RESEARCH ARTICLE

Pregnancy, Obstetric and Neonatal Outcomes in HIV Positive Nigerian Women

Ezechi OC[1], Gab-Okafor CV[1], Oladele DA, Kalejaiye O.O[1], Oke BO[1], Ohwodo HO[1], Adu RA, Ekama SO[1], Musa Z[1], Onwujekwe DI[1], David AN[1] and Ujah IAO[1].*

Clinical Sciences, Division, Nigerian Institute of Medical Research, Lagos Nigeria

***For correspondence**: *E-mail: oezechi@yahoo.co.uk*

Abstract

While the effect of HIV infection on some maternal outcomes is well established, for some others there is conflicting information on possible association with HIV. In this study we investigated pregnancy and neonatal outcome of HIV positive women in large HIV treatment centre over a period of 84 months. They were managed according to the Nigerian PMTCT protocol. Adverse obstetric and neonatal outcome were observed in 48.3% HIV positives compared 30.3% to the negatives (OR: 2.08; CI: 1.84-2.34). Low birth weight (OR:2.95; CI:1.95-3.1), preterm delivery (OR:2.05;CI:1.3-3.1), perinatal death (OR:1.9;CI:1.3-3.2), and spontaneous abortion (OR:1.37; CI:1.1-2.3) were factors found to be independently associated with HIV. Low CD4 count (OR: 2.45; CI: 1.34- 4.56) and opportunistic infections (OR: 2.11; CI: 1.56-3.45) were to be associated with adverse obstetric and neonatal outcome. This study confirms the association of HIV, severe immunosuppression and opportunistic infection and adverse obstetric and neonatal outcome. *(Afr J Reprod Health 2013; 17[3]: 160-168).*

Résumé

Alors que l'effet de l'infection par le VIH sur certains résultats maternels sont bien établis, pour certains d'autres, il ya des informations contradictoires sur l'association possible avec le VIH. Dans cette étude, nous avons étudié la grossesse et l'état néonatal des femmes séropositives dans un grand centre de traitement du VIH au cours d'une période de 84 mois. Elles étaient prises en charge selon le protocole nigérian de PTME. On a remarqué des résultats obstétricaux et néonatals Indésirables chez 48,3% des séropositives par rapport à 30,3% pour les négatifs (OR: 2,08, IC: 1,84 à 2,34). Le faible poids de naissance (OR: 2,95, IC : 1,95-3 ,1), l'accouchement prématuré (OR: 2,05, IC : 1,3-3 ,1), la mortalité périnatale (OR: 1,9, IC : 1,3-3 ,2), et l'avortement spontané (OR: 1,37 IC :1,1-2 3) étaient des facteurs qui seraient associés de façon indépendante avec le VIH. Les femmes qui ont un faible taux de CD4 (OR: 2,45, IC: 1,34 à 4,56) et les infections opportunistes (OR: 2,11, IC : 1,56-3 .45) devaient être associées aux résultats obstétricaux et néonatals défavorables. Cette étude confirme l'association entre le VIH, l'immunosuppression sévère et l'infection opportuniste, les résultats obstétricaux et néonatals défavorables. *(Afr J Reprod Health 2013; 17[3]: 160-168).*

Keywords: Pregnancy, delivery, HIV, neonate, adverse outcome

Introduction

HIV-1 infection has remained a major public health challenge in sub-Saharan Africa, accounting for over two third of the global estimate of persons living with HIV/AIDS[1,2]. Young adults especially women within the reproductive age group and children are mainly affected[2]. In most sub Saharan African countries including Nigeria, HIV infection has become a leading medical complication of pregnancy and cause of maternal and neonatal morbidity and mortality[2,3]. Fortunately, antiretroviral medication and good obstetric practice have greatly reduced both maternal deaths and the transmission of HIV infection to the infant[1-5].

While the effect of HIV infection on maternal morbidity, mortality and vertical transmission to her offspring are well established, controversy exists on the relationship between maternal HIV

infection and the adverse pregnancy outcomes of miscarriage, stillbirth, low birth weight, prematurity and intrauterine growth retardation[6,7]. Several investigators both in the developed and developing countries have tried to resolve the controversy by studying the obstetric and neonatal outcomes in HIV infected women, they ended up leaving more questions than answers[1,2,4,8-11].

While better designed but small sample sized studies from developed countries failed to show a significant adverse effect of maternal HIV infection on pregnancy[16,8-10], the larger, predominantly observational or retrospective studies from developing countries an association between maternal HIV infection and adverse pregnancy outcome[1,2,4,5,11]. Resolving the controversy requires studies that will take into consideration all the weaknesses observed in previous studies[7]. In 2004 we initiated a prospective study in a large HIV treatment centre in a HIV endemic country utilizing methodology that addressed some of the weakness of the previous studies with the aim of contributing to the body of knowledge on the subject.

Method

Study Setting and population.

The study was conducted at the HIV treatment centre, Nigerian Institute of Medical Research, Lagos. The centre started operation in 2002 following the commencement of the Federal Government of Nigeria ARV access programme. It was included in the 25 ART centres across the country to give research back up to the national ARV access programme. In 2004 it became one of the centers supported by the Harvard School of Public Health (HSPH), Boston through The US Presidents Emergency Fund for AIDS Relief (PEPFAR). The centre currently provides comprehensive, HIV care, treatment and support for over 18,000 patients (65.0% are women). Sixty five percent of the patients come from Lagos and the rest from the other 5 states of southwestern Nigeria, north-central, south-south and south-eastern Nigeria. A little over 0.025% comes from the neigbouring West African countries. No user fee is charged at the centre. Patients are enrolled into the HIV treatment programme following a referral from the HIV Counseling and Testing Centre, Nigerian Institute of Medical Research Lagos or transfer from other government HIV treatment centres.

HIV Positive Pregnant women is seen and registered for PMTCT services at the Wednesday PMTCT clinic. While the antenatal and postnatal services, including infant post exposure prophylaxis are provided by the centre, the intrapartum care is provided in collaboration with private and public hospitals and clinics. Health workers from these centres have been trained on intrapartum care of HIV positive mothers either by our centre, State or National HIV programme. The mothers are referred to any of these centres nearest to their place of residence at 36 weeks or as soon as possible with detailed information about their chosen mode of delivery, infant feeding choice, Viral Load and CD4 count results. Infant post exposure drug and mothers' ARV drugs are also given to the women. After their delivery at the facility, the women are referred back to the centre at 2 weeks post-delivery with a completed Case Record Form (CRF) designed specifically to capture all delivery related information. Information on the CRF is used to complete the postnatal data base. The home based care team contacts any mother who did not report back to centre at 2 weeks post expected date of delivery to ascertain the reasons for the default.

Study population

All HIV positive women enrolled into our PMTCT programme who from July 2004 and completed all PMTCT activities, including 6 week follow up for infant DNA PCR by 5th July 2011. HIV negative women seen in the referral hospital after each HIV positive served as control. Gestational age was estimated by the number of days between the first day of the last menstrual period (LMP) and date of birth expressed in completed weeks after LMP. A preterm birth was defined as births of infants occurring at less than 37 completed weeks of gestation. Low birth weight was defined as birth weight less than 2500grams. Women who did not know/remember their last menstrual period (3.3%) or did not return for postnatal care after delivery

and could not be traced (11.1%) were excluded from the analysis.

Antiretroviral regimen used during the study period

Antiretroviral drug regimen used during the period changed over time as a result of the change in national PMTCT guideline. The regimen changed thrice between July 2004 and July 2011. From July 2004 till March 2006, because of non-availability of widely accepted Nigerian national PMTCT guideline, HAART based regimen was used for PMTCT except for women who presented in labour who were given single dose Nevirapine with combivir tail of seven days. Between March 2006 and December 2009, the then national PMTCT was nationally adopted and our centre switched to the dictates of the guideline. Triple ARV therapy (HAART) was used only for women eligible for it based on stage of their HIV infection (CD4 count less than 200). Those with CD4 count above 200cells/mm3 were placed on ART prophylaxis of either monotherapy (Zidovudine) or dual therapy (Zidovudine + Lamivudine) depending on the gestational age at booking. From Jan. 2010 we reverted back to triple ARV based regimen for all women as the national guideline was revised in line with WHO recommendation. While NNRTI based HAART was given to women with CD4 count less than 350 cells/m3, PI based HAART was prescribed for women with CD4 cell count of greater or equal to 350 cells/m3.

Data Management

Information on maternal age and parity, height and weight, marital status, previous obstetric history, estimated gestation, birth weight, sex and vital status of the baby at birth, mode of delivery were collected prospectively. For the HIV positive women information on CD4 count, viral load, opportunistic infection status and HIV treatment history were also collected.

A mother was considered as 'booked' if both her pregnancy and HIV status were assessed; laboratory results reviewed and decision taken on the management of her pregnancy otherwise she is unbooked. Data were analyzed using SPSS for windows version 16.0. Frequency distributions were generated and cross-tabulations by each covariate were examined. Odds Ratios (OR) and 95% Confidence Intervals (CI) for the OR were calculated. The p value was based on 95% Confidence Intervals (CI); a p value > 0.05 was not significant (NS). A stepwise forward logistic regression was used. All variables were included in the initial analysis; the variable with the strongest association was estimated first, followed by all significant variables.

Ethical Issues

Approval for the study was obtained from the Institutional Review Board, Nigerian Institute of Medical Research, Lagos Nigeria. Written informed consents were obtained from all the women, for the use of their data for study. Low literates were assisted by an impartial witness who ensured that the content of the informed consent document were explained to the women in a language they understood before appending their thumb print. Women who declined consent to participate in the study were provided care but excluded from the study. The clinic patients are organized into an independent support group of people living with HIV (Positive Life Organization of Nigeria) that ensures that patients are not stigmatized and discriminated against. This group ensures that no patient is denied requisite care because of failure to participate in any of our studies including this study.

Results

A total of 2381 pregnancies met the eligibility for inclusion into the cohort. The 2381 pregnancies were in 1702 HIV positive women. While two pregnancies each were in 291 women, three, four and five pregnancies each were in thirty eight, four and one woman respectively. The remaining 1368 pregnancies were in 1368 women. Of the 2175 babies that were delivered and alive at 6 weeks, 21(0.97%) tested positive to HIV infection.

The sociodemographic characteristics of the women are shown in Table I. The characteristics of the women studied were comparable in all the parameters compared except for previous history

of spontaneous abortion, previous history of preterm delivery and gestational age at registration for care. The HIV positive women were more likely to have had a previous spontaneous abortion (p = 0.001) and preterm delivery (P<0.001) compared to the HIV negative women. A significantly (P<0.00) more number of HIV positive women (78.9%) registered for Prevention of Mother to Child Transmission of HIV (PMTCT) clinic after the first trimester compared to their HIV negative controls (68.1%).

Table 1: The sociodemographic, biologic characteristics and past reproductive history of the pregnant women in the study.

Factors	HIV positive women (%) N=2381	HIV Negative women (%) N=2381	P value
Mean age (years)	30.1±3.7	29.2±4.6	0.98
Mean Parity	1.7±1.1	1.6±1.7	0.87
Mean Body Max Index	28.9±3.9	29.1±3.9	0.61
Marital status			
Married	2062(86.6)	2069(89.1)	
Not married	319(13.4)	312(13.1)	0.79
Previous abortion history	1164(48.9)	1102(44.2)	0.001
Previous preterm delivery	376(15.8)	138(5.8)	<0.001
Social Class[12]			
I & II	250(10.5)	260(10.9)	
III	631(26.5)	660(27.7)	0.51
IV & V	1500(63.0)	1462(61.4)	
Gestational age at booking			
≤13 weeks	502(21.1)	741(31.1)	
>13 weeks	1879(78.9)	1640(68.1)	<0.001

Table II shows the pregnancy, obstetrics and neonatal outcome in the cohort. One thousand one hundred and fifty adverse events (48.3%) were recorded in the HIV positive women compared to seven hundred and twenty two (30.3%) events recorded in the HIV negative women. The difference was statistical significant at P <0.001 (OR: 2.08; CI: 1.84-2.34). While the rates of spontaneous miscarriage (p=0.002), severe anaemia (P=0.03), preterm delivery (P<0.001), low birth weight (P<0.001) and perinatal death (P<0.001) were found to be significantly higher in HIV positive women compared to their HIV negative counterparts, there were no differences between the two groups in the rates of obstetric haemorrhage (P=0.77), pregnancy induced hypertension (P=0.77), Apgar score less than 7 at the first minute (P=0.46), neonatal admission (P=0.24) and congenital anomaly (P=0.38). Subjecting the adverse pregnancy outcomes found to be associated with HIV positive pregnancy at univariate analysis to multiple logistic regression while controlling for potential confounders of age, parity, gestational age at registration for care, previous preterm delivery, previous spontaneous abortion, prematurity and low birth weight (see table 111) showed that only adverse events of low birth weight (OR:2.95; CI:1.95-3.1), preterm delivery (OR:2.05;CI:1.3-3.1), perinatal death (OR:1.9;CI:1.3-3.2), and spontaneous abortion (OR:1.37; CI:1.1-2.3) retained independent association with HIV infection in pregnancy.

Table 2: Pregnancy, obstetric and neonatal outcome in the pregnant women in the study.

Outcome	HIV positive women (%) N=2381	HIV Negative women (%) N=2381	P value	Crude Odd Ratio	Confidence Interval
Spontaneous abortion	76(3.2)	50(2.1)	0.02	1.54	1.06 – 2.24
Severe Anaemia	86(3.6	59(2.5)	0.03	1.47	1.04 – 2.09
Preterm delivery	276(13.1)	140(5.9)	<0.001	2.10	1.69 – 2.61
Obstetric haemorrhage	93(3.9)	98(4.1)	0.77	0.95	0.70 – 1.28

Pregnancy Induced Hypertension	97(4.1)	102(4.3)	0.77	0.95	0.71 – 1.27
Low birth weight	223(9.4)	79(3.3)	<0.001	3.01	2.30 – 3.95
Apgar Score <7@1min.	64(2.7)	55(2.3)	0.46	1.17	0.80 – 1.71
Neonatal admission	93(3.9)	77(3.2)	0.24	1.22	0.88 – 1.62
Perinatal death	130(5.5)	55(2.3)	<0.001	2.44	1.75 – 3.41
Congenital anomaly	12(0.5)	7(0.3)	0.38	1.72	0.63 – 4.82

One thousand one hundred and seventy (46.9%) HIV positive women were delivered through cesarean section compared to only six hundred and fifty one (27.3%) HIV negative women. The difference observed between the two groups was found to be statistically significant at P<0.001 (OR: 2.35; CI: 2.08-2.65).

The association between some selected sociodemographic and biologic characteristics and adverse pregnancy, obstetric and neonatal outcome is shown in table IV. Viral load greater than 10,000copies/ml (P=0.02), CD4 cell count below 200 cells/mm3 (P=0.001) and the presence of opportunistic infection (P=0.03) were significantly associated with adverse outcomes. However after controlling for potential cofounders in a multiple logistic regression model only CD4 cell count less than 200 cells/mm3 (OR:2.45; CI: 1.34- 4.56) and presence of opportunistic infections (OR:2.11; CI:1.56-3.45) retained their independent association with adverse outcomes of spontaneous abortion, preterm delivery, low birth weight and perinatal deaths.

Table 3: The adverse pregnancy outcome found to be independently associated with HIV infection after controlling for potential confounding variables

Factors independently associated with adverse pregnancy outcome	Adjusted Odd ratio	95% confidence Interval
Low birth weight	2.95	1.95 – 3.1
Preterm delivery	2.05	1.3 – 3.1
Perinatal death	1.9	1.3 – 3.2
Spontaneous abortion	1.37	1.1 - 2.3

Table 4: The association between sociodemographic and biologic characteristics of the HIV positive women and adverse pregnancy outcome

Characteristics	Outcome of pregnancy in HIV positives		P value	Odd Ratio		
	Adverse outcome n = 610(%)	No adverse outcome n= 1771(%)				95 % CI
Age (years)						
<20	21(3.5)	50(2.8)	0.48	1.25		0.72 – 2.15
20 – 35	516(84.6)	1531(86.5)	0	0		
>35	73(11.9)	190(10.7)	0.41	1.14		0.85 – 1.53
Parity						
0	158(25.9)	466(26.3)	0.91	1.02		0.80 – 1.30
1 – 2	234(38.4)	705(39,8)	0	0		
>2	218(35.7)	600(33.9)	0.44	1.09		0.88 – 1.36
Social Class[12]			0.2			
I & II	51(8.3)	214(12.1)	0	0.85		0.45 – 0.94
III	168(27.5)	457(25.8)	0.81	0		
IV & V	392(64.2)	1100(62.1)	0.001	0.97		0.78 – 1.20
CD4 level			0.067			
<200	161(26.4)	352(19.9)	0	1.46	1.03	1.15 – 1.84
200 – 350	158(25.9)	491(27.7)	0.85	0		0.82 – 1.29
>351	291(47.7)	928(52.4)	0			
Viral load			0.015	1.03		
<1000	290(47.5)	901(50.9)		0		0.81 – 1.30

1000 – 10,000	149(24.4)	476(26.9)	0.26	1.39	
>10,000	171(28.1)	394(22.2)	0		1.06 – 1.81
Body Mass Index			0.06	0.87	
< 23	164(26.9)	508(28.7)	0.03	0	0.68 – 1.11
23 – 25	212(34.8)	570(32.2)		0.94	
>25	242(39.8)	693(39.1)			0.75 – 1.17
Opportunistic Infection	73(12.0)	158(8.9)		1.39	
					1.02 – 1.88

Discussion

The introduction of highly active antiretroviral therapy (HAART), choice of delivery based on viral load and infant feeding counseling have changed the fate of the unborn child of HIV positive women especially in developed countries where vertical transmission of HIV Infection has virtually been eliminated. In developing countries where over 70-80% of the affected women reside and comprehensive health care limited, vertical transmission of the virus as well as other adverse pregnancy, obstetric and neonatal outcomes are still very common and often attributed to HIV infection. However evidence from developed countries and some developing countries have shown no association between HIV and adverse pregnancy, obstetric and neonatal outcome. It may therefore be right to assume that the effect observed in the developing countries are not due to HIV infection but to other cofounders of poor obstetric services , malnutrition, endemic anaemia and lack or poor HIV services. It may also be as a result of poor study methodology or insufficient sample size to make strong conclusions.

Premised on the above, we initiated this study in a setting that offers free comprehensive HIV care, treatment and support and subsidized caesarean delivery for HIV positive women. In addition the facility has a large pool of HIV positive women. Initiating this study in this setting was aimed at removing the possible contribution of poor HIV services and inadequate sample size to the conflicting findings of previous studies. The findings from this study are thus expected to reflect the actual effect of HIV infection on pregnancy, obstetric and neonatal outcome.

A limitation observed in this study that may have some impact on the findings is the fact that the intrapartum care of these women was not in the same facility where the antenatal and postnatal care was conducted. In addition the use of both private and public facilities may also have some effect on the finding. In the design of the study we tried to limit these effects by ensuring that the women only deliver in centres that have received training on intrapartum care of HIV positive women according to the Nigerian National PMTCT training manual. In addition controls were chosen from the same facilities that the HIV positive women delivered when possible.

The finding in this study of a large number of the women (334) presenting and managed with more than one pregnancy during the study period is very significant especially when viewed in the context of various recommendations in the early years of the epidemic. The grim picture painted has really changed. Thanks to the advances in HIV treatment care and support. The large number of the women with repeated pregnancies may be either as a result of the women trying to make up for the lost child through the high spontaneous abortion and perinatal death (replacement syndrome) or the women having had previous successful pregnancy outcome evidenced by a HIV negative baby and would want to quickly have another baby hoping for a repeat of the previous experience. It is not uncommon in our clinic to hear the HIV positive women proudly saying to our staff “we want to quickly complete our family before these free and quality services stop”. In our setting due to the unpredictable nature of polity including health services, clients tend to rush for free services, whenever available for fear the services may not last.

The mother to child transmission (MTCT) of HIV infection rate of 0.97% in this study is not only much lower than figures from developing countries but comparable to rates in developed countries. This very low rate may be as a result of several factors. In the period between July 2004 and April 2006, HAART was the antiretroviral

drug combination of choice irrespective of the CD4 cells count of the pregnant women who presented before 36 weeks. This was later changed when the national programme and our sponsors insisted we change to a new protocol that provided HAART only for pregnant women found to be eligible for their own disease. From the records during the HAART-only era, only one MTCT was recorded in a 29 year old lady with genital warts who presented at 36 weeks with CD4 count of 117 cells. She declined the offer of caesarean delivery after repeated counseling. She had rupture of fetal membrane lasting for more than 4 hours in labour and practiced mixed feeding. It is important to note that this case was in early 2005 when knowledge of HIV and PMTCT strategies was not wide spread and the stigma and discrimination were quite huge. Another reason that may have contributed to the low MTCT rate was that the default option for delivery in women with viral load greater than 10,000 copies/mm3 was cesarean section. Over 95% of the women offered cesarean section after counseling accepted to have it. This was at variance with what is obtainable in the larger society where there is a great aversion to cesarean section[13]. It is therefore not surprising that cesarean delivery was found to be statisitically significantly higher in the HIV positive women compared to HIV negatives in this study. We also practiced active PMTCT protocol that ensures that all HIV positive pregnant are commenced on antiretroviral drugs within one week of presentation except if they present before 13 weeks and not eligible to be commenced on HAART. Also majority of the HIV positive women opted not to breastfeed after counseling on infant feeding options in the context of HIV infection[14]. The indigent women who opted not to breastfeed were provided free infant formula for six months.

The overall adverse pregnancy, obstetric and neonatal outcome of 48.3% though high is not unexpected as several studies in sub-Saharan Africa had shown an increased adverse outcome in pregnant HIV positive women. In HIV endemic countries, the background adverse obstetric and neonatal outcome due to poverty, low status of women, poor health system and malnutrition are superimposed on the adverse events due to HIV[2,4]. Findings from this study confirm this as the adverse events in HIV positive of 48.3% was significantly higher than 30.3% in the HIV negatives (P<0.001).

Although previous studies[1,2,4] found an association between HIV infection in pregnancy and increased rates of low birth weight, prematurity, miscarriage, anemia, perinatal deaths, birth asphyxia, neonatal admission, and congenital abnormality , however it was only low birth weight (OR:2.95), prematurity (OR:2.05), perinatal death (OR:1.9) and spontaneous abortion (OR: 1.37) that were significantly associated with HIV infection in this study. Our study methodology and large sample size may have enabled us to sieve out only outcomes that were directly linked to HIV infection. The presence of opportunistic infection in HIV positive predisposes women to preterm delivery as a result of ill health and fever of infection. In addition prematurity and low births are the leading cause of perinatal mortality[14]. The poor weight gain as a result of HIV infection may also be contributing to high low birth weight rate in this study.

To add further value to this study, we conducted sub-analysis to identify the socioeconomic and biologic characteristics associated with adverse obstetric and neonatal outcome of low birth weight, prematurity, perinatal deaths and spontaneous abortion. This information is essential for the modification of the present PMTCT strategy. Of the socioeconomic and biologic characteristics studied, only CD4 count less than 200cells/mm3 (OR: 2.45; CI: 1.34-4.56) and presence of opportunistic infection (OR: 2.11; CI: 1.56-3.45) were found to be independently associated with poor obstetric and neonatal outcome after controlling for potential confounders. The above finding is similar to finding from previous studies[5,7,11]. The findings thus call for early identification of HIV positive women, prompt identification and treatment of opportunistic infection and early initiation of an effective combination antiretroviral therapy to allow good enough time for treatment of opportunistic infection, viral suppression below 1000 copies/mls and immune reconstitution. The higher cesarean section rate found among the HIV positive women compared to their HIV negative

counterpart is not unexpected. Apart from obstetric reasons of low birth weight, prematurity and rupture of membrane to avoid the 4 hour window period of increased MTCT rate, all women with viral load greater than 1000 copies were offered cesarean section . In addition cesarean section was free in all public health institutions during the period of study except for the last four months. All these add up to an increased cesarean section rate in HIV positive women in this cohort. This rate is likely to drop drastically with the revision of the national PMTCT guideline restoring HAART as the antiretroviral drug combination of choice and the withdrawal of the subsidy for cesarean section in public hospitals.

Conclusion

This study has confirmed the link between HIV infection and adverse obstetric and neonatal outcomes of spontaneous abortion, low birth weight, prematurity and perinatal death using a large population of HIV positive women and methodology that took into consideration the weakness of the previous studies. The mother to child transmission of HIV infection rate of 0.99% showed that it is possible to achieve MTCT rate less than 1 % in our setting. Severe Immunosuppression and presence of opportunistic infections were the factors found to be independently associated with poor obstetric and neonatal outcome in this study.

Conflict of Interest

All authors declare no conflict of interest

Acknowledgement

The Medical Directors of the collaborating public and private Institutions especially that of Havana. Rao, New Capstone and Felin Hospitals Lagos for allowing us access to their patient data. APIN Plus and APIN for funding the HIV treatment centre. Mrs. Yemi Nwogbe and Mr. Abdul Rasheed Oba for their assistance with HIV data.

References

1. Leroy V, Ladner J, Nyiraziraje M, A De Clercq, Bazubagira A, Van de Perre P, Karita E, and Dabis F. Effect of HIV-1 infection on pregnancy outcome in women in Kigali, Rwanda, 1992–1994. AIDS 1998, 12:643–650
2. Onah HE, Obi SN, Agbata TA, & Oguanuo TC. Pregnancy outcome in HIV-positive women in Enugu, Nigeria. Journal of Obstetrics and Gynaecology, April 2007; 27(3): 271 – 274
3. Abdol – Karim Q, AbouZahr C, Dehne K, Mangiaterra V, Moodley J, Rollins N, Say L, Schaffer N, Rosen JE, de Zoysa I. HIV and maternal mortality: turning point. The Lancet 2010;375:1948-1949
4. Chama CM, Bello M, Ajayi BA, Zarma S, Gashau W. The use of highly active antiretroviral therapy for the prevention of mother-to-child transmission of the human immunodeficiency virus in Nigeria. Journal of Obstetrics and Gynaecology, May 2010; 30(4): 362–3665.
5. Fageeh WMK. Presentation and pregnancy outcome of HIV-positive women in Jeddah, Saudi Arabia. International Journal of Gynecology and Obstetrics 2011; 113:39–2486.
6. Kumar RM, Udumanb SA,Khurrannac AK. Impact of maternal HIV-l infection on perinatal outcome. International Journal of Gynecology & Obstetrics. 1995; 49: 137- 143
7. Brocklehurst P, French R. The association between maternal HIV infection and perinatal outcome: a systematic review of the literature and meta-analysis. *British Journal of Obstetrics and Gynaecology*, 1998, 105:839-848.
8. Johnstone FD, MacCallum L, Brettle R. Inglis JM, Peutherer JF. Does infection with HIV affect the outcome of pregnancy? Br Med J 1988; 296: 467.
9. Minkoff HL, Henderson C, Mendez H, et al. Pregnancy outcomes among mothers infected with human immunodeficiency virus and uninfected control subjects. Am J Obstet Gynecol 1990: 163: 1598-1604.
10. Semprini AE, Ravizza M, Bucceri A, Vucetich A, Pardi C. Perinatal outcome in HIV-infected pregnant women. Gynecol Obstet Invest 1990; 30: 15- 18.
11. Taguebue J, Monebenimp F, Zingg W, Mve Koh V, Atchoumi A, Gervaix A, Tetanye E. Risk Factors for Prematurity among Neonates from HIV Positive Mothers in Cameroon . *World Journal of AIDS*, 2011, 1, 1-7
12. Olusanya O, Amiegheme N. Biosocial factors in maternal mortality. A study from a Nigerian Mission Hospital. West African Journal of Medicine 1989;8:160-165
13. Ezechi O.C., Kalu B. E.K., Loto O.M., Fasubaa, O.B., Obiesie L.O., Nwokoro C.A. Caesarean delivery: Why the aversion? Tropical Journal of Obstetrics and Gynaecology. Tropical Journal of Obstetrics and Gynaecology 2004; 21(2): 164-167.
14. Ezechi OC, C. Gab-okafor, C. Ukaegbu, N. David, P.M. Ezeobi, T. Gbajabiamila, R.A. Adu, O.E. Somefun, D. Oladele, D. Onwujekwe, N.N. Odunukwe, E.N. Amadi, R. Anyanwu, O.E. Idigbe, E. Herbertson . Infant feeding practices of HIV-Infected and uninfected women in Lagos Nigeria. 15th International

Conference on AIDS and STIs in Africa Dakar Senegal 3-7 December 2008. Abstract number : 23/SOC01

15. Zupan J, Aahman E. Perinatal mortality for the year 2000: estimates developed by WHO. Geneva: World Health Organization, 2005.