hospital in Dar es Salaam, Tanzania. *Tanzan J Health Res* 2014; **16**: 9-15 [PMID: 26867267 DOI: 10.4314/thrb.v16i1.2]

219 **Rasmussen DN**, Vieira N, Hønge BL, da Silva Té D, Jespersen S, Bjerregaard-Andersen M, Oliveira I, Furtado A, Gomes MA, Sodemann M, Wejse C, Unger HW. HIV-1 and HIV-2 prevalence, risk factors and birth outcomes among pregnant women in Bissau, Guinea-Bissau: a retrospective cross-sectional hospital study. *Sci Rep* 2020; **10**: 12174 [PMID: 32699381 DOI: 10.1038/s41598-020-68806-5]

220 **Reuschel E**, Tibananuka S, Seelbach-Goebel B. HIV-1 seroprevalence among pregnant women in rural Uganda: a longitudinal study over fifteen years. *Gynecol Obstet Invest* 2013; **75**: 169-174 [PMID: 23486005 DOI: 10.1159/000346175]

221 **Rochat TJ**, Richter LM, Doll HA, Buthelezi NP, Tomkins A, Stein A. Depression among pregnant rural South African women undergoing HIV testing. *JAMA* 2006; **295**: 1376-1378 [PMID: 16551708 DOI: 10.1001/jama.295.12.1376]

222 **Rodier MH**, Berthonneau J, Bourgoin A, Giraudeau G, Agius G, Burucoa C, Hekpazo A, Jacquemin JL. Seroprevalences of Toxoplasma, malaria, rubella, cytomegalovirus, HIV and treponemal infections among pregnant women in Cotonou, Republic of Benin. *Acta Trop* 1995; **59**: 271-277 [PMID: 8533662 DOI: 10.1016/0001-706x(95)00087-u]

223 **Rouet F**, Ekouevi DK, Inwoley A, Chaix ML, Burgard M, Bequet L, Viho I, Leroy V, Simon F, Dabis F, Rouzioux C. Field evaluation of a rapid human immunodeficiency virus (HIV) serial serologic testing algorithm for diagnosis and differentiation of HIV type 1 (HIV-1), HIV-2, and dual HIV-1-HIV-2 infections in West African pregnant women. *J Clin Microbiol* 2004; **42**: 4147-4153 [PMID: 15365003 DOI: 10.1128/JCM.42.9.4147-4153.2004]

224 **Sagay AS**, Imade GE, Nwokedi EE. Human immunodeficiency virus infection in pregnant women in Nigeria. *Int J Gynaecol Obstet* 1999; **66**: 183-184 [PMID: 10468347 DOI: 10.1016/s0020-7292(99)00060-0]

225 **Sagay AS**, Kapiga SH, Imade GE, Sankale JL, Idoko J, Kanki P. HIV infection among pregnant women in Nigeria. *Int J Gynaecol Obstet* 2005; **90**: 61-67 [PMID: 15907849 DOI: 10.1016/j.ijgo.2005.03.030]

226 **Sagay AS**, Musa J, Adewole AS, Imade GE, Ekwempu CC, Kapiga S, Sankale JL, Idoko J, Kanki P. Rapid HIV testing and counselling in labour in a northern Nigerian setting. *Afr J Reprod Health* 2006; **10**: 76-80 [PMID: 16999197]

227 **Sahlu I**, Howe CJ, Clark MA, Marshall BD. HIV status, knowledge of mother-to-child transmission of HIV and antenatal care use among Ethiopian women. *J Epidemiol Glob Health* 2014; **4**: 177-184 [PMID: 25107653 DOI: 10.1016/j.jegh.2014.01.001]

228 **Sama CB**, Feteh VF, Tindong M, Tanyi JT, Bihle NM, Angwafo FF 3rd. Prevalence of maternal HIV infection and knowledge on mother-to-child transmission of HIV and its prevention among antenatal care attendees in a rural area in northwest Cameroon. *PLoS One* 2017; **12**: e0172102 [PMID: 28199373 DOI: 10.1371/journal.pone.0172102]

229 **Sangaré L**, Meda N, Lankoandé S, Van Dyck E, Cartoux M, Compaoré IP, Catraye J, Sanou PT, Soudré R. HIV infection among pregnant women in Burkina Faso: a nationwide serosurvey. *Int J STD AIDS* 1997; **8**: 646-651 [PMID: 9310226 DOI: 10.1258/0956462971918797]

230 **Schönfeld A**, Feldt T, Tufa TB, Orth HM, Fuchs A, Mesfun MG, Pfäfflin F, Nordmann T, Breuer M, Hampl M, Häussinger D. Prevalence and impact of sexually transmitted infections in pregnant women in central Ethiopia. *Int J STD AIDS* 2018; **29**: 251-258 [PMID: 28776463 DOI: 10.1177/0956462417723545]

231 **Sebastião CS**, Neto Z, Jandondo D, Mirandela M, Morais J, Brito M. HIV, hepatitis B virus, hepatitis C virus, and syphilis among pregnant women attending antenatal care in Luanda, Angola: Seroprevalence and risk factors. *J Med Virol* 2020 [PMID: 32515502 DOI: 10.1002/jmv.26148]

232 **Shetty AK**, Mhazo M, Moyo S, von Lieven A, Mateta P, Katzenstein DA, Maldonado Y, Hill D, Bassett MT. The feasibility of voluntary counselling and HIV testing for pregnant women using community volunteers in Zimbabwe. *Int J STD AIDS* 2005; **16**: 755-759 [PMID: 16303072 DOI: 10.1258/095646205774763090]

233 **Simpore J**, Granato M, Santarelli R, Nsme RA, Coluzzi M, Pietra V, Pignatelli S, Bere A, Faggioni A, Angeloni A. Prevalence of infection by HHV-8, HIV, HCV and HBV among pregnant women in Burkina Faso. *J Clin Virol* 2004; **31**: 78-80 [PMID: 15288619 DOI: 10.1016/j.jcv.2004.06.001]

234 **Simpore J**, Ilboudo D, Samandoulougou A, Guardo P, Castronovo P, Musumeci S. HCV and HIV co-infection in pregnant women attending St. Camille Medical Centre in Ouagadougou (Burkina Faso). *J Med Virol* 2005; **75**: 209-212 [PMID: 15602740 DOI: 10.1002/jmv.20258]

235 **Sirengo M**, Rutherford GW, Otieno-Nyunya B, Kellogg TA, Kimanga D, Muraguri N, Umuro M, Mirjahangir J, Stein E, Ndisha M, Kim AA. Evaluation of Kenya's readiness to transition from sentinel surveillance to routine HIV testing for antenatal clinic-based HIV surveillance. *BMC Infect Dis* 2016; **16**: 113 [PMID: 26945861 DOI: 10.1186/s12879-016-1434-1]

236 **Ssentongo P**, Ba DM, Ssentongo AE, Ericson JE, Wang M, Liao D, Chinchilli VM. Associations of malaria, HIV, and coinfection, with anemia in pregnancy in sub-Saharan Africa: a population-based cross-sectional study. *BMC Pregnancy Childbirth* 2020; **20**: 379 [PMID: 32600355 DOI: 10.1186/s12884-020-03064-x]

237 **Strand RT**, Fernandes Dias L, Bergström S, Andersson S. Unexpected low prevalence of HIV among fertile women in Luanda, Angola. Does war prevent the spread of HIV? *Int J STD AIDS* 2007; **18**: 467-471 [PMID: 17623504 DOI: 10.1258/095646207781147300]

238 **Stringer EM**, Chintu NT, Levy JW, Sinkala M, Chi BH, Muyanga J, Bulterys M, Bweupe M, Megazzini K, Stringer JS. Declining HIV prevalence among young pregnant women in Lusaka, Zambia. *Bull World Health Organ* 2008; **86**: 697-702 [PMID: 18797645 DOI: 10.2471/blt.07.045260]

239 **Sule WF,** Adewumi MO, Samuel TC. Human immunodeficiency virus (HIV) specific antibodies among married pregnant women and female commercial sex workers attending voluntary counseling and HIV testing (VCT) centre in Abuja, Nigeria. *African Journal of Biotechnology* 2009; **8** [DOI: 10.1186/1471-2164-10-120]

240 **Swai RO**, Somi G GR, Matee MI, Killewo J, Lyamuya EF, Kwesigabo G, Tulli T, Kabalimu TK, Ng'ang'a L, Isingo R, Ndayongeje J. Surveillance of HIV and syphilis infections among antenatal clinic attendees in Tanzania-2003/2004. *BMC Public Health* 2006; **6**: 91 [PMID: 16603091 DOI: 10.1186/1471-2458-6-91]

241 **Takow SE**, Atashili J, Enow-Tanjong R, Mesembe MT, Ikomey GM, Ndip LM, Mbuagbaw JC, Ndumbe PM. Time for Option B+? Prevalence and characteristics of HIV infection among attendees of 2 antenatal clinics in Buea, Cameroon. *J Int Assoc Provid AIDS Care* 2015; **14**: 77-81 [PMID: 24309753 DOI: 10.1177/2325957413510607]

242 **Taremwa IM**, Twelwanike A, Mwambi B, Atuhairwe C. Laboratory assessment of SD Bioline HIV/Syphilis Duo Kit among pregnant women attending antenatal clinic Mayuge Health Center III, East central Uganda. *BMC Res Notes* 2019; **12**: 238 [PMID: 31023349 DOI: 10.1186/s13104-019-4272-6]

243 **Temmerman M**, Ali FM, Ndinya-Achola J, Moses S, Plummer FA, Piot P. Rapid increase of both HIV-1 infection and syphilis among pregnant women in Nairobi, Kenya. *AIDS* 1992; **6**: 1181-1185 [PMID: 1466850 DOI: 10.1097/00002030-199210000-00019]

244 **Tenthani L**, Haas AD, Egger M, Van Oosterhout JJ, Jahn A, Chimbwandira F, Tal K, Myer L, Estill J, Keiser O. Brief Report: HIV Testing Among Pregnant Women Who Attend Antenatal Care in Malawi. *J Acquir Immune Defic Syndr* 2015; **69**: 610-614 [PMID: 25950205 DOI: 10.1097/QAI.0000000000000669]

245 **Tohon Z**, Mamadou S, Mainassara HB, Boukary RM, Lagare A, Ali Maazou AR, Izamne M, Chanteau S. HIV seroprevalence surveys in Nigerien pregnant women: a comparison between 2002 and 2006. *Trans R Soc Trop Med Hyg* 2007; **101**: 1101-1105 [PMID: 17662323 DOI: 10.1016/j.trstmh.2007.06.002]

246 **Torimiro JN**, Nanfack A, Takang W, Keou CK, Joyce AN, Njefi K, Agyingi K, Domkam I, Takou D, Moudourou S, Sosso S, Mbu RE. Rates of HBV, HCV, HDV and HIV type 1 among pregnant women and HIV type 1 drug resistance-associated mutations in breastfeeding women on antiretroviral therapy. *BMC Pregnancy Childbirth* 2018; **18**: 504 [PMID: 30577760 DOI: 10.1186/s12884-018-2120-7]

247 **Tsegaye A**, Rinke De Wit TF, Mekonnen Y, Beyene A, Aklilu M, Messele T, Abebe A, Coutinho R, Sanders E, Fontanet AL. Decline in prevalence of HIV-1 infection and syphilis among young women attending antenatal care clinics in Addis Ababa, Ethiopia: results from sentinel surveillance, 1995-2001. *J Acquir Immune Defic Syndr* 2002; **30**: 359-362 [PMID: 12131574 DOI: 10.1097/00126334-200207010-00013]

248 **Turan JM**, Bukusi EA, Onono M, Holzemer WL, Miller S, Cohen CR. HIV/AIDS stigma and refusal of HIV testing among pregnant women in rural Kenya: results from the MAMAS Study. *AIDS Behav* 2011; **15**: 1111-1120 [PMID: 20827573 DOI: 10.1007/s10461-010-9798-5]

249 **Ukaire BC**, Agboghoroma CO, Durojaiye KW. The Prevalence of Human Immunodeficiency Virus Infection among Pregnant Women in Labour with Unknown Status and those with Negative Status Early in the Index Pregnancy in a Tertiary Hospital in Nigeria. *Afr J Reprod Health* 2015; **19**: 137-143 [PMID: 26897922]

250 **Umoke M**, Sage P, Bjoernsen T, Umoke PCI, Ezeugworie C, Ejiofor D, Agha O, Nwalieji CA, Onwe RN, Nwafor IE, Chukwu OJ. Co-infection and Risk Factors Associated with STIs among Pregnant Women in Rural Health Facilities in Nigeria: A Retrospective Study. *Inquiry* 2021; **58**: 46958021992912 [PMID: 33736517 DOI: 10.1177/0046958021992912]

251 **Uneke CJ**, Duhlinska DD, Igbinedion EB. Prevalence and public-health significance of HIV infection and anaemia among pregnant women attending antenatal clinics in south-eastern Nigeria. *J Health Popul Nutr* 2007; **25**: 328-335 [PMID: 18330066]

252 **Urassa M**, Kumogola Y, Isingo R, Mwaluko G, Makelemo B, Mugeye K, Boerma T, Calleja T, Slaymaker E, Zaba B. HIV prevalence and sexual behaviour changes measured in an antenatal clinic setting in northern Tanzania. *Sex Transm Infect* 2006; **82**: 301-306 [PMID: 16877579 DOI: 10.1136/sti.2005.016766]

253 **Urassa W**, Kaaya S, Mwakagile D, O'Brien M, Antelman G, Hunter D, Fawzi W, Msamanga G. Evidence of a substantial decline in prevalence of HIV-1 infection among pregnant women: data from 1995 to 2003 in Dar es Salaam, Tanzania. *Scand J Public Health* 2006; **34**: 272-278 [PMID: 16754585 DOI: 10.1080/14034940500434871]

254 **Utoo BT,** Utoo PM, Bassey SN, Ojinnaka VC. Hepatitis C Virus and Human Immunodeficiency Virus Co-Infection among Pregnant Women in South-South, Nigeria. *Jos Journal of Medicine* 2011; **5**: 31-35 [DOI:10.4314/jjm.v5i2.70691]

255 **Utulu SN**, Lawoyin TO. Epidemiological features of HIV infection among pregnant women in Makurdi, Benue State, Nigeria. *J Biosoc Sci* 2007; **39**: 397-408 [PMID: 16928285 DOI: 10.1017/S0021932006001489]

256 **van den Broek NR**, White SA, Neilson JP. The relationship between asymptomatic human immunodeficiency virus infection and the prevalence and severity of anemia in pregnant Malawian women. *Am J Trop Med Hyg* 1998; **59**: 1004-1007 [PMID: 9886214 DOI: 10.4269/ajtmh.1998.59.1004]

257 **Schim van der Loeff MF**, Sarge-Njie R, Ceesay S, Awasana AA, Jaye P, Sam O, Jaiteh KO, Cubitt D, Milligan P, Whittle HC. Regional differences in HIV trends in The Gambia: results from sentinel surveillance among pregnant women. *AIDS* 2003; **17**: 1841-1846 [PMID: 12891071 DOI: 10.1097/01.aids.0000076303.76477.49]

258 **van Eijk AM**, Ayisi JG, ter Kuile FO, Misore A, Otieno JA, Kolczak MS, Kager PA, Steketee RW, Nahlen BL. Human immunodeficiency virus seropositivity and malaria as risk factors for third-trimester anemia in asymptomatic pregnant women in western Kenya. *Am J Trop Med Hyg* 2001; **65**: 623-630 [PMID: 11716125 DOI: 10.4269/ajtmh.2001.65.623]

259 **Vueba AN**, Almendra R, Santana P, Faria C, do Céu Sousa M. Prevalence of HIV and hepatitis B virus among pregnant women in Luanda (Angola): geospatial distribution and its association with socio-demographic and clinical-obstetric determinants. *Virol J* 2021; **18**: 239 [PMID: 34863183 DOI: 10.1186/s12985-021-01698-7]

260 **Wannan GJ**, Cutting WA, Fischer PR. HIV seroprevalence amongst pregnant women in northeastern Zaire. *Int J STD AIDS* 1997; **8**: 317-319 [PMID: 9175654 DOI: 10.1258/0956462971920163]

261 **Westheimer EF**, Urassa W, Msamanga G, Baylin A, Wei R, Aboud S, Kaaya S, Fawzi WW. Acceptance of HIV testing among pregnant women in Dar-es-Salaam, Tanzania. *J Acquir Immune Defic Syndr* 2004; **37**: 1197-1205 [PMID: 15319681 DOI: 10.1097/01.qai.0000120806.43677.ff]

262 **Wilkinson D**. HIV infection among pregnant women in the South African private medical sector. *AIDS* 1999; **13**: 1783 [PMID: 10509582 DOI: 10.1097/00002030-199909100-00024]

263 **Wilkinson D**, Connolly C, Rotchford K. Continued explosive rise in HIV prevalence among pregnant women in rural South Africa. *AIDS* 1999; **13**: 740 [PMID: 10397577 DOI: 10.1097/00002030-199904160-00023]

264 **Woldesenbet S**, Cheyip M, Lombard C, Manda S, Ayalew K, Kufa T, Puren A. Progress towards the UNAIDS 95-95-95 targets among pregnant women in South Africa: Results from the 2017 and 2019 national Antenatal HIV Sentinel Surveys. *PLoS One* 2022; **17**: e0271564 [PMID: 35862306 DOI: 10.1371/journal.pone.0271564]

265 **Woldesenbet S**, Kufa-Chakezha T, Lombard C, Manda S, Cheyip M, Ayalew K, Chirombo B, Barron P, Diallo K, Parekh B, Puren A. Recent HIV infection among pregnant women in the 2017 antenatal sentinel cross-sectional survey, South Africa: Assay-based incidence measurement. *PLoS One* 2021; **16**: e0249953 [PMID: 33852629 DOI: 10.1371/journal.pone.0249953]

266 **Woodburn PW**, Muhangi L, Hillier S, Ndibazza J, Namujju PB, Kizza M, Ameke C, Omoding NE, Booth M, Elliott AM. Risk factors for helminth, malaria, and HIV infection in pregnancy in Entebbe, Uganda. *PLoS Negl Trop Dis* 2009; **3**: e473 [PMID: 19564904 DOI: 10.1371/journal.pntd.0000473]

267 **Worku WZ**, Azale T, Ayele TA, Mekonnen DK. HIV is still a major public health problem among pregnant women attending ANC in Referral Hospitals of the Amhara Regional State, Ethiopia: a cross sectional study. *BMC Womens Health* 2022; **22**: 468 [PMID: 36434557 DOI: 10.1186/s12905-022-02059-4]

268 **Wumba RD**, Zanga J, Aloni MN, Mbanzulu K, Kahindo A, Mandina MN, Ekila MB, Mouri O, Kendjo E. Interactions between malaria and HIV infections in pregnant women: a first report of the magnitude, clinical and laboratory features, and predictive factors in Kinshasa, the Democratic Republic of Congo. *Malar J* 2015; **14**: 82 [PMID: 25884992 DOI: 10.1186/s12936-015-0598-2]

269 **Ya'aba Y,** Isu N, Mohammed S, Oladepo D, Ibrahim K, Oladusu P, Izebe K, Onoja A. Prevalence of Hepatitis C Virus (HCV) and Human Immunodeficiency Virus (HIV) Co-Infection Among Pregnant Women Attending Antenatal Clinics in Abuja, Nigeria. *Journal of Phytomedicine and Therapeutics* 2011; **14**: 45-48 [DOI: 10.4314/jopat.v14i1.69409]

270 **Yahya-Malima KI**, Olsen BE, Matee MI, Fylkesnes K. The silent HIV epidemic among pregnant women within rural Northern Tanzania. *BMC Public Health* 2006; **6**: 109 [PMID: 16643653 DOI: 10.1186/1471-2458-6-109]

271 **Young N**, Achieng F, Desai M, Phillips-Howard P, Hill J, Aol G, Bigogo G, Laserson K, Ter Kuile F, Taegtmeyer M. Integrated point-of-care testing (POCT) for HIV, syphilis, malaria and anaemia at antenatal facilities in western Kenya: a qualitative study exploring end-users' perspectives of appropriateness, acceptability and feasibility. *BMC Health Serv Res* 2019; **19**: 74 [PMID: 30691447 DOI: 10.1186/s12913-018-3844-9]

272 **Zenebe Y**, Mulu W, Yimer M, Abera B. Sero-prevalence and risk factors of hepatitis B virus and human immunodeficiency virus infection among pregnant women in Bahir Dar city, Northwest Ethiopia: a cross sectional study. *BMC Infect Dis* 2014; **14**: 118 [PMID: 24580859 DOI: 10.1186/1471-2334-14-118]

273 **Grollman C**, Ronsmans C. Systematic review of the proportion of pregnancy-related deaths attributed to HIV in population-based studies in sub-Saharan Africa. *Trop Med Int Health* 2014; **19**: 83-97 [PMID: 24851260 DOI: 10.1111/tmi.12226]

274 **Wu S**, Wang J, Guo Q, Lan H, Sun Y, Ren M, Liu Y, Wang P, Wang L, Su R, Zhang J, Chen Y, Li G. Prevalence of human immunodeficiency virus, syphilis, and hepatitis B and C virus infections in pregnant women: a systematic review and meta-analysis. *Clin Microbiol Infect* 2023; **29**: 1000-1007 [PMID: 36921717 DOI: 10.1016/j.cmi.2023.03.002]

275 **Abu-Raddad LJ**, Hilmi N, Mumtaz G, Benkirane M, Akala FA, Riedner G, Tawil O, Wilson D. Epidemiology of HIV infection in the Middle East and North Africa. *AIDS* 2010; **24 Suppl 2**: S5-23 [PMID: 20610949 DOI: 10.1097/01.aids.0000386729.56683.33]

276 **Muula AS**. HIV infection and AIDS among young women in South Africa. *Croat Med J* 2008; **49**: 423-435 [PMID: 18581623 DOI: 10.3325/cmj.2008.3.423]

277 **Zuma K**, Simbayi L, Zungu N, Moyo S, Marinda E, Jooste S, North A, Nadol P, Aynalem G, Igumbor E, Dietrich C, Sigida S, Chibi B, Makola L, Kondlo L, Porter S, Ramlagan S, On Behalf Of The Sabssm V Study Group Contributors. The HIV Epidemic in South Africa: Key Findings from 2017 National Population-Based Survey. *Int J Environ Res Public Health* 2022; **19** [PMID: 35805784 DOI: 10.3390/ijerph19138125]

278 **Eaton JW**, Rehle TM, Jooste S, Nkambule R, Kim AA, Mahy M, Hallett TB. Recent HIV prevalence trends among pregnant women and all women in sub-Saharan Africa: implications for HIV estimates. *AIDS* 2014; **28 Suppl 4**: S507-S514 [PMID: 25406753 DOI: 10.1097/QAD.0000000000000412]

279 **Mugambi ML**, Pintye J, Heffron R, Barnabas RV, John-Stewart G. HIV Prevention Tools Across the Pregnancy Continuum: What Works, What Does Not, and What Can We Do Differently? *Curr HIV/AIDS Rep* 2022; **19**: 293-300 [PMID: 35984551 DOI: 10.1007/s11904-022-00621-1]

280 **American Academy of Pediatrics Committee on Pediatric AIDS**. HIV testing and prophylaxis to prevent mother-to-child transmission in the United States. *Pediatrics* 2008; **122**: 1127-1134 [PMID: 18977995 DOI: 10.1542/peds.2008-2175]

281 **Manguro GO**, Musau AM, Were DK, Tengah S, Wakhutu B, Reed J, Plotkin M, Luchters S, Gichangi P, Temmerman M. Increased condom use among key populations using oral PrEP in Kenya: results from large scale programmatic surveillance. *BMC Public Health* 2022; **22**: 304 [PMID: 35164707 DOI: 10.1186/s12889-022-12639-6]

282 **Visseaux B**, Le Hingrat Q, Damond F, Charpentier C, Descamps D. [Physiopathology of HIV-2 infection]. *Virologie (Montrouge)* 2019; **23**: 277-291 [PMID: 31826849 DOI: 10.1684/vir.2019.0789]

283 **Nyamweya S**, Hegedus A, Jaye A, Rowland-Jones S, Flanagan KL, Macallan DC. Comparing HIV-1 and HIV-2 infection: Lessons for viral immunopathogenesis. *Rev Med Virol* 2013; **23**: 221-240 [PMID: 23444290 DOI: 10.1002/rmv.1739]

284 **Boswell MT**, Rowland-Jones SL. Delayed disease progression in HIV-2: the importance of TRIM5α and the retroviral capsid. *Clin Exp Immunol* 2019; **196**: 305-317 [PMID: 30773620 DOI: 10.1111/cei.13280]

285 **Campbell-Yesufu OT**, Gandhi RT. Update on human immunodeficiency virus (HIV)-2 infection. *Clin Infect Dis* 2011; **52**: 780-787 [PMID: 21367732 DOI: 10.1093/cid/ciq248]

286 **Nakanwagi M**, Bulage L, Kwesiga B, Ario AR, Birungi DA, Lukabwe I, Matovu JB, Taasi G, Nabitaka L, Mugerwa S, Musinguzi J. Low proportion of women who came knowing their HIV status at first antenatal care visit, Uganda, 2012-2016: a descriptive analysis of surveillance data. *BMC Pregnancy Childbirth* 2020; **20**: 498 [PMID: 32854636 DOI: 10.1186/s12884-020-03197-z]

287 **DiTullio DJ**, Farley E, Gomba Y, Coates TJ, Bekker LG, Myer L, Joseph Davey DL. Factors associated with knowledge of pre-exposure prophylaxis in pregnant women in Cape Town, South Africa. *Int J STD AIDS* 2019; **30**: 1063-1070 [PMID: 31462164 DOI: 10.1177/0956462419863216]

288 **Oyefabi A**, Ameh N, Aliyu A. Awareness and Utilization: Prevention of Mother-to-Child Transmission (PMTCT) Services among Primigravid Women attending Primary Health Care Facilities in Zaria, North-Western Nigeria. *West Afr J Med* 2018; **35**: 144-152 [PMID: 30387085]

**Footnotes**

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**Figure Legends**



**Figure 1 Study selection.**



**Figure 2 Human immunodeficiency virus seroprevalence among pregnant African women according to United Nation regions from 1984 to 2020.**



**Figure 3 Map of the distribution seroprevalence data among pregnant women in Africa.** A: Human immunodeficiency virus; B: Human immunodeficiency virus-1; C: Human immunodeficiency virus-2. The base map was taken from (https://www.naturalearthdata.com/) and modified with Qgis software. HIV: Human immunodeficiency virus.

**Table 1 Summary of meta-analysis results for human immunodeficiency virus seroprevalence among pregnant African women from 1984 to 2020**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **Prevalence (95%CI, %)** | **95% prediction interval** | **N Studies** | **N Participants** | **H (95%CI)** | ***I*² (95%CI)** | ***P* heterogeneity** | ***P* difference subtypes** |
| Study design |  |  |  |  |  |  |  | < 0.001 |
| Cohort | 21.6 (15.5-28.4) | (2.6-51.8) | 12 | 95334 | 19.6 (18.4-21) | 99.7 (99.7-99.8) | < 0.001 |  |
| Cross-sectional | 8.8 (7.7-9.8) | (0-30.6) | 236 | 1276343 | 20.7 (20.4-21) | 99.8 (99.8-99.8) | < 0.001 |  |
| Sampling |  |  |  |  |  |  |  | 0.554 |
| Non probabilistic | 9.1 (8.1-10.2) | (0.1-29.9) | 225 | 1228039 | 19.7 (19.5-20) | 99.7 (99.7-99.8) | < 0.001 |  |
| Probabilistic | 10.5 (6.4-15.5) | (0-45.1) | 26 | 146353 | 24.4 (23.5-25.4) | 99.8 (99.8-99.8) | < 0.001 |  |
| Timing of samples collection |  |  |  |  |  |  |  | 0.936 |
| Prospectively | 9.2 (8.1-10.5) | (0-32.1) | 205 | 942978 | 19.3 (19-19.6) | 99.7 (99.7-99.7) | < 0.001 |  |
| Retrospectively | 9.2 (6.9-11.8) | (0-31.2) | 43 | 428329 | 26.6 (25.9-27.3) | 99.9 (99.9-99.9) | < 0.001 |  |
| Countries |  |  |  |  |  |  |  | < 0.001 |
| Angola | 4.9 (0.6-13.2) | (0-100) | 3 | 3008 | 7.8 (5.8-10.4) | 98.3 (97-99.1) | < 0.001 |  |
| Burkina Faso | 7.6 (5.6-9.9) | (1.6-17.5) | 10 | 55644 | 6 (5.1-7.1) | 97.2 (96.2-98) | < 0.001 |  |
| Cameroon | 6.6 (5.4-7.9) | (2.5-12.3) | 13 | 55429 | 5.5 (4.7-6.4) | 96.7 (95.5-97.5) | < 0.001 |  |
| Democratic Republic of the Congo | 3 (2-4) | (0.5-7.3) | 6 | 21268 | 3.8 (2.9-5.1) | 93.2 (87.9-96.2) | < 0.001 |  |
| Ethiopia | 5.6 (3.1-8.8) | (0-25.1) | 18 | 25412 | 9.2 (8.4-10.1) | 98.8 (98.6-99) | < 0.001 |  |
| Ghana | 3.4 (0.4-9) | (0-46.7) | 4 | 4736 | 6.7 (5.2-8.8) | 97.8 (96.3-98.7) | < 0.001 |  |
| Ivory Coast | 13 (12.1-13.8) | (10.2-16) | 9 | 74677 | 2.9 (2.2-3.8) | 88.3 (80-93.2) | < 0.001 |  |
| Kenya | 14.4 (10.4-18.8) | (1.8-36) | 14 | 51495 | 13.2 (12.2-14.3) | 99.4 (99.3-99.5) | < 0.001 |  |
| Malawi | 18.7 (14.2-23.8) | (3.9-41.2) | 12 | 130923 | 17.6 (16.4-18.9) | 99.7 (99.6-99.7) | < 0.001 |  |
| Nigeria | 6.1 (5-7.3) | (0.4-17.2) | 57 | 84396 | 6.6 (6.2-7) | 97.7 (97.4-98) | < 0.001 |  |
| Republic of the Congo | 5 (4.1-6) | (2.3-8.7) | 7 | 12841 | 2.4 (1.7-3.4) | 82.8 (66-91.3) | < 0.001 |  |
| Rwanda | 14.5 (6.9-24.2) | (0-70.4) | 4 | 28796 | 18.4 (16.1-21) | 99.7 (99.6-99.8) | < 0.001 |  |
| Senegal | 0.7 (0.5-0.9) | (0-4.5) | 3 | 23529 | 1.6 (1-3.1) | 62.9 (0-89.4) | 0.068 |  |
| South Africa | 29.9 (26.7-33.2) | (16.7-45.1) | 18 | 134840 | 10 (9.2-10.9) | 99 (98.8-99.2) | < 0.001 |  |
| Sudan | 1 (0.4-1.7) | (0-3.2) | 4 | 1296 | 1.1 (1-2.7) | 12.2 (0-86.6) | 0.332 |  |
| Tanzania | 7.3 (5.9-8.8) | (1.9-15.8) | 21 | 157211 | 10 (9.3-10.9) | 99 (98.8-99.2) | < 0.001 |  |
| Uganda | 11.4 (6.9-16.8) | (0.2-35) | 8 | 50585 | 14.6 (13.2-16.2) | 99.5 (99.4-99.6) | < 0.001 |  |
| Zambia | 18.6 (14.7-22.8) | (6.3-35.3) | 8 | 326966 | 20.3 (18.7-22) | 99.8 (99.7-99.8) | < 0.001 |  |
| Zimbabwe | 25.7 (16.4-36.3) | (0.7-68.5) | 10 | 33198 | 17.6 (16.3-19.1) | 99.7 (99.6-99.7) | < 0.001 |  |
| WHO Region |  |  |  |  |  |  |  | < 0.001 |
| Africa | 9.5 (8.4-10.6) | (0-31.3) | 244 | 1366377 | 20.8 (20.5-21.1) | 99.8 (99.8-99.8) | < 0.001 |  |
| Eastern Mediterranean | 1.4 (0.6-2.4) | (0-5.7) | 6 | 7651 | 2.1 (1.4-3.2) | 78.3 (52.3-90.2) | < 0.001 |  |
| UN Regions |  |  |  |  |  |  |  | < 0.001 |
| Eastern Africa | 11.7 (10.2-13.2) | (1.2-30.3) | 99 | 813901 | 20.1 (19.7-20.5) | 99.8 (99.7-99.8) | < 0.001 |  |
| Middle Africa | 4.8 (4-5.8) | (0.9-11.5) | 33 | 101346 | 6.6 (6-7.1) | 97.7 (97.3-98) | < 0.001 |  |
| Northern Africa | 0.7 (0.3-1.3) | (0-2.8) | 5 | 4328 | 1.4 (1-2.3) | 46.4 (0-80.4) | 0.113 |  |
| Southern Africa | 29.4 (26.5-32.4) | (16.5-44.2) | 21 | 136338 | 9.3 (8.6-10.1) | 98.8 (98.6-99) | < 0.001 |  |
| Western Africa | 6.2 (5.2-7.3) | (0.2-19.2) | 92 | 317532 | 11.5 (11.2-11.9) | 99.3 (99.2-99.3) | < 0.001 |  |
| Sustainable Development Goal regions |  |  |  |  |  |  |  | < 0.001 |
| Northern Africa and Western Asia | 0.7 (0.3-1.3) | (0-2.8) | 5 | 4328 | 1.4 (1-2.3) | 46.4 (0-80.4) | 0.113 |  |
| Sub-Saharan Africa | 9.5 (8.5-10.6) | (0-31.4) | 246 | 1370064 | 20.7 (20.4-21) | 99.8 (99.8-99.8) | < 0.001 |  |
| World Bank Income Groups |  |  |  |  |  |  |  | < 0.001 |
| Low-income countries | 8.4 (6.9-10.1) | (0-28.5) | 81 | 712218 | 23.3 (22.8-23.9) | 99.8 (99.8-99.8) | < 0.001 |  |
| Lower-middle-income countries | 8.1 (7.2-9.1) | (0.5-23.2) | 147 | 521930 | 12.7 (12.4-13) | 99.4 (99.3-99.4) | < 0.001 |  |
| Upper-middle-income countries | 24 (19.9-28.3) | (6.9-47.2) | 22 | 139297 | 14.8 (13.9-15.7) | 99.5 (99.5-99.6) | < 0.001 |  |
| Study period |  |  |  |  |  |  |  | 0.255 |
| (1987-2001) | 9.9 (8.1-11.8) | (0.4-29) | 62 | 238301 | 14.7 (14.2-15.3) | 99.5 (99.5-99.6) | < 0.001 |  |
| (2001-2016) | 8 (6.8-9.4) | (0-27.7) | 128 | 919743 | 21.7 (21.3-22.1) | 99.8 (99.8-99.8) | < 0.001 |  |
| (2016-2020) | 9.5 (5.9-13.8) | (0-41.9) | 30 | 189325 | 26.6 (25.8-27.5) | 99.9 (99.8-99.9) | < 0.001 |  |
| Parity |  |  |  |  |  |  |  | 0.69 |
| Multiparous | 6.5 (4.5-8.8) | (0.9-16.1) | 10 | 18015 | 4.6 (3.8-5.5) | 95.2 (92.9-96.8) | < 0.001 |  |
| Nulliparous | 6.7 (4-10) | (0.1-21.1) | 9 | 14035 | 5.3 (4.4-6.4) | 96.5 (94.9-97.6) | < 0.001 |  |
| Primiparous | 5 (2.8-7.8) | (0-16.6) | 9 | 8581 | 4 (3.2-5) | 93.8 (90.3-96) | < 0.001 |  |
| Gravidity |  |  |  |  |  |  |  | 0.276 |
| Multigravidae | 9.2 (5.5-13.7) | (0-35.1) | 17 | 53860 | 14.2 (13.2-15.2) | 99.5 (99.4-99.6) | < 0.001 |  |
| Primigravidae | 6.5 (4.2-9.2) | (0-21) | 16 | 22946 | 6.6 (5.9-7.5) | 97.7 (97.1-98.2) | < 0.001 |  |
| Gestational age |  |  |  |  |  |  |  | 0.902 |
| First trimester | 7.3 (3.5-12.2) | (0-32.7) | 17 | 6164 | 4.1 (3.5-4.8) | 94 (91.8-95.6) | < 0.001 |  |
| Second trimester | 9.6 (5.2-15) | (0-40.7) | 18 | 15874 | 7.8 (7.1-8.6) | 98.4 (98-98.7) | < 0.001 |  |
| Third trimester | 8.7 (5.2-13.1) | (0-39.4) | 27 | 16897 | 8.5 (7.8-9.2) | 98.6 (98.4-98.8) | < 0.001 |  |
| Residence |  |  |  |  |  |  |  | 0.789 |
| Rural | 8.1 (5.8-10.6) | (0-29.9) | 43 | 103272 | 13.5 (12.9-14.1) | 99.5 (99.4-99.5) | < 0.001 |  |
| Urban | 8.5 (7-10.2) | (1.6-20.2) | 32 | 92657 | 8.5 (7.9-9.1) | 98.6 (98.4-98.8) | < 0.001 |  |
| Education |  |  |  |  |  |  |  | 0.804 |
| None | 5.8 (3.8-8.2) | (0-18) | 18 | 29175 | 6 (5.3-6.8) | 97.2 (96.5-97.8) | < 0.001 |  |
| Primary | 6.6 (4.1-9.6) | (0-24.6) | 21 | 26835 | 7.9 (7.2-8.7) | 98.4 (98.1-98.7) | < 0.001 |  |
| Secondary | 7.3 (5.4-9.6) | (0.8-19.1) | 20 | 13337 | 4.1 (3.5-4.7) | 94 (92-95.5) | < 0.001 |  |
| Tertiary | 6.2 (4.3-8.5) | (0.3-17.6) | 18 | 4744 | 2.8 (2.3-3.3) | 86.8 (80.6-91) | < 0.001 |  |
| Type of HIV |  |  |  |  |  |  |  | < 0.001 |
| HIV-1 | 8.2 (6.6-10) | (0.2-25.7) | 58 | 279778 | 15.9 (15.4-16.5) | 99.6 (99.6-99.6) | < 0.001 |  |
| HIV-2 | 1.2 (0.7-1.9) | (0-5.2) | 16 | 143453 | 9.7 (8.8-10.6) | 98.9 (98.7-99.1) | < 0.001 |  |
| Sample size |  |  |  |  |  |  |  | 0.097 |
| < 100 | 19.5 (7-36.1) | (0-82.2) | 6 | 425 | 3.8 (2.9-5.1) | 93.2 (87.9-96.2) | < 0.001 |  |
| ≥ 100 | 9.1 (8.1-10.2) | (0-30.8) | 242 | 1371252 | 21 (20.7-21.3) | 99.8 (99.8-99.8) | < 0.001 |  |
| Risk of bias |  |  |  |  |  |  |  | 0.205 |
| Low risk of bias | 8.8 (7.5-10.2) | (0-31) | 146 | 1159206 | 25.3 (24.9-25.6) | 99.8 (99.8-99.8) | < 0.001 |  |
| Moderate risk of bias | 10 (8.6-11.5) | (0.6-28.5) | 102 | 212471 | 10.6 (10.3-11) | 99.1 (99.1-99.2) | < 0.001 |  |

HIV: Human immunodeficiency virus.



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