Maternal health care utilization and child health outcomes among HIV-positive adolescent girls in Kenya

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Introduction

Teenage pregnancy and childbearing presents a kind of paradox in many parts of sub-Saharan Africa region. In particular, although many cultures do not approve of teenage pregnancy, they still sanction early marriages which are in turn associated with increased coital frequency, decreased condom use, hence increased chances of early childbearing (Mturi and Moerane 2001; Clark 2004; Westoff 2003). In addition, recent evidence points to declining trends in early marriages in many countries in the region but this has been characterized by a shift in the context of sexual initiation from marriage to premarital sex (Manzini 2001; Mensch et al. 2005; Mensch et al. 2006; Westoff 2003). Sub-Saharan Africa therefore continues to be characterized by the greatest proportion of teenagers who are mothers compared to other regions of the world (Gupta and Mahy 2003; Kaufman et al. 2001; Mba 2003; Westoff 2003). At the same time, perhaps because of the cultural view towards teenage sexuality and pregnancy or weak health care systems, reproductive health services are in most cases not oriented towards adequately meeting the needs of adolescents including teenage mothers (Katz and Naré 2002; Warenius et al. 2006; Wood and Jewkes 2006).

A number of studies in the developed and developing world have documented poor maternal and child health outcomes among teenage compared to older mothers, including increased risks of pre-term delivery, low birth weight, neonatal mortality, and pregnancy wastage. The teenage disadvantage has been attributed to physiological immaturity,

inadequate use of prenatal and delivery care services, low socio-economic conditions and high rates of unintended pregnancies among adolescent mothers (Abou-Zahr and Wardlaw 2003; Alam 2000; Chen et al. 2007; Conde-Agudelo et al. 2005; Jolly et al. 2000; Magadi 2006; Magadi et al. 2007a, 2007b; Reynolds et al. 2006). These disadvantages are likely to be exacerbated in contexts such as that of sub-Saharan Africa where the rates of teenage pregnancies are high, the health care systems are weak, and even profound disparities in maternal and child health outcomes exist in countries and settings such as urban areas with relatively good health care services (Fotso 2006; Magadi et al. 2003, 2007a, 2007b; Zere et al. 2007).

The high HIV prevalence in parts of the region may complicate further the reproductive health outcomes of HIV-positive teenage mothers not only in terms of infant deaths but also access to relevant services such as prenatal and delivery care as well as prevention of mother-to-child transmission (PMTCT) of infection. Teenage mothers who are living with HIV might not only have to confront unfriendly health care providers because of their age but also stigma and discrimination which are still associated with being HIV-positive in many parts of the region (Bond et al. 2002; Skinner and Mfecane 2004). Nonetheless, with the increased availability of antiretroviral treatment (ART) and emphasis on treatment, care and prevention, there should be improvements in maternal and child health outcomes for all HIV-positive mothers including adolescents. However, emerging evidence indicates that the existing HIV/AIDS treatment, care and support programs in the region do not screen their adolescent clients for sexual and reproductive health needs as most service providers emphasize that they refrain from or postpone sexual intercourse (Birungi et al. 2008, 2009a, 2009b). This therefore presents a missed

opportunity for systematically identifying and addressing the reproductive health concerns of HIV-positive adolescent clients.

Given the challenges teenage mothers generally face and the limitations of existing HIV/AIDS programs, it seems reasonable to suppose that the maternal and child health outcomes of HIV-positive adolescents in the region remain poor. However, there is still limited understanding in this area. This paper uses unique pregnancy history data collected among HIV-positive adolescent girls aged 15-19 years who were receiving treatment, care and support services from various HIV/AIDS programs in Kenya. It is in three parts. The first part examines the distribution of pregnancies and births by maternal background characteristics, use of health care services, and child health outcomes. The second part explores the determinants of maternal health care utilization and child health outcomes among this group of adolescents with specific focus on prenatal care, PMTCT services, delivery care, post-natal care, testing of infants for HIV, infant's sero-status, and the survival status of the child. The final section compares selected outcomes among HIV-positive adolescent mothers with those of similar adolescents from the general population based on data from the 2008-09 Kenya Demographic and Health Survey (KDHS). The purpose is to determine whether HIV-positive adolescent mothers have better or worse maternal and child health outcomes than their counterparts in the general population. The outcomes considered in the comparison include prenatal care, delivery care, post-natal care and the survival status of the child.

Data

The data are from a study conducted in 2009 among HIV-positive adolescent boys and girls aged 15-19 years in some of the high HIV prevalence regions in Kenya. These included Nyanza, Nairobi, Rift Valley, and Coast provinces with adult (15-49 years) HIV prevalence of 14%, 7%, 5% and 4% respectively (KNBS and ICF Macro 2010). It comprised both quantitative survey and qualitative interviews with adolescents aged 15-19 years who are living with HIV, were aware of their HIV sero-status, and were willing and able to talk about their inner lives. The participants were identified and recruited through the existing orphaned and vulnerable children (OVC) programs, comprehensive care centers (CCCs), youth counseling centers, and voluntary counseling and testing (VCT) centers in the respective provinces. Service providers/counselors, community healthcare workers (CHWs), and social workers who interacted with the adolescents at the centers assisted with the identification and mobilization of the respondents. Written consent was obtained from willing participants before conducting interviews. For adolescents aged 15-17 years, written consent was first obtained from the parent/guardian before obtaining assent from the adolescents themselves. For those aged 18-19 years and those aged 15-17 years but were living alone, married, or taking care of siblings, only individual written consent was obtained.

The quantitative survey involved structured interviews which were conducted by young research assistants aged between 18 and 24 years who received training on the study procedures, data collection, and ethics. The survey tool was adapted and modified from the one used for a similar study in Uganda (Birungi et al. 2008). It was then translated into *Kiswahili* (the national language) and *Dholuo*, the dominant language spoken in Nyanza

province. The study collected information on respondents' background characteristics, access to information and support services, relationships and dating, sexual behavior and desires, knowledge and use of preventive/ contraceptive methods, pregnancy and childbearing experiences and intentions, pregnancy outcomes and use of maternal and child health services, experiences with physical and sexual violence, and issues of self-esteem. The interview setting was agreed upon between the research assistant and the respondents. A total of 1,070 HIV-positive adolescents were identified to participate in the study and interviews were completed with 1,059 individuals. Of those who did not complete interviews, one declined while the remaining interviews were partially completed either due to emotional breakdown or because the individuals were still unaware or in denial about their sero-status.

Besides the quantitative survey, 8 focus group discussions (FGDs) were held with a subset of the survey participants aged 18-19 years. This age group was chosen for the FGDs because they could provide individual written consent given that there was limited time to allow for obtaining parental/guardian consent for those aged 15-17 years. One FGD was held with female and another with male adolescents in each of the study sites (Rift Valley, Coast, Nairobi and Nyanza). The purpose of the FGDs was to determine group opinions, perceptions, attitudes around their sexuality as well as their sexual and reproductive health information and service needs. Each FGD had, on average, 6 participants. In addition, 12 in-depth interviews were conducted with HIV-positive adolescent girls who have ever been pregnant. The purpose was to gain a more depth understanding of their experiences with maternal and child health services including PMTCT, assistance during delivery, post-natal care, and child health services. Unstructured

interviews were also conducted with a total of 16 service providers/ counselors, CHWs and social workers to understand the issues around SRH counseling for HIV-positive adolescents from the providers' point of view. The service providers were purposively selected based on how frequently they interacted with HIV-positive adolescents.

This paper uses data from the quantitative and in-depth interviews with HIV-positive adolescent girls who have ever been pregnant. The number of female respondents who completed individual interviews was 757, comprising 71% of participants in the study. Of these, 78% (587) had ever had sexual intercourse. Two-thirds (67%) of those who had ever had intercourse had been pregnant while 24% of those who had been pregnant experienced multiple pregnancies. The total number of pregnancies reported was 506; these form the unit of analysis for this paper. For each pregnancy, respondents were asked detailed questions on whether the pregnancy was intended, the relationship to the person who was responsible, antenatal care and the number of visits made, PMTCT services, the outcome of pregnancy, the place of delivery or pregnancy termination, the person who assisted during delivery or pregnancy termination, post-natal care, use of family planning after delivery or pregnancy termination, and for live births, whether the child was tested for HIV, respondent's willingness to share the results of the test, the outcome of the test, as well as whether the child was still alive at the time of the survey. The birth history data from the 2008-09 KDHS among adolescent girls aged 15-19 years in Coast, Nairobi, Nyanza and Rift Valley provinces is used for comparison. Of 1,767 adolescent girls interviewed in the KDHS, 912 (52%) were from the four provinces. The number of births reported by the adolescents was 353 with 241 being from the four provinces.

Analysis

The data are hierarchical with pregnancies or births being clustered within individual adolescent mothers identified from the same HIV/AIDS treatment, care and support facility, or from the same cluster in the case of KDHS. The nature of the data requires an analysis technique that takes into account unobserved characteristics of pregnancies or births to the same mother as well as of individuals identified from the same facility or cluster. The analysis therefore entails estimation of multilevel random-intercept logit models (Rabe-Hesketh and Skrondal 2008) predicting utilization of maternal health care services and various child health outcomes. The basic model is of the form:

$$\log it(\pi_{ijk}) = X_{ijk}\beta + \mu_{jk} \qquad (1)$$

where π_{ijk} is the probability of a given outcome for pregnancy or birth i to individual mother j identified from facility or cluster k; X_{ijk} is the vector of covariates; β is the associated vector of fixed parameters; and μ_{jk} are the unobserved characteristics of individual mothers from the same facility or cluster k that might be correlated with the outcomes of interest.

The first set of models predicts utilization of maternal health care services by HIV-positive adolescent mothers. Utilization is measured by five dichotomous outcomes, namely, receiving prenatal care (model 1); making four or more prenatal care visits (among those who obtained such care; model 2); receiving PMTCT services (model 3); being assisted by a doctor, nurse or midwife during delivery or pregnancy termination, that is, skilled attendance (model 4); and receiving post-natal care services (model 5). The first two models include as covariates the age at first pregnancy (in single years), study site (Coast, Nairobi, Nyanza and Rift Valley), the highest level of education of the mother (no

schooling, primary and secondary and above), pregnancy order (from 1 to 4), relationship to the person who was responsible for the pregnancy (boyfriend/fiancé, husband, and other persons, that is, friend/acquaintance/stranger), as well as whether the pregnancy was intended. In addition to these, the next two models include whether prenatal care was received (none, less than 4 visits, and 4 visits or more) while the fifth model includes whether skilled attendance was received during delivery or pregnancy termination as well.

Models for child health outcomes are estimated for live births only and are measured by three dichotomous outcomes, that is, whether the infant was tested for HIV (model 6), was HIV-positive (among those who were tested and the mother was willing to share the results; model 7), and was still alive at the time of the survey (model 8). Apart from the covariates included in the previous models, models 6 and 7 include whether PMTCT was received while model 8 includes the HIV status of the infant as well (HIV-positive, HIV-negative, and not tested/undetermined/don't know). The final set of models—also estimated for live births only—predicts five selected indicators of maternal health care utilization and child health outcomes using combined datasets for adolescents living with HIV and those from the general population (KDHS). The indicators include receiving any prenatal care (model 9), making four or more prenatal care visits (among those who received such care; model 10), having skilled attendance during delivery or pregnancy termination (model 11), receiving post-natal care services (model 12), and whether the child was still alive at the time of the survey (model 13). Models 9 and 10 control for age at first pregnancy, study site, maternal education level, birth order, and whether the pregnancy was intended. In addition to these, model 11 controls for prenatal care visits while models 12 and 13 include skilled attendance as well.

Results

Distribution of pregnancies and births by various characteristics

The distribution of pregnancies and births among HIV-positive adolescent girls by maternal background characteristics, use of health care services, and child health outcomes is presented in Table 1. Adolescents aged 18 years or older at the time of the survey reported about four-fifths of the pregnancies although most of the pregnancies (79%) occurred earlier, that is, at ages 17 years and below. In addition, nearly three-quarters (73%) of the pregnancies were reported in only two study sites, that is, Nyanza and Nairobi provinces which also have the highest HIV prevalence in the country. The fact that 74% of the respondents were not married at the time of the survey and that other persons (boyfriends, fiancés, friends, acquaintances, and strangers) and not husbands were responsible for 75% of the pregnancies indicates that many of the pregnancies occurred outside of marriage. Consequently, the majority of the pregnancies were unintended.

<Table 1 about here>

Although mothers received prenatal care for 84% of the pregnancies, they made four or more visits for only 54% of the pregnancies for which prenatal care was received (Table 1). Similarly, despite the fact that the provision of PMTCT services to HIV-positive mothers should be part of prenatal care, the proportion of pregnancies for which mothers received PMTCT services was significantly lower than that for which they received prenatal care ($p<0.01$). Results from further analysis show a similar pattern among adolescent girls who were still pregnant at the time of the survey with 89% having received prenatal care while a lower proportion (74%) had received PMTCT services. Insights from in-depth interviews with a subset of the adolescents suggest that this could partly be

attributed to lack of awareness as well as accessibility and quality of services as the following excerpts indicate:

Respondent: *They are, right now most of the people are complaining about there because a doctor may come in then leave, then he takes long to come back, I don't know if they go for breaks or what. When he come s to attend to you, you have been waiting for long you are tired and hungry. I don't like that service.*

…

Respondent: *When he comes he says, you what problem do you have? If you explain to him he does not carry on tests on you. He only prescribes for you medicine and you go to collect it. And sometimes you do not have money for the medicine. So you do not get it* (In-depth interview No. 1, 19-year old, Coast)

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Interviewer: *Did you ever attend antenatal clinic when you were pregnant?*

Respondent: *I went but I was not tested.*

Interviewer: *But did they do any physical examination on you?*

Respondent: *Yes, I was examined and I was given vitamin tablets which I took. After that I gave birth.*

Interviewer: *So, was it a requirement to get tested for HIV or was it not a requirement to get tested when you went to the clinic while pregnant?*

Respondent: *I was not told anything about it but I did not see them testing anybody.*

…

Interviewer: *So, you did not use any PMTCT services when you were pregnant?*

Respondent: *I did not because I did not know about them and I was not told anything about them when I went to the hospital.*

…

Interviewer: *Was it a big hospital or a small one?*

Respondent: *It is just a small center* (In-depth interview No. 3, 19-year old, Rift Valley).

Most of the pregnancies resulted in a live birth while mothers were still pregnant in 5% of the cases (Table 1). Further analysis shows that the proportion of pregnancy outcomes for which mothers received skilled attendance was significantly lower ($p<0.01$) for miscarriages, stillbirths or abortion (20%) than for full-term or pre-term live births (79% and 78% respectively). A similar pattern is observed for the proportion of pregnancy outcomes for which mothers received post-natal care, that is, 33% for miscarriages, stillbirths or abortion, 89% for full-term and 85% for pre-term live births. This is an indication that most HIV-positive adolescent girls who experienced poor birth outcomes did not receive proper care during or after pregnancy termination. The majority of infants who were born alive were, however, tested for HIV (87%) and the mothers were willing to share the results of the test in 98% of the cases with 17% of the infants turning HIV-positive.

Determinants of service utilization and child health outcomes

Table 2 presents the results from the multilevel models predicting utilization of prenatal care, PMTCT, skilled attendance and post-natal care services by pregnant HIV-positive adolescent girls. The use of prenatal care services was significantly lower in Coast than in Nyanza province. Nonetheless, when they did receive prenatal care, adolescent mothers from Coast province were significantly more likely to make four or more visits compared

to their counterparts from Nyanza or Nairobi provinces ($p<0.05$ and $p<0.01$ respectively). Similarly those from Rift Valley were significantly more likely to make four or more visits compared to those from Nairobi province ($p<0.5$). In contrast, the likelihood of using PMTCT services was significantly higher in Nairobi than in Nyanza or Rift Valley provinces ($p<0.05$ and $p<0.01$ respectively). Similarly, adolescent mothers from Nairobi province were significantly more likely to be assisted by a doctor, nurse or midwife during birth or pregnancy termination compared to those from Nyanza ($p<0.01$). However, adolescents from Nyanza were significantly more likely to have received post-natal care compared to their counterparts from the other sites.

<Table 2 about here>

Results in Table 2 further show that adolescent mothers were significantly less likely to have received prenatal care (including making four or more prenatal visits), PMTCT services, and skilled attendance during delivery or pregnancy termination for most recent compared to earlier pregnancies. They were, however, significantly more likely to have received prenatal care and PMTCT services when the person responsible for the pregnancy was the husband rather than the boyfriend/fiancé or friend/acquaintance/stranger ($p<0.05$ in all cases). Moreover, as expected, receiving prenatal care was significantly associated with higher likelihood of obtaining PMTCT services, skilled attendance during delivery or pregnancy termination, and post-natal care services. In addition, adolescent mothers who were attended to by doctor, nurse or midwife during delivery or pregnancy termination were also significantly more likely to obtain post-natal care services compared to those who did not receive skilled care.

With respect to child health outcomes, mothers who received PMTCT services were significantly more likely to have their infants tested for HIV compared to their counterparts who did not receive such services (Table 3). Differences by study site show that infants from Coast province were significantly more likely to have been tested for HIV compared to those from Rift Valley ($p<0.05$). Among infants who were tested, those from Coast province were significantly more likely to be HIV-positive compared to those from Rift Valley ($p<0.05$). The results further show that, as expected, infants born to mothers who received PMTCT services were significantly less likely to be HIV-positive compared to those born to mothers who did not receive the services. There was, however, no significant difference in the survival status of HIV-positive and HIV-negative infants. But infants who were not tested, whose sero-status was undetermined, or were tested but the mother did not know the results were significantly less likely to be alive at the time of the survey compared to those who were HIV-negative ($p<0.01$).

<Table 3 about here>

Comparison with adolescent mothers from the general population

The results from models comparing maternal health care utilization and child health outcomes among HIV-positive adolescent mothers and those from the general population are presented in Table 4. The two groups of adolescents do not significantly differ in terms of receiving prenatal care. Among those who received such care, HIV-positive adolescent mothers were significantly more likely to make four or more visits compared to their counterparts from the general population. They were also significantly more likely to be assisted by a doctor, nurse or midwife during delivery or pregnancy termination, and to receive post-natal care services. Nonetheless, infants of HIV-positive adolescent mothers

were significantly less likely to be alive at the time of the survey compared to those of mothers from the general population.

<Table 4 about here>

Discussion

One of the major findings of this study is the significantly low use of PMTCT compared to prenatal care services among HIV-positive adolescent mothers in Kenya. This is against the backdrop of national and international guidelines emphasizing the provision of PMTCT to HIV-positive mothers as an integral component of prenatal care (NASCOP/MOH 2009; WHO 2007). In-depth interviews with some of the adolescents suggest that this could partly be attributed to lack of awareness about the services on the part of the adolescents as well as the availability, accessibility and quality of the services. It could also be due to the lower likelihood of seeking care, including PMTCT services, for most recent (higher order) compared to earlier pregnancies observed among adolescent mothers in the study. Although the low likelihood of seeking care for higher order births has been observed among mothers in general (Magadi et al. 2003, 2007a), for HIV-positive mothers this has implications for vertical transmission of HIV especially to later born children. This suggests that there is still need to strengthen the provision of PMTCT services to HIV-positive adolescent mothers within maternal and child health care programs in the country.

The second major finding of the study is the significantly low use of certain maternal health care services, especially skilled attendance and post-natal care, for pregnancies that resulted in wastage (miscarriage, stillbirth or abortion) among HIV-positive adolescent girls. It implies that most of the pregnancy wastages occurred under

unsafe conditions thereby exposing the adolescents to increased risks of maternal morbidity and mortality. However, this is not unique to HIV-positive adolescents. Unsafe abortion practices have, for instance, been documented among adolescent girls in parts of sub-Saharan Africa (Magadi 2006; Varga 2002). The case for HIV-positive adolescents stems from the fact that most of them visit clinics regularly for treatment, care and support. This offers an opportunity to systematically screen them for sexual and reproductive health information and service needs. This will allow for early identification of pregnant HIV-positive adolescent girls so that they are linked to appropriate services. It also suggests the need for creating effective linkages between the HIV/AIDS centers and maternal and child health clinics to ensure comprehensive service provision for HIV-positive adolescent mothers.

The findings further suggest that strengthening the maternal and child health care services for HIV-positive adolescent mothers needs to take into account the regional variations in access, parity and paternity dynamics, as well as the social context. Specifically, the fact that HIV-positive adolescent mothers from Nairobi were significantly more likely to receive PMTCT services and skilled attendance during delivery or pregnancy termination could be indicative of service availability and accessibility (in terms of distance and time one needs to cover to obtain the services) in the city compared to other regions. In addition, the significantly higher likelihood of using prenatal care and PMTCT services when the person responsible for the pregnancy was the husband underscores the role of paternity dynamics in the use of maternal health services among adolescent mothers. Adolescent girls who experience pre- or extra-marital pregnancies might not seek

appropriate services partly because of the social stigma—perceived or otherwise—associated with such pregnancies (Mturi and Moerane 2001; Varga 2002).

With respect to whether the child was alive at the time of the survey, the lack of significant difference in the survival status of HIV-positive and HIV-negative infants could reflect the impact of ART. Although mothers of HIV-positive children were not specifically asked whether the child was on ART, this is an indication that most of the children could have been on treatment. This should be expected given that the mothers were also receiving services from the centers. In contrast, the significantly lower likelihood of survival of infants who were not tested for HIV, whose sero-status was undetermined, or who were tested but the mother did not know the results of the test could suggest two things. In particular, it could be that: (1) the infants died before they could be tested given that the national guidelines recommend conducting the first test at 6 weeks (NASCOP/MOH 2009), or (2) non-testing or inability to determine the sero-status of the infants in time when in fact they were HIV-positive led to delays in providing the necessary treatment thereby hastening their death. The study did not, however, ask about the timing of testing and death which could allow for determining the sequence of the two events.

Finally, HIV-positive adolescent mothers were significantly more likely to make four or more prenatal care visits, be assisted by a doctor, nurse or midwife during delivery or pregnancy termination, and to receive post-natal care services compared to their counterparts from the general population. This could be attributed to the fact that they have regular contacts with HIV/AIDS clinics for treatment, care and support services. Nonetheless, their children were significantly less likely to be alive at the time of survey compared to children of adolescent mothers from the general population. The difference in

the likelihood of child survival is observed despite the fact that for adolescents who got infected through heterosexual contact, some of their children could have been born prior to infection. However, the study did not ask about when infection occurred which could make it possible to determine whether some children might have been born before then, and thus compare their survival status to that of children from the general population.

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Table 1: Percent distribution of pregnancies among HIV-positive adolescent girls in Kenya by maternal background characteristics, use of health care services, and child health outcomes, 2009

Distribution by maternal background characteristics

Characteristics	Percent	N	Characteristics	Percent	N
Current age			Highest education level		
15-17	14.9	75	No schooling	5.3	27
18-19	84.1	431	Primary	70.6	357
Study site			Secondary and above	23.3	118
Coast	14.4	73	Missing	0.8	4
Nairobi	36.2	183	Currently married		
Nyanza	36.8	186	Yes	36.5	134
Rift Valley	12.6	64	No	73.5	372

Distribution by use of maternal health care services and child health outcomes

Age at first pregnancy			Four or more prenatal visits	53.7	425
<15 years	11.5	58	Received PMTCT care	66.8	506
15-17 years	67.6	342	Outcome of pregnancy		
18-19 years	20.4	103	Full-term live birth	74.3	376
Don't remember/missing	0.6	3	Pre-term live birth	10.7	54
Pregnancy order			Miscarriage/stillbirth	4.0	25
First	73.7	373	Ended it/aborted	4.1	21
Second	21.7	110	Still pregnant	5.3	27
Third	3.6	18	Missing	0.6	2
Fourth	1.0	5	Assisted by doctor/nurse[b]	72.9	476
Unintended pregnancies	73.9	506	Received post-natal care[b]	82.8	476
Relationship to person			Infant tested for HIV[c]	86.5	430
Boyfriend/fiancé	66.2	335	HIV status of infant[d]		
Husband	24.7	125	HIV-negative	77.5	285
Other[a]	8.7	44	HIV-positive	17.4	64
Missing	0.4	2	Undetermined/don't know	5.2	19
Received prenatal care	84.0	506	Child is alive[c]	89.5	430

Notes: [a]Other refers to friend, acquaintance or stranger; PMTCT- prevention of mother-to-child transmission (of HIV).

[b]Among pregnancies that had ended, that is, live births, miscarriages, stillbirths or abortions.

[c]Among infants who were born alive.

[d]Among infants born alive who were tested for HIV and whose mothers were willing to share the results of the test.

Table 2: Coefficient estimates from the multi-level models predicting utilization of various maternal health care services by HIV-positive adolescent girls in Kenya, 2009

Covariates	Model 1	Model 2	Model 3	Model 4	Model 5
Age at first pregnancy (single years)	0.10	-0.08	0.15	-0.06	-0.08
	(0.09)	(0.10)	(0.14)	(0.09)	(0.17)
Study site (ref=Nyanza)					
Coast	-1.16*	1.10*	0.29	0.49	-1.99*
	(0.49)	(0.55)	(0.68)	(0.44)	(0.98)
Nairobi	-0.32	-0.62	1.75*	1.09**	-1.69*
	(0.42)	(0.36)	(0.68)	(0.35)	(0.81)
Rift Valley	-0.42	0.43	-0.87	0.38	-2.46*
	(0.51)	(0.47)	(0.62)	(0.43)	(1.08)
Maternal education level (ref=No schooling)					
Primary education	-0.06	1.04	0.18	-0.21	-0.38
	(0.60)	(0.78)	(0.93)	(0.60)	(1.16)
Secondary and above	0.24	1.62	0.12	0.26	0.03
	(0.67)	(0.84)	(0.99)	(0.65)	(1.25)
Pregnancy order (ranges from 1 to 4)	-0.57*	-0.74*	-0.92*	-0.50*	-0.42
	(0.25)	(0.29)	(0.40)	(0.23)	(0.47)
Relationship to person (ref=Boyfriend/fiancé)					
Husband	1.32*	0.37	1.46*	0.32	0.56
	(0.52)	(0.37)	(0.60)	(0.38)	(0.76)
Other[a]	-0.35	-0.67	-0.29	0.18	0.36
	(0.44)	(0.58)	(0.64)	(0.50)	(0.95)
Pregnancy was intended (Yes=1)	0.82	0.35	0.08	0.14	-0.54
	(0.51)	(0.35)	(0.49)	(0.37)	(0.69)
Prenatal care received (ref=None)					
<4 visits	n/a	n/a	4.19**	2.55**	2.46*
			(1.15)	(0.49)	(0.98)
4+ visits	n/a	n/a	5.33**	3.36**	2.21*
			(1.40)	(0.59)	(0.99)
Assisted by doctor/nurse (Yes=1)	n/a	n/a	n/a	n/a	3.71**
					(1.17)
Number of cases					
Pregnancies	495	420	495	466	466
Mothers	388	349	388	369	369
Facilities	56	53	56	54	54

Notes: [a]Other refers to friend, acquaintance or stranger; Models 1 to 5 respectively predict the likelihood of: (1) receiving prenatal care; (2) making four visits or more among those who received prenatal care; (3) receiving services for prevention of mother-to-child transmission of HIV; (4) being assisted by a doctor or nurse/midwife during delivery or pregnancy termination; and (5) receiving post-natal care services; ref=reference category; n/a=not applicable; Standard errors are in parenthesis; *p<0.05; **p<0.01.

Table 3: Coefficient estimates from the multi-level models predicting various child health outcomes among live births to HIV-positive adolescent girls in Kenya, 2009

Covariates	Model 6	Model 7	Model 8
Age at first pregnancy (single years)	0.08 (0.12)	-0.19 (0.13)	0.02 (0.14)
Study site (ref=Nyanza)			
Coast	1.22 (0.75)	0.71 (0.57)	-0.48 (0.69)
Nairobi	0.08 (0.44)	0.30 (0.47)	-0.25 (0.56)
Rift Valley	-0.72 (0.49)	-0.91 (0.70)	-0.47 (0.66)
Maternal education level (ref=No schooling)			
Primary education	-0.95 (0.94)	-0.88 (0.82)	0.24 (0.90)
Secondary and above	-0.35 (0.99)	-0.70 (0.87)	0.01 (0.98)
Birth order (ranges from 1 to 4)	-0.42 (0.31)	-0.23 (0.36)	-0.49 (0.37)
Relationship to person responsible (ref=Boyfriend/fiancé)			
Husband	-0.02 (0.50)	-0.27 (0.51)	-0.76 (0.58)
Other[a]	0.52 (0.64)	1.13 (0.62)	0.88 (0.94)
Pregnancy was intended (Yes=1)	0.72 (0.53)	0.28 (0.47)	0.58 (0.62)
Prenatal care received (ref=None)			
<4 visits	0.01 (0.56)	0.85 (0.70)	0.40 (0.72)
4+ visits	0.57 (0.62)	0.56 (0.72)	0.58 (0.79)
Assisted by doctor/nurse (Yes=1)	0.43 (0.42)	-0.97 (0.50)	0.73 (0.50)
Received PMTCT services (Yes=1)	0.94* (0.41)	-1.87** (0.60)	-0.20 (0.54)
HIV status of infant (ref=HIV-negative)			
HIV-positive	n/a	n/a	-1.04 (0.62)
Not tested/undetermined/don't know	n/a	n/a	-2.11** (0.64)
Number of cases			
Births	423	362	417
Mothers	348	312	348
Facilities	54	48	54

Notes: [a]Other refers to friend, acquaintance or stranger; Models 6 to 8 respectively predict the likelihood of: (6) the infant being tested for HIV; (7) the infant being HIV-positive; and (8) the child still being alive at the time of the survey; PMTCT=prevention of mother-to-child transmission (of HIV); ref=reference category; n/a=not applicable; Standard errors are in parenthesis; *p<0.05; **p<0.01.

Table 4: Coefficient estimates from the multi-level models predicting maternal health care utilization and child health outcomes among the different samples of adolescent girls in Kenya, 2008-09

Covariates	Model 9	Model 10	Model 11	Model 12	Model 13
Adolescent sample (HIV-positive=1)	-0.30	1.82**	1.33**	3.21**	-1.26*
	(0.57)	(0.48)	(0.23)	(1.20)	(0.53)
Age at first pregnancy (single years)	0.30	0.12	-0.04	-0.01	-0.02
	(0.17)	(0.10)	(0.07)	(0.15)	(0.11)
Study site (ref=Nyanza)					
Coast	-0.69	0.61	0.51	-0.12	0.60
	(0.75)	(0.45)	(0.29)	(0.71)	(0.69)
Nairobi	0.16	-0.17	1.08*	-0.68	0.47
	(0.81)	(0.69)	(0.29)	(0.85)	(0.59)
Rift Valley	-1.70*	0.07	-0.08	-0.10	0.35
	(0.81)	(0.43)	(0.28)	(0.68)	(0.56)
Maternal education level (ref=No schooling)					
Primary education	1.55	2.03*	0.20	0.43	-0.30
	(0.93)	(0.81)	(0.41)	(0.93)	(0.74)
Secondary and above	1.76	2.48**	0.84	0.12	-0.42
	(1.10)	(0.89)	(0.47)	(1.04)	(0.81)
Birth order (ranges from 1 to 4)	-0.40	-0.35	-0.61**	0.75	-0.30
	(0.43)	(0.28)	(0.19)	(0.50)	(0.29)
Pregnancy was intended (Yes=1)	1.58*	0.89**	0.12	-0.70	0.04
	(0.73)	(0.32)	(0.22)	(0.51)	(0.38)
Prenatal care received (ref=None)					
<4 visits	n/a	n/a	2.04**	2.24	0.02
			(0.36)	(1.14)	(0.55)
4+ visits	n/a	n/a	2.75**	2.10	0.36
			(0.37)	(1.10)	(0.60)
Assisted by doctor/nurse (Yes=1)	n/a	n/a	n/a	3.75**	0.62
				(1.26)	(0.38)
Number of cases					
Births	629	589	629	629	629
Mothers	554	530	554	554	554
Facilities/clusters	151	150	151	151	151

Notes: Models 9 to 13 respectively predict the likelihood of: (9) receiving prenatal care; (10) making four visits or more among those who received prenatal care; (11) being assisted by a doctor or nurse/midwife during delivery or pregnancy termination; (12) receiving post-natal care services; and (13) the child still being alive at the time of the survey; ref=reference category; n/a=not applicable; Standard errors are in parenthesis; *p<0.05; **p<0.01.