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Title

Prevalence and determinants of unplanned pregnancy in HIV-positive and HIV-negative pregnant women in Cape Town, South Africa: a cross-sectional study

Short title

Unplanned pregnancy among HIV-positive and HIV-negative pregnant women in South Africa

Authors

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ABSTRACT

Objectives: Prevention of unplanned pregnancy is a crucial aspect of preventing mother-to-child HIV transmission (PMTCT). There are few data investigating how HIV status and use of antiretroviral therapy (ART) influences pregnancy planning in high HIV burden settings. Our objective was to examine the prevalence and determinants of unplanned pregnancy among HIV-positive and HIV-negative women in Cape Town, South Africa.

Design: Cross-sectional analysis.

Settings: Single primary-level antenatal care clinic in Cape Town, South Africa.

Participants: HIV-positive and -negative pregnant women, booking for antenatal care from March 2013 - August 2015, were included.

Main Outcome measures: Unplanned pregnancy was measured at the first antenatal care visit using the London Measure of Unplanned Pregnancy (LMUP). Analyses examined LMUP scores across four groups of participants defined by their HIV status, awareness of their HIV status prior to the current pregnancy, and/or whether they were using ART prior to the current pregnancy.

Results: Among 2105 pregnant women (1512 HIV-positive; 593 HIV-negative), median age was 28 years, 43% were married/co-habiting and 20% were nulliparous. Levels of unplanned pregnancy were significantly higher in HIV-positive versus HIV-negative women (50% vs. 33%, $p<0.001$); and highest in women who were known HIV-positive but not on ART (53%). After adjusting for age, parity and marital status, the odds of unplanned pregnancy were greatest among women newly diagnosed and women who were known HIV-positive but not on ART (compared to HIV-negative women, adjusted odds ratio [aOR]: 1.43; 95% confidence interval [CI]: 1.06-1.94 and aOR: 1.57; 95% CI: 1.14-2.16, respectively). Increased parity and younger age (<24years) were also associated with unplanned pregnancy (aOR: 1.42; 95% CI: 1.25-1.60 and aOR: 1.84; 95% CI: 1.23-2.75, respectively).

Conclusions: We observed high levels of unplanned pregnancy, particularly among HIV-positive women not on ART, suggesting ongoing missed opportunities for improved family planning and counselling services for HIV-positive women.

Strengths and limitations of this study:

- One of the first studies to examine pregnancy intentions by HIV status and antiretroviral therapy use utilizing a relatively large cross-sectional sample of participants including an HIV-negative comparator group.
- Employed a robust pregnancy intention instrument fairly new to our setting which performed well in comparison to an existing measure.
- Although the findings of this study is largely representative of existing sexual and reproductive practices within the country, it may not be generalizable to other resource-limited settings.
- Self-reported pregnancy intentions after pregnancy recognition and entering antenatal care, may have increased acceptance of the pregnancy and resulted in over reporting of planned pregnancy.

INTRODUCTION

Efforts to eliminate mother-to-child transmission of HIV (MTCT) continue to escalate globally, with unprecedented numbers of HIV-infected pregnant women receiving triple drug antiretroviral therapy (ART) during pregnancy and breastfeeding.[1] These advances in prevention of mother-to-child transmission (PMTCT) services have led to significant reductions in the number of new pediatric infections across resource-limited settings including Africa.[1] South Africa has the highest number of individuals living with HIV worldwide with up to 18.8% prevalence among women of child-bearing age.[2] HIV prevalence is particularly high among pregnant women, with almost 30% of those seeking antenatal care (ANC) testing HIV-positive nationally.[3] Despite the substantial efforts of current PMTCT programmes, MTCT remains a major driving force of the country's HIV epidemic and in turn, an ongoing concern.[4]

Even where ART is widely available to pregnant and breastfeeding women, the timing and intention of a pregnancy may be important indirect risk factors for MTCT.[5 6] Unplanned pregnancies predict maternal health behaviours during pregnancy and in the postpartum period, including late presentation for ANC, reduced ART adherence and suboptimal breastfeeding practices.[6-9] Preventing unplanned pregnancies among HIV-positive women through addressing the unmet need for family planning is a relatively low-cost, effective method for preventing new paediatric HIV infections.[10 11 12]

Around the world, 40% of all pregnancies are estimated to be unplanned. In comparison, 55-65% of pregnancies among HIV-positive women may be unplanned.[13] However, the current evidence for the association between HIV status, ART use and unplanned pregnancy remains inconsistent.[14-16] While some previous studies documented higher levels of unplanned pregnancies among HIV-positive compared to HIV-negative women,[17] others found no association between HIV status and unplanned pregnancy.[18-20] Further, women who are not aware of their HIV status prior to conception may be more likely to have an unplanned pregnancy.[19] In contrast, there is also some evidence to suggest that women recently initiating ART may be more likely to experience an unplanned pregnancy.[15 21 22] There are few robust data on pregnancy planning among HIV-positive women initiating ART in the current era of PMTCT.

In this context, there is a clear need for further insights into pregnancy planning and associated factors among HIV-positive women in high burden settings. To address this, we examined the prevalence and determinants of unplanned pregnancy among HIV-positive and HIV-negative women in Cape Town, South Africa.

METHODS

Study setting and design

This cross-sectional analysis utilized data obtained from the enrolment visit of the MCH-ART (Maternal-Child Health Antiretroviral Therapy) study, a multicomponent implementation science study investigating optimal strategies for delivering ART services to HIV-positive pregnant and postpartum women (ClinicalTrials.gov NCT01933477). The study took place in the community of Gugulethu, a historically disadvantaged community with a high burden of HIV. The MCH-ART study methods have been described in detail previously.[23] Briefly, HIV-positive pregnant women above 18 years of age were consecutively enrolled at their first ANC visit. In addition, this analysis utilized data from a parallel sub-study to MCH-ART, the HIV-unexposed, uninfected (HU2) study which enrolled HIV-negative women attending their first ANC visit, to provide a comparison group. [23]

Ethical considerations

The MCH-ART and HU2 studies were approved by the University of Cape Town's Faculty of Health Sciences Human Research Ethics Committee and the Institutional Review Board of Columbia University. All participants provided a written informed consent prior to participation in both studies.

Data collection

Following enrolment at their first ANC visit, all participants completed a structured interviewer-administered questionnaire in their language of choice - isiXhosa or English. Information collected included basic socio-demographic characteristics, medical history, pregnancy intentions and contraceptive use. All measures were translated into isiXhosa, and back-translated into English by a second translator, to ensure accuracy.

Contraceptive use was defined as any contraceptive method used in the 12 months prior to pregnancy recognition. A categorical variable was created for socio-economic status (SES) based on employment status, highest level of education, housing type and number of amenities in the household, and was categorized into quartiles. Pregnancy intentions were assessed using a validated 6-item questionnaire, the London Measure of Unplanned Pregnancy (LMUP). This instrument asked women to report the circumstances of their most recent pregnancy, with each item in the tool scored 0, 1 or 2 according to published scoring guidelines (LMUP analysis guidance paper). [24] Women's scores were summed across all 6 items, resulting in a total score from 0-12 with each point increase representing an increase in pregnancy intention. Total LMUP scores were divided into categories of pregnancy intentions: unplanned (0-3), ambivalent (4-9) and planned (10-12), based on the scoring used in the original development of the scale.[24] A separate single item, three level response question (Current pregnancy intended: Yes, No, Unsure) was used to examine the performance of the LMUP.

Statistical analysis

Statistical analyses were performed using STATA version 12.0 (Stata Corporation, College Station, Texas, USA). In this analysis, participants were categorized into four groups based on routine public sector HIV testing at entry into ANC, and self-reported ART use: (1) known HIV-positive and established on ART, (2) known HIV-positive but not on ART, (3) newly diagnosed HIV-positive during the current pregnancy, and (4) HIV-negative, used as the reference category. Socio-demographic characteristics at enrolment were compared across these four groups. Cronbach's α was used to assess the reliability of the isiXhosa translated LMUP in this context, and bivariate analysis using a χ^2 test compared the isiXhosa LMUP to the single three-level response question. Associations between characteristics at enrollment and unplanned pregnancy were explored using χ^2 and Fisher's exact tests for categorical, and Wilcoxon rank-sum tests for continuous variables. A multivariable logistic regression model was built to examine independent predictors of unplanned pregnancy, with maternal age and SES considered as *a priori* confounders. Model fit was explored using Akaike's information criterion (AIC). For the logistic regression analysis, LMUP scores were dichotomized into unplanned/ ambivalent (LMUP score 0-9) versus planned pregnancy (LMUP score 10-12).

RESULTS

A total of 2105 women (1512 HIV-positive and 593 HIV-negative), enrolled between March 2013 and August 2015, were included in this analysis. The median age of participants was 28 [inter-quartile range (IQR) 24-33] years, 29% had completed high school, 61% were unemployed and 43% were married or cohabiting. Across all groups, 20% were nulliparous (Table 1). Among the overall group of HIV-positive women, 37% were on ART at entry into ANC, 29% were not on ART but previously diagnosed with HIV, and 34% were newly diagnosed. Compared to HIV-negative women, HIV-positive women as a group were slightly older, less likely to be employed and more likely to live in informal housing. Among the HIV-infected women, those who were newly diagnosed were more likely to be younger, have completed high school and less likely to be married/co-habiting.

Overall, 69% of women reported using at least one contraceptive method in the 12 months prior to pregnancy recognition. HIV-positive women on ART and HIV-negative women were more likely to report using a contraceptive method than those who were HIV-positive not on ART or newly diagnosed (74% and 74%, versus 65% and 63%, $p<0.001$). Injectable hormonal contraceptives were the most common contraceptive methods used by both HIV-positive and HIV-negative women, followed by condom use; hormonal injections were more commonly reported by HIV-negative women.

The LMUP performed well (Cronbach's α: 0.84), with similar levels of internal consistency across HIV status. The LMUP performed well in comparison to the χ^2 test assessing the single item three level response question on pregnancy intention: 99% of women who had an unplanned pregnancy based on LMUP score also reported unplanned pregnancies based on the three level response question; 91% of women classified as having a planned pregnancy by the LMUP score responded similarly to the three level response question ($p<0.001$; Table 2). Item-rest correlations were ≥ 0.7 for all items of the LMUP.

The median LMUP score in the total sample was 4 (IQR 3-10; Figure 1). Nearly half (46%) of all pregnancies were unplanned (LMUP score: 0-3); 29% of women had ambivalent pregnancy intentions (LMUP score: 4-9); and 25% had a planned pregnancy (LMUP score: 10-12). Compared to HIV-positive women, fewer HIV-negative women experienced an unplanned pregnancy (33% vs. 50%, $p<0.001$). Across the four comparison groups, the

highest level of unplanned pregnancy was observed in women who were HIV-positive not on ART while HIV-negative women were the least likely to report an unplanned pregnancy (54% vs.33%, p<0.001; Figure 2).

Women with planned pregnancies were older and more likely to be married/co-habiting. Among those with an unplanned pregnancy, 75% (721/959) reported using at least one contraceptive method in the year prior to pregnancy recognition, compared to 58% (257/539) of those reporting a planned pregnancy. Women who had discussed family planning with their partner in the past year, and HIV-positive women who had disclosed their HIV status to their male partner, were less likely to have an unplanned pregnancy (Table 3).

In a multivariable logistic regression model adjusted for age, parity, relationship status and SES, unplanned pregnancy was associated with HIV-ART status. Compared to HIV-negative women, HIV-positive women not receiving ART were most likely to have an unplanned pregnancy [adjusted odds ratio (AOR): 1.57; 95% confidence interval (CI): 1.14-2.16], followed by women newly diagnosed with HIV (AOR: 1.43; 95% CI: 1.06-1.94). There were no apparent differences in unplanned pregnancy between HIV-negative and HIV-positive women established on ART. Unplanned pregnancy was also associated with increasing parity (AOR 1.42; 95% CI: 1.25-1.61) and younger age (compared to 35-44 years of age: 18-24 years, AOR 1.84; 95% CI: 1.23-2.75; 25-34 years, AOR 1.29; 95% CI 0.95-1.75). Recent contraceptive use and marital status (married/co-habiting) reduced the odds of unplanned pregnancy.

DISCUSSION

This study provides valuable insights into unplanned pregnancy among HIV-positive and HIV-negative women in peri-urban South Africa. Nearly half (46%) of all pregnancies in this sample were reported as unplanned, evidence that levels of unplanned pregnancy remain unacceptably high in South Africa.[15 18] Of note, levels of unplanned pregnancy were considerably higher among HIV-positive compared to HIV-negative women, particularly among those HIV-positive women not on ART. Contraceptive use mirrored these results, with the lowest levels of use reported among HIV-positive women newly diagnosed or previously diagnosed but not using ART.

This study is one of the first to examine pregnancy intentions by HIV status and ART use in South Africa. The finding that levels of unplanned pregnancy may be higher among HIV-positive compared to HIV-negative women has been previously documented in other African countries[18-20] as well as in high-income countries,[14 16] but has not been previously documented in this high burden setting. Although previous research has demonstrated slightly higher levels of unplanned pregnancy among HIV-positive women on ART,[15 25] the current study adds to the evidence base that women who were not aware of their HIV status prior to conception and those HIV-positive not on ART may be more likely to have an unplanned pregnancy.[19] The lower prevalence of unplanned pregnancy observed among ART users compared to those not yet on ART could potentially be linked to the family planning services received by HIV-positive women engaged in care. However, one-third of women were only diagnosed HIV-positive at their first ANC visit, highlighting possible missed opportunities for HIV diagnosis before pregnancy. Our finding that unplanned pregnancy is associated with younger age, increasing parity and contraceptive use in the year prior to conception is consistent with previous research.[21 26 27]

Reported use of contraceptives prior to unplanned pregnancy was high across all groups, similar to findings from a study conducted in Swaziland,[20] and may have resulted in women being more likely to consider their pregnancy unplanned. The high level of unplanned pregnancy despite high uptake of contraceptives could potentially be linked to high contraceptive failure rates, incorrect use or poor adherence to short-acting methods, presenting an opportunity for improving family planning services. Levels and methods of contraceptive use differed slightly by HIV status, with use of hormonal injections more frequently reported by HIV-negative women. Similar to our findings, previous studies in Southern Africa have shown that uptake of long-acting contraceptive methods such as intrauterine devices and hormonal implants among HIV-positive women is relatively low, possibly due to low availability of these options and poorly integrated reproductive health and HIV services.[15 28 29]

While this study focused on women, the involvement of male partners and education around family planning and prevention of unplanned pregnancy also requires attention. Our results illustrate that women who were married or living with their male partners, those who had discussed family planning with their partners before conception and HIV-positive women who had disclosed their HIV status to their partners were less likely to have an unplanned

pregnancy. Similar results from other studies have shown that male partners' attitudes towards contraception impact strongly on pregnancy planning and contraceptive use among both HIV-positive and HIV-negative women in other settings.[29]

Finally, this study is one of the first to examine the validity of the LMUP within a low- and middle-income country setting in Africa. The translated LMUP proved to be a reliable measure of pregnancy intention in this sample, similar to results obtained from other validation studies conducted in Malawi and South Africa.[30, 31] The LMUP is therefore recommended for use in research across similar settings in South Africa.

This study has some limitations**.** The cross-sectional design means that causal associations could not be examined and the significance of some of the predictors identified needs to be further explored using longitudinal studies. This study was specific to a single setting in South Africa and although it is largely representative of existing sexual and reproductive practices within the country, further research is needed in other resource-limited settings. As women were asked to report on pregnancy intentions after pregnancy recognition and entering ANC, acceptance of the pregnancy during this time may have resulted in over reporting of planned pregnancy. In contrast, women who terminated their pregnancy without presenting for ANC were not included in this study; therefore, the prevalence of unplanned pregnancy may have been underestimated. Finally, as contraceptive use was assessed only as any use of a contraceptive method in the 12 months prior to pregnancy recognition, our data are not robust to assess consistent contraceptive use during this time.

Despite some limitations, this study is notable and presents key differences between HIV-positive and HIV-negative women regarding pregnancy intentions and family planning practices. It is evident from our findings that HIV-positive women regardless of ART use require additional support to avoid unplanned pregnancy. While further research is required, young, HIV-positive women and those with previous pregnancies may be particularly vulnerable. Moreover, our results suggest that HIV-negative women also require improved engagement in reproductive health services for HIV testing and prevention, as well as family planning services. There is an urgent need to empower all women in this context with appropriate and effective tools to prevent unplanned pregnancies. Focused and innovative interventions may be required to improve women's understanding of various options for effective family planning.

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COMPETING INTERESTS:

The authors have no competing interests to declare.

ETHICS APPROVAL:

Human Research Ethics Committee of the University of Cape Town, Faculty of Health Sciences and the Columbia University Medical Centre Institutional Review Board.

CONTRIBUTORS:

EJA and LM conceptualized the study. TKP, SLR and AZ directed data collection. VI conducted the analysis, led data interpretation and drafted the manuscript, with critical inputs

from KB, TKP, SLR, JAM, AZ, GP, EJA and LM. All authors read and approved the final manuscript to be published.

DATA SHARING STATEMENT

No additional data are available.

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Table 1: *Demographic characteristics of women booking for antenatal care by HIV status and antiretroviral treatment*

Women's characteristics	Total (N=2105)	Known HIV+ on ART (N=556)	Known HIV+ Not on ART (N=444)	Newly Diagnosed (N=512)	HIV-Negative (N=2105)	P-value*
Age, years	28 (24-33)	31 (28-34)	29 (26-32)	26 (22-30)	27 (23-32)	
Age Category						
18-24	532 (25)	51 (9)	77 (17)	187 (37)	217 (37)	<0.001
25-34	1235 (59)	368 (66)	307 (69)	276 (54)	284 (48)	
35-44	338 (16)	137 (25)	60 (14)	49 (9)	92 (15)	
Parity	1 (1-2)	2 (1-2)	2 (1-2)	1 (0-2)	1 (0-2)	<0.001
Completed High School	601 (29)	109 (20)	103 (23)	359 (70)	236 (40)	<0.001
Employment Status						
Employed	833 (39)	210 (38)	144 (32)	200 (39)	275 (46)	<0.001
Housing						
Informal	1100 (52)	318 (57)	236 (53)	270 (53)	276 (47)	0.005
Socioeconomic Status (SES)						
Low	524 (25)	166 (30)	132 (30)	139 (27)	87 (15)	
Low-Moderate	469 (22)	134 (24)	103 (23)	108 (21)	124 (21)	
Moderate-High	565 (27)	164 (30)	116 (26)	127 (25)	158 (27)	
High	541 (26)	92 (16)	93 (21)	138 (27)	218 (37)	
Married/Cohabiting	882 (43)	258 (47)	200 (47)	180 (36)	244 (42)	<0.001
Disclosed HIV Status to Current Partner	816 (55)	462 (84)	289 (67)	65 (13)	NA	<0.001
Single item question - Current Pregnancy						
Unintended	1347 (64)	310 (56)	291 (66)	343 (67)	403 (68)	<0.001
Intended	752 (36)	244 (44)	152 (34)	167 (33)	189 (32)	
Unsure	5 (0)	2 (0)	1 (0)	2 (0)	0 (0)	
Used Contraceptives in Past 12 Months	1459 (69)	414 (74)	287 (65)	320 (63)	438 (74)	<0.001
Contraceptive Method Used in Past 12 Months						
None	646 (31)	142 (26)	157 (36)	192 (38)	155 (26)	<0.001
Oral Contraceptive	57 (3)	5 (1)	8 (2)	12 (3)	32 (5)	
Injectable	752 (36)	152 (27)	139 (31)	155 (30)	306 (52)	
IUD	8 (0)	0	2	2 (0)	4 (1)	
Sterilization	1 (0)	0	0	0	1 (0)	
Condom	641 (30)	257 (46)	138 (31)	151 (29)	95 (16)	
Discussed Family Planning with Partner in Past 12months	964 (49)	275 (54)	198 (49)	235 (50)	256 (44)	0.006

Note: Values are given as number (percentage) or median (interquartile range)
Abbreviations: HIV+, HIV positive; HIV-, HIV negative; ART, Antiretroviral therapy; IQR, inter-quartile range
*Chi –square or Fisher's exact tests were used to assess bivariate associations

Table 2: *The London Measure of Unplanned Pregnancy intention scores in comparison with the single item on pregnancy intentions*

Single item - Pregnancy Intention	London Measure of Unplanned Pregnancy			
	Total (N=2105)	**Unplanned** (N=959)	**Ambivalent** (N=607)	**Planned** (N=539)
No	1347 (64)	**950 (99)**	346 (57)	51 (9)
Yes	752 (36)	8 (1)	256 (42)	**488 (91)**
Unsure	5 (0)	0 (0)	**5 (1)**	0 (0)

Note: Values are given as number (percentage)

Table 3: *Demographic characteristics of participants by the London Measure of Unplanned Pregnancy intention categories*

Women's Characteristics	Total (N=2105)	Unplanned (N=959)	Ambivalent (N=607)	Planned (N=539)	P-value*
Age, years	28 (24-33)	28 (24-32)	28 (25-33)	29 (25-33)	<0.001
Age Category					
18-24	532 (25)	274 (29)	150 (25)	108 (20)	
25-34	1235 (59)	548 (57)	356 (59)	331 (61)	0.004
35-44	338 (16)	137 (14)	101 (17)	100 (19)	
Parity, Median	1 (1-2)	1 (1-2)	1 (1-2)	1 (1-2)	<0.001
Completed High School					
Yes	601 (29)	236 (25)	205 (34)	160 (30)	<0.001
Level of Education					
Primary	73 (3)	38 (4)	16 (3)	19 (3)	
Secondary	1973 (94)	889 (93)	574 (94)	510 (95)	0.309
Tertiary	59 (3)	32 (3)	17 (3)	10 (2)	
Employment Status					
Employed	833 (39)	352 (37)	265 (44)	212 (39)	0.022
Housing					
Informal	1100 (52)	476 (50)	307 (51)	317 (59)	0.002
Socio-economic Status					
Low	524 (25)	274 (29)	118 (19)	132 (25)	
Low-Moderate	469 (22)	195 (20)	143 (24)	131 (24)	0.004
Moderate-High	565 (27)	251 (26)	167 (28)	147 (27)	
High	541 (26)	238 (25)	175 (29)	128 (24)	
Married/Cohabiting					
Yes	882 (43)	273 (30)	242 (40)	367 (69)	<0.001
Disclosed HIV Status to Current Partner (HIV+ Women)	816 (55)	367 (50)	214 (56)	235 (64)	<0.001
Intention of Current Pregnancy					
Unintended	1347 (64)	950 (99)	346 (57)	51 (9)	
Intended	752 (36)	8 (1)	256 (42)	488 (91)	<0.001
Unsure	5 (0)	0 (0)	5 (1)	0 (0)	
Used Contraceptive in Past 12 Months	1459 (69)	721 (75)	427 (70)	311 (58)	<0.001
Contraceptive Method Used in Past 12 Months					
None	646 (31)	238 (25)	180 (30)	228 (42)	
Oral Contraceptive	57 (3)	26 (3)	16 (3)	15 (3)	
Injectable	752 (36)	335 (35)	233 (38)	184 (34)	<0.001
IUD	8 (0)	4 (0)	2 (0)	2 (0)	
Sterilization	1 (0)	0 (0)	1 (0)	0 (0)	
Condom	641 (30)	356 (37)	175 (29)	110 (20)	
Discussed Family Planning with Partner in Past 12months	964 (49)	234 (26)	347 (60)	383 (78)	<0.001

Note: Values are given as number (percentage) or median (interquartile range)
*Chi –square or Fisher's exact tests were used to assess bivariate associations

Table 4: *Multivariable logistic regression model of determinants of unplanned pregnancy among HIV-positive and HIV-negative women*

Variables	Univariate analysis			Multivariate analysis		
	OR	95% CI	p-value	AOR	95% CI	p-value
HIV Status and ART Use						
HIV Negative						
Newly Diagnosed	1.36	1.03-1.78	0.028	1.43	1.06-1.94	0.020
Known HIV+ - No ART	1.44	1.08-1.92	0.013	1.57	1.14-2.16	0.006
Known HIV+ - On ART	1.04	0.80-1.34	0.766	1.10	0.82-1.48	0.513
Age Category						
35-44						
25-34	1.15	0.88 - 1.49	0.309	1.29	0.95-1.75	0.099
18-24	1.65	1.20-2.26	0.002	1.84	1.23-2.75	0.003
Parity	1.07	0.98-1.17	0.136	1.42	1.25-1.61	0.000
Married/Cohabiting						
No						
Yes	0.23	0.19- 0.29	0.000	0.20	0.15-0 .25	0.000
Used Contraceptive in Past 12 Months						
No						
Yes	0.73	0.59-0.91	0.005	1.94	1.55-2.43	0.000
Socioeconomic Status						
Low						
Low-Middle	0.87	0.65-1.15	0.329	1.80	0.58-1.09	0.151
Middle-High	0.96	0.73-1.26	0.755	0.74	0.56-1.01	0.054
High	1.09	0.82-1.44	0.561	0.84	0.61-1.16	0.301
Finished High School						
No						
Yes	0.93	0.75-1.15	0.499	-	-	-
Employed						
No						
Yes	1.00	0.8-1.22	0.994	-	-	-
Housing						
Informal						
Formal	1.42	1.17-1.73	0.000	-	-	-
Gravidity	1.06	0.97-1.16	0.201	-	-	-

Abbreviations: OR, Odds ratio; AOR, Adjusted Odds ratio; CI, Confidence interval

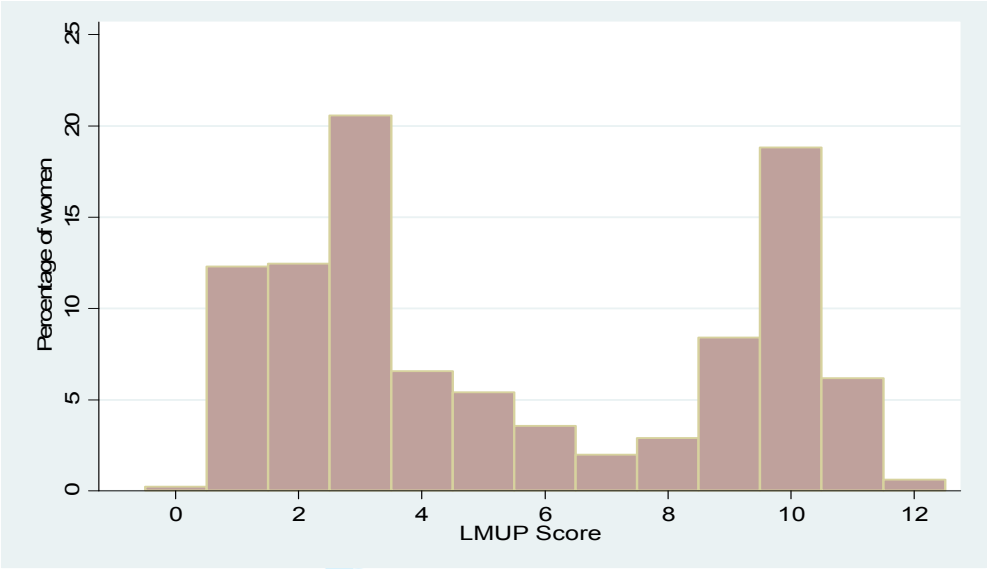

Figure 1: The distribution of the London Measure of Unplanned Pregnancy scores for all women

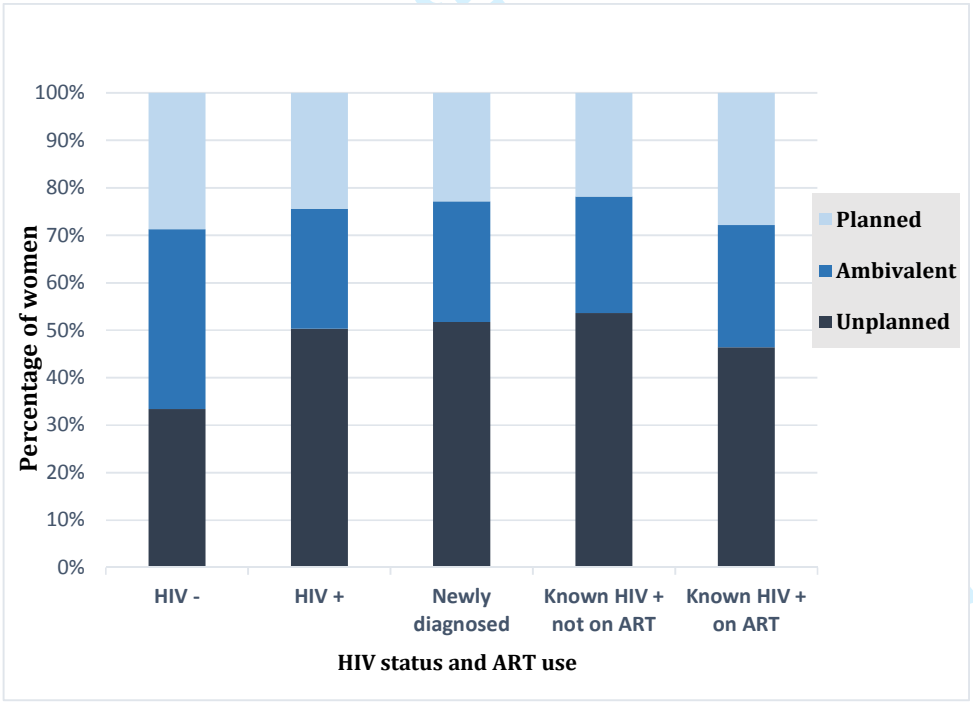

Figure 2: The London Measure of Unplanned Pregnancy score categories by HIV status and antiretroviral therapy use

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Prevalence and determinants of unplanned pregnancy in HIV-positive and HIV-negative pregnant women in Cape Town, South Africa: a cross-sectional study

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Title

Prevalence and determinants of unplanned pregnancy in HIV-positive and HIV-negative pregnant women in Cape Town, South Africa: a cross-sectional study

Short title

Unplanned pregnancy among HIV-positive and HIV-negative pregnant women in South Africa

Authors

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ABSTRACT

Objectives: Prevention of unplanned pregnancy is a crucial aspect of preventing mother-to-child HIV transmission (PMTCT). There are few data investigating how HIV status and use of antiretroviral therapy (ART) influences pregnancy planning in high HIV burden settings. Our objective was to examine the prevalence and determinants of unplanned pregnancy among HIV-positive and HIV-negative women in Cape Town, South Africa.

Design: Cross-sectional analysis.

Settings: Single primary-level antenatal care clinic in Cape Town, South Africa.

Participants: HIV-positive and -negative pregnant women, booking for antenatal care from March 2013 - August 2015, were included.

Main Outcome measures: Unplanned pregnancy was measured at the first antenatal care visit using the London Measure of Unplanned Pregnancy (LMUP). Analyses examined LMUP scores across four groups of participants defined by their HIV status, awareness of their HIV status prior to the current pregnancy, and/or whether they were using ART prior to the current pregnancy.

Results: Among 2105 pregnant women (1512 HIV-positive; 593 HIV-negative), median age was 28 years, 43% were married/co-habiting and 20% were nulliparous. Levels of unplanned pregnancy were significantly higher in HIV-positive versus HIV-negative women (50% vs. 33%, p<0.001); and highest in women who were known HIV-positive but not on ART (53%). After adjusting for age, parity and marital status, unplanned pregnancy was most common among women newly diagnosed and women who were known HIV-positive but not on ART (compared to HIV-negative women, adjusted odds ratio [aOR]: 1.43; 95% confidence interval [CI]: 1.05-1.94 and aOR: 1.57; 95% CI: 1.13-2.15, respectively). Increased parity and younger age (<24years) were also associated with unplanned pregnancy (aOR: 1.42; 95% CI: 1.25-1.60 and aOR: 1.83; 95% CI: 1.23-2.74, respectively).

Conclusions: We observed high levels of unplanned pregnancy, particularly among HIV-positive women not on ART, suggesting ongoing missed opportunities for improved family planning and counselling services for HIV-positive women.

Strengths and limitations of this study:

- This is one of the first studies to examine pregnancy intentions in a large sample of HIV-positive and negative women aged (18-44) in South Africa.
- This study utilized a robust pregnancy intention instrument fairly new to our study setting; the London Measure of Unplanned Pregnancy, to measure levels of unplanned pregnancy.
- The cross-sectional design means that causal associations of unplanned pregnancy could not be determined.
- This study included participants based on convenience sampling from a single urban setting, therefore findings may not be generalizable to other resource-limited settings.
- Our retrospective self-reported measurement of pregnancy intentions after pregnancy recognition and entering antenatal care, may have increased acceptance of the pregnancy and resulted in over reporting of planned pregnancy.

INTRODUCTION

Efforts to eliminate mother-to-child transmission of HIV (MTCT) continue to escalate globally and advances in prevention of mother-to-child transmission (PMTCT) services have led to significant reductions in the number of new pediatric infections across resource-limited settings including Africa.[1] In South Africa, over 95% of HIV-infected pregnant women receive triple drug antiretroviral therapy (ART) during pregnancy and breastfeeding and the rate of MTCT declined from 8% in 2008 to 1.3 % in 2016.[1 2]

South Africa has the highest number of individuals living with HIV worldwide with up to 18.8% prevalence among women of child-bearing age.[3] HIV prevalence is particularly high among pregnant women, with almost 30% of those seeking antenatal care (ANC) testing HIV-positive nationally.[4] Despite the substantial efforts of national PMTCT programmes in high-burden countries, new paediatric infections remains a major public health concern. [2 5]

Even where ART is widely available to pregnant and breastfeeding women, the timing and planning of a pregnancy may be important determinants of MTCT.[6 7] Unplanned pregnancies predict maternal health behaviours during pregnancy and in the postpartum period, including late presentation for ANC, reduced ART adherence and suboptimal breastfeeding practices.[7-10] Preventing unplanned pregnancies among HIV-positive women through addressing the unmet need for family planning is a relatively low-cost, effective method for preventing new paediatric HIV infections.[11 12 13] Contraceptive use is high in South Africa with an estimated 65% of sexually active women using at least one method and studies have shown an association between contraception and pregnancy intentions.[14 15] Modern contraceptive methods are freely available at public sector health care facilities in South Africa with short acting methods–primarily injectable contraceptives being the most commonly used by sexually active women in South Africa.[16]

An estimated 40% of all pregnancies worldwide and 35% of pregnancies in Africa are unplanned.[17] In comparison, 35-65% of pregnancies among HIV-positive women across sub-Saharan Africa may be unplanned,[18-21] with up to two-thirds of HIV-positive women reporting unplanned pregnancies in South Africa.[14 22] However, the current evidence for the association between HIV status, ART use and unplanned pregnancy remains inconsistent.[23] While some previous studies documented higher levels of unplanned pregnancies among

HIV-positive compared to HIV-negative women,[20] others found no association between HIV status and unplanned pregnancy.[24 25]

Women who are not aware of their HIV status prior to conception may be more likely to have an unplanned pregnancy. Findings from a recent study in Botswana demonstrated an almost 2-fold increase in the likelihood of unplanned pregnancy among women unaware of their HIV-positive serostaus prior to conception compared to those who were aware.[19] In contrast, there is also some evidence to suggest that pregnancy incidence is significantly higher for women after ART initiation compared to those not on ART, and approximately 60% of HIV-positive women on ART experience an unplanned pregnancy. [18 22 26] There are few robust data on pregnancy planning among HIV-positive women initiating ART in the current era of PMTCT. In this context, there is a clear need for further insights into pregnancy planning and associated factors among HIV-positive women in high burden settings. To address this, we examined the prevalence and determinants of unplanned pregnancy among HIV-positive and HIV-negative women in Cape Town, South Africa.

METHODS

Study setting and design

This cross-sectional analysis utilized data obtained from the enrolment visit of the MCH-ART (Maternal-Child Health Antiretroviral Therapy) study, a multicomponent implementation science study investigating optimal strategies for delivering ART services to HIV-positive pregnant and postpartum women (ClinicalTrials.gov NCT01933477). The study took place in the community of Gugulethu, a historically disadvantaged community with a high burden of HIV. The MCH-ART study methods have been described in detail previously.[27] Briefly, 1554 HIV-positive pregnant women above 18 years of age were consecutively enrolled at their first ANC visit. In addition, this analysis utilized data from a parallel sub-study to MCH-ART, the HIV-unexposed, uninfected (HU2) study which enrolled 612 HIV-negative women attending their first ANC visit, to provide a comparison group.[27] For this analysis we restricted the sample to 1512 HIV-positive women and 593 HIV-negative women who had complete data on pregnancy planning.

Ethical considerations

The MCH-ART and HU2 studies were approved by the University of Cape Town's Faculty of Health Sciences Human Research Ethics Committee and the Institutional Review Board of

Columbia University. All participants provided a written informed consent prior to participation in both studies.

Data collection

Following enrolment at their first ANC visit, all participants completed a structured interviewer-administered questionnaire in their language of choice - isiXhosa or English. Information collected included basic socio-demographic characteristics, medical history, pregnancy intentions and contraceptive use. All measures were translated into isiXhosa, and back-translated into English by a second translator, to ensure accuracy.

Contraceptive use was defined as any contraceptive method used in the 12 months prior to pregnancy recognition. A categorical variable was created for socio-economic status (SES) based on employment status, years of education, housing type and number of amenities in the household, and was categorized into quartiles.[28] Pregnancy intentions were assessed using a validated 6-item questionnaire, the London Measure of Unplanned Pregnancy (LMUP). This instrument asked women to report the circumstances of their most recent pregnancy, with each item in the tool scored 0, 1 or 2 according to published scoring guidelines (LMUP analysis guidance paper).[29] Women's scores were summed across all 6 items, resulting in a total score from 0-12 with each point increase representing an increase in pregnancy intention. Total LMUP scores were divided into categories of pregnancy intentions: unplanned (0-3), ambivalent (4-9) and planned (10-12), based on the scoring used in the original development of the scale.[29] A separate single item, three level response question (Current pregnancy intended: Yes, No, Unsure) was used to examine the performance of the LMUP.

Statistical analysis

Statistical analyses were performed using STATA version 12.0 (Stata Corporation, College Station, Texas, USA). In this analysis, participants were categorized into four groups based on routine public sector HIV testing at entry into ANC, and self-reported ART use: (1) known HIV-positive and established on ART, (2) known HIV-positive but not on ART, (3) newly diagnosed HIV-positive during the current pregnancy, and (4) HIV-negative, used as the reference category. Socio-demographic characteristics at enrolment were compared across

these four groups. Cronbach's α was used to assess the reliability of the isiXhosa translated LMUP in this context, and bivariate analysis using a χ^2 test compared the isiXhosa LMUP to the single three-level response question. Associations between characteristics at enrollment and unplanned pregnancy were explored using χ^2 and Fisher's exact tests for categorical, and Wilcoxon rank-sum tests for continuous variables. A multivariable logistic regression model was built to examine independent predictors of unplanned pregnancy, with maternal age and SES considered as *a priori* confounders. Model fit was explored using Akaike's information criterion (AIC) and *a priori* hypothesis about confounders namely age and SES. For the log-binomial regression analysis, LMUP scores were dichotomized into unplanned/ ambivalent (LMUP score 0-9) versus planned pregnancy (LMUP score 10-12).

RESULTS

A total of 2105 women (1512 HIV-positive and 593 HIV-negative), enrolled between March 2013 and August 2015, were included in this analysis. The median age of participants was 28 [inter-quartile range (IQR) 24-33] years, 29% had completed high school, 61% were unemployed and 43% were married or cohabiting. Across all groups, 20% were nulliparous (Table 1). Among the overall group of HIV-positive women, 37% were on ART at entry into ANC, 29% were not on ART but previously diagnosed with HIV, and 34% were newly diagnosed. Compared to HIV-negative women, HIV-positive women as a group were slightly older, less likely to be employed and more likely to live in informal housing. Among the HIV-infected women, those who were newly diagnosed were more likely to be younger, have completed high school and less likely to be married/co-habiting.

Overall, 69% of women reported using at least one contraceptive method in the 12 months prior to pregnancy recognition. HIV-positive women on ART and HIV-negative women were more likely to report using a contraceptive method than those who were HIV-positive not on ART or newly diagnosed (74% and 74%, versus 65% and 63%, $p<0.001$). Injectable hormonal contraceptives were the most common contraceptive methods used by both HIV-positive and HIV-negative women, followed by condom use; hormonal injections were more commonly reported by HIV-negative women.

The LMUP performed well (Cronbach's α: 0.84), with similar levels of internal consistency across HIV status. The LMUP performed well in comparison to the χ^2 test assessing the

single item three level response question on pregnancy intention: 99% of women who had an unplanned pregnancy based on LMUP score also reported unplanned pregnancies based on the three level response question; 91% of women classified as having a planned pregnancy by the LMUP score responded similarly to the three level response question ($p<0.001$; Table 2). Item-rest correlations were ≥ 0.7 for all items of the LMUP.

The median LMUP score in the total sample was 4 (IQR 3-10; Figure 1). Nearly half (46%) of all pregnancies were unplanned (LMUP score: 0-3); 29% of women had ambivalent pregnancy intentions (LMUP score: 4-9); and 25% had a planned pregnancy (LMUP score: 10-12). Compared to HIV-positive women, fewer HIV-negative women experienced an unplanned pregnancy (33% vs. 50%, $p<0.001$). Across the four comparison groups, the highest level of unplanned pregnancy was observed in women who were HIV-positive not on ART while HIV-negative women were the least likely to report an unplanned pregnancy (54% vs.33%, $p<0.001$; Figure 2).

Women with planned pregnancies were older and more likely to be married/co-habiting. Among those with an unplanned pregnancy, 75% (721/959) reported using at least one contraceptive method in the year prior to pregnancy recognition, compared to 58% (257/539) of those reporting a planned pregnancy. Women who had discussed family planning with their partner in the past year, and HIV-positive women who had disclosed their HIV status to their male partner, were less likely to have an unplanned pregnancy (Table 3).

In a multivariable log-binomial regression model adjusted for age, parity, relationship status and SES, unplanned pregnancy was associated with HIV-ART status. Compared to HIV-negative women, HIV-positive women not receiving ART were most likely to have an unplanned pregnancy [adjusted odds ratio (aOR): 1.57; 95% confidence interval (CI): 1.13-2.15], followed by women newly diagnosed with HIV (aOR: 1.43; 95% CI: 1.05-1.94). There were no apparent differences in unplanned pregnancy between HIV-negative and HIV-positive women established on ART. Unplanned pregnancy was also associated with increasing parity (aOR 1.42; 95% CI: 1.25-1.60) and younger age (compared to 35-44 years of age: 18-24 years, aOR 1.83; 95% CI: 1.23-2.74; 25-34 years, aOR 1.29; 95% CI 0.95-1.75) (Table 4). Recent contraceptive use and marital status (married/co-habiting) reduced the odds of unplanned pregnancy.

Including individual proxy measures of SES (employment, education and home type) in the adjusted model did not change our main findings. The adjusted odds ratio of an unplanned pregnancy with individual proxy measures of SES (compared to HIV negative women) was aOR 1.43; 95% CI: 1.05-1.94 in newly diagnosed HIV-positive women, 1.56; 95% CI: 1.13-2.15 for previously diagnosed HIV positive women not on ART and 1.10 95% CI 0.82-1.47 for previously diagnosed HIV positive women on ART. In comparison, SES was included as a composite measure, the adjusted odds ratio of an unplanned pregnancy (compared to HIV negative women) aOR 1.43; 95% CI: 1.05-1.94 in newly diagnosed HIV-positive women, 1.56; 95% CI: 1.13-2.15 for previously diagnosed women not on ART and 1.10; 95% CI: 0.82-1.47 for previously diagnosed HIV positive women on ART).

DISCUSSION

This study provides valuable insights into unplanned pregnancy among HIV-positive and HIV-negative women in peri-urban South Africa. Similar to high levels of approximately 56-60% of unplanned pregnancy previously reported in South Africa, nearly half (46%) of all pregnancies in this study were reported as unplanned, evidence that levels of unplanned pregnancy remain unacceptably high in South Africa.[14 22] Of note, levels of unplanned pregnancy were considerably higher among HIV-positive compared to HIV-negative women, particularly among those HIV-positive women not on ART. Contraceptive use mirrored these results, with the lowest levels of use reported among HIV-positive women newly diagnosed or previously diagnosed but not using ART.

This study is one of the first to examine pregnancy intentions by HIV status and ART use in South Africa. The finding that levels of unplanned pregnancy may be higher among HIV-positive compared to HIV-negative women has been previously documented in other African countries as well as in high-income countries,[24 25] but has not been previously documented in this high burden setting. Although previous research across sub-Saharan Africa has demonstrated slightly higher levels of unplanned pregnancy reaching up to 62% among HIV-positive women ,[14 19 21] the current study provides additional evidence that women who were not aware of their HIV status prior to conception and those HIV-positive not on ART may be more likely to have an unplanned pregnancy.[19] The lower prevalence of unplanned pregnancy observed among ART users compared to those not yet on ART could potentially be linked to the family planning services received by HIV-positive women engaged in care. However,

one-third of women were only diagnosed HIV-positive at their first ANC visit, highlighting possible missed opportunities for HIV diagnosis before pregnancy. Our finding that unplanned pregnancy is associated with younger age, increasing parity and contraceptive use in the year prior to conception is consistent with previous research.[18 30 31] One study found that HIV-positive Rwandan women with two or more children were four times more likely to have an unplanned pregnancy,[18] while evidence from a study Botswana and Swaziland demonstrated that younger age (<20 years old) and low level of education (not beyond high school) were associated with an increased odds of an unplanned pregnancy.[19 21] Similar findings were reported from a high income country.[31] Supporting our findings of high unplanned pregnancy levels despite high uptake of contraceptives, a South African study found up to 62% of unplanned pregnancy despite high contraceptive uptake of 89% among HIV positive and negative women.[14]

Reported use of contraceptives prior to unplanned pregnancy was high across all groups, similar to findings from a study conducted in Swaziland,[32] and may have resulted in women being more likely to consider their pregnancy unplanned. The high level of unplanned pregnancy despite high uptake of contraceptives in our study population could potentially be linked to high contraceptive failure rates, incorrect use or poor adherence to short-acting methods, presenting an opportunity for improving family planning services The high levels of unplanned pregnancy observed among newly diagnosed HIV positive women and HIV positive women not on ART suggests a potential difference in risk factors, specifically poorer health seeking behaviours compared to HIV-positive women who have engaged with the health care facility and are on ART.[8 30 10] Women on ART have also been shown to be twice as likely to use contraceptive methods compared to HIV-negative women.[15] Even among HIV positive women on ART in this study who routinely receive family planning services alongside HIV care services, unplanned pregnancy rate was considerably high. Levels and methods of contraceptive use differed slightly by HIV status, with use of hormonal injections more frequently reported by HIV-negative women. Similar to our findings, previous studies in Southern Africa have shown that uptake of long-acting contraceptive methods such as intrauterine devices and hormonal implants among HIV-positive women is relatively low, possibly due to low availability of these options and poorly integrated reproductive health and HIV services.[22 33 34] In addition, there is a high reliance on injectable hormonal contraceptives in South Africa which may be because this method is routinely offered at no cost, after delivery in most public health sector facilities, reflecting the general contraceptive

method use patterns across the country.[35] Similar to findings from this study, uptake of contraceptives is generally high (65%) however, uptake of efficient long-acting contraceptive methods has been shown to be relatively low, with majority of women relying on the male condom.[36 15] A study conducted in Cape Town found that only 6% of 538 HIV-positive and negative women used long acting and permanent contraceptive methods and this finding was mainly driven by poor knowledge of more efficient long acting and permanent contraceptive methods. Choice of contraceptive method was primarily based on health care provider recommendations and convenience.[35]

While this study focused on women, the involvement of male partners and education around family planning and prevention of unplanned pregnancy also requires attention. Our results illustrate that women who were married or living with their male partners, those who had discussed family planning with their partners before conception and HIV-positive women who had disclosed their HIV status to their partners, were less likely to have an unplanned pregnancy. Similar results from other studies have shown that male partners' attitudes towards contraception impact strongly on pregnancy planning and contraceptive use among both HIV-positive and HIV-negative women in other settings.[34]

Finally, this study is one of the first to examine the validity of the LMUP within a low- and middle-income country setting in Africa. The translated LMUP proved to be a reliable measure of pregnancy intention in this sample, similar to results obtained from another validation study conducted in Malawi.[37] The LMUP is therefore recommended for use in research across similar settings in South Africa.

This study has some limitations**.** The cross-sectional design means that causal associations could not be examined and the significance of some of the predictors identified needs to be further explored using longitudinal studies. This study was specific to a single urban setting in South Africa and although it may be representative of existing knowledge of contraceptive methods, uptake and method preference within similar settings across the country,[35 36] further research is needed in other countries. As women were asked to report on pregnancy intentions after pregnancy recognition and entering ANC, acceptance of the pregnancy during this time may have resulted in over reporting of planned pregnancy. In contrast, women who terminated their pregnancy without presenting for ANC were not included in this study; therefore, the prevalence of unplanned pregnancy may have been underestimated. Finally, as

contraceptive use was assessed only as any use of a contraceptive method in the 12 months prior to pregnancy recognition, our data are not robust to assess consistent contraceptive use during this time.

Despite some limitations, this study is notable and presents key differences between HIV-positive and HIV-negative women regarding pregnancy intentions and family planning practices. It is evident from our findings that HIV-positive women regardless of ART use require additional support to avoid unplanned pregnancy. While further research is required, young, HIV-positive women and those with previous pregnancies may be particularly vulnerable. Moreover, our results suggest that HIV-negative women also require improved engagement in reproductive health services for HIV testing and prevention, as well as family planning services. There is an urgent need to empower all women in this context with appropriate and effective tools to prevent unplanned pregnancies. Focused and innovative interventions may be required to improve women's understanding of various options for effective family planning.

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COMPETING INTERESTS:

The authors have no competing interests to declare.

ETHICS APPROVAL:

Human Research Ethics Committee of the University of Cape Town, Faculty of Health Sciences and the Columbia University Medical Centre Institutional Review Board.

CONTRIBUTORS:

EJA and LM conceptualized the study. TKP, SLR and AZ directed data collection. VI conducted the analysis, led data interpretation and drafted the manuscript, with critical inputs from KB, TKP, SLR, JAM, AZ, GP, EJA and LM. All authors read and approved the final manuscript to be published.

DATA SHARING STATEMENT

No additional data are available.

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Table 1: *Demographic characteristics of women booking for antenatal care by HIV status and antiretroviral treatment*

Women's characteristics	Total (N=2105)	Known HIV+ on ART (N=556)	Known HIV+ Not on ART (N=444)	Newly Diagnosed (N=512)	HIV-Negative (N=2105)	P-value*
Age, years	28 (24-33)	31 (28-34)	29 (26-32)	26 (22-30)	27 (23-32)	
Age Category						
18-24	532 (25)	51 (9)	77 (17)	187 (37)	217 (37)	<0.001
25-34	1235 (59)	368 (66)	307 (69)	276 (54)	284 (48)	
35-44	338 (16)	137 (25)	60 (14)	49 (9)	92 (15)	
Parity	1 (1-2)	2 (1-2)	2 (1-2)	1 (0-2)	1 (0-2)	<0.001
Completed High School	601 (29)	109 (20)	103 (23)	359 (70)	236 (40)	<0.001
Employment Status						
Employed	833 (39)	210 (38)	144 (32)	200 (39)	275 (46)	<0.001
Housing						
Informal	1100 (52)	318 (57)	236 (53)	270 (53)	276 (47)	0.005
Socioeconomic Status (SES)						
Low	524 (25)	166 (30)	132 (30)	139 (27)	87 (15)	
Low-Moderate	469 (22)	134 (24)	103 (23)	108 (21)	124 (21)	
Moderate-High	565 (27)	164 (30)	116 (26)	127 (25)	158 (27)	
High	541 (26)	92 (16)	93 (21)	138 (27)	218 (37)	
Married/Cohabiting	882 (43)	258 (47)	200 (47)	180 (36)	244 (42)	<0.001
Disclosed HIV Status to Current Partner	816 (55)	462 (84)	289 (67)	65 (13)	NA	<0.001
Single item question - Current Pregnancy						
Unintended	1347 (64)	310 (56)	291 (66)	343 (67)	403 (68)	<0.001
Intended	752 (36)	244 (44)	152 (34)	167 (33)	189 (32)	
Unsure	5 (0)	2 (0)	1 (0)	2 (0)	0 (0)	
Used Contraceptives in Past 12 Months	1459 (69)	414 (74)	287 (65)	320 (63)	438 (74)	<0.001
Contraceptive Method Used in Past 12 Months						
None	646 (31)	142 (26)	157 (36)	192 (38)	155 (26)	<0.001
Oral Contraceptive	57 (3)	5 (1)	8 (2)	12 (3)	32 (5)	
Injectable	752 (36)	152 (27)	139 (31)	155 (30)	306 (52)	
IUD	8 (0)	0	2	2 (0)	4 (1)	
Sterilization	1 (0)	0	0	0	1 (0)	
Condom	641 (30)	257 (46)	138 (31)	151 (29)	95 (16)	
Discussed Family Planning with Partner in Past 12months	964 (49)	275 (54)	198 (49)	235 (50)	256 (44)	0.006

Note: Values are given as number (percentage) or median (interquartile range)
Abbreviations: HIV+, HIV positive; HIV-, HIV negative; ART, Antiretroviral therapy; IQR, inter-quartile range
*Chi –square or Fisher's exact tests were used to assess bivariate associations

Table 2: *The London Measure of Unplanned Pregnancy intention scores in comparison with the single item on pregnancy intentions*

Single item - Pregnancy Intention	London Measure of Unplanned Pregnancy			
	Total (N=2105)	Unplanned (N=959)	Ambivalent (N=607)	Planned (N=539)
No	1347 (64)	**950 (99)**	346 (57)	51 (9)
Yes	752 (36)	8 (1)	256 (42)	**488 (91)**
Unsure	5 (0)	0 (0)	**5 (1)**	0 (0)

Note: Values are given as number (percentage)

Table 3: *Demographic characteristics of participants by the London Measure of Unplanned Pregnancy intention categories*

Women's Characteristics	Total (N=2105)	Unplanned (N=959)	Ambivalent (N=607)	Planned (N=539)	P-value*
Age, years	28 (24-33)	28 (24-32)	28 (25-33)	29 (25-33)	<0.001
Age Category					
18-24	532 (25)	274 (29)	150 (25)	108 (20)	
25-34	1235 (59)	548 (57)	356 (59)	331 (61)	0.004
35-44	338 (16)	137 (14)	101 (17)	100 (19)	
Parity, Median	1 (1-2)	1 (1-2)	1 (1-2)	1 (1-2)	<0.001
Completed High School					
Yes	601 (29)	236 (25)	205 (34)	160 (30)	<0.001
Level of Education					
Primary	73 (3)	38 (4)	16 (3)	19 (3)	
Secondary	1973 (94)	889 (93)	574 (94)	510 (95)	0.309
Tertiary	59 (3)	32 (3)	17 (3)	10 (2)	
Employment Status					
Employed	833 (39)	352 (37)	265 (44)	212 (39)	0.022
Housing					
Informal	1100 (52)	476 (50)	307 (51)	317 (59)	0.002
Socio-economic Status					
Low	524 (25)	274 (29)	118 (19)	132 (25)	
Low-Moderate	469 (22)	195 (20)	143 (24)	131 (24)	0.004
Moderate-High	565 (27)	251 (26)	167 (28)	147 (27)	
High	541 (26)	238 (25)	175 (29)	128 (24)	
Married/Cohabiting					
Yes	882 (43)	273 (30)	242 (40)	367 (69)	<0.001
Disclosed HIV Status to Current Partner (HIV+ Women)	816 (55)	367 (50)	214 (56)	235 (64)	<0.001
Intention of Current Pregnancy					
Unintended	1347 (64)	950 (99)	346 (57)	51 (9)	
Intended	752 (36)	8 (1)	256 (42)	488 (91)	<0.001
Unsure	5 (0)	0 (0)	5 (1)	0 (0)	
Used Contraceptive in Past 12 Months	1459 (69)	721 (75)	427 (70)	311 (58)	<0.001
Contraceptive Method Used in Past 12 Months					
None	646 (31)	238 (25)	180 (30)	228 (42)	
Oral Contraceptive	57 (3)	26 (3)	16 (3)	15 (3)	
Injectable	752 (36)	335 (35)	233 (38)	184 (34)	<0.001
IUD	8 (0)	4 (0)	2 (0)	2 (0)	
Sterilization	1 (0)	0 (0)	1 (0)	0 (0)	
Condom	641 (30)	356 (37)	175 (29)	110 (20)	
Discussed Family Planning with Partner in Past 12months	964 (49)	234 (26)	347 (60)	383 (78)	<0.001

Note: Values are given as number (percentage) or median (interquartile range)
*Chi –square or Fisher's exact tests were used to assess bivariate associations

Table 4: *Multivariable log-binomial regression model predicting unplanned pregnancy among HIV-positive and HIV-negative women*

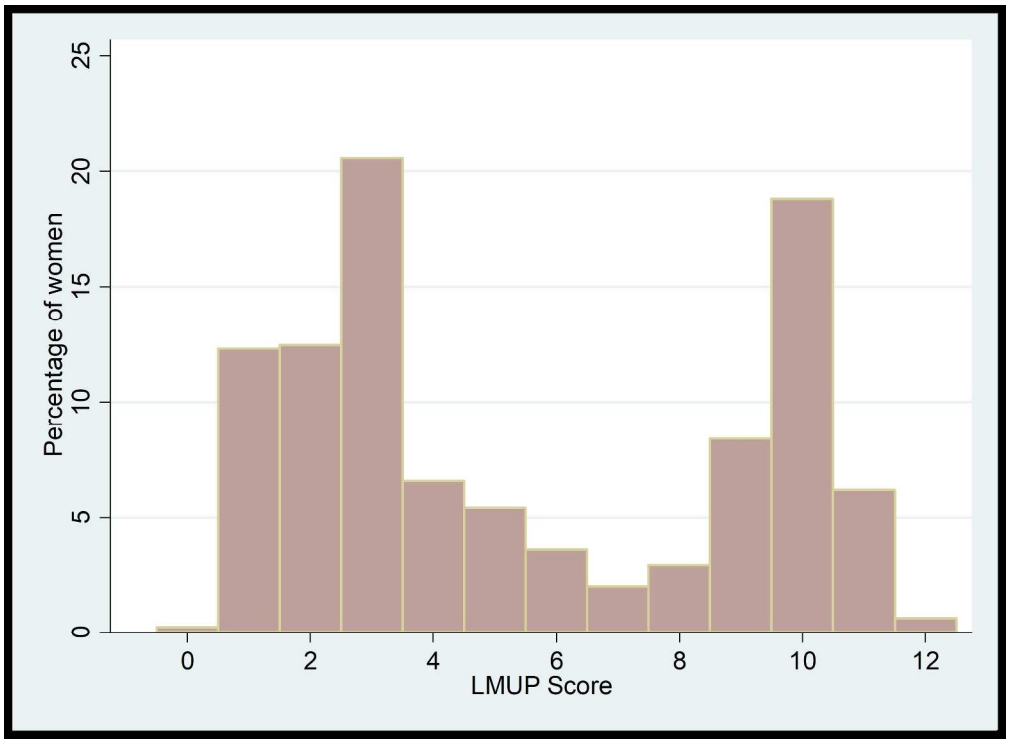
Variables	Univariate analysis			Multivariate analysis		
	OR	95% CI	p-value	AOR	95% CI	p-value
HIV Status and ART Use						
HIV Negative						
Newly Diagnosed	1.35	1.03-1.78	0.028	1.43	1.05-1.94	0.020
Known HIV+ - No ART	1.43	1.08-1.92	0.013	1.57	1.13-2.15	0.006
Known HIV+ - On ART	1.03	0.80-1.34	0.766	1.10	0.82-1.47	0.513
Age Category						
35-44						
25-34	1.14	0.88- 1.49	0.309	1.29	0.95-1.75	0.099
18-24	1.64	1.20-2.26	0.002	1.83	1.23-2.74	0.003
Parity	1.07	0.97-1.17	0.136	1.42	1.25-1.60	0.000
Married/Cohabiting						
No						
Yes	0.23	0.19- 0.29	0.000	0.19	0.15-0.24	0.000
Used Contraceptive in Past 12 Months						
No						
Yes	0.73	0.59-0.91	0.005	1.94	1.55-2.43	0.000
Socioeconomic Status						
Low						
Low-Middle	0.86	0.65-1.15	0.329	0.79	0.58-1.08	0.151
Middle-High	0.95	0.73-1.26	0.755	0.74	0.54-1.00	0.054
High	1.08	0.82-1.44	0.561	0.84	0.61-1.16	0.301
Finished High School						
No						
Yes	0.92	0.74-1.15	0.499	-	-	-
Employed						
No						
Yes	1.00	0.81-1.22	0.994	-	-	-
Housing						
Informal						
Formal	1.42	1.17-1.73	0.000	-	-	-
Gravidity	1.06	0.97-1.16	0.201	-	-	-

Abbreviations: OR, Odds ratio; AOR, Adjusted Odds ratio; CI, Confidence interval

FIGURE LEGENDS

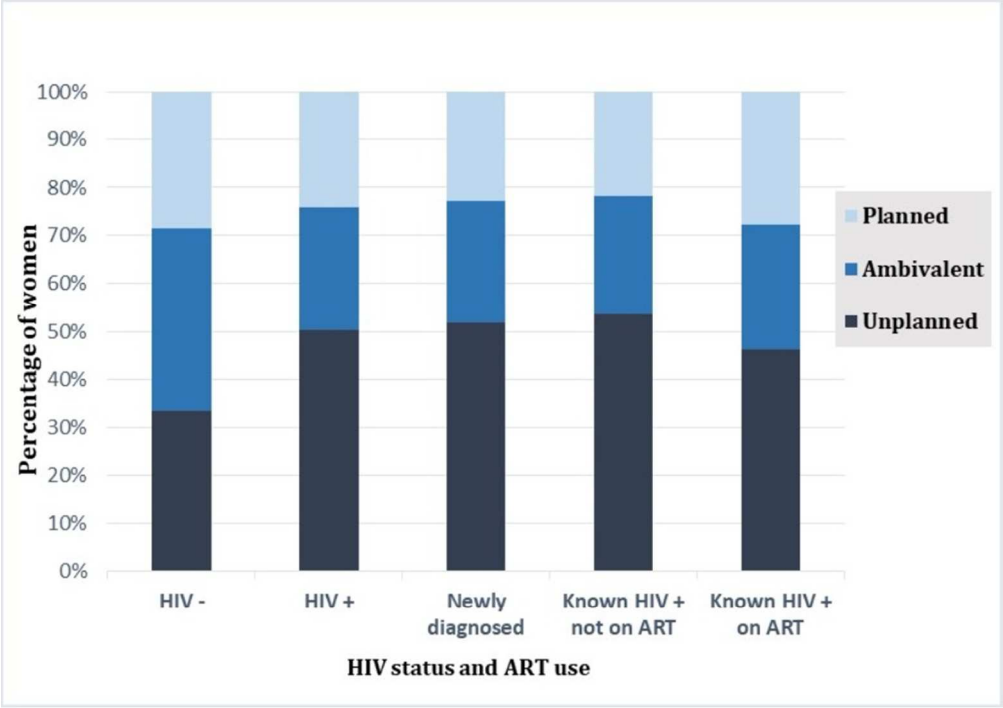
Figure 1: The distribution of the London Measure of Unplanned Pregnancy scores in HIV positive and negative pregnant women booking for antenatal care, 2013-2015.

Figure 2: The London Measure of Unplanned Pregnancy score categories stratified by HIV status and antiretroviral therapy use.



The distribution of the London Measure of Unplanned Pregnancy scores in HIV positive and negative pregnant women booking for antenatal care, 2013-2015.

284x208mm (300 x 300 DPI)



The London Measure of Unplanned Pregnancy score categories stratified by HIV status and antiretroviral therapy use.

84x59mm (300 x 300 DPI)

STROBE Statement—Checklist of items that should be included in reports of ***cross-sectional studies***

	Item No	Recommendation
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract **(p. 1)**
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found **(pp. 2–3)**
Introduction		
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported **(p. 1, paragraph 2 + p. 5, paragraph 1)**
Objectives	3	State specific objectives, including any prespecified hypotheses **(p. 5, paragraph 3)**
Methods		
Study design	4	Present key elements of study design early in the paper **(pp. 6-7)**
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection **(pp. 6-7)**
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants **(p. 6, paragraph 1)**
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable **(pp. 6-7)**
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group **(pp. 6-7)**
Bias	9	Describe any efforts to address potential sources of bias **(pp. 6 paragraph 3)**
Study size	10	Explain how the study size was arrived at **(p. 6)**
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why **(p. 7)**
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding **(p. 7)**
		(*b*) Describe any methods used to examine subgroups and interactions **(p. 7)**
		(*c*) Explain how missing data were addressed **(p. 7)**
		(*d*) If applicable, describe analytical methods taking account of sampling strategy
		(*e*) Describe any sensitivity analyses **(p. 7)**
Results		
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed **(p. 8)**
		(b) Give reasons for non-participation at each stage **(N/A)**
		(c) Consider use of a flow diagram **(N/A)**
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential **confounders *(Table 1*)**
		(b) Indicate number of participants with missing data for each variable of interest **(N/A)**
Outcome data	15*	Report numbers of outcome events or summary measures **(p. 7)**
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included **(p. 9 + *Table 4*)**
		(*b*) Report category boundaries when continuous variables were categorized **(N/A)**

		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses ***(p. 21 +Table 2*)**
Discussion		
Key results	18	Summarise key results with reference to study objectives applicable **(pp. 10-11)**
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias applicable **(pp. 12-13)**
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence applicable **(pp. 10-13)**
Generalisability	21	Discuss the generalisability (external validity) of the study results applicable **(p. 11)**
Other information		
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based **(p. 13)**

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

BMJ Open

Prevalence and determinants of unplanned pregnancy in HIV-positive and HIV-negative pregnant women in Cape Town, South Africa: a cross-sectional study

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Secondary Subject Heading:	Infectious diseases, Epidemiology, HIV/AIDS, Sexual health
Keywords:	unplanned pregnancy, contraception, family planning, HIV, women

Title

Prevalence and determinants of unplanned pregnancy in HIV-positive and HIV-negative pregnant women in Cape Town, South Africa: a cross-sectional study

Short title

Unplanned pregnancy among HIV-positive and HIV-negative pregnant women in South Africa

Authors

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ABSTRACT

Objectives: Prevention of unplanned pregnancy is a crucial aspect of preventing mother-to-child HIV transmission (PMTCT). There are few data investigating how HIV status and use of antiretroviral therapy (ART) influences pregnancy planning in high HIV burden settings. Our objective was to examine the prevalence and determinants of unplanned pregnancy among HIV-positive and HIV-negative women in Cape Town, South Africa.

Design: Cross-sectional analysis.

Settings: Single primary-level antenatal care clinic in Cape Town, South Africa.

Participants: HIV-positive and -negative pregnant women, booking for antenatal care from March 2013 - August 2015, were included.

Main Outcome measures: Unplanned pregnancy was measured at the first antenatal care visit using the London Measure of Unplanned Pregnancy (LMUP). Analyses examined LMUP scores across four groups of participants defined by their HIV status, awareness of their HIV status prior to the current pregnancy, and/or whether they were using ART prior to the current pregnancy.

Results: Among 2105 pregnant women (1512 HIV-positive; 593 HIV-negative), median age was 28 years, 43% were married/co-habiting and 20% were nulliparous. Levels of unplanned pregnancy were significantly higher in HIV-positive versus HIV-negative women (50% vs. 33%, p<0.001); and highest in women who were known HIV-positive but not on ART (53%). After adjusting for age, parity and marital status, unplanned pregnancy was most common among women newly diagnosed and women who were known HIV-positive but not on ART (compared to HIV-negative women, adjusted odds ratio [aOR]: 1.43; 95% confidence interval [CI]: 1.05-1.94 and aOR: 1.57; 95% CI: 1.13-2.15, respectively). Increased parity and younger age (<24years) were also associated with unplanned pregnancy (aOR: 1.42; 95% CI: 1.25-1.60 and aOR: 1.83; 95% CI: 1.23-2.74, respectively).

Conclusions: We observed high levels of unplanned pregnancy, particularly among HIV-positive women not on ART, suggesting ongoing missed opportunities for improved family planning and counselling services for HIV-positive women.

Strengths and limitations of this study:

- This is one of the first studies to examine pregnancy intentions in a large sample of HIV-positive and negative women aged (18-44) in South Africa.
- This study utilized a robust pregnancy intention instrument fairly new to our study setting; the London Measure of Unplanned Pregnancy, to measure levels of unplanned pregnancy.
- The cross-sectional design means that causal associations of unplanned pregnancy could not be determined.
- This study included participants based on convenience sampling from a single urban setting, therefore findings may not be generalizable to other resource-limited settings.
- Our retrospective self-reported measurement of pregnancy intentions after pregnancy recognition and entering antenatal care, may have increased acceptance of the pregnancy and resulted in over reporting of planned pregnancy.

INTRODUCTION

Efforts to eliminate mother-to-child transmission of HIV (MTCT) continue to escalate globally and advances in prevention of mother-to-child transmission (PMTCT) services have led to significant reductions in the number of new pediatric infections across resource-limited settings including Africa.[1] In South Africa, over 95% of HIV-infected pregnant women receive triple drug antiretroviral therapy (ART) during pregnancy and breastfeeding and the rate of MTCT declined from 8% in 2008 to 1.3 % in 2016.[1 2]

South Africa has the highest number of individuals living with HIV worldwide with up to 18.8% prevalence among women of child-bearing age.[3] HIV prevalence is particularly high among pregnant women, with almost 30% of those seeking antenatal care (ANC) testing HIV-positive nationally.[4] Despite the substantial efforts of national PMTCT programmes in high-burden countries, new paediatric infections remains a major public health concern. [2 5]

Even where ART is widely available to pregnant and breastfeeding women, the timing and planning of a pregnancy may be important determinants of MTCT.[6 7] Unplanned pregnancies predict maternal health behaviours during pregnancy and in the postpartum period, including late presentation for ANC, reduced ART adherence and suboptimal breastfeeding practices.[7-10] Preventing unplanned pregnancies among HIV-positive women through addressing the unmet need for family planning is a relatively low-cost, effective method for preventing new paediatric HIV infections.[11 12 13] Contraceptive use is high in South Africa with an estimated 65% of sexually active women using at least one method and studies have shown an association between contraception and pregnancy intentions.[14 15] Modern contraceptive methods are freely available at public sector health care facilities in South Africa with short acting methods–primarily injectable contraceptives being the most commonly used by sexually active women in South Africa.[16]

An estimated 40% of all pregnancies worldwide and 35% of pregnancies in Africa are unplanned.[17] In comparison, 35-65% of pregnancies among HIV-positive women across sub-Saharan Africa may be unplanned,[18-21] with up to two-thirds of HIV-positive women reporting unplanned pregnancies in South Africa.[14 22] However, the current evidence for the association between HIV status, ART use and unplanned pregnancy remains inconsistent.[23] While some previous studies documented higher levels of unplanned pregnancies among

HIV-positive compared to HIV-negative women,[20] others found no association between HIV status and unplanned pregnancy.[24 25]

Women who are not aware of their HIV status prior to conception may be more likely to have an unplanned pregnancy. Findings from a recent study in Botswana demonstrated an almost 2-fold increase in the likelihood of unplanned pregnancy among women unaware of their HIV-positive serostaus prior to conception compared to those who were aware.[19] In contrast, there is also some evidence to suggest that pregnancy incidence is significantly higher for women after ART initiation compared to those not on ART, and approximately 60% of HIV-positive women on ART experience an unplanned pregnancy. [18 22 26] There are few robust data on pregnancy planning among HIV-positive women initiating ART in the current era of PMTCT. In this context, there is a clear need for further insights into pregnancy planning and associated factors among HIV-positive women in high burden settings. To address this, we examined the prevalence and determinants of unplanned pregnancy among HIV-positive and HIV-negative women in Cape Town, South Africa.

METHODS

Study setting and design

This cross-sectional analysis utilized data obtained from the enrolment visit of the MCH-ART (Maternal-Child Health Antiretroviral Therapy) study, a multicomponent implementation science study investigating optimal strategies for delivering ART services to HIV-positive pregnant and postpartum women (ClinicalTrials.gov NCT01933477). The study took place in the community of Gugulethu, a historically disadvantaged community with a high burden of HIV. The MCH-ART study methods have been described in detail previously.[27] Briefly, 1554 HIV-positive pregnant women above 18 years of age were consecutively enrolled at their first ANC visit. In addition, this analysis utilized data from a parallel sub-study to MCH-ART, the HIV-unexposed, uninfected (HU2) study which enrolled 612 HIV-negative women attending their first ANC visit, to provide a comparison group.[27] For this analysis we restricted the sample to 1512 HIV-positive women and 593 HIV-negative women who had complete data on pregnancy planning.

Ethical considerations

The MCH-ART and HU2 studies were approved by the University of Cape Town's Faculty of Health Sciences Human Research Ethics Committee and the Institutional Review Board of

Columbia University. All participants provided a written informed consent prior to participation in both studies.

Data collection

Following enrolment at their first ANC visit, all participants completed a structured interviewer-administered questionnaire in their language of choice - isiXhosa or English. Information collected included basic socio-demographic characteristics, medical history, pregnancy intentions and contraceptive use. All measures were translated into isiXhosa, and back-translated into English by a second translator, to ensure accuracy.

Contraceptive use was defined as any contraceptive method used in the 12 months prior to pregnancy recognition. A categorical variable was created for socio-economic status (SES) based on employment status, years of education, housing type and number of amenities in the household, and was categorized into quartiles.[28] Pregnancy intentions were assessed using a validated 6-item questionnaire, the London Measure of Unplanned Pregnancy (LMUP). This instrument asked women to report the circumstances of their most recent pregnancy, with each item in the tool scored 0, 1 or 2 according to published scoring guidelines (LMUP analysis guidance paper).[29] Women's scores were summed across all 6 items, resulting in a total score from 0-12 with each point increase representing an increase in pregnancy intention. Total LMUP scores were divided into categories of pregnancy intentions: unplanned (0-3), ambivalent (4-9) and planned (10-12), based on the scoring used in the original development of the scale.[29] A separate single item, three level response question (Current pregnancy intended: Yes, No, Unsure) was used to examine the performance of the LMUP.

Statistical analysis

Statistical analyses were performed using STATA version 12.0 (Stata Corporation, College Station, Texas, USA). In this analysis, participants were categorized into four groups based on routine public sector HIV testing at entry into ANC, and self-reported ART use: (1) known HIV-positive and established on ART, (2) known HIV-positive but not on ART, (3) newly diagnosed HIV-positive during the current pregnancy, and (4) HIV-negative, used as the reference category. Socio-demographic characteristics at enrolment were compared across

these four groups. Cronbach's α was used to assess the reliability of the isiXhosa translated LMUP in this context, and bivariate analysis using a χ^2 test compared the isiXhosa LMUP to the single three-level response question. Associations between characteristics at enrollment and unplanned pregnancy were explored using χ^2 and Fisher's exact tests for categorical, and Wilcoxon rank-sum tests for continuous variables. A multivariable log-binomial regression model was built to examine independent predictors of unplanned pregnancy, with maternal age and SES considered as *a priori* confounders. Model fit was explored using Akaike's information criterion (AIC) and *a priori* hypothesis about confounders namely age and SES. For the log-binomial regression analysis, LMUP scores were dichotomized into unplanned/ ambivalent (LMUP score 0-9) versus planned pregnancy (LMUP score 10-12).

RESULTS

A total of 2105 women (1512 HIV-positive and 593 HIV-negative), enrolled between March 2013 and August 2015, were included in this analysis. The median age of participants was 28 [inter-quartile range (IQR) 24-33] years, 29% had completed high school, 61% were unemployed and 43% were married or cohabiting. Across all groups, 20% were nulliparous (Table 1). Among the overall group of HIV-positive women, 37% were on ART at entry into ANC, 29% were not on ART but previously diagnosed with HIV, and 34% were newly diagnosed. Compared to HIV-negative women, HIV-positive women as a group were slightly older, less likely to be employed and more likely to live in informal housing. Among the HIV-infected women, those who were newly diagnosed were more likely to be younger, have completed high school and less likely to be married/co-habiting.

Overall, 69% of women reported using at least one contraceptive method in the 12 months prior to pregnancy recognition. HIV-positive women on ART and HIV-negative women were more likely to report using a contraceptive method than those who were HIV-positive not on ART or newly diagnosed (74% and 74%, versus 65% and 63%, $p<0.001$). Injectable hormonal contraceptives were the most common contraceptive methods used by both HIV-positive and HIV-negative women, followed by condom use; hormonal injections were more commonly reported by HIV-negative women.

The LMUP performed well (Cronbach's α: 0.84), with similar levels of internal consistency across HIV status. The LMUP performed well in comparison to the χ^2 test assessing the

single item three level response question on pregnancy intention: 99% of women who had an unplanned pregnancy based on LMUP score also reported unplanned pregnancies based on the three level response question; 91% of women classified as having a planned pregnancy by the LMUP score responded similarly to the three level response question ($p<0.001$; Table 2). Item-rest correlations were ≥ 0.7 for all items of the LMUP.

The median LMUP score in the total sample was 4 (IQR 3-10; Figure 1). Nearly half (46%) of all pregnancies were unplanned (LMUP score: 0-3); 29% of women had ambivalent pregnancy intentions (LMUP score: 4-9); and 25% had a planned pregnancy (LMUP score: 10-12). Compared to HIV-positive women, fewer HIV-negative women experienced an unplanned pregnancy (33% vs. 50%, $p<0.001$). Across the four comparison groups, the highest level of unplanned pregnancy was observed in women who were HIV-positive not on ART while HIV-negative women were the least likely to report an unplanned pregnancy (54% vs.33%, $p<0.001$; Figure 2).

Women with planned pregnancies were older and more likely to be married/co-habiting. Among those with an unplanned pregnancy, 75% (721/959) reported using at least one contraceptive method in the year prior to pregnancy recognition, compared to 58% (257/539) of those reporting a planned pregnancy. Women who had discussed family planning with their partner in the past year, and HIV-positive women who had disclosed their HIV status to their male partner, were less likely to have an unplanned pregnancy (Table 3).

In a multivariable log-binomial regression model adjusted for age, parity, relationship status and SES, unplanned pregnancy was associated with HIV-ART status. Compared to HIV-negative women, HIV-positive women not receiving ART were most likely to have an unplanned pregnancy [adjusted odds ratio (aOR): 1.57; 95% confidence interval (CI): 1.13-2.15], followed by women newly diagnosed with HIV (aOR: 1.43; 95% CI: 1.05-1.94). There were no apparent differences in unplanned pregnancy between HIV-negative and HIV-positive women established on ART. Unplanned pregnancy was also associated with increasing parity (aOR 1.42; 95% CI: 1.25-1.60) and younger age (compared to 35-44 years of age: 18-24 years, aOR 1.83; 95% CI: 1.23-2.74; 25-34 years, aOR 1.29; 95% CI 0.95-1.75) (Table 4). Recent contraceptive use and marital status (married/co-habiting) reduced the odds of unplanned pregnancy.

Including individual proxy measures of SES (employment, education and home type) in the adjusted model did not change our main findings. The adjusted odds ratio of an unplanned pregnancy with individual proxy measures of SES (compared to HIV negative women) was aOR 1.43; 95% CI: 1.05-1.94 in newly diagnosed HIV-positive women, 1.56; 95% CI: 1.13-2.15 for previously diagnosed HIV positive women not on ART and 1.10 95% CI 0.82-1.47 for previously diagnosed HIV positive women on ART. In comparison, SES was included as a composite measure, the adjusted odds ratio of an unplanned pregnancy (compared to HIV negative women) aOR 1.43; 95% CI: 1.05-1.94 in newly diagnosed HIV-positive women, 1.56; 95% CI: 1.13-2.15 for previously diagnosed women not on ART and 1.10; 95% CI: 0.82-1.47 for previously diagnosed HIV positive women on ART).

DISCUSSION

This study provides valuable insights into unplanned pregnancy among HIV-positive and HIV-negative women in peri-urban South Africa. Similar to high levels of approximately 56-60% of unplanned pregnancy previously reported in South Africa, nearly half (46%) of all pregnancies in this study were reported as unplanned, evidence that levels of unplanned pregnancy remain unacceptably high in South Africa.[14 22] Of note, levels of unplanned pregnancy were considerably higher among HIV-positive compared to HIV-negative women, particularly among those HIV-positive women not on ART. Contraceptive use mirrored these results, with the lowest levels of use reported among HIV-positive women newly diagnosed or previously diagnosed but not using ART.

This study is one of the first to examine pregnancy intentions by HIV status and ART use in South Africa. The finding that levels of unplanned pregnancy may be higher among HIV-positive compared to HIV-negative women has been previously documented in other African countries as well as in high-income countries, [24 25] but has not been previously documented in this high burden setting. Although previous research across sub-Saharan Africa has demonstrated slightly higher levels of unplanned pregnancy reaching up to 62% among HIV-positive women ,[14 19 21] the current study provides additional evidence that women who were not aware of their HIV status prior to conception and those HIV-positive not on ART may be more likely to have an unplanned pregnancy.[19] The lower prevalence of unplanned pregnancy observed among ART users compared to those not yet on ART could potentially be linked to the family planning services received by HIV-positive women engaged in care. However,

one-third of women were only diagnosed HIV-positive at their first ANC visit, highlighting possible missed opportunities for HIV diagnosis before pregnancy. Our finding that unplanned pregnancy is associated with younger age, increasing parity and contraceptive use in the year prior to conception is consistent with previous research.[18 30 31] One study found that HIV-positive Rwandan women with two or more children were four times more likely to have an unplanned pregnancy,[18] while evidence from a study Botswana and Swaziland demonstrated that younger age (<20 years old) and low level of education (not beyond high school) were associated with an increased odds of an unplanned pregnancy.[19 21] Similar findings were reported from a high income country.[31] Supporting our findings of high unplanned pregnancy levels despite high uptake of contraceptives, a South African study found up to 62% of unplanned pregnancy despite high contraceptive uptake of 89% among HIV positive and negative women.[14]

Reported use of contraceptives prior to unplanned pregnancy was high across all groups, similar to findings from a study conducted in Swaziland,[32] and may have resulted in women being more likely to consider their pregnancy unplanned. The high level of unplanned pregnancy despite high uptake of contraceptives in our study population could potentially be linked to high contraceptive failure rates, incorrect use or poor adherence to short-acting methods, presenting an opportunity for improving family planning services The high levels of unplanned pregnancy observed among newly diagnosed HIV positive women and HIV positive women not on ART suggests a potential difference in risk factors, specifically poorer health seeking behaviours compared to HIV-positive women who have engaged with the health care facility and are on ART.[8 30 10] Women on ART have also been shown to be twice as likely to use contraceptive methods compared to HIV-negative women.[15] Even among HIV positive women on ART in this study who routinely receive family planning services alongside HIV care services, unplanned pregnancy rate was considerably high. Levels and methods of contraceptive use differed slightly by HIV status, with use of hormonal injections more frequently reported by HIV-negative women. Similar to our findings, previous studies in Southern Africa have shown that uptake of long-acting contraceptive methods such as intrauterine devices and hormonal implants among HIV-positive women is relatively low, possibly due to low availability of these options and poorly integrated reproductive health and HIV services.[22 33 34] In addition, there is a high reliance on injectable hormonal contraceptives in South Africa which may be because this method is routinely offered at no cost, after delivery in most public health sector facilities, reflecting the general contraceptive

method use patterns across the country.[35] Similar to findings from this study, uptake of contraceptives is generally high (65%) however, uptake of efficient long-acting contraceptive methods has been shown to be relatively low, with majority of women relying on the male condom.[36 15] A study conducted in Cape Town found that only 6% of 538 HIV-positive and negative women used long acting and permanent contraceptive methods and this finding was mainly driven by poor knowledge of more efficient long acting and permanent contraceptive methods. Choice of contraceptive method was primarily based on health care provider recommendations and convenience.[35]

While this study focused on women, the involvement of male partners and education around family planning and prevention of unplanned pregnancy also requires attention. Our results illustrate that women who were married or living with their male partners, those who had discussed family planning with their partners before conception and HIV-positive women who had disclosed their HIV status to their partners, were less likely to have an unplanned pregnancy. Similar results from other studies have shown that male partners' attitudes towards contraception impact strongly on pregnancy planning and contraceptive use among both HIV-positive and HIV-negative women in other settings.[34]

Finally, this study is one of the first to examine the validity of the LMUP within a low- and middle-income country setting in Africa. The translated LMUP proved to be a reliable measure of pregnancy intention in this sample, similar to results obtained from another validation study conducted in Malawi.[37] The LMUP is therefore recommended for use in research across similar settings in South Africa.

This study has some limitations**.** The cross-sectional design means that causal associations could not be examined and the significance of some of the predictors identified needs to be further explored using longitudinal studies. This study was specific to a single urban setting in South Africa and although it may be representative of existing knowledge of contraceptive methods, uptake and method preference within similar settings across the country,[35 36] further research is needed in other countries. As women were asked to report on pregnancy intentions after pregnancy recognition and entering ANC, acceptance of the pregnancy during this time may have resulted in over reporting of planned pregnancy. In contrast, women who terminated their pregnancy without presenting for ANC were not included in this study; therefore, the prevalence of unplanned pregnancy may have been underestimated. Finally, as

contraceptive use was assessed only as any use of a contraceptive method in the 12 months prior to pregnancy recognition, our data are not robust to assess consistent contraceptive use during this time.

Despite some limitations, this study is notable and presents key differences between HIV-positive and HIV-negative women regarding pregnancy intentions and family planning practices. It is evident from our findings that HIV-positive women regardless of ART use require additional support to avoid unplanned pregnancy. While further research is required, young, HIV-positive women and those with previous pregnancies may be particularly vulnerable. Moreover, our results suggest that HIV-negative women also require improved engagement in reproductive health services for HIV testing and prevention, as well as family planning services. There is an urgent need to empower all women in this context with appropriate and effective tools to prevent unplanned pregnancies. Focused and innovative interventions may be required to improve women's understanding of various options for effective family planning.

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COMPETING INTERESTS:

None declared.

ETHICS APPROVAL:

Human Research Ethics Committee of the University of Cape Town, Faculty of Health Sciences and the Columbia University Medical Centre Institutional Review Board.

CONTRIBUTORS:

EJA and LM conceptualized the study. TKP, SLR and AZ directed data collection. VI conducted the analysis, led data interpretation and drafted the manuscript, with critical inputs from KB, TKP, SLR, JAM, AZ, GP, EJA and LM. All authors read and approved the final manuscript to be published.

DATA SHARING STATEMENT

No additional data are available.

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Table 1: *Demographic characteristics of women booking for antenatal care by HIV status and antiretroviral treatment*

Women's characteristics	Total (N=2105)	Known HIV+ on ART (N=556)	Known HIV+ Not on ART (N=444)	Newly Diagnosed (N=512)	HIV-Negative (N=2105)	P-value*
Age, years	28 (24-33)	31 (28-34)	29 (26-32)	26 (22-30)	27 (23-32)	
Age Category						
18-24	532 (25)	51 (9)	77 (17)	187 (37)	217 (37)	<0.001
25-34	1235 (59)	368 (66)	307 (69)	276 (54)	284 (48)	
35-44	338 (16)	137 (25)	60 (14)	49 (9)	92 (15)	
Parity	1 (1-2)	2 (1-2)	2 (1-2)	1 (0-2)	1 (0-2)	<0.001
Completed High School	601 (29)	109 (20)	103 (23)	359 (70)	236 (40)	<0.001
Employment Status						
Employed	833 (39)	210 (38)	144 (32)	200 (39)	275 (46)	<0.001
Housing						
Informal	1100 (52)	318 (57)	236 (53)	270 (53)	276 (47)	0.005
Socioeconomic Status (SES)						
Low	524 (25)	166 (30)	132 (30)	139 (27)	87 (15)	
Low-Moderate	469 (22)	134 (24)	103 (23)	108 (21)	124 (21)	
Moderate-High	565 (27)	164 (30)	116 (26)	127 (25)	158 (27)	
High	541 (26)	92 (16)	93 (21)	138 (27)	218 (37)	
Married/Cohabiting	882 (43)	258 (47)	200 (47)	180 (36)	244 (42)	<0.001
Disclosed HIV Status to Current Partner	816 (55)	462 (84)	289 (67)	65 (13)	NA	<0.001
Single item question - Current Pregnancy						
Unintended	1347 (64)	310 (56)	291 (66)	343 (67)	403 (68)	<0.001
Intended	752 (36)	244 (44)	152 (34)	167 (33)	189 (32)	
Unsure	5 (0)	2 (0)	1 (0)	2 (0)	0 (0)	
Used Contraceptives in Past 12 Months	1459 (69)	414 (74)	287 (65)	320 (63)	438 (74)	<0.001
Contraceptive Method Used in Past 12 Months						
None	646 (31)	142 (26)	157 (36)	192 (38)	155 (26)	<0.001
Oral Contraceptive	57 (3)	5 (1)	8 (2)	12 (3)	32 (5)	
Injectable	752 (36)	152 (27)	139 (31)	155 (30)	306 (52)	
IUD	8 (0)	0	2	2 (0)	4 (1)	
Sterilization	1 (0)	0	0	0	1 (0)	
Condom	641 (30)	257 (46)	138 (31)	151 (29)	95 (16)	
Discussed Family Planning with Partner in Past 12months	964 (49)	275 (54)	198 (49)	235 (50)	256 (44)	0.006

Note: Values are given as number (percentage) or median (interquartile range)
Abbreviations: HIV+, HIV positive; HIV-, HIV negative; ART, Antiretroviral therapy; IQR, inter-quartile range
*Chi –square or Fisher's exact tests were used to assess bivariate associations

Table 2: *The London Measure of Unplanned Pregnancy intention scores in comparison with the single item on pregnancy intentions*

Single item - Pregnancy Intention	London Measure of Unplanned Pregnancy			
	Total (N=2105)	Unplanned (N=959)	Ambivalent (N=607)	Planned (N=539)
No	1347 (64)	**950 (99)**	346 (57)	51 (9)
Yes	752 (36)	8 (1)	256 (42)	**488 (91)**
Unsure	5 (0)	0 (0)	**5 (1)**	0 (0)

Note: Values are given as number (percentage)

Table 3: *Demographic characteristics of participants by the London Measure of Unplanned Pregnancy intention categories*

Women's Characteristics	Total (N=2105)	Unplanned (N=959)	Ambivalent (N=607)	Planned (N=539)	P-value*
Age, years	28 (24-33)	28 (24-32)	28 (25-33)	29 (25-33)	<0.001
Age Category					
18-24	532 (25)	274 (29)	150 (25)	108 (20)	
25-34	1235 (59)	548 (57)	356 (59)	331 (61)	0.004
35-44	338 (16)	137 (14)	101 (17)	100 (19)	
Parity, Median	1 (1-2)	1 (1-2)	1 (1-2)	1 (1-2)	<0.001
Completed High School					
Yes	601 (29)	236 (25)	205 (34)	160 (30)	<0.001
Level of Education					
Primary	73 (3)	38 (4)	16 (3)	19 (3)	
Secondary	1973 (94)	889 (93)	574 (94)	510 (95)	0.309
Tertiary	59 (3)	32 (3)	17 (3)	10 (2)	
Employment Status					
Employed	833 (39)	352 (37)	265 (44)	212 (39)	0.022
Housing					
Informal	1100 (52)	476 (50)	307 (51)	317 (59)	0.002
Socio-economic Status					
Low	524 (25)	274 (29)	118 (19)	132 (25)	
Low-Moderate	469 (22)	195 (20)	143 (24)	131 (24)	0.004
Moderate-High	565 (27)	251 (26)	167 (28)	147 (27)	
High	541 (26)	238 (25)	175 (29)	128 (24)	
Married/Cohabiting					
Yes	882 (43)	273 (30)	242 (40)	367 (69)	<0.001
Disclosed HIV Status to Current Partner (HIV+ Women)	816 (55)	367 (50)	214 (56)	235 (64)	<0.001
Intention of Current Pregnancy					
Unintended	1347 (64)	950 (99)	346 (57)	51 (9)	
Intended	752 (36)	8 (1)	256 (42)	488 (91)	<0.001
Unsure	5 (0)	0 (0)	5 (1)	0 (0)	
Used Contraceptive in Past 12 Months	1459 (69)	721 (75)	427 (70)	311 (58)	<0.001
Contraceptive Method Used in Past 12 Months					
None	646 (31)	238 (25)	180 (30)	228 (42)	
Oral Contraceptive	57 (3)	26 (3)	16 (3)	15 (3)	
Injectable	752 (36)	335 (35)	233 (38)	184 (34)	<0.001
IUD	8 (0)	4 (0)	2 (0)	2 (0)	
Sterilization	1 (0)	0 (0)	1 (0)	0 (0)	
Condom	641 (30)	356 (37)	175 (29)	110 (20)	
Discussed Family Planning with Partner in Past 12months	964 (49)	234 (26)	347 (60)	383 (78)	<0.001

Note: Values are given as number (percentage) or median (interquartile range)
*Chi –square or Fisher's exact tests were used to assess bivariate associations

Table 4: *Multivariable log-binomial regression model predicting unplanned pregnancy among HIV-positive and HIV-negative women*

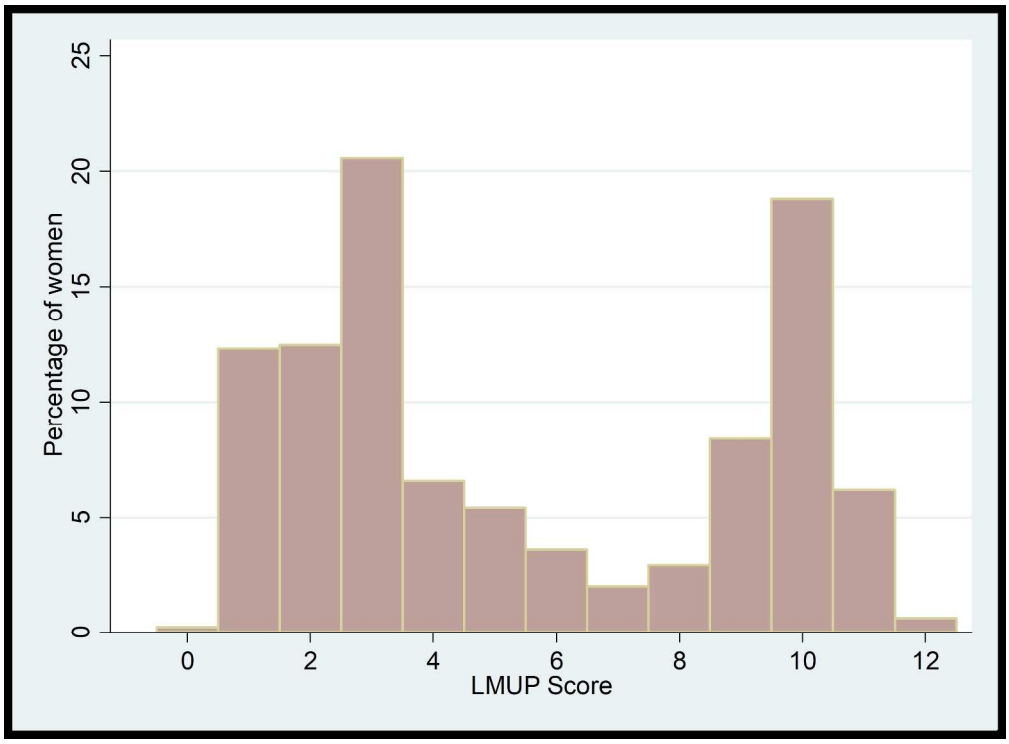
Variables	Univariate analysis			Multivariate analysis		
	OR	95% CI	p-value	AOR	95% CI	p-value
HIV Status and ART Use						
HIV Negative						
Newly Diagnosed	1.35	1.03-1.78	0.028	1.43	1.05-1.94	0.020
Known HIV+ - No ART	1.43	1.08-1.92	0.013	1.57	1.13-2.15	0.006
Known HIV+ - On ART	1.03	0.80-1.34	0.766	1.10	0.82-1.47	0.513
Age Category						
35-44						
25-34	1.14	0.88- 1.49	0.309	1.29	0.95-1.75	0.099
18-24	1.64	1.20-2.26	0.002	1.83	1.23-2.74	0.003
Parity	1.07	0.97-1.17	0.136	1.42	1.25-1.60	0.000
Married/Cohabiting						
No						
Yes	0.23	0.19- 0.29	0.000	0.19	0.15-0.24	0.000
Used Contraceptive in Past 12 Months						
No						
Yes	0.73	0.59-0.91	0.005	1.94	1.55-2.43	0.000
Socioeconomic Status						
Low						
Low-Middle	0.86	0.65-1.15	0.329	0.79	0.58-1.08	0.151
Middle-High	0.95	0.73-1.26	0.755	0.74	0.54-1.00	0.054
High	1.08	0.82-1.44	0.561	0.84	0.61-1.16	0.301
Finished High School						
No						
Yes	0.92	0.74-1.15	0.499	-	-	-
Employed						
No						
Yes	1.00	0.81-1.22	0.994	-	-	-
Housing						
Informal						
Formal	1.42	1.17-1.73	0.000	-	-	-
Gravidity	1.06	0.97-1.16	0.201	-	-	-

Abbreviations: OR, Odds ratio; AOR, Adjusted Odds ratio; CI, Confidence interval

FIGURE LEGENDS

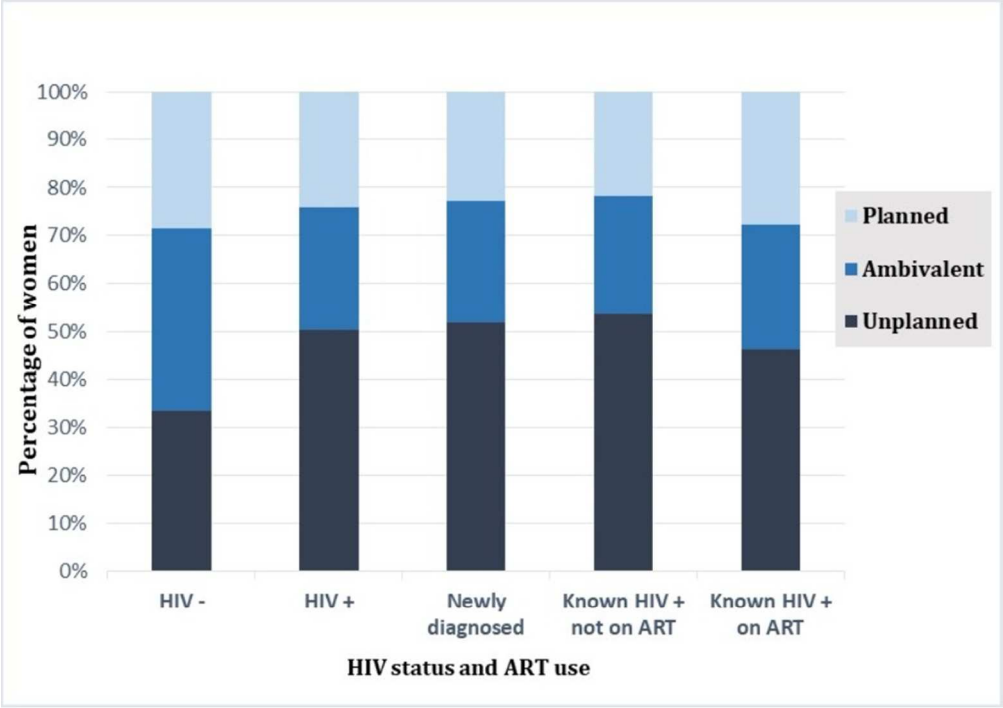
Figure 1: The distribution of the London Measure of Unplanned Pregnancy scores in HIV positive and negative pregnant women booking for antenatal care, 2013-2015.

Figure 2: The London Measure of Unplanned Pregnancy score categories stratified by HIV status and antiretroviral therapy use.



The distribution of the London Measure of Unplanned Pregnancy scores in HIV positive and negative pregnant women booking for antenatal care, 2013-2015.

284x208mm (300 x 300 DPI)



The London Measure of Unplanned Pregnancy score categories stratified by HIV status and antiretroviral therapy use.

84x59mm (300 x 300 DPI)

STROBE Statement—Checklist of items that should be included in reports of ***cross-sectional studies***

	Item No	Recommendation
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract **(p. 1)**
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found **(pp. 2–3)**
Introduction		
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported **(p. 1, paragraph 2 + p. 5, paragraph 1)**
Objectives	3	State specific objectives, including any prespecified hypotheses **(p. 5, paragraph 3)**
Methods		
Study design	4	Present key elements of study design early in the paper **(pp. 6-7)**
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection **(pp. 6-7)**
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants **(p. 6, paragraph 1)**
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable **(pp. 6-7)**
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group **(pp. 6-7)**
Bias	9	Describe any efforts to address potential sources of bias **(pp. 6 paragraph 3)**
Study size	10	Explain how the study size was arrived at **(p. 6)**
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why **(p. 7)**
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding **(p. 7)**
		(*b*) Describe any methods used to examine subgroups and interactions **(p. 7)**
		(*c*) Explain how missing data were addressed **(p. 7)**
		(*d*) If applicable, describe analytical methods taking account of sampling strategy
		(*e*) Describe any sensitivity analyses **(p. 7)**
Results		
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed **(p. 8)**
		(b) Give reasons for non-participation at each stage **(N/A)**
		(c) Consider use of a flow diagram **(N/A)**
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential **confounders *(Table 1*)**
		(b) Indicate number of participants with missing data for each variable of interest **(N/A)**
Outcome data	15*	Report numbers of outcome events or summary measures **(p. 7)**
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included **(p. 9 + *Table 4*)**
		(*b*) Report category boundaries when continuous variables were categorized **(N/A)**

		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses ***(p. 21 +Table 2*)**
Discussion		
Key results	18	Summarise key results with reference to study objectives applicable **(pp. 10-11)**
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias applicable **(pp. 12-13)**
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence applicable **(pp. 10-13)**
Generalisability	21	Discuss the generalisability (external validity) of the study results applicable **(p. 11)**
Other information		
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based **(p. 13)**

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.