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Background: In sub-Saharan Africa, women's disclosure of HIV-positive status to others may affect their use of services for prevention of mother-to-child transmission of HIV (PMTCT) of HIV and maternal and child health—including antenatal care, antiretroviral drugs (ARVs) for PMTCT, and skilled birth attendance.

Methods: Using data from the Migori and AIDS Stigma Study conducted in rural Nyanza Province, Kenya, we compared the use of PMTCT and maternal health services for all women by HIV status and disclosure category (n = 390). Among HIV-infected women (n = 145), associations between disclosure of HIV-positive status and the use of services were further examined with bivariate and multivariate logistic regression analyses.

Results: Women living with HIV who had not disclosed to anyone had the lowest levels of maternity and PMTCT service utilization. For example, only 21% of these women gave birth in a health facility, compared with 35% of HIV-negative women and 49% of HIV-positive women who had disclosed (P < 0.001). Among HIV-positive women, the effect of disclosure to anyone on ARV drug use [odds ratio (OR) = 5.8; 95% confidence interval (CI): 1.9 to 17.8]

and facility birth (OR = 2.9; 95% CI: 1.4 to 5.7) remained large and significant after adjusting for confounders. Disclosure to a male partner had a particularly strong effect on the use of ARVs for PMTCT (OR = 7.9; 95% CI: 3.7 to 17.1).

Conclusions: HIV-positive status disclosure seems to be a complex yet critical factor for the use of PMTCT and maternal health services in this setting. The design of interventions to promote such disclosure must recognize the impact of HIV-related stigma on disclosure decisions and protect women's rights, autonomy, and safety.

Key Words: HIV/AIDS, disclosure, stigma, PMTCT, maternal health, Kenya

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INTRODUCTION

Considerable advances have been made in global maternal and child health over the last few decades. In sub-Saharan Africa, however, death and disability for childbearing women and children remain exceptionally high. This region accounts for an estimated 62% of global burden of maternal mortality[1] and 50% of deaths in children younger than 5 years.[2] In addition to common causes of maternal mortality such as postpartum hemorrhage and preeclampsia, HIV infection contributes significantly to maternal mortality; women living with HIV during pregnancy or postpartum are 8 times more likely to die than women who are HIV negative.[3,4] Ninety-one percent of global HIV-related maternal mortality occurs in sub-Saharan Africa,[1] where estimates of maternal deaths attributable to HIV range from 4% to 25%.[1,3] This region also accounts for 90% of global mother-to-child transmission of HIV,[5] which is responsible for the majority of this infection in children.[6]

Services for prevention of mother-to-child transmission of HIV (PMTCT) and for maternal health can drastically reduce the incidence of adverse outcomes for women and children. PMTCT services, including the use of antiretroviral drugs (ARVs) during and after pregnancy, can improve survival of HIV-infected childbearing women[7] and bring the rate of newborn infection to as low as 1%–2%.[8,9] A critical component of both PMTCT and maternal health services is antenatal care (ANC), which includes HIV testing and counseling, pregnancy screening and monitoring, and treatment of complications. ANC also links women to other HIV, PMTCT, and maternal and child health services, including institutional delivery. Skilled care at birth has been associated

with substantial declines in maternal mortality,[10,11] as well as with enhancing effectiveness of PMTCT interventions that take place around the time of the birth.[12–15] Often referred to as "skilled birth attendance," this care is provided by a trained health worker proficient in midwifery skills (such as a midwife, nurse, or doctor) in a supportive environment (typically a primary or referral level health facility).[16]

Although these services are important, access to them can be extremely difficult in sub-Saharan Africa, where social and material inequalities are repeatedly shown to have strong effects on women's use of PMTCT and maternal health interventions. In this region, use of ANC and skilled birth attendance are influenced by factors such as age, parity, education, wealth, geographical proximity to care, women's autonomy, and personal interactions with health workers.[17–20] A similar cluster of sociodemographic, sociocultural, and health system factors has been shown to affect HIV-positive women's use of PMTCT services.[13,21–25]

In such contexts, the effect of women's HIV-positive status disclosure on care-seeking behavior during pregnancy and postpartum remains incompletely understood. Decisions about whether to disclose HIV-positive status are often influenced by anticipations and experiences of HIV-related stigma, as evidenced by studies documenting women's fears of violence, abandonment, and loss of economic support as a result of this disclosure.[26–30] Disclosure rates to a male sexual partner in sub-Saharan Africa range from 17% to 86%, and tend to be lower for women who test for HIV in ANC settings.[27] Lack of disclosure to male partners can limit women's ability to receive HIV care for their own health, increase the risk for sexual transmission of HIV if the male partner is serostatus negative, and increase the likelihood of suboptimal adherence to PMTCT interventions.[31,32] Disclosure to and involvement of a male partner in HIV testing have been associated with higher adherence to PMTCT interventions[15,22,27,32–35] and improved infant outcomes.[36] However, most studies to date have not examined the effects of disclosure to persons other than male partners, nor have they considered the impacts on use of maternal health services.

In this study, we explore the influence of HIV-positive status disclosure on women's use of essential PMTCT and maternal health services, hypothesizing that disclosure will be positively associated with service use. Specifically, we examine the effects of disclosure to different categories of persons (anyone, male partner, family, and other persons) on the use of ANC, ARVs for PMTCT, and skilled birth attendance, while controlling for established determinants of service use. Data were collected as part of the Maternity in Migori and AIDS Stigma (MAMAS) Study conducted from November 2007 to April 2009 in rural Nyanza Province, Kenya—an extremely low-resource setting where about 1 in 5 pregnant women is HIV positive,[37] and HIV infection has been estimated to account for as much as 20% of maternal mortality.[38]

METHODS

Study Setting and Participants

The MAMAS Study was a longitudinal investigation of pregnant women attending rural antenatal clinics, with the aim of examining the effects of HIV-related stigma on use of maternal and PMTCT health services. Study recruitment occurred at 9 government facilities (4 subdistrict hospitals and 5 health centers or dispensaries) supported by Family AIDS Care and Education Services, a program funded by the President's Emergency Plan for AIDS Relief. Women were invited to participate in the baseline questionnaire if they were: 18 years or older, less than 29 weeks pregnant, attending their first ANC clinic visit, and unaware of their HIV status (ie, never tested or tested negative over 3 months ago). A total of 1777 women participated in the antenatal baseline questionnaire.[30]

Before the initial ANC visit, a trained study interviewer administered the baseline questionnaire in the participant's preferred language. Women were subsequently offered voluntary HIV counseling and rapid testing as part of the ANC visit, followed by posttest counseling and PMTCT services for those testing positive per Kenyan national guidelines.[39] Information on women's acceptance of HIV testing and HIV serostatus were abstracted from medical records and contact information for potential follow-up was obtained.

Women selected for follow-up included all who tested HIV-positive (n = 226), all who were not tested for HIV at the first ANC visit (n = 145, including 94 women who refused testing), and a random sample who tested HIV-negative, roughly equal to the number of women who tested positive (n = 227). Among the total group (n = 598), 69% participated in a follow-up questionnaire 4–8 weeks after birth, administered by a trained interviewer either at the participant's home or at a health facility. On most sociodemographic and other characteristics examined, the women who completed this follow-up interview (n = 411) did not differ significantly from those who were lost to follow-up (n = 187).[40] Of the women participating in the follow-up interview, 7 (1.7%) were excluded from the current analyses because they had experienced a miscarriage before 20 weeks of gestation, and 14 (3.4%) were only included in descriptive and bivariate analyses because they were missing data on disclosure. Thus, the study primarily used data from a total of 390 women, focusing on the 145 women with disclosure data who tested HIV-positive at baseline (n = 131) or reported subsequent HIV-positive testing (n = 14).

This study received ethical approval from the Kenya Medical Research Institute (KEMRI) Ethical Review Committee, the University of California, San Francisco Committee on Human Research, and the University of Alabama at Birmingham's Institutional Review Board. All women provided signed informed consent for participation in the questionnaires and abstraction of data from their medical records.

Measures

Use of PMTCT and Maternal Health Services

Study outcomes included women's use of ANC services, ARVs during pregnancy, and skilled birth attendance. In accordance with recommendations of the World Health Organization for focused ANC,[41] we constructed a binary variable for having 4 or more ANC visits vs. having fewer visits. A

binary variable was also created for having used ARVs during pregnancy, defined as whether a woman reported using these drugs for PMTCT or not (detailed information on adherence was not available). Finally, we created a binary variable for birth in a health facility vs. outside a health facility. Because skilled birth attendants do not assist births outside health facilities in this part of Kenya, we considered facility birth equivalent to skilled birth attendance. Each of these variables was based on women's self-reports on the postpartum questionnaire.

HIV-Positive Status Disclosure

The independent variables of interest included binary constructs for HIV-positive status disclosure to anyone (including male partner, immediate family members, and other persons; excluding health workers), disclosure to a male sexual partner, disclosure to an immediate family member (on the woman's side or on her male partner's side), and disclosure to other persons (friends, more distant relatives, and other members of the community). In addition, we created a 3-level categorical variable that was dummy coded as: (1) women who disclosed to no one, (2) women who disclosed to their male partner nonexclusively (ie, disclosure to male partner regardless of whomever else was disclosed to), and (3) women who disclosed to anyone other than their male partner (family and/or others only). Disclosure status was assessed at the postpartum interview, and the question used did not distinguish between intentional or accidental disclosure ("Who knows about your HIV-positive status?").

Potential Confounders

Other factors that could influence the use of PMTCT and maternal health services were selected for their theoretical importance and significance in the literature. Sociodemographic factors measured at baseline included age, parity, marital status, education, and women's occupation. Age was not included in the final regression analyses because of its lack of significance in previous models and our desire to maintain parsimony given the small sample size. Parity was retained in the final analyses because we considered this variable to more directly reflect pregnancy and childbirth experience than age, and thus be more relevant for examining behaviors during these events. Occupation was used to indicate women's personal wealth and autonomy; specific categories were based on information from the study setting and included housework, farm or agricultural work, and other work outside the home (market sales, manual labor, etc). Baseline anticipations of HIV-related stigma (during pregnancy, before HIV testing) were measured with a 9-item scale initially developed and tested in a study in Botswana.[30,42]

Health care-related factors were measured postpartum and consisted of travel time from the woman's home to the nearest health facility (less than 1 hour vs. 1 hour or longer), the total number of ANC visits completed (3 or less vs. 4 or more), and having discussed plans for the birth with a male partner (Yes/No). As an independent variable, use of ANC indicated ties to the health care system in predicting use of ARVs and facility birth. Whether a woman discussed a birth plan with her male partner (Yes/No) was considered to signal involvement of the male partner in decision making for intrapartum care.

Analysis

We initially examined use of the selected outcome services among all women in the follow-up sample, comparing the following categories using the χ^2 test: (1) HIV status negative or unknown, (2) HIV-positive disclosed (to anyone), and (3) HIV-positive undisclosed (had not disclosed to anyone). Given that there were no significant differences for these outcomes between women who tested HIV-negative and those whose HIV status was unknown, we combined these women into a single group. Among HIV-positive women, we first performed χ^2 tests to examine differences between women who reported using the services with those who did not. Bivariate logistic regression analyses were then used to investigate associations of different HIV-positive status disclosure categories (anyone, male partner, family, others) with the use of ANC, ARVs, and birth in a health facility. Finally, multiple logistic regression models were estimated to examine the independent effects of different types of disclosure on each outcome, controlling for the potential confounders described above. To correct for any intracluster correlation, we used clustered robust estimates of variance with clinic as the primary sampling unit. All analyses were performed using Stata 12 statistical software package.[43]

RESULTS

Use of Services by HIV Serostatus and Disclosure to Anyone

Figure 1 gives the results for use of ANC visits, facility birth, and ARVs for PMTCT by HIV and disclosure status in the follow-up sample. The rate of birth in a health facility was similar when the 2 HIV status groups were compared: 35% of the women with an HIV-negative/unknown status (n = 245) and 34% of women who tested HIV-positive (n = 145) gave birth in a health facility. However, separating HIV-positive women into groups based on disclosure status revealed important differences. Birth in a facility was highest among HIV-positive women who had disclosed their HIV status to anyone (49%), followed by those with a negative/unknown HIV status (35%), whereas a much lower rate was observed among HIV-positive women who had not disclosed their status to anyone (21%) ($P < 0.001$). For ANC use, 51% of
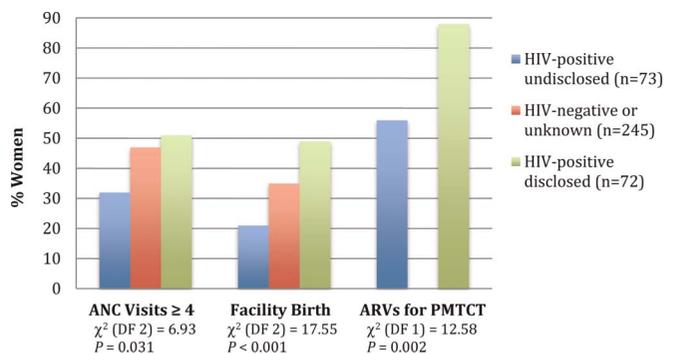

FIGURE 1. Proportion of women with ≥4 ANC visits, facility birth, and use of ARVs for PMTCT by HIV and disclosure status (n = 390).

HIV-positive women who had disclosed their status and 47% of HIV-negative women had 4 or more ANC visits, compared with only 32% of HIV-positive women who had not disclosed (P = 0.03). Among HIV-positive women, 88% of those who had disclosed their status reported using ARVs for PMTCT, compared with 56% of those who had not disclosed (P = 0.002).

Use of Services by Different Types of HIV-Positive Status Disclosure

Table 1 presents descriptive statistics for all HIV-positive women in the total sample (n = 159), as well as bivariate analyses for use of PMTCT and maternal health services. Most women in the sample were 21–30 year-old, married, had experienced a previous birth, and had finished primary school. Of the 20 unmarried women, 16 reported that they were not currently living with a male partner. Among all women, 42% engaged in farming and 40% worked outside the home in another capacity. The women were almost evenly split on whether it took less than an hour or longer to reach the nearest health facility. Only 41% completed 4 ANC visits or more, but a majority (67%) discussed a birth plan with their male partner.

Regarding HIV-positive status disclosure, 45% (n = 72) of women reported having disclosed to anyone, with 28% (n = 44) disclosing nonexclusively to a male partner, 20%

TABLE 1. Characteristics of HIV-Positive Women by Use of PMTCT and Maternal Health Services (n = 159)

	Total (n = 159), n (Column %)	Women With ANC Visits ≥4 (n = 65), n (Row %)	Women With ARVs in Pregnancy (n = 104), n (Row %)	Women With Birth in a Facility (n = 53), n (Row %)
Age				
≤20	46 (28.9)	17 (37.0)	29 (74.4)	13 (28.3)
21–30	95 (59.8)	40 (42.1)	62 (69.7)	31 (32.6)
≥31	18 (11.3)	8 (44.4)	13 (76.5)	9 (50.0)
Parity				
No previous births	22 (13.8)	8 (36.4)	15 (71.4)	7 (31.8)
Any previous births	137 (86.2)	57 (41.6)	89 (71.8)	46 (33.6)
Marital status				
Unmarried	20 (12.6)	4 (20.0)	15 (79.0)	4 (20.0)
Married	139 (87.4)	61 (43.9)**	89 (70.6)	49 (35.3)
Education				
≤Completed primary school	141 (88.7)	56 (39.7)	93 (73.2)	43 (30.5)
>Primary school	18 (11.7)	9 (50.0)	11 (61.1)	10 (55.6)**
Woman's occupation				
Housework	32 (18.5)	12 (37.5)	23 (76.7)	12 (37.5)
Farming or agriculture	65 (41.5)	27 (41.5)	42 (73.7)	14 (21.5)***
Other occupation†	62 (40.0)	26 (41.9)	39 (67.2)	27 (43.6)**
HIV status disclosure				
Missing/unknown	14 (8.8)	5 (35.7)	0 (0.0)	3 (21.4)
Anyone‡	72 (45.3)	37 (51.4)**	63 (87.5)***	35 (48.6)***
Male partner§	44 (27.7)	21 (47.7)	39 (88.6)***	22 (50.0)***
Family§‖	32 (20.1)	14 (43.8)	29 (90.6)***	14 (43.8)
Others§¶	19 (12.0)	13 (68.4)***	16 (84.2)	7 (36.8)
Travel time to nearest health facility				
<1 h	73 (45.9)	27 (37.0)	43 (65.2)	27 (32.5)
≥1 h	86 (54.1)	38 (44.2)	61 (77.2)	26 (34.2)
ANC visits				
1–3 visits	94 (59.1)	NA	53 (62.4)	20 (21.3)
≥4 visits	65 (40.9)	NA	51 (85.0)***	33 (50.8)***
Birth plan				
Missing/unknown	2 (1.26)	NA	2 (100.0)	0 (0.0)
No	52 (33.1)	NA	28 (58.3)	9 (17.3)
Yes	105 (66.9)	NA	74 (77.9)**	44 (41.9)***

χ^2 test.
*P < 0.10; **P < 0.05; ***P < 0.01.
†Includes market sales, manual labor, and other occupations.
‡Excludes health workers.
§Does not exclude disclosure to any other persons.
‖Includes immediate family members on own or husband's side.
¶Includes friends, more distant relatives, and other community members.
NA, not applicable.

(n = 32) to a family member, and 12% (n = 19) to another person. The χ^2 results in Table 1 indicate that these disclosure variables tended toward association with use of the selected health services. Descriptive statistics for the 3-level disclosure variable described in the Methods section (among the 145 women who had disclosure data) are as follows: 50% (n = 73) disclosed to no one, 30% (n = 44) disclosed nonexclusively to a male partner, and 19% (n = 28) disclosed to anyone other than a male partner (family and/or others). Additional descriptive statistics for exclusive disclosure and for other combinations of disclosure to different categories of persons can be found in Table S1 (see **Supplemental Digital Content,** http://links.lww.com/QAI/A578).

Bivariate logistic regression analyses revealed significant relationships between the different disclosure types and use of services, as shown in Table 2. Compared with women who had not disclosed their HIV-positive status to anyone, women who had disclosed to anyone were more than 5 times as likely to use ARVs during pregnancy ($P < 0.01$), almost 4 times as likely to give birth in a health facility ($P < 0.01$), and tended to have greater odds of completing at least 4 ANC visits ($P < 0.10$). Nonexclusive disclosure to a male partner was significantly associated with both ARV use and birth in a health facility, whereas nonexclusive disclosure to a family member was associated with use of ARVs. In contrast, nonexclusive disclosure to others was significantly associated with having completed 4 or more ANC visits, but not with the other outcomes. Although significant correlations were found between anticipated HIV-related stigma and subsequent disclosure, this variable was not associated with any of our service use outcomes (data not shown).

Results of the multiple regression models for disclosure to anyone are presented in Table 3. Disclosure to anyone retained its strong associations with use of ARVs and facility birth in these analyses: women who had disclosed to anyone still had 5.8 [95% confidence interval (CI): 1.9 to 17.8] higher odds of using ARVs, and 2.9 (95% CI: 1.4 to 5.7) higher odds of giving birth in a health facility. Again, disclosure to anyone tended to be associated with having completed 4 or more ANC visits, but not to a significant degree. Other factors in these models that were strongly related to the service outcomes included farm work (facility birth), having 4 or more ANC visits (ARV use and facility birth), and having discussed plans for the birth with a male partner (ARV use and facility birth).

To examine the relative impact of different disclosure types on use of services, we estimated multiple regression models including the variables for nonexclusive disclosure to a male partner and disclosure to anyone other than a male partner (family and/or others), vs. disclosure to no one. These results are shown in Table 4. As compared with those who had not disclosed their HIV-positive status to anyone, women who had disclosed their status to a male partner had 7.9 (95% CI: 3.7 to 17.1) higher odds of using ARVs for PMTCT. Women who had disclosed their status to family and/or others only had a 3.6 (95% CI: 1.1 to 12.1) higher likelihood of completing 4 or more ANC visits. Both disclosure to male partner and disclosure to family and/or others were significant predictors for facility birth [odds ratio (OR) = 2.9, 95% CI: 1.3 to 6.3; OR = 2.9, 95% CI: 1.4 to 6.1, respectively].

DISCUSSION

In this high HIV-prevalence setting in sub-Saharan Africa, our findings indicate that disclosure of HIV-positive status is an important factor for use of PMTCT and maternal health services. HIV-positive women who had not disclosed their status had the lowest use of ARVs and facility birth. HIV-positive women who had disclosed their status (to anyone) had the highest use of services—higher even than that of HIV-negative/unknown women in the same communities. Closer examination revealed significant associations between HIV-positive status disclosure and service use. Although disclosure to anyone was more or less relevant for use of all services, bivariate results indicated that different disclosure types influenced service use in different ways: disclosure to male partner was associated with both ARV use and facility birth, disclosure to family was associated with ARV use, and disclosure to other persons was associated with completion of 4 or more ANC visits.

Controlling for potential confounders, multivariate analysis of disclosure to anyone demonstrated similar associations and trends. In the multivariate models examining the effects of different disclosure types, disclosure to male partner was significant for use of ARVs, disclosure to family and/or others was significant for use of ANC, and both disclosure to a male partner and to family and/or others were important for facility birth. Gender norms and distance in social relationships may partially account for these findings, as disclosure to

TABLE 2. Bivariate Logistic Regression Results for HIV Status Disclosure Type and Use of Maternity and PMTCT Services Among HIV-Positive Women (n = 145)

	ANC Visits ≥4 OR (95% CI)	ARVs in Pregnancy OR (95% CI)	Birth in a Facility OR (95% CI)
Disclosure to anyone†	2.30 (0.85 to 6.18)*	5.46 (2.00 to 14.92)***	3.66 (1.93 to 6.92)***
Disclosure to male partner‡	1.45 (0.64 to 3.31)	4.32 (2.20 to 8.49)***	2.61 (1.25 to 5.44)**
Disclosure to family‡§	1.13 (0.10 to 2.50)	4.90 (1.36 to 17.70)**	1.66 (0.95 to 2.90)*
Disclosure to others‡‖	3.67 (1.03 to 13.08)**	2.30 (0.53 to 10.01)	1.19 (0.64 to 2.21)

Accounting for clustering by clinic.
*$P < 0.10$; **$P < 0.05$; ***$P < 0.01$.
†Excludes health workers.
‡Does not exclude disclosure to any other persons.
§Includes immediate family members on own or husband's side.
‖Includes friends, more distant relatives, and other community members.

TABLE 3. Multiple Logistic Regression Results for Disclosure to Anyone and Use of PMTCT and Maternal Health Services Among HIV-Positive Women (n = 145)

	ANC Visits ≥4 OR (95% CI)	ARVs in Pregnancy OR (95% CI)	Birth in a Facility OR (95% CI)
Any previous births	1.11 (0.34 to 3.58)	0.60 (0.17 to 2.11)	1.74 (0.94 to 3.24)*
Married	3.66 (0.94 to 14.23)*	0.50 (0.11 to 2.34)	1.50 (0.53 to 4.27)
>Primary school	1.59 (0.50 to 5.09)	0.26 (0.06 to 1.10)	2.44 (0.79 to 7.56)
Woman's occupation			
Housework (reference category)			
Farming or agriculture	1.13 (0.43 to 3.11)	0.90 (0.23 to 3.52)	0.29 (0.12 to 0.70)***
Other†	1.09 (0.50 to 2.39)	0.68 (0.19 to 2.46)	0.99 (0.50 to 1.95)
Disclosure of HIV status to anyone‡	2.43 (0.89 to 6.67)*	5.75 (1.86 to 17.79)***	2.85 (1.44 to 5.67)***
Travel time to nearest health facility ≥1 h	1.31 (0.78 to 2.18)	1.51 (0.69 to 3.30)	1.08 (0.46 to 2.56)
ANC visits ≥4	NA	3.00 (1.11 to 8.11)**	2.73 (1.28 to 5.81)***
Birth plan	NA	2.57 (1.28 to 5.17)***	3.20 (1.06 to 9.66)**

Accounting for clustering by clinic.
*$P < 0.10$; **$P < 0.05$; ***$P < 0.01$.
†Includes market sales, manual labor, and other occupations.
‡Excludes health workers.
NA, not applicable.

male partner may be particularly salient for services requiring more social and economic resources, but less relevant for accessing routine care such as ANC. The effect of disclosure to other relations on completing 4 or more ANC visits suggests a positive impact from this source of social support, whereas the lack of effect for a male partner may signify the lack of male participation in ANC that is typical in this setting. Except for the weak showing of travel time to nearest health facility, the potential confounders yielded expected results. Especially notable are the consistently strong effects of both adequate ANC visits and male partner involvement in a birth plan on use of ARVs and facility birth.

Limitations of these analyses include the relatively small sample size of HIV-positive women and the resulting need for parsimony in the multiple regression models. Complex wealth measures were not captured in this study, and simple indicators such as individual household assets were not included because of lack of significance in

TABLE 4. Multiple Logistic Regression Results for Different Types of Disclosure and Use of PMTCT and Maternal Health Services Among HIV-Positive Women (n = 145)

	ANC Visits ≥4 OR (95% CI)	ARVs in Pregnancy OR (95% CI)	Birth in a Facility OR (95% CI)
Any previous births	1.22 (0.38 to 3.96)	0.56 (0.19 to 1.66)	1.75 (0.98 to 3.15)*
Married	4.01 (0.97 to 16.61)*	0.45 (0.09 to 2.31)	1.53 (0.47 to 4.99)
>Primary school	1.72 (0.55 to 5.41)	0.22 (0.06 to 0.79)**	2.50 (0.75 to 8.35)
Woman's occupation			
Housework			
Farming or agriculture	1.19 (0.39 to 3.66)	0.84 (0.25 to 2.87)	0.29 (0.12 to 0.70)***
Other†	1.15 (0.49 to 2.72)	0.64 (0.20 to 2.01)	1.00 (0.50 to 2.00)
Disclosure of HIV status			
No one (reference category)			
Male partner‡	1.92 (0.64 to 5.72)	7.90 (3.65 to 17.13)***	2.87 (1.30 to 6.34)***
Anyone other than a male partner (family and/or others)§‖	3.63 (1.09 to 12.12)**	3.65 (0.84 to 15.82)*	2.87 (1.35 to 6.10)***
Travel time to nearest health facility ≥1 h	1.35 (0.79 to 2.31)	1.49 (0.71 to 3.14)	1.16 (0.48 to 2.80)
ANC visits ≥4	NA	3.16 (1.28 to 7.84)**	2.70 (1.31 to 5.56)***
Birth plan	NA	2.60 (1.32 to 5.12)***	3.16 (1.03 to 9.69)**

Accounting for clustering by clinic.
*$P < 0.10$; **$P < 0.05$; ***$P < 0.01$.
†Includes market sales, manual labor, and other occupations.
‡Does not exclude disclosure to any other persons.
§Includes immediate family members on own or husband's side.
‖Includes friends, more distant relatives, and other community members.
NA, not applicable.

preliminary analyses and because these measures may not accurately reflect woman's access to material resources for their own purposes. However, the occupation variable may have served as an indirect measure of household wealth, because women working in agriculture tend to live in less well-off households than those in which women work only at home or have other occupations. Other potential determinants not present in these analyses include measures of personal motivation and psychosocial support (beyond male partner involvement in a birth plan) that could influence both HIV-positive status disclosure and use of services.

Our previous findings suggest that women's fears and experiences of HIV-related stigma may be driving decisions to not disclose HIV-positive status and resultant avoidance of health services. In agreement with other studies of HIV-related stigma and use of PMTCT and maternal health interventions,[44] prospective data from the MAMAS Study revealed that among all women, those with higher baseline perceptions of stigma were subsequently less likely to accept HIV testing[30] and to give birth in a health facility[40] than those with lower perceptions of stigma. With respect to facility birth, however, further analyses showed that these perceptions were more influential for HIV-negative women than for HIV-positive women. Regarding the correlation between stigma and disclosure, recent results from a study in Uganda indicate that the effect of HIV-related stigma may be more inhibiting for disclosure to more distal relations (community leaders, neighbors, strangers) than to closer relations (male sexual partners, family members, friends).[45] Findings such as these suggest that further research is needed to unravel the complicated relationships between HIV-related stigma, disclosure, and use of PMTCT and maternal health services.

In contexts with high levels of HIV-related stigma and discrimination, HIV-positive status disclosure is a complex and sensitive issue. Such disclosure seems to have a strong and positive effect on women's use of lifesaving health services—possibly through allowing women to gain the support of close relations in accessing needed services and in reducing the negative impact of HIV-related stigma. Disclosure of positive HIV status may become even more critical for adherence to PMTCT programs as more countries opt to provide lifelong antiretroviral therapy to pregnant and breastfeeding women regardless of CD4 count.[46] Whatever specific strategy is used, disclosure assistance should take into account women's social and economic needs as well as medical needs,[47,48] and must be designed in a manner that protects women's rights, autonomy, and safety. Better understanding of HIV-related stigma, HIV status disclosure, and the impacts of these social processes on women's health care seeking could prove essential for more effective prevention of HIV transmission and for improving maternal and child health outcomes in sub-Saharan Africa.

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