We estimated the prevalence, seroconversion and incidence of HIV infection and risk factors of pregnant women who gave childbirths from January 2018 to December 2019 using a retrospective cohort design. Risk factors for prevalence and incidence of HIV were identified using logistic regression analysis. The prevalence and incidence of HIV were 44.7% (95% CI: 42.4-47.1) and 18.3 per 100 person-years respectively. The seroconversion rates after 12 weeks and at delivery of these pregnant women were 3.1% (95% CI: 2.8-3.5%) and 3.2% (95% CI: 2.8-3.5%) respectively. Ages < 20 years 87% (OR=0.13, 95% CI:0.03:0.58, p=0.007) and 20-24 years 76% (OR=0.24, 95% CI: 0.60:0.97, p=0.046) were less likely to have HIV. Nil parity 55%,(OR=0.45, 95% CI:0.27:0.73, p=0.001), having antenatal care 84% (OR=0.16, 95% CI:0.05:0.48, p=0.001), higher number of antenatal care visit (4-7) 32% (OR=0.68, 95% CI: 0.50:0.93, p=0.015) and women without syphilis 61% (OR=0.39, 95% CI:0.18:0.87, p=0.022) were less likely to have HIV infection. Strategies must target the risk factors to prevent HIV among pregnant women.

**Keywords:** Midwife obstetric unit, low-risk pregnancy, antenatal care, antenatal visit, syphilis.
identifying risk factors can facilitate the evaluation of existing intervention programs. Little is known regarding the prevalence, incidence and risk factors for HIV infection among pregnant women living in a semi-urban setting and attending a midwife obstetric unit (MOU). The aim of this research is to provide information to assist programme managers and health services planners to identify the magnitude of the problem and plan for effective strategies to test, treat and control HIV infection during pregnancy. The objectives are to estimate the prevalence, seroconversion, incidence and risk factors for HIV infection among pregnant women attending a MOU.

II. METHODS

A. Study Design

A retrospective study was designed to abstract data from the birth register of a MOU between January 2018 to December 2019.

B. Population and Sampling

All women who had given childbirth during the study period were included in the study. The number of women who gave childbirth was 1628 and constituted the sample of the study.

C. Study Setting

The study was conducted at Kwadabeka Community Health Centre (KCHC) facilitated by the public health authority of SA which provides free reproductive health including maternity services. It is situated in a peri-urban community of the eThekwini health district. The facility serves predominantly the black population of over 150,000 with the majority of individuals residing in informal types of dwellings and classified as part of low socioeconomic status. The facility also provides a comprehensive PHC services package according to SA national (DOH) policy and priority [17]. Maternity services are available 24 hours a day and are run by qualified midwives. Antenatal care and delivery services are rendered according to the national protocol and guidelines [15]. The facility conducts about 800 deliveries annually. Pregnant women who attend public health facilities are tested for HIV and treated those who are HIV infected with HAART including those who seroconvert during the course of pregnancy to improve maternal health and prevent mother-to-child transmission [9].

D. Ethical consideration

Umgungundlovu Health ethics Review Board had given Ethical clearance (Reference no. UHERRB 015/2020) for the study. Permission was sought from the Research Committee of the KZN department of health. Additional written permission was obtained from the institutional management to use the relevant data for the study. Informed consent was waived due to the use of secondary data.

E. Data sources, Screening, Testing and Management of HIV

Data was collected from the labour ward “birth register”. The register was developed and implemented by the KZN Department of Health for all maternity units for recording selective variables for ANC initiation (booking), follow up visits and delivery in a structured format [15]. The selective antenatal variables for the study were obtained from the birth register by the research assistant. The birth register contains among others the age in years, parity, gravidity, ANC history, gestational age (GA) in weeks for booking, subsequent ANC visits and at delivery, HIV test results and the time (before or during the index pregnancy) women became HIV positive and initiation of ART. The researchers obtained the birth register from the labour ward and captured manual data in electronic format using Microsoft Excel 365 programme with double entry by the research assistants to minimize data entry errors.

As a routine practice at KCHC all pregnant women were counselled in a group and individually with information on HIV testing at their first and follow-up visits being communicated. All pregnant mothers were tested for HIV and syphilis in addition to rhesus factors for blood grouping and estimation of haemoglobin (Hb) to detect and treat anaemia. Finger prick blood samples were used for two rapid tests of two different (make) suppliers. If the results of both tests were positive, the mother was considered HIV infected. If one of the rapid test results was negative, a confirmatory Enzyme-Linked Immunosorbent Assay (ELISA) was performed to confirm HIV infection at the laboratory. Every infected HIV woman was offered HAART on the same day. Those pregnant women who had HIV negative results at the booking visit were retested after 12 weeks (according to national policy) or later or and at delivery and offered ART for HIV infected women at any stage of pregnancy or post-partum.

III. DATA ANALYSIS

The Microsoft excel data was exported, coded, and analysed using SPSS 22.0. Ages were categorised into; < 20 (teenage), 20–24, 25-29, 30-34, 35-39 and ≥ 40 years, GA into 0–13 (first trimester), 14–27 (second trimester) and ≥ 28 weeks (third trimester). Parity was categorised as; nil-parity (0), 1-2, 3-4 and ≥ 5. ANC visits were categorized into; 0 (un-booked), 1-3, 4-7 and ≥ 8 visits. The HIV test results at the booking, 12 weeks repeat visits and at delivery were used to estimate the total prevalence, incidence and seroconversion of maternal HIV. The incidence of HIV after calculating the total person-years followed up for repeat HIV tests and measured the incidence of HIV per 100 person-years. Univariate and multivariate analyses were undertaken. The independent and outcome variables of the study were summarized using descriptive statistics e. g., the mean with standard deviation (SD) for continuous variables and percent for categorical variables. Differences in proportions of HIV infection for different demographic and obstetric variables at the booking visit were examined by cross-table analysis using the Pearson chi-square (χ2) test and p-values. Variables showing significant differences in the proportion of outcome variables (HIV prevalence and incidence or seroconversion) were used in step by step backward binary logistic regression to determine the predictors. Logistic regression outputs were presented with adjusted odds ratios (OR) (as an effect) with the corresponding 95% confidence intervals (95% CI) and p-values (values <0.05 were considered statistically significant).
IV. RESULTS

A total of 1628 women delivered during the study period. The mean age (SD) of the mothers was 26 (5.7) years with the minimum and maximum ages of 14 and 44 years respectively. The descriptive statistics (frequency and per cent) are shown in Table I.

In total, 981 (60.4%) of 1628 mothers knew their HIV status at booking visits and of those that knew their status, 539 (55%) were HIV positive and on ART. Of the 94 mothers who had no ANC bookings, 53 (56%) knew their HIV status and 31 (58%) of them (53) knew that they were HIV positive. Among those who did not know their HIV status and were known as HIV negative, (1089) were tested at booking visit with 137 (12.5%) of them being HIV positive. A total of 963 pregnant women who were HIV negative (HIV free) at booking visits were retested after 12 weeks and 29 of them were found to be HIV positive resulting in a seroconversion rate of 3.1% (95% CI 2.8-3.5%). Those (126) that defaulted after 12 weeks of the first retest and those that tested (682) negative (after 12 weeks retest) were retested (resulted in a total of 808) at delivery with 26 of them found HIV positive and therefore a seroconversion rate of 3.2% (95% CI 2.8-3.5%). Those (126) that defaulted after 12 weeks of the first retest and those that tested (682) negative (after 12 weeks retest) were retested (resulted in a total of 808) at delivery with 26 of them found HIV positive and therefore a seroconversion rate of 3.2% (95% CI 2.8-3.5%) was found at the time of delivery. Calculating the person-years for repeat HIV tests using gestational ages at booking visit and repeat HIV test positive results (after 12 weeks and at delivery) it was found that a total of 289 persons-years were followed for 963 pregnant women and 53 new occurrences of HIV resulting in the incidence of HIV of 18.3 per 100 person-years during the index pregnancy. Among all women who had childbirths during the study period, 729 were HIV positive which resulted in the total percentage of 44.7 (42.2-47.1) of the pregnant women (p < 0.05) in Table II.

TABLE I: FREQUENCY DISTRIBUTION OF DEMOGRAPHIC, ANTENATAL AND HIV RELATED INFORMATION

| Variables | Frequency | Percent (95% CI) |
|-----------|-----------|-----------------|
| Age       |           |                 |
| <19 years (Teenage pregnancy) | 239 | 14.7 |
| 20-24 years | 464 | 28.6 |
| 25-29 years | 469 | 28.9 |
| 30-34 years | 318 | 28.9 |
| 35-39 years | 120 | 7.4 |
| >40 years | 15 | 0.9 |
| Parity |           |                 |
| Nil parity (0) | 489 | 30.2 |
| Parity 1-2 | 909 | 56.1 |
| Parity 3-4 | 205 | 12.7 |
| Parity >5 parity | 16 | 1.0 |
| ANC booking <20 weeks (n=1596) | | |
| Yes | 837 | 47.4 |
| No | 759 | 52.6 |
| No of antenatal visits (n=1603) | | |
| Un-booked visit | 94 | 5.8 |
| 1-3 visits | 319 | 20.1 |
| 4-7 visits | 806 | 50.2 |
| =>8 visits | 384 | 23.9 |
| GA at childbirths (n=1551) | | |
| <32 weeks | 43 | 2.8 |
| 32-36 weeks | 193 | 12.4 |
| =>37 weeks | 1315 | 84.8 |
| Syphilis status (n=1621) | | |
| Positive | 36 | 2.2 |
| Negative | 1585 | 97.8 |
| HIV Status known at booking visit (n=1625) | | |
| HIV positive | 981 | 60.4 |
| HIV known at booking visit (n=981) | | |
| HIV test positive at booking visit (n=1089) | | |
| 183 | 12.5 |
| HIV Seroconversion after 12 weeks (n=963) | | |
| HIV Seroconversion at childbirth (n=808) | | |
| HIV incidence Total HIV positive (Prevalence) (n=1628) | | |

Teenage pregnancy rate (age < 20 years) was 14.7%. A considerable percentage (77.1%) of the mothers belonged in ages between 20 to 34 years. Less than 1% of the mothers were the ages ≥40 years. Nearly a third (30.2%) of them were nulliparous women. The majority of women (56.1%) had parity between 1 and 2 and only 1% had parity ≥5. The rate of no ANC visit was 6.2% among these women who delivered during the study period. Four or more ANC visits were completed by 74.1% of pregnant women. However, the rate of 8 or more ANC visits (new target) was completed by only 23.9% of women. Majority of women (85%) delivered at term gestation. The prevalence of syphilis was 2.2% at birth. Significantly different HIV infection rates were found in different age groups, parity, numbers of ANC visits and syphilis status of the pregnant women (p < 0.05) in Table II.

TABLE II: CROSS TABLE ANALYSIS OF THE INDEPENDENT AND OUTCOME (HIV POSITIVE) VARIABLES

| Variables | HIV positive (%) | X² values | p-values |
|-----------|-----------------|-----------|----------|
| Age       |                 |           |          |
| <19 years | 5.1             | 230.213   | 0.000    |
| 20-24 years | 19.8       |           |          |
| 25-29 years | 32.9          |           |          |
| 30-34 years | 28.3          |           |          |
| 35-39 years | 12.3          |           |          |
| ≥40 years | 1.6             |           |          |
| Parity (n=1619) |             |           |          |
| Nil parity | 13.9           |           |          |
| Parity 1-2 | 66.7           |           |          |
| Parity 3-4 | 18.3           | 172.693   | 0.000    |
| Parity >5 parity | 1.1          |           |          |
| Number of antenatal visits | | | |
| Un-booked visit (o visit) | 6.3 |           |          |
| 1-3 visits | 20.1           | 6.320     | 0.017    |
| 4-7 visits | 47.1           |           |          |
| =>8 visits | 26.5           |           |          |
| ANC initiation | | | |
| Initiation before 20 weeks | 54.6 | 4.067 | 0.131 |
| Initiation after 20 weeks | 45.4 |           |          |
| Syphilis status | | | |
| Positive | 96.9           | 8.816     | 0.003    |
| Negative | 3.4            |           |          |
| Gestation (GA) | | | |
| <32 weeks | 3.0            |           |          |
| 32-36 weeks | 13.3          | 1.173     | 0.556    |
| ≥37 weeks | 83.7           |           |          |
prevalence of HIV of 44.7% (95% CI; 42.4:47.1).

Logistic regression output (Table III) showed that women of older ages had a higher risk of being HIV positive (prevalence). Teenage mothers 87% (OR=0.13, 95% CI; 0.03:0.58, p=0.007) and the ages between 20 to 24 years 76% (OR=0.24, 95% CI; 0.06:0.97, p=0.046) were less likely to have HIV infection compared to mothers aged ≥ 40 years. Similarly, lower parity (nil parity) was 55% less likely (OR=0.45, 95% CI; 0.27:0.73, p=0.001) to have HIV infection. Pregnant women who had ANC were 84% (OR=0.16, 95% CI; 0.05:0.48, p=0.001) less likely to have HIV. The number of ANC visits between 4 and 7 was 32% (OR=0.68, 95% CI; 0.50:0.93, p=0.015) less likely to have HIV. Having a diagnosis of syphilis was a risk factor for HIV infection compared to those not having syphilis as 61% (OR=0.39, 95% CI; 0.18:0.87, p=0.022) were less likely to have HIV infection. However, no factor was found associated with seroconversion of HIV (Table IV).

### Table III: Logistic Regression Output for All HIV Positive Women

| Variables     | Significance (p values) | Adjusted Odds Ratios (OR) | 95% C.I. for OR |
|---------------|-------------------------|---------------------------|----------------|
| Age           | 0.000                   |                           |                |
| Teenage (< 20 years) | 0.007                  | 0.139                     | 0.033:0.585    |
| Age 20-24 years       | 0.046                  | 0.245                     | 0.061:0.978    |
| Age 25-29 years       | 0.272                  | 0.464                     | 0.118:1.827    |
| Age 30-34 years       | 0.721                  | 0.779                     | 0.198:3.065    |
| Age 35-39 years       | 0.719                  | 1.297                     | 0.315:5.343    |
| Parity           | 0.000                   |                           |                |
| Parity nil        | 0.001                  | 0.453                     | 0.279:0.737    |
| Parity 1-2        | 0.928                  | 0.982                     | 0.661:1.458    |
| Parity 3-4        | 0.687                  | 1.084                     | 0.731:1.609    |
| Initiated ANC     | 0.001                  | 0.161                     | 0.053:0.485    |
| No. of ANC visits | 0.013                  |                           |                |
| No of ANC visits (0) | 0.853                  | 1.056                     | 0.592:1.883    |
| ANC visits (1-3)   | 0.909                  | 1.020                     | 0.725:1.434    |
| ANC visits (4-7)   | 0.015                  | 0.686                     | 0.506:0.931    |
| Syphilis negative  | 0.022                  | 0.398                     | 0.180:0.876    |
| Constant         | 0.999                  | 0.000                     |                |

### Table IV: Logistic Regression Output for Seroconversion or Incidence of HIV

| Variables     | Sig. | Exp(B) | 95% C.I. for EXP(B) |
|---------------|------|--------|---------------------|
| Age coded     | 0.061|        |                     |
| Age < 20 years| 0.176| 0.370  | 0.088:1.560         |
| Age 20-24 years| 0.169| 0.392  | 0.103:1.488         |
| Age 25-29 years| 0.655| 0.743  | 0.202:2.738         |
| Age 30-34 years| 0.810| 1.177  | 0.311:4.458         |
| No. of ANC visits| 0.038|        |                     |
| ANC visits (0/nil) | 0.301| 1.716  | 0.617:4.776         |
| ANC visits (1-3) | 0.051| 0.409  | 0.166:1.003         |
| ANC visits (4-7) | 0.148| 0.583  | 0.281:1.210         |
| Constant      | 0.002| 0.132  |                     |

### Discussion

This study estimated HIV prevalence, seroconversion and incidence of HIV among the pregnant population of a small community attending an MOU of a CHC (first level of health care facility). Firstly, the antenatal care utilization patterns of this cohort were similar to other reports as 94% of pregnant women attended at least one ANC visit and 96% attended childbirths at health facilities [18]. Three fourths (74.8%) of women had 4 or more ANC visits during their pregnancy. This rate is higher than the national target of 70% and also similar to other findings from an urban setting in SA [15], [18].

We found an HIV prevalence of 44.7% in our study population. This is higher than the prevalence of 40.9% estimated in 2019 in an annual antenatal HIV seroprevalence survey from KZN [16]. However, the rate we found in our study was similar to the rate (44.4%) estimated in an earlier report from KZN and a report from Western Cape of SA [19], [20]. The seroconversion rate of HIV in our study of 3.1% at 12 weeks of follow-up and 3.2% at delivery were also higher than a rate found in Tanzania (2%) [21]. A higher (9.2%) HIV seroconversion rate was found between the initiation of ANC and at the time of delivery from an earlier report in Durban SA [22]. However, lower HIV seroconversion rates among pregnant women of 1.2% and 1.5% were found at 12 weeks of follow up and at the time of delivery respectively from a regional hospital in Durban, SA [22]. The higher rate of HIV seroconversion in our study can be associated with a higher seroprevalence (44.7%) of HIV estimated among pregnant women in our study compared to a much lower prevalence (7.2%) in other studies from Tanzania [21].

The HIV incidence among our study sample of 18 per 100 person-year was higher than the incidence estimated (4.7 per 100 person-years) for pregnant women from a meta-analysis of 19 cohort studies [23]. Even among the general population of rural KZN, the HIV incidence among the female population was lower at 3.06 per 100 person-years and it was higher than the male incidence in 2017 [24]. A lower rate of 1.5 cases per 100 person-years of HIV incidence was found in a different population in SA [25]. However, the higher incidence of HIV in our study could be due to the higher prevalence of HIV and the unprotected sexual activity among these pregnant women as most of the pregnant women are sexually active.

Risk factors for HIV infection in our study were older pregnant women, advanced in gestation or pregnancy (last trimester), higher parity and lastly infection with syphilis. It is known that syphilis infection increases the risk for HIV infection by between 2 to 4 folds in pregnant women and unborn fetuses [26]. These higher rates of HIV and syphilis infections among pregnant women also suggest that these infections coexist and remain an important public health problem in SA with the hypothesis that there are differences in prevalence and incidence of HIV infection in different geographical areas and populations that may have masked the national and provincial rates. It is therefore important to strengthen HIV intervention programme efforts at the institutional and or community levels based on the risk groups. A decreasing trend of HIV prevalence among younger pregnant women (age < 29 years) was reported from SA from a rate of 21.8% in 2010 to 18.5% in 2017 [16]. Thus,
our findings are in contrast with the age distribution of HIV infection among pregnant women attending this health facility in SA and other African countries [27]. The retrospective study design limited the study variables for risk factors. The prevalence of syphilis at booking visits and completion of treatment were not available. However, it is known that a higher proportion (>95%) of pregnant women do attend ANC at least once in KZN therefore our study sample represented the pregnant population of the community [28].

VI. CONCLUSION

The study found a higher rates of HIV prevalence, seroconversion and incidence among the pregnant women of SA. There is a change in age distribution of HIV infection with the younger women being less likely to be infected with HIV. Having quality of ANC and more ANC visits (> 4) among pregnant women are found with decreasing prevalence of HIV infection.

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AUTHOR CONTRIBUTIONS

AMH- Conceptualization, data verification and analysis, writing report and finalization of the manuscript.

SB- Conceptualization, writing report and finalization of the manuscript.

MH- Data capture, verification, coding, analysis and finalization of the manuscript.

CONFLICT OF INTEREST

The authors declare that they do not have any conflict of interest.

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