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**HIV and unintended fertility in sub-Saharan Africa: multilevel predictors of mistimed and unwanted fertility among HIV-positive women.**

**Short title: HIV and unintended fertility in sub-Saharan Africa**

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## **HIV and unintended fertility in sub-Saharan Africa: multilevel predictors of mistimed and unwanted fertility among HIV-positive women.**

### **Abstract**

Sub-Saharan Africa (SSA) has a disproportionate burden of both unintended fertility and HIV infection, but the relationship between these two reproductive health risks is not well understood. This paper investigates the association between HIV status and unintended (mistimed and unwanted) fertility and examines multilevel predictors and national variations of unintended fertility among HIV-positive women across countries in SSA. Multilevel multinomial logistic regression models are applied to Demographic and Health Surveys data collected during 2006-2014 from 25 countries of SSA. Overall findings reveal that across countries of SSA, pregnancies of HIV-positive women are, on average, less likely to be mistimed (RR=0.90,  $p<0.05$ ) but more likely to be unwanted (RR=1.18,  $p<0.05$ ), rather than wanted, compared to pregnancies among HIV-negative counterparts with similar characteristics. Besides, knowledge of HIV status is associated with lower unintended fertility among HIV-negative, but not HIV-positive women. At country level, higher HIV prevalence and testing coverage are associated with higher mistimed and unwanted, rather than wanted fertility. Interaction effects suggest different effect sizes between HIV-positive and HIV-negative women: pregnancies among HIV-positive women are more likely than those among HIV-negative women to be unwanted rather than wanted among those who know their HIV status, are of older age, are married, have higher parity or reside in rural areas. The results further reveal notable country effects on unintended fertility, depicting regional variations that mirror HIV prevalence – being highest in Southern Africa and lowest in Western/Central Africa.

(WORD COUNT = 235)

**Key words:** unintended fertility; HIV-positive women; multilevel multinomial logistic regression; sub-Saharan Africa; contextual predictors; national variations.

## **1. Introduction**

### **1.1 Study rationale and objectives**

Sub-Saharan Africa (SSA) has a disproportionate burden of both unintended fertility and HIV infection, but the relationship between these two reproductive health risks in the region is not well understood (Bankole et al. 2014). The vast majority (66-92%) of women living with HIV in SSA do not want another child, yet only a small proportion (20-43%) are using contraception (Sarnquist et al. 2013). While a number of studies in SSA suggest that the risk of unintended fertility is higher among HIV-positive than HIV-negative women (Kimani et al. 2015; McCoy et al. 2014; Schaan et al. 2014), some have shown no evidence of a significant relationship between HIV status and unintended fertility (Bankole et al. 2014). Unintended pregnancies among HIV-infected women is of particular concern given the concomitant risk of mother-to-child transmission of HIV and maternal mortality (Kendall et al. 2014). This concern is compounded by the issue of contraceptive effectiveness among HIV-positive women (Wall et al. 2013; Schaan et al. 2014).

In settings where a significant proportion of women do not know their HIV status, knowledge of HIV status may be a more important determinant of reproductive preferences than sero-status (Mayondi et al. 2015). Mumah et al (2014) noted that ‘...the assumption that reproductive intention and behavior of HIV-positive women will differ compared with that of HIV-negative women may only hold true to the extent that women know their HIV status’. Besides, other HIV/AIDS related factors, including stigma, are likely to influence pregnancy intendedness among HIV-positive women. Schaan et al (2014) observed that women in Botswana who perceived stigma from healthcare workers and family or believed that it was irresponsible for HIV-positive women to want a child were less likely to plan to have a child. These issues underscore the need for comprehensive empirical evidence on the intricate link

between HIV and unintended fertility to inform efforts to address the problem in SSA, including effective integration of family planning and HIV services (Akelo et al. 2015; Haddad et al. 2015; O'Reilly et al. 2013).

Besides, it is important to gain an ample understanding of the predictors of unintended fertility among HIV-positive women, and the extent to which these may differ from HIV-negative women in the region. The demographic and socio-economic predictors of unintended fertility among HIV-positive women in various SSA settings have received considerable research attention, but patterns remain inconclusive. In particular, mixed patterns have been observed with respect to parity (Obare et al. 2012; Eliason et al. 2014; Mayondi et al. 2015), maternal age (Wall, et al 2013; Schaan et al. 2014; Tebekaw et al. 2014) and socio-economic status (Tebekaw et al. 2014; Mayondi et al. 2015).

We recognize that the association between fertility intendedness and HIV status or other predictors may differ between mistimed (wanted later) and unwanted (wanted no more) fertility (Mayondi et al. 2015). The distinction between mistimed and unwanted fertility may indeed explain some of the apparent inconsistencies in socio-economic and demographic predictors of unintended fertility observed in previous studies. Analysis of overall unintended fertility, combining mistimed and unwanted fertility, is likely to mask salient differences between the two.

Existing studies have no doubt made an important contribution to our understanding of a possible link between HIV and unintended fertility and the predictors of unintended fertility among HIV-positive women in specific settings of sub-Saharan Africa. However, despite indications that patterns may differ across settings, our understanding of overall cross-national patterns or variations across countries/settings of SSA is limited by different study designs and approaches used in previous studies, which makes meaningful comparisons

across countries problematic. Furthermore, most studies have focused on individual-level predictors of unintended fertility with little attention to important contextual predictors (DeGraff, et al. 1997; Steele et al. 1999; Stephenson and Tsui 2002). This study, therefore, aims to improve understanding of the complex link between HIV and unintended fertility in SSA, with particular focus on national variations and multilevel predictors of mistimed and unwanted fertility among HIV-positive women. It is the first empirical study of its kind to examine these relationships cross-nationally, contributing to our understanding of overall patterns across the sub-Saharan Africa region as a whole. The specific objectives are to:

- (i) establish cross-national associations between HIV/AIDS and unintended (mistimed and unwanted) fertility across countries of SSA; and
- (ii) examine multilevel predictors and national variations of mistimed and unwanted fertility among HIV-positive women in SSA.

## **1.2 Theoretical/conceptual underpinnings**

### ***1.2.1 The link between HIV/AIDS and fertility intentions***

Existing studies portray a complex link between HIV and reproductive goals which varies through the childbearing life course (Yeatman, 2009; Yeatman et al., 2013). Yeatman (2009) provides a comprehensive discussion of perceived theoretical link between HIV and fertility preferences. HIV/AIDS may influence fertility through both biological and behavioural mechanisms, the latter gaining prominence in SSA as HIV testing coverage increases across the region and most HIV-infected individuals know their status. Previous evidence of the link between HIV status and fertility intention had been weak, presumably due to dominant high-fertility norms in most SSA settings contributing to prevalent fertility desires even in the advent of HIV/AIDS (Temmerman et al, 1990; Setel, 1995; Aka-Dago-Akribi et al, 1999; Baylis 2000; Lutalo et al 2000; Rutenberg et al. 2000), and most HIV-positive women not

being aware of their HIV status to trigger behaviour change (Gregson 1994). However, with increasing HIV testing coverage across SSA and widespread awareness of HIV status, there is growing support for the argument that knowledge of HIV-positive status is expected to suppress fertility intention (Gregson et al, 1997; Baylies, 2000; Cooper et al, 2007), while at the same time credible counter argument also exist, linking HIV-positive status to increased fertility intention (Temmerman et al, 1990; Grieser et al. 2001; Magadi and Agwanda, 2010).

Knowledge of HIV-positive status (or perceived high risk of HIV infection) may lead to reduced fertility preferences through mechanisms exemplified in the health belief model (Yeatman, 2009). It has been argued that, in general, people will try to avoid negative health outcomes if the barriers are outweighed by the benefits (Janz and Becker, 1984). In the case of HIV and fertility intentions, HIV-positive women may fear transmitting HIV to their baby, partner, or have anxieties about worsening their own health condition (Gregson et al, 1997; Baylies, 2000; Cooper et al, 2007). Also, concerns about increased mortality risk (for self and baby) due to HIV/AIDS, and about care for children left as orphans when parents die, is likely to increase the desire to limit fertility (Grieser et al, 2001). Furthermore, prevailing stigma and prejudice surrounding fertility for HIV-positive women in many SSA settings (Homsy et al., 2009; Kisakye et al., 2010; Schaan et al., 2014) is likely to lead to reduced fertility desire among people living with HIV. HIV-positive women who get pregnant are sometimes looked down upon (Kisakye et al., 2010), or subjected to stigma and prejudice by health service providers (Schaan et al., 2014). Consequently, it is not surprising that HIV-positive status would be associated with increased desire to stop childbearing in various SSA settings (Hoffman et al., 2008; Johnson et al., 2009; Dube et al, 2012).

On the other hand, a number of mechanisms have been proposed to support the argument linking HIV-positive status to higher fertility preference. The first relates to child “replacement” and “insurance” phenomenon (Preston 1978), where HIV-positive women

desire to have more children to replace children who have died or in anticipation of some children dying (child mortality being higher among HIV-positive women), or to maximize chances of the desired number of children surviving (Temmerman et al 1994; Ntozi and Kirunga, 1998; Grieser et al. 2001; Magadi and Agwanda, 2010). Furthermore, it has been argued that HIV-positive women may choose to shorten birth intervals and have children more quickly before their health begins to deteriorate (Gregson 1994; Setel 1995; Trinitapoli & Yeatman, 2011; Hayford et al., 2012).

Besides, it has been observed that even where no evidence of a significant relationship between HIV status and unintended fertility is apparent, HIV-positive women are likely to make greater efforts than HIV-negative women to prevent unintended fertility, but with less success (Bankole et al. 2014). HIV-positive women may be predisposed to a higher risk of unintended fertility due to disproportionate reliance on less effective contraceptive methods such as condoms or periodic abstinence (Wall, et al., 2013; Schaan et al., 2014; Magadi, 2016), with low practice of dual protection (Berer 2006).

### ***1.2.2 The predictors of unintended fertility among HIV-positive women***

The predictors of unintended fertility among HIV-positive women are expected to be largely consistent with the predictors among the general population which include both demographic and socio-economic factors. In general, predictors of high unintended fertility among overall population include high parity, young age, unmarried status, low education, urban residence and wealth (Calvert et al., 2013; Ikamari et al, 2013; Tebekaw et al, 2014). Despite expected similarities, there are plausible reasons why the predictors of unintended fertility may differ between HIV-positive and HIV-negative women.

A number of studies investigating the predictors of unintended fertility among HIV-positive women in specific settings of SSA show mixed patterns. While higher parity was associated with higher rates of unintended pregnancy in Ghana (Eliason et al. 2014) and in

Botswana (Mayondi et al. 2015), a study of factors associated with unintended fertility among HIV-positive adolescents in Kenya observed that lower order parities were just as likely to be unintended as higher order ones (Obare et al. 2012). Mixed findings have also been observed with respect to age – older age was associated with not planning to have a child in Botswana (Schaan et al. 2014), while younger age was associated with higher unintended pregnancy in Zambia (Wall, et al 2013). However, patterns with respect to socio-economic status and marital/union status among HIV-positive women seem consistent with those observed in the general population. Low educational attainment has been linked to higher unintended fertility in Botswana (Mayondi et al. 2015), and across different settings of SSA, HIV-positive women who are unmarried are more likely to report unintended fertility than their married counterparts (Eliason et al. 2014; Mayondi et al. 2015; Obare et al. 2012). Reliable comparison of the predictors of unintended fertility between HIV-positive and HIV negative women is not available from previous research, but notable patterns observed for related fertility indicators (e.g contraceptive use) may be applicable. For instance, a comparison of the determinants of contraceptive use between HIV-positive and HIV-negative women in Kenya observed that education was an important predictor of contraceptive use among HIV-negative but not HIV-positive women for whom wealth was the main predictor (Magadi and Magadi, 2017). The effect of socio-economic status on unwanted fertility may be expected to be stronger for HIV-positive than HIV-negative women since the former are likely to have greater determination to prevent unwanted fertility (see mechanisms illustrated in the health belief model above) and are more likely to take the necessary action to prevent unwanted fertility if they have the means to do so. Also, an earlier study in Rwanda observed lower fertility among high parity HIV-positive, but not HIV-negative women who knew their status, suggesting that even though HIV-positive women still wanted children, the motivation was determined by the number of children they already had (Allen et al, 1993). It is possible



that HIV-positive women of low parity who have not yet achieved their desired fertility will try to have children quickly before their health start to deteriorate (Trinitapoli & Yeatman, 2011; Hayford et al., 2012), and therefore would be less likely to report a pregnancy or birth as mistimed, compared to their HIV-negative counterparts who may prefer to wait and achieve desired fertility later.

### ***1.2.3 Conceptual framework***

Overall the relationship between HIV status and unintended fertility is not a straightforward one since the share of unintended fertility among HIV-positive versus HIV-negative women is likely to be the result of two often opposing processes: differences in fertility intentions and differences in effective contraception. For instance, women who know they are HIV-positive might reduce their fertility intentions, leading to an increase in unintended fertility as a share of overall fertility. At the same time, women who know they are HIV-positive might take more precaution to not get pregnant, compared to those who do not know they are HIV-positive, thus driving down unintended fertility. Any interpretation of observed associations between HIV status and unintended fertility should recognize this complexity.

We note that individual and contextual predictors of unintended (mistimed or unwanted) fertility may differ between HIV-positive and HIV-negative women. Furthermore, important demographic and socio-economic predictors of unintended fertility – including marital status, age, parity, education, wealth and urban/rural residence - are also important predictors of HIV infection (see, for example Magadi and Desta, 2011). Therefore, these factors are likely to confound/mediate the relationship between unintended (mistimed and unwanted) fertility and HIV status or knowledge of status.

#### ***1.2.4 Interpretation of reported fertility intention***

The concept of fertility intendedness used in this paper has well-recognized shortcomings with respect to both validity and reliability of the measure and has long been subject to conceptual and methodological debates (Bongaarts, 1990; Trussel et al. 1999). The interpretation of reported fertility intention is complicated by a number of factors. The first relates to conceptualization of intentionality, which would imply commitment to behaviours towards having or not having children (Kodzi et al., 2010) and has aspects of planning (Stanford et al, 2000). It has been argued that fertility is not always an outcome of a reasoned action (Aizen 1985), and fertility unintendedness may be as a result of impetuses that do not necessarily reflect a conscious decision. The concerns about meaning of fertility intention/preference have received particular attention in sub-Saharan African context where it has been argued that women may delay having children without being clear on whether or when to have another child (Timaues and Moultrie, 2008). Interpretation of results presented in this paper should recognize that such conceptualization of intentionality is likely to differ between HIV-positive and HIV-negative women.

Moreover, ambivalence, tentativeness and instability of fertility preferences further complicate the interpretation of reported fertility intention. Available empirical evidence suggests that the level of uncertainty towards fertility intention is important (Westoff and Ryder, 1977); that the degree of strength of fertility intention may vary (Speizer, 2006); and that fertility arising from contraceptive failure are not consistently reported as unintended, nor unhappiness regularly expressed towards unintended fertility (Trussell et al 1999). Although there is evidence of high stability in reported fertility preference among married women who want to stop childbearing (Casterline et al ., 2003), a number of studies in different settings (Ghana, Malawi and United States) show a high degree of instability among young women (Kodzi *et al.* 2010; Rocca *et al.* 2010; Sennott and Yeatman 2012). Such

instability has been attributed to the future being unpredictable and uncertain, necessitating the need for young people to remain adaptable (Johnson-Hanks 2002, Johnson-Hanks 2005). The ambivalence and instability of fertility preferences is likely to differ between HIV-positive and HIV-negative women. It is possible that inconsistencies in reporting of fertility intention may reflect true changes occurring after childbirth or may arise from post-facto rationalization (Koenig et al., 2006). The latter applies to retrospective reporting of fertility intendedness which is subject to reporting bias that may be influenced by the child's age or survival status, with reported intentions generally becoming more positive with time or when the child is dead (Santelli et al. 2003; Koenig et al, 2006; Smith-Greenaway and Sennott 2016). Our analysis strategy will need to take into consideration the effect of child survival on reporting bias, given expected higher infant/child mortality among children of HIV-positive than HIV-negative women.

It has been noted that even though retrospective measures may underestimate fertility unintendedness compared to prospective measures (Koenig et al, 2006), aggregate-level retrospective and prospective estimates tend to be similar (Yeatman and Sennott, 2015). Moreover, many studies from different developing country settings (Ghana, Morocco and Pakistan) suggest strong predictive power of reported fertility unintendedness, with relatively lower proportions of women who want no more children going on to have children, compared to those who report wanting more children (Bankole and Westoff, 1998; Kodzi et al., 2010; Jain et al., 2014). Thus, albeit not perfect, reported fertility intendedness constitutes an important measure for identifying women (especially those who are HIV-positive) who are motivated to delay/limit fertility.

Finally, we note that there are two approaches to measuring unintended fertility and the approach used has important implications on interpretation of findings. Measures may be based on: (i) the proportion of women of reproductive age who experience unintended

fertility within a specific reference time period (e.g. Bankole et al, 2014); or (ii) the proportion of overall fertility that is unintended (Bongaarts, 1990; Santelli et al., 2003). The measurement of unintended fertility adopted in this paper is based on the latter, consistent with Bongaarts' (1990) partitioning of total fertility into wanted and unwanted components, focusing on the proportion of fertility that are unintended (Santelli et al (2003) which has direct implications for maternal/newborn health outcomes. It is important to recognize that this measure may be particularly subject to potential selection bias due to disproportionate maternal mortality among HIV-positive women from direct/indirect obstetric risks (Myer, 2013).

## **2. Data and Methods**

### **2.1 The Data**

This study is based on secondary analysis of Demographic and Health Surveys (DHS) data collected during 2006-2014 from 25 countries of sub-Saharan Africa (SSA), where the DHS has included HIV testing on nationally-representative samples of women of reproductive age. This period represents an important stage in the HIV epidemic in SSA, ahead of the 2015 UN Sustainable Development Goals (SDGs). Where national HIV test results are available from multiple DHS surveys, only the most recent survey has been included in the analysis. Since the early 2000s, the international DHS programme has included HIV testing on nationally-representative samples of survey respondents, providing an opportunity to anonymously link HIV test results with the full survey record at individual level to enable examination of the association between HIV and a range of demographic and reproductive factors. The DHS protocol for HIV testing is subject to rigorous ethical review to ensure maximum confidentiality and anonymity of HIV test results (ICF Macro 2010). Our analysis sample comprises all women tested for HIV who had a recent birth (i.e. during the five years

preceding the surveys) or pregnant at the time of the survey. The analysis sample only includes the last birth/pregnancy for each woman. The sample distribution by country and HIV status is presented in Table 1.

(Table 1 about here)

The standardized nature of the DHS survey design and data collection instruments (ICF Macro, 2010) allows for pooling of data across countries to achieve sufficient samples of HIV-positive respondents and enable national comparisons.

## **2.2 Study variables**

The outcome/dependent variable is fertility intendedness, classified into three mutually exclusive categories: wanted; mistimed and unwanted. For current pregnancies and all births that occurred in the five years preceding each of the DHS, women respondents were asked whether at the time they become pregnant they wanted the pregnancy then (wanted), later (mistimed) or no more (unwanted). We prefer to use the term unintended fertility, rather than unintended pregnancy, recognizing that some unintended pregnancies may have ended up in abortion. Although potentially of interest, abortion data in most SSA countries are deficient, given the restrictive abortion laws and most procedures being clandestine.

The key explanatory variables for the cross-national analysis of the association between HIV status and unintended fertility (Objective i) is HIV status and knowledge of status. Information on knowledge of status is not directly available and therefore derived from questions on previous HIV testing and receipt of results, assuming that those who had been previously tested before the survey and received their results knew their status. While we do recognize that a significant proportion of those previously tested for HIV may not have accurate knowledge of their current HIV status, it is encouraging to note that analysis of DHS data from selected SSA countries suggest that the proportion of HIV-positive women who

know their results from previous test is as high as 75%-78% (Fishel et al, 2014). The same study observed that although comparisons with DHS HIV test results suggested that self-misreporting of HIV-positive status was high, this was largely attributed to deliberate misreporting rather than lack of knowledge or sero-conversion. We believe that it is knowledge of status, rather than accurate self-report of status, that is likely to influence reproductive behaviour.

Other HIV/AIDS-related factors incorporated in the analysis include HIV/AIDS stigma and awareness, both at individual and country-level. Besides HIV/AIDS-related factors, a number of demographic and socio-economic potential confounding or mediating factors that are likely to influence the association between HIV status and unintended fertility (including socio-economic and demographic factors discussed under ‘theoretical underpinnings’ above), are controlled for in the analysis. The analysis of multilevel predictors of unintended fertility among HIV-positive women (Objective ii) includes both individual-level (HIV/AIDS-related, socio-economic and demographic characteristics) as well as country-level contextual factors. A description of the study variables is presented in Annex(i)

In addition to the socio-economic (education, wealth, urban/rural residence) and demographic (age, parity, marital status) covariates discussed earlier, survival status of the index child is also controlled for to cater for potential post-facto rationalization reporting bias of fertility intendedness (Smith-Greenaway and Sennott 2016).

### **2.3 Methods of Analysis**

A two-level multinomial logistic regression model was applied to pooled data, taking women as level-1 and country as level-2, to establish multilevel predictors of unintended fertility across countries in SSA, focusing on the role of HIV. The multilevel analysis accounted for potential correlation of women in the same country due to both observed and unobserved

country – level factors associated with unintended fertility. Unobserved country-level factors may include possible differences in the survey design and cultural/structural variations across countries. Preliminary analysis considered three-level models (women as Level-1; Cluster as level-2; and country as Level-3), but there was no evidence of significant correlation of unintended fertility within clusters, and hence, two level models were used. Further preliminary analysis considered random slopes models, but there was no evidence that the effect of key explanatory variables, including HIV status, on unintended fertility varied significantly across countries. Therefore, random intercept models were used. The general equation of the random intercepts two-level multinomial Logistic regression model used for analysis of predictors of unintended fertility takes the form:

$$\text{Log} [\pi_{ij}^{(s)} / \pi_{ij}^{(r)}] = \beta_0^{(s)} + \beta_1^{(s)}X_{1ij} + \beta_2^{(s)}X_{2ij} + \dots + \beta_k^{(s)}X_{kij} + u_j^{(s)}, \quad s=2,3.$$

where:  $\pi_{ij}^{(s)}$  denotes the probability of having unintended fertility,  $s$  (i.e. mistimed=2 or unwanted=3) for woman  $i$ , in the  $j^{\text{th}}$  country;  $\pi_{ij}^{(r)}$  is the probability of having a wanted fertility ( $r=1$  for wanted fertility used as reference category) for woman  $i$ , in country  $j$ ;  $\beta_0^{(s)}$  are the regression intercepts for unintended fertility  $s$ ;  $X_{(1-k)ij}$  are 1- $k$  explanatory variables defined at woman or country level;  $\beta_{(1-k)}^{(s)}$  are the associated usual regression parameter estimates for unintended fertility  $s$ ; and  $u_j^{(s)}$  are the country-level residuals for unintended fertility,  $s$ . These are assumed to be normally distributed with mean zero and variance  $\sigma^{2(s)}_u$ . The country random effects may be correlated across unintended fertility categories: covariance ( $u_j^{(s2)}, u_j^{(s3)}$ ) =  $\sigma^{(s2,s3)}_u$ , ( $s2$ =mistimed,  $s3$ =unwanted). (Rasbash et al. 2016).

The multilevel analysis was carried out in MLwiN and estimates based on second order PQL procedure (Rasbash et al. 2016). The analysis paid particular attention to variations in levels of unintended fertility across countries of SSA. The country-level

residuals were used to construct 95 percent simultaneous confidence intervals, presented graphically (Goldstein and Healy, 1995) for comparison of country effects. Countries with non-overlapping confidence intervals are considered to have different levels of mistimed or unwanted fertility.

The multivariate analysis adopted sequential modelling, noting changes in effect sizes (and standard errors) of HIV-related factors following introduction of individual covariates in the model. This was in recognition of strong links between some key covariates (e.g age, parity and marital status) and unintended fertility, and possible confounding/mediation or multicollinearity that may lead to unstable parameter estimates. No evidence of multicollinearity was detected. Given perceived differences in the predictors of unintended fertility between HIV-positive and HIV-negative women (Allen et al, 1993; Magadi and Magadi, 2017), interaction effects between HIV status and key covariates were noted to aid comparison of the predictors of unintended fertility among HIV-positive women, relative to HIV-negative counterparts. The multivariate analysis was preceded with descriptive analysis of the distribution of mistimed and unwanted pregnancy by country, and bivariate associations between rates of unintended fertility and key contextual country-level factors, including HIV prevalence and other HIV/AIDS-related factors.

## **2.4 Robustness checks**

Some key data limitations that have potential implications on our findings have been addressed through robustness checks. First and foremost, we recognize limitation in the measurement of fertility intendedness outlined under 1.2.4 above. In particular, retrospective reporting of fertility intendedness being likely to be influenced by the child's presence or survival status (Santelli et al. 2003; Smith-Greenaway and Sennott 2016) deserves particular attention. Our analysis has been restricted to the last birth within five years preceding the



surveys to minimise potential post-facto rationalization and recall biases from retrospective reporting. Furthermore, we have included an assessment of potential bias in reporting of fertility intendedness due to child's presence or survival status through comparison of reporting intendedness for current pregnancy versus the study sample (see Annex ii), and controlling for survival status of the index child in the multivariate analysis. The analysis provided some evidence of underreporting of unintended fertility for living, compared to unborn children. However, systematic underreporting of unwanted fertility in our study sample due to survival status of index child was unlikely, and controlling for child survival did not alter the effect size for HIV status on unintended fertility. These are discussed in more detail in Section 4.4.

Second, the cross-sectional nature of the DHS data used in the analysis limits our ability to infer precise causal relationships. In particular, we have no information on timing of HIV infection, in relation to births within the five years preceding the surveys. Further robustness checks involved replicating some of the main analyses (e.g. country-level correlations) for current pregnancies only (Annex iii). For these cases it can be reasonably assumed that pregnancies were conceived while respondents were HIV-positive. The findings, discussed in more detail in Section 3.1, highlight the need for caution in interpretation of the apparent positive correlation between HIV prevalence and unintended fertility.

Finally, we acknowledge potential problems of sample heterogeneity arising from the surveys being conducted in different years, corresponding to different periods in the dynamic of the local HIV epidemics. We have restricted the period for DHS data (i.e 2006-2014) in an effort to address this. Also, an effort has been made to control for sample heterogeneity to the extent possible, by adjusting on a range of individual-level and random/contextual country-level factors. The overall patterns of unintended fertility by HIV status observed in the

multilevel multivariate analysis that controlled for sample heterogeneity were largely consistent with bivariate patterns with respect to unwanted fertility. However, but there were some notable variations, especially for mistimed fertility, that warrant attention when interpreting results from bivariate analysis.

### **3. Results.**

#### **3.1 Descriptive analysis**

The distribution of unintended fertility among HIV-positive and HIV-negative women by country (Table 2) suggests wide variations in both mistimed and unwanted fertility across countries in SSA, in general and by HIV status. Levels of unwanted fertility range from below 5% in Niger (0.8%), Gambia (1.3%), Burkina Faso (2.1%), Mali (3%), Sierra Leone (3.1%), Guinea (3.2%) and Cote d'Ivoire (4.1%), to high levels exceeding 20% in Eswatini (38.9%), Malawi (28.4%), Sao Tome (23.9%) and Lesotho (21.9%). Levels of mistimed fertility are relatively higher, ranging from below 10% in Niger (8.4%) and Burkina Faso (8.9%) to more than 40% in Namibia (43.7). Overall levels of unintended fertility are highest in Southern African countries, with at least 55% of fertility reported as unintended (either mistimed or unwanted) in Eswatini (67%), Lesotho (56%) and Namibia (55%). On the other hand, all countries with relatively low overall levels of unintended fertility below 20% are in Western Africa, including Niger (9%), Burkina Faso (11%), Mali (13%), Gambia and Sierra Leone (16%).

(Table 2 about here)

A comparison of levels of unintended fertility by HIV status reveals considerable differences, especially with respect to unwanted fertility. Overall patterns suggest that fertility of HIV-positive women are more likely to be unwanted than those of HIV-negative

women. With the exception of Sao Tome where unwanted fertility is notably lower among HIV-positive (12.5%) than HIV-negative (24.1%) women, there is evidence of considerably higher levels of unwanted fertility among HIV-positive than HIV-negative women who had recent births (by at least 5 percentage points) in a number of countries, including Burundi (17% vs 8%), Ethiopia (21% vs 11%), Lesotho (29% vs 20%), Malawi (35% vs 28%), Niger (10% vs 1%), Senegal (14% vs 5%), Togo (13% vs 8%) and Zimbabwe (15% vs 7%).

It is possible that some of the country variations may be explained by differences in country context, including HIV/AIDS-related factors, demographic/reproductive indicators and socio-economic factors. Bivariate correlations of levels of mistimed, unwanted and overall unintended fertility by various country-level characteristics (Table 3) suggest moderate/strong and significant correlations with most indicators considered (Similar correlations have been included in Annex (iii) for the sample of current pregnancies only for robustness checks). Although significant, the correlation between mistimed and unwanted fertility is relatively weak ( $r=0.41$ ,  $p=0.039$ ), and ceases to be significant when only current pregnancies are considered (Annex iii), further justifying the need for distinction between mistimed and unwanted fertility in this paper.

(Table 3 about here).

There is a positive correlation between HIV prevalence and unintended fertility, suggesting that levels of unintended (especially unwanted) fertility are higher in countries of higher HIV prevalence. However, there is need for caution in interpreting this result since the positive country-level correlation between HIV prevalence and unwanted fertility ceases to be significant when only current pregnancies are considered (Annex iii). Other HIV/AIDS-related factors also have significant correlations with unintended fertility, both mistimed and unwanted. Higher HIV testing coverage and HIV/AIDS knowledge are associated with higher

levels of mistimed and unwanted fertility, while countries with higher HIV/AIDS stigma have lower levels ( $r < -0.6$ ,  $p < 0.01$ ). The patterns with respect to demographic/ reproductive indicators suggest that unintended fertility is lower (especially for mistimed births) in higher fertility countries, but higher in countries of higher contraceptive prevalence. The socio-economic indicators generally show positive correlations between levels of unintended fertility (especially mistimed) with both educational attainment and GDP per capita. However, the correlations with socioeconomic indicators are weaker (and cease to be significant for GDP per capita) when only current pregnancies are considered (Annex iii). It is possible that these bivariate correlations are confounded by a range of individual and country-level factors which are controlled for in the multivariate analysis presented in the next section.

## **3.2 Multivariate Analysis**

### ***3.2.1 HIV/AIDS-related predictors of unintended fertility***

The results of multilevel analysis of individual-level and country-level predictors of mistimed and unwanted fertility, based on a two-level multinomial Logistic regression model are presented in Table 4. The parameter estimates are presented in terms of average Relative Risks (RR), with corresponding 95% confidence intervals. A  $RR > 1.00$  denotes a greater average risk of unintended (mistimed or unwanted) than wanted fertility, while a  $RR < 1.00$  denotes lower average risk.

(Table 4 about here)

Across countries of SSA, HIV-positive status is generally associated with lower mistimed, but higher unwanted, rather than wanted, fertility. Fertility of HIV-positive women are, on average, about 10% less likely to be mistimed and 18% more likely to be unwanted

(rather than wanted) compared to those of HIV-negative counterparts with similar characteristics in the same country. Besides HIV status, knowledge of HIV status is also important, with fertility of women who know their status being less likely to be unintended, both mistimed (RR=0.78,  $p<0.05$ ) and unwanted (RR=0.84,  $p<0.05$ ), rather than wanted, compared to those of women with similar characteristics who do not know their HIV status. These two HIV-related factors are also significant at country-level.

Consistent with patterns observed in the bivariate analysis, fertility of women in countries of higher HIV prevalence are more likely to be unwanted (rather than wanted) than those of counterparts with similar characteristics in countries of lower HIV prevalence. Also, fertility of women in countries with higher HIV testing coverage are more likely to be both mistimed and unwanted, rather than wanted. However, although significant in the bivariate analysis, there was no evidence that average HIV/AIDS stigma or awareness were significant, once other important factors were controlled for. A number of country-level demographic and socio-economic factors, significant in the bivariate analysis, including average fertility, contraceptive prevalence, GDP per capita and average women's education were considered, but there was no evidence that these were significant in the multivariate model that simultaneously controlled for the effect of other important factors.

Interaction effects between HIV status and key predictors of unintended fertility suggest significant differences in the predictors of unintended fertility between HIV-positive and HIV-negative women. Knowing HIV status, older age, being married, higher parity and rural residence are associated with significantly higher unwanted, rather than wanted fertility among HIV-positive, compared to HIV-negative women. Including these significant interactions in the final model would greatly complicate interpretation of parameter estimates for the effect of HIV status. Therefore, the predictors of unintended fertility among HIV-

positive women are presented in the next section, since significant interactions imply that effect sizes are different from HIV-negative women.

### ***3.2.2 Predictors of unintended fertility among HIV-positive women***

The predictors of mistimed and unwanted fertility among HIV-positive women are presented in Table 5. Similar to Table 4, the parameter estimates are presented in terms of Relative Risks (RR), with 95% confidence intervals. An equivalent model for predictors of unintended fertility among HIV-negative women is presented in Annex (iv) for reference.

(Table 5 about here).

An important finding on predictors of unintended fertility among HIV-positive women relates to knowledge of HIV status. Although knowledge of HIV status is generally associated with reduced experience of unintended (both mistimed and unwanted) fertility in the overall sample (Table 4) and among HIV-negative women (Annex iv), the results in Table 5 provide no evidence that fertility of HIV-positive women who know their HIV status have a reduced risk of being unintended compared to those of their counterparts with similar characteristics who do not know their status. Indeed, observed patterns suggest that the risk of unintended fertility may be higher for HIV-positive women who know their status, albeit this is not significant.

With respect to country-level contextual factors, the results suggest that fertility of HIV-positive women residing in countries with higher HIV prevalence have an increased risk of being unintended compared to those of women in lower HIV prevalence countries. On average across countries of SSA, an increase of 10 percentage points in HIV prevalence is associated with a 23% increase in mistimed and about double the risk (RR=2.06) of unwanted, rather than wanted fertility among HIV-positive women.. Although higher HIV

testing coverage in a country is not significant for HIV-positive women (possibly due to reduced statistical power), HIV prevalence in a country is significant for HIV-positive, but not HIV-negative women.

The demographic and socio-economic predictors of unintended fertility among HIV-positive women are largely consistent with patterns in the overall sample (or among HIV-negative women). Fertility of women of parity 6+ are, on average, about 15 times more likely to be reported as unwanted (rather than wanted) compared to those of counterparts with similar characteristics who are of parity 0-1. Although parity and age are strongly positively correlated, the mistimed fertility patterns according to these two factors are reversed. Higher parity is associated with increased while higher age is associated with reduced mistimed fertility. Fertility of older women aged 35+ years, have on average, about one-third risk (RR=0.32) of being mistimed (rather than wanted) compared to those of the youth aged 15-24 years with similar characteristics. The risks of both mistimed and unwanted (rather than wanted) fertility are substantially lower among currently or previously married women compared to never married counterparts. Country-level demographic factors, including average fertility and contraceptive prevalence were considered, but there was no evidence that these were significant in the multivariate model.

Higher socio-economic status (i.e. higher educational attainment and higher household wealth) is generally associated with higher unintended fertility, the effect of education being more apparent for mistimed, while the effect of household wealth is evident for unwanted births. Measures of country-level socio-economic status, including average women's education and GDP per capita were considered, but there was no evidence that these factors were significant in the multivariate models that controlled for the effects of other important factors.

### ***3.2.3 Country variations in unintended fertility***

The country random effect estimates for variance component models before controlling for the effect of any individual-level or country-level factors (Model 0), and for the final models for HIV-positive, HIV-negative and overall sample are presented in Table 6.

(Table 6 about here)

The random variance estimates in initial models (Model 0) suggest significant variations in both mistimed and unwanted fertility across countries of sub-Saharan Africa, the country effect being stronger for unwanted than mistimed births. In addition, there is a significant positive covariance, suggesting that countries with higher mistimed fertility tend to have higher unwanted fertility, consistent with the positive correlation observed in the bivariate analysis. The random country effects are considerably reduced when significant individual-level and contextual country-level factors are included in the models (Final model), but nevertheless remain significant, apart from covariance for HIV-positive women. The country effects for HIV-negative women are more or less similar to overall sample. The country variations are illustrated in Figures 1a and 1b for mistimed and unwanted fertility, respectively, for HIV-positive women. The countries are ordered from left to right by increasing residuals based on variance components models (i.e. Model 0). Corresponding figures for HIV-negative women (these are more or less similar to overall sample) are presented in Annex v (a and b).

(Figures 1a & 1b about here)

Before controlling for any explanatory variables (Model 0), the relative risk of mistimed fertility (versus wanted fertility) is lowest in Mali and highest in Namibia (Figure 1a). Once significant explanatory variables at individual and country-level are controlled for (Final model), Sierra Leone has the lowest risk while Ethiopia has the highest risk of



mistimed fertility among HIV-positive women. It is worth noting that even though Ethiopia has about the same or lower risk of mistimed fertility among HIV-positive women in the initial model compared to Malawi, Zimbabwe and Zambia, it has a significantly higher risk than these three countries, once the effects of important covariates are controlled for.

Country variations in unwanted fertility among HIV-positive women in SSA (Figure 1b) are to some extent consistent with patterns observed above for mistimed fertility. Before controlling for any covariates, Mali has the lowest risk, while Eswatini has the highest risk of unwanted fertility among HIV-positive women. Once significant covariates are controlled for, the risk of unwanted fertility is lowest in Sierra Leone and highest in Ethiopia. Indeed, fertility of HIV-positive women in Ethiopia have a significantly higher risk of being unwanted than those of their counterparts with similar individual characteristics and in similar HIV context (i.e with respect to HIV prevalence and testing coverage) in all other SSA countries included in the study, except Eswatini and Togo.

#### **4. Discussion and conclusions.**

##### **4.1 Summary of key findings**

The main objectives of this paper were to: (i) establish cross-national associations between HIV status and unintended (mistimed and unwanted) fertility in sub-Saharan Africa (SSA); and (ii) examine multilevel predictors and national variations of unintended fertility among HIV-positive women in SSA. Overall findings suggest that across countries in SSA, HIV-positive status is associated with lower mistimed, but higher unwanted fertility. Besides, knowledge of status is protective for both mistimed and unwanted fertility of HIV-negative but not HIV-positive women. In addition to individual-level HIV status and knowledge of status, country-level HIV prevalence and HIV testing coverage are also associated with increased unintended fertility. Significant interactions suggest that knowing HIV status, older

age, being married, higher parity and rural residence are associated with higher unwanted fertility among HIV-positive than HIV-negative women.

Among HIV-positive women, there is no evidence that knowledge of HIV status is protective for unintended fertility. However, Higher HIV prevalence in a country is associated with increased unintended (both mistimed and unwanted) fertility. Important demographic and socio-economic predictors of mistimed or unwanted fertility among HIV-positive women are generally consistent with overall patterns in the general population. Older age is associated with reduced mistimed fertility while higher parity is associated with increased unintended (especially unwanted) fertility, and being in union (currently or previously) is associated with reduced mistimed and unwanted (rather than wanted) fertility. Higher socio-economic status is generally associated with increased risk of both mistimed and unwanted fertility, although some of the associations are not significant for HIV-positive women, presumably due to inadequate statistical power.

The results further reveal notable country variations in mistimed and unwanted fertility among HIV-positive women in SSA. The country effects are stronger for unwanted than mistimed fertility, and partly explained by contextual country-level factors relating to HIV prevalence and testing coverage. The country effects on unintended fertility depict distinct regional patterns that tend to mirror HIV prevalence – being particularly high in Southern Africa and relatively low in Western/Central African countries. These patterns may suggest a causal link or the two having similar underlying causes which induce the observed positive association.

#### **4.2 Association between HIV-positive status and fertility intention**

Overall, the main results observed in this paper reinforce what other scholars have argued. Although conclusive patterns across SSA are lacking from previous studies, the apparent

opposing cross-national associations observed in this study – HIV-positive status being negatively correlated with reported mistimed fertility but positively correlated with unwanted fertility – is consistent with arguments advanced in previous studies based on specific SSA settings. Observed patterns support the theoretical argument that HIV-positive women would be less likely to report that they wanted the child “later” in light of evidence that they may want to speed up births, given that they are well aware that HIV has the potential to compromise their fecundity (Gregson 1994; Setel 1995; Trinitapoli & Yeatman, 2011; Hayford et al., 2012).

The observed cross-national higher unwanted (rather than wanted) fertility among HIV-positive than HIV-negative women observed in this study supports the argument that HIV-positive status may lead to reduced fertility preferences through mechanisms exemplified in the health belief model (Yeatman, 2009). The findings are consistent with evidence from a number of previous studies in specific settings of SSA (Hoffman et al., 2008; Johnson et al., 2009; McCoy et al. 2014; Schaan et al. 2014; Kimani et al. 2015). Observed patterns may be attributed to a number of factors, including: prevalent stigma and prejudice surrounding fertility for women living with HIV in various SSA settings leading to reduced fertility desire (Homsy et al., 2009; Kisakye et al., 2010; Schaan et al., 2014); or HIV-infected women having concerns about worsening their health condition, or fear transmitting HIV to their baby or partner (Gregson et al, 1997; Baylies, 2000; Cooper et al, 2007). The fact that HIV/AIDS stigma (both contextual and at individual-level) was not significantly associated with unintended fertility in this paper suggests that these factors are important in specific SSA settings rather than apply cross-nationally. On the other hand, the observed lower unintended fertility in higher fertility countries may be a manifestation of dominant high-fertility norms in some SSA settings leading to prevalent fertility desires even in the context of HIV/AIDS (Setel, 1995; Baylis 2000; Rutenberg et al. 2000), or may suggest

evidence of child ‘replacement’ and ‘insurance’ mechanisms leading to higher fertility preferences (Preston 1978).

The apparent higher risk of unintended fertility among HIV-positive women may also be attributed to overall lower contraceptive uptake (Siveregi et al. 2015) or use of less effective contraceptive methods (Schaan et al. 2014; Wall et al. 2013) by HIV-positive women. In particular, data from a multinational trial suggest that while African HIV-positive women generally use condoms, they seldom use other contraceptive methods consistently (Heffron et al. 2010; Kott 2010), despite use of condoms only (rather than dual method use) being associated with high rates of unintended pregnancies in various SSA settings (Mayondi et al. 2015; Wall et al. 2013).

#### **4.3 The predictors of unintended fertility among HIV-positive women**

The cross-national patterns with respect to individual-level demographic predictors of unintended fertility among HIV-positive women are largely consistent with patterns observed in specific SSA settings in previous studies. In particular, the patterns observed with respect to marital status support existing evidence from different settings of SSA which consistently show a higher risk of unintended fertility among never married women compared to those who are married or in union (Eliason et al. 2014; Mayondi et al. 2015; Obare et al. 2012). This is not surprising given the adverse social (e.g. stigmatization) and economic (including school drop-out and economic hardship) consequences of premarital pregnancy and childbearing in most SSA settings (Levandowski et al. 2012; Madhavan et al. 2013; Zwang & Garenne 2008). Also, observed patterns by parity are largely consistent with patterns observed in most SSA settings (Eliason et al. 2014; Mayondi et al. 2015; Tebekaw et al. 2014), while the observed higher risk of mistimed births among younger women are consistent with patterns earlier observed in Zambia and Ethiopia (Tebekaw et al. 2014; Wall et al. 2013).

Consistent with perceived notions of different predictors of reproductive behaviour between HIV-positive and HIV-negative women (Allen et al, 1993; Magadi and Magadi 2017), interactions between HIV status and key demographic and socio-economic predictors of unintended fertility reveal different effect sizes between HIV-positive and HIV-negative women. In particular, the elevated risk of unintended fertility among higher parity HIV-positive women is consistent with earlier findings in Rwanda, suggesting that the motivation for HIV-positive women to have children was strongly determined by the number of children they already had (Allen et al, 1993). The importance of knowledge of HIV status – being protective for HIV-negative but not HIV-positive women - has important policy implications. While improved HIV testing coverage may enable HIV-negative women to make informed choices to meet their reproductive goals (Habte & Namasasu 2015; Raifman, et al. 2014), factors not measured in this study (e.g. fertility imperative, contraceptive use, etc) may be more important for HIV-positive women's risk of unintended fertility than their knowledge of their HIV status.

Besides confirming patterns observed in previous studies, the findings observed here contribute to better understanding of cross-national multilevel predictors of unintended fertility among HIV-positive women across countries of SSA and national variations. The positive gradient between socio-economic status (based on education and wealth) and unintended fertility is evident both at individual/household and at country level. This may seem unexpected especially since women of higher socio-economic status would be expected to be more empowered and have the necessary knowledge and resources to enable them take appropriate action (e.g use contraceptive or abortion services) to prevent unintended fertility (Al Riyami et al. 2004). Bongaarts (2010) postulates that better educated women in sub-Saharan Africa have lower unintended fertility since they use contraception more effectively, have greater autonomy in reproductive decision making and are more motivated to satisfy

contraceptive demand, given higher opportunity costs of unintended childbearing. Our bivariate country-level analysis also show unexpected positive correlations between unintended fertility and measures of reproductive health service access, including contraceptive prevalence and HIV testing coverage. Although factors relating to country-level socio-economic context, including access of reproductive health services, are largely explained by factors included in the multilevel model, the individual/household socio-economic predictors persist even after other important covariates are controlled for. We recognize that the relationship between unintended fertility and socio-economic status is a complex one and can run in either direction. While women of higher socio-economic status have higher uptake of contraceptive and abortion services (Creanga et al. 2011; Mutua et al. 2015), they also have a greater desire to limit or space births (Dodoo 1992; Skirbekk 2008; Westoff et al. 2013). It is possible that the increased desire to limit/space childbearing by women of higher socio-economic status in SSA (both HIV-positive and HIV-negative) is not fully offset by their ability to prevent unintended births through uptake of relevant services, leading to the observed positive gradient.

Consistent with regional patterns portrayed by country effects on unintended fertility, the socio-economic argument may provide a plausible explanation for association patterns observed between HIV prevalence and unintended fertility. Southern Africa countries have, in general, better indicators of socio-economic development than Western Africa countries, including GDP/GNI per capita and women's education, as well as lower fertility and higher contraceptive prevalence (Population Reference Bureau, 2015; World Bank, 2016). It is possible that the desire for lower fertility in socio-economically better off countries, is not fully offset by higher contraceptive use to reduce unintended fertility. The Southern African countries also have higher HIV prevalence than Western/Central Africa (Magadi & Desta 2011), and it is possible that the significant positive correlation between unintended fertility

and HIV prevalence at country-level is partly driven by relatively higher unintended fertility in Southern Africa countries, the region with also the highest HIV prevalence in SSA.

Controlling for individual and country-level predictors of unintended fertility notably alters the country effects, with some of the less socio-economically better off countries outside Southern Africa, such as Ethiopia (for HIV-positive women) or DRC Congo and Sao Tome (for HIV-negative women) emerging to have the highest risk of mistimed and unwanted fertility.

#### **4.4 Implications of shortcomings of reported fertility intention**

We undertook an evaluation of potential implications on our findings of well-recognized shortcomings of reported fertility intentions outlined earlier. In particular, post-facto rationalization influenced by child survival (Koenig et al., 2006) and ambivalence towards reported fertility intentions (Westoff and Ryder, 1977; Trussell et al 1999; Speizer, 2006) are of notable relevance in this study since HIV-positive women are likely to experience higher child mortality and have greater uncertainty about the future. Our analysis (see Table 4 & Annex iv) confirms that children who had died were less likely to be reported as unwanted, while those who were unborn were more likely to be reported as mistimed or unwanted than those who were alive, consistent with patterns from previous studies (Koenig, et al., 2006). For HIV-positive women (see Table 5), there was evidence of underreporting of unintended fertility for live births (regardless of survival status) compared to unborn children. Nevertheless, controlling for child survival did not significantly alter effect size for HIV status, suggesting that any apparent reporting bias is unlikely to have significantly affected the patterns observed.

Further assessment of the extent to which reporting of unintended fertility may have been influenced by presence/survival of index child by comparing the distributions or

country-level correlations between study sample and current pregnancy (Annexes ii & iii) show consistent overall patterns. For both samples, HIV-positive women were considerably more likely to report unwanted fertility than HIV-negative women. Reported mistimed fertility is also higher among HIV-positive than HIV-negative women (albeit only marginally) for both samples. However, while reported mistimed fertility is somewhat higher among current pregnancies than our study sample, the reporting of unwanted pregnancies is higher among our study sample than current pregnancies, especially among HIV-positive women (dead children:21%; living children: 19%; current pregnancies: 15%), suggesting that systematic underreporting of unwanted fertility in our study sample due to survival status of index child is unlikely. Nevertheless, there is evidence of possible underreporting of unwanted fertility among higher parity and older women. In particular, reporting of unwanted fertility by highest parity HIV-positive women is substantially lower in the study sample than current pregnancies and calls for caution in interpretation of relevant findings.

Also, we recognize that HIV and family planning (FP) counselling in the general population, and more specifically in HIV-positive women, may have an impact on the way women report their pregnancy intention. In many countries, HIV-positive women receive counselling about FP and safe-sex (including condom use) following HIV diagnosis or child birth, and may rather report unintended than wanted fertility (social desirability bias). Also as noted earlier, retrospective reporting of fertility intendedness being quite subjective, the distinction between mistimed and unwanted fertility may not always be clear, further reinforcing the need for caution in interpretation of specific findings.

#### **4.5 Data Limitations**

In this final section, we acknowledge some limitations relating to the DHS data analysed, which have important implications for interpretation of findings presented. First, given the



cross-sectional nature of data analysed in this paper, we recognize that the patterns observed in this paper are mere associations and do not infer causality. Another important limitation arising from cross-sectional nature of DHS data worth noting is potential selection bias. HIV-positive women with recent fertility are more likely to have died prior to the survey due to obstetric risks and indirect maternal causes (Myer, 2013). Existing evidence across SSA suggest that earlier initiation and longer duration of antiretroviral therapy (ART) reduces the risk of maternal mortality (Kendal et al 2014). Therefore, HIV-positive women included in our analysis represent those who survived HIV/AIDS thus far, who are more likely to be on effective ART (and likely to have higher desired fertility) compared to those who did not survive.

Second, the study restricted the period for DHS data analysed (i.e 2006-2014). Therefore, it is important to recognize that the results reported in this paper capture a certain stage of the HIV epidemic, ahead of the SDGs global development agenda spanning from 2015-2030. The landscape of the HIV epidemic in SSA is rapidly evolving, and in the context of the scale-up of the 90-90-90 strategy (i.e 90% of all people living with HIV diagnosed; 90% of those diagnosed receive treatment; 90% of those on treatment virally suppressed), the meaning of HIV infection and its perceived implications are dramatically changing. In particular, fertility behaviours resulting from HIV/AIDS may have changed in more recent times, and there have been important developments in HIV programs, that might have drastically affected fertility behaviours. The rapidly evolving HIV-treatment scenario in SSA with respect to accessibility of ART and prevention of mother-to-child transmission (PMTCT)<sup>1</sup> is likely to have important implications for reproductive choices of women in the region.

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<sup>1</sup> For example, it is estimated that in Eastern and Southern Africa, 68% of pregnant women living with HIV received ART in 2009, and a number of countries had set targets for near universal coverage by 2015 (UNICEF 2012 - Factsheets on the status of national PMTCT responses in the most affected countries)

Although pooling of data across DHSs from different countries was necessary to increase statistical power for analysis of unintended fertility among HIV-positive women, we recognize potential implications of this methodological approach on our results. While the sample of countries included in the analysis represents good coverage from different regions of sub-Saharan Africa (SSA), we recognize that the criteria for selection of these countries was based on availability of DHS with HIV test data, rather than randomization, limiting generalizability of findings across all countries of SSA.

The multilevel analysis has no doubt revealed important individual and country-level contextual factors associated with unintended fertility in sub-Saharan Africa. However, we recognize that some important individual level and contextual factors that are likely to play a role in fertility intentions have not been included in the analysis due to lack of data. For instance, unintended fertility among HIV-positive women is likely to be influenced by their health status (or disease stage) which has not been included in the analysis due to lack of data. At country level, different policies on prevention of mother-to-child transmission (PMTCT) of HIV (which is expected to reduce the risk of HIV infection in children), may have been implemented in different countries at the time of the surveys. Furthermore, ART has been shown to be associated with an increase in fertility desire (Maier et.al, 2009) and unintended fertility (Schwartz, et. al, 2012) among HIV-infected women, which implies that unintended fertility in specific countries may differ, depending on ART coverage. All these, and other relevant contextual country-level factors not included in the analysis constitute unobserved country factors, measured by the country effects/residuals.

Finally, the number of countries included in the multilevel analysis (n=25) is limited in providing adequate statistical power to detect significance of contextual country-level factors (Snijders 2005). This may partly explain why most country-level factors considered in the analysis were not significant in the final multilevel models.

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**Table 1: Distribution of unweighted study sample by HIV status**

Country	Year of survey	Women tested for HIV who were pregnant or had a birth within the last 5 years preceding the DHS		
		HIV-positive	HIV-negative	All cases
Burkina Faso	2010	60	5289	5349
Burundi	2010	71	2430	2501
Cameroon	2011	209	3562	3771
DR Congo	2013	67	5893	5960
Cote d'Ivoire	2012	104	2652	2756
Ethiopia	2011	122	7608	7730
Gabon	2012	136	2843	2979
Gambia	2013	48	2479	2527
Ghana	2014	51	2235	2286
Guinea	2012	53	2692	2745
Kenya	2008	174	1786	1960
Lesotho	2009	421	1250	1671
Liberia	2013	52	2689	2741
Malawi	2010	466	4167	4633
Mali	2013	43	3487	3530
Namibia	2013	324	1663	1987
Niger	2012	17	3655	3672
Rwanda	2010	131	3212	3343
Sao Tome	2008	15	1471	1486
Senegal	2011	30	2973	3003
Siera Leone	2013	68	4330	4398
Eswatini	2006	797	1325	2122
Togo	2013	59	2613	2672
Zambia	2013	1206	8128	9334
Zimbabwe	2010	709	3406	4115
Total	2006-14	5433	83838	89271

**Table 2: Percent (weighted) distribution of unintended fertility among HIV-positive and HIV-negative women across countries of sub-Saharan Africa (SSA)**

Country	HIV-negative		HIV-positive		All cases	
	Mistimed	Unwanted	Mistimed	Unwanted	Mistimed	Unwanted
Burkina Faso	8.9	2.1	10.3	1.7	8.9	2.1
Burundi	29.7	7.5	9.6	17.3	29.3	7.7
Cameroon	19.9	7.3	14.9	7.2	19.7	7.3
DR Congo	28.2	7.0	22.1	7.8	28.1	7.0
Cote d'Ivoire	24.1	4.2	25.8	1.0	24.1	4.1
Ethiopia	22.3	11.1	12.8	21.1	22.1	11.3
Gabon	36.3	6.9	39.2	2.0	36.5	6.7
Gambia	14.5	1.3	7.0	4.7	14.3	1.3
Ghana	26.0	8.4	31.0	5.2	26.1	8.3
Guinea	18.1	3.2	26.7	2.2	18.2	3.2
Kenya	28.9	18.7	28.5	19.9	28.9	18.8
Lesotho	35.4	19.5	29.2	28.9	33.8	21.9
Liberia	30.7	5.8	35.9	9.4	30.8	5.9
Malawi	20.5	27.6	14.3	34.9	19.8	28.4
Mali	10.3	2.9	2.3	4.5	10.2	3.0
Namibia	44.2	10.4	41.6	14.3	43.7	11.1
Niger	8.4	0.8	0.0	10.0	8.4	0.8
Rwanda	30.0	16.0	26.2	19.2	29.8	16.2
Sao Tome	30.1	24.1	43.8	12.5	30.2	23.9
Senegal	23.8	5.2	13.6	13.6	23.8	5.2
Siera Leone	12.7	3.1	9.5	1.6	12.7	3.1
Eswatini	28.5	39.8	27.6	37.4	28.1	38.9
Togo	24.1	7.6	14.7	13.2	23.8	7.7
Zambia	35.6	6.9	31.6	10.4	35.1	7.3
Zimbabwe	27.5	6.8	25.9	14.8	27.2	8.1
Total	23.6	8.7	26.4	18.7	23.8	9.3

**Table 3: Bivariate correlation of mistimed, unwanted and overall unintended fertility by country-level characteristics (n=25 countries).**

Country-level characteristic	Correlation coefficient and significance	Mistimed births	Unwanted births	Unintended births
Proportion of births unwanted	Correlation p-value	.406* .039	1	
Proportion of births unintended	Correlation p-value	.833** .000	.844** .000	1
HIV prevalence	Correlation p-value	.520** .006	.702** .000	.730** .000
Proportion in country tested for HIV	Correlation p-value	.674** .000	.432* .027	.657** .000
Mean HIV/AIDS stigma in country	Correlation p-value	-.614** .001	-.629** .001	-.742** .000
Mean HIV/AIDS knowledge index in country	Correlation p-value	.572** .002	.729** .000	.777** .000
Country fertility based on mean children ever born	Correlation p-value	-.597** .001	-.402* .042	-.593** .001
Country contraceptive prevalence	Correlation p-value	.731** .000	.629** .001	.810** .000
Country mean years of completed education	Correlation p-value	.724** .000	.542** .004	.753** .000
GDP per capita	Correlation p-value	.545** .004	.200 .326	.441* .024

\*. Significant at the 0.05 level (2-tailed).

\*\*.. Significant at the 0.01 level (2-tailed).

**Table 4: Predictors of unintended fertility in SSA: Average Relative Risk (RR) ratios of mistimed and unwanted (versus wanted) fertility ( n = 89271).**

Explanatory variables (Ref. category in brackets)	Mistimed fertility			Unwanted fertility				
	RR	95% CI		RR	95% CI			
<i>Individual-level factors</i>								
HIV status (negative)								
Positive.	0.91	[0.84,	0.98]	*	1.20	[1.09,	1.32]	*
Know HIV status (no)								
Yes.	0.78	[0.71,	0.85]	*	0.83	[0.73,	0.95]	*
Age group (15-24 years)								
25-34	0.53	[0.50,	0.56]	*	0.69	[0.63,	0.77]	*
35+	0.27	[0.25,	0.30]	*	1.17	[1.03,	1.33]	*
Marital status (Never married)								
Currently married	0.23	[0.22,	0.25]	*	0.16	[0.14,	0.18]	*
Previously married	0.35	[0.32,	0.38]	*	0.36	[0.31,	0.41]	*
Parity (0-1)								
2-3	1.41	[1.33,	1.50]	*	2.03	[1.81,	2.28]	*
4-5	2.14	[1.98,	2.32]	*	5.69	[4.94,	6.56]	*
6+	2.93	[2.66,	3.23]	*	16.2	[13.8,	18.9]	*
Residence (urban)								
Rural	0.95	[0.90,	1.00]	ns	0.83	[0.77,	0.90]	*
Education level (none)								
Primary	1.43	[1.34,	1.52]	*	1.33	[1.21,	1.46]	*
Secondary+	1.61	[1.49,	1.73]	*	1.27	[1.14,	1.42]	*
Household wealth (poorest)								
Poorer	1.15	[1.08,	1.23]	*	1.19	[1.08,	1.31]	*
Middle	1.15	[1.07,	1.23]	*	1.33	[1.21,	1.46]	*
Richer	1.10	[1.02,	1.18]	*	1.31	[1.18,	1.45]	*
Richest	1.04	[0.95,	1.13]	ns	1.30	[1.15,	1.47]	*
Child survival status (alive)								
Dead	0.50	[0.79,	1.01]	ns	0.82	[0.69,	0.96]	*
Unborn	1.24	[1.17,	1.32]	*	1.65	[1.51,	1.80]	*
<i>Country-level factors<sup>§</sup></i>								
HIV prevalence	1.19	[0.98,	1.43]	ns	2.20	[1.44,	3.35]	*
HIV testing coverage	1.11	[1.03,	1.19]	*	1.19	[1.01,	1.40]	*

\* - significant at 5% level (p<0.05)

§ - measures re-scaled to ease interpretation: a unit is equivalent to 10 percentage points

**Table 5: The predictors of unintended fertility among HIV-positive women in SSA: Average Relative Risks (RR) of mistimed and unwanted (versus wanted) fertility (n = 5433).**

Explanatory variables (Ref. category in brackets)	Mistimed			Unwanted		
	RR	95% CI		RR	95% CI	
<i>Individual-level factors</i>						
Know HIV status (no)						
Yes.	1.04	[0.75, 1.44]	ns	1.23	[0.83, 1.82]	ns
Age group (15-24 years)						
25-34	0.52	[0.43, 0.63]	*	0.82	[0.63, 1.07]	ns
35+	0.31	[0.24, 0.41]	*	1.07	[0.77, 1.48]	ns
Marital status (Never married)						
Currently married	0.33	[0.27, 0.40]	*	0.24	[0.19, 0.32]	*
Previously married	0.36	[0.28, 0.47]	*	0.46	[0.34, 0.63]	*
Parity (0-1)						
2-3	1.51	[1.23, 1.85]	*	2.79	[2.03, 3.84]	*
4-5	2.80	[2.16, 3.64]	*	8.92	[6.10, 13.0]	*
6+	2.85	[2.03, 3.98]	*	18.2	[11.8, 28.1]	*
Residence (urban)						
Rural	1.01	[0.84, 1.21]	ns	1.15	[0.92, 1.43]	ns
Education level (none)						
Primary	1.31	[1.00, 1.72]	ns	1.18	[0.88, 1.58]	ns
Secondary+	1.44	[1.09, 1.91]	*	1.15	[0.83, 1.58]	ns
Household wealth (poorest)						
Poorer	1.23	[0.96, 1.57]	ns	1.63	[1.23, 2.16]	*
Middle	1.18	[0.92, 1.50]	ns	1.44	[1.08, 1.91]	*
Richer	1.17	[0.90, 1.52]	ns	1.93	[1.43, 2.60]	*
Richest	1.13	[0.85, 1.51]	ns	1.38	[0.97, 1.96]	ns
Child survival status (alive)						
Dead	1.03	[0.80, 1.33]	ns	1.07	[0.81, 1.42]	ns
Unborn	1.54	[1.25, 1.91]	*	1.97	[1.50, 2.58]	*
<i>Country-level factors</i> <sup>§</sup>						
HIV prevalence	1.24	[1.02, 1.50]	*	2.08	[1.37, 3.18]	*
HIV testing coverage	1.09	[1.00, 1.20]	ns	1.21	[0.99, 1.47]	ns

\* - significant at 5% level (p<0.05)

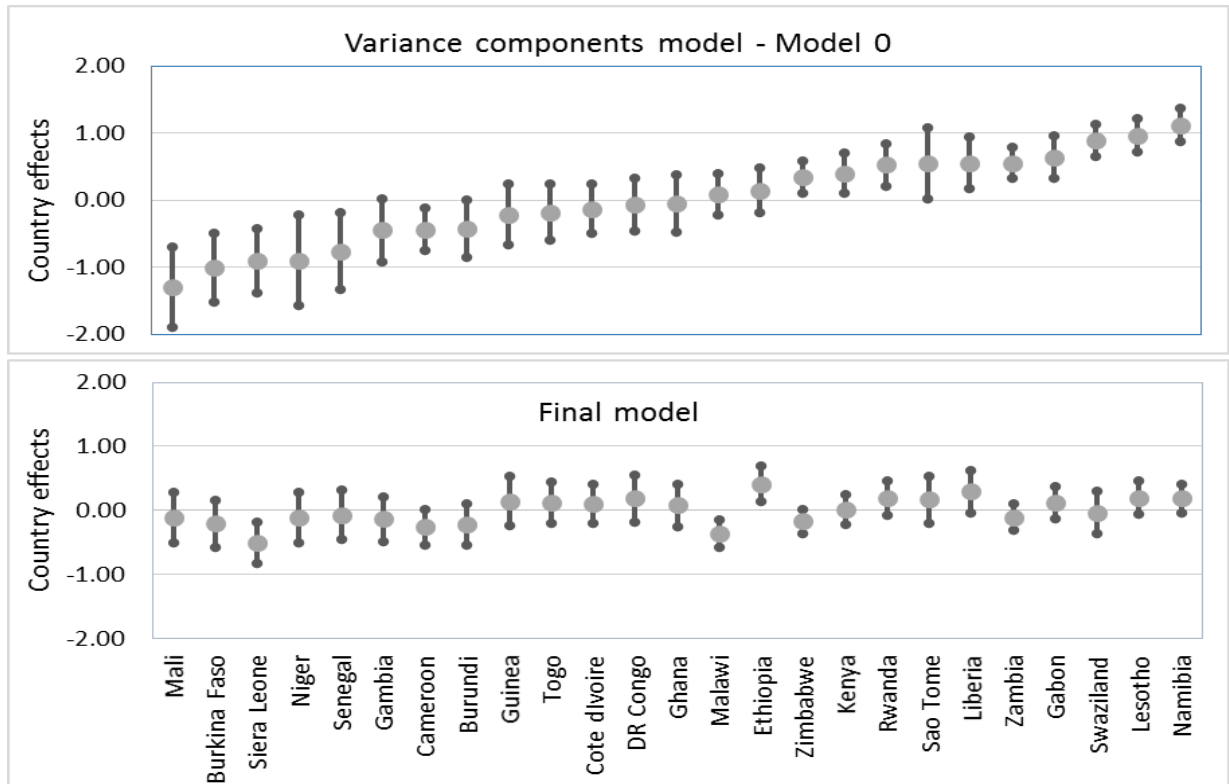
§ - measures re-scaled to ease interpretation: a unit is equivalent to 10 percentage points

**Table 6: Country effects of mistimed and unwanted fertility for initial and final models**

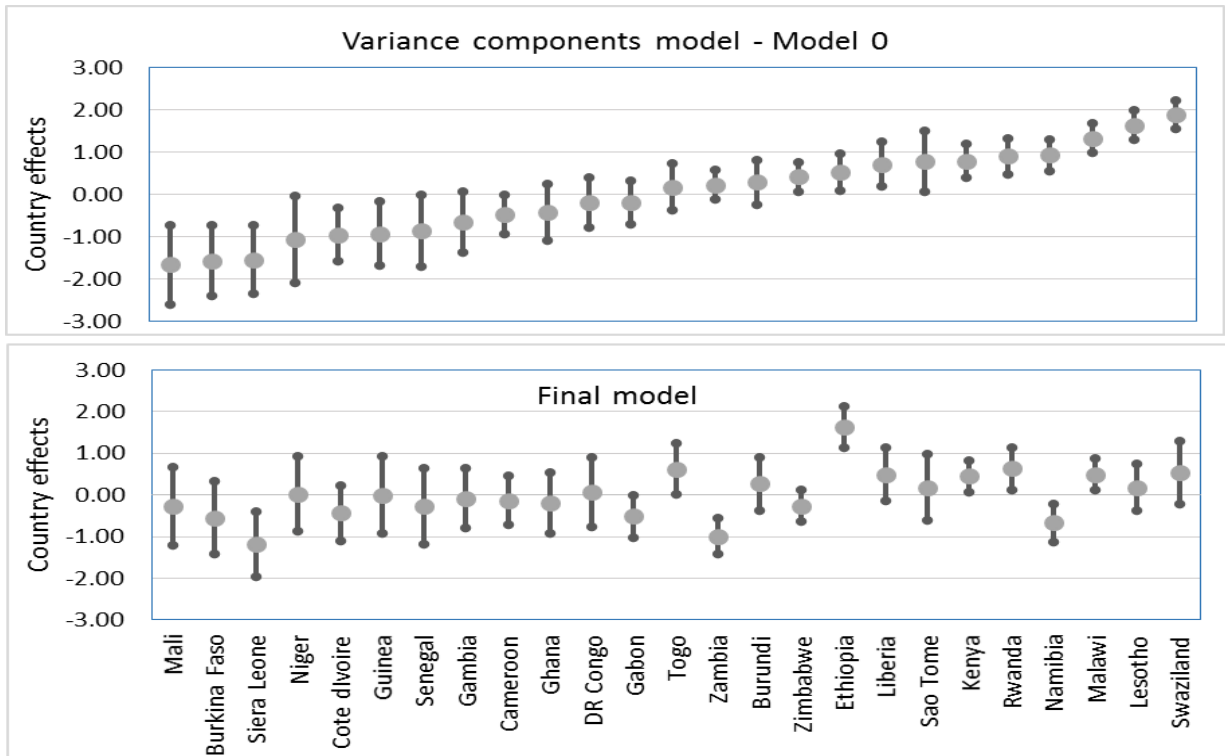
Country random effect	Random effect estimate (standard errors given in brackets)	
	Model 0	Final Model
<i>HIV-positive women</i>		
Variance-mistimed	0.49 (0.163)*	0.10 (0.047 )*
Variance-unwanted	1.12 (0.367)*	0.56 ( 0.223)*
Covariance	0.58 (0.211)*	0.09 ( 0.076)ns
<i>HIV-negative women</i>		
Variance-mistimed	0.41 (0.117)*	0.12 (0.037)*
Variance-unwanted	1.23 (0.350)*	0.70 (0.203)*
Covariance	0.61 (0.187)*	0.18 (0.071)*
<i>Overall sample</i>		
Variance-mistimed	0.41 (0.119)*	0.13 (0.037)*
Variance-unwanted	1.26 (0.361)*	0.65 (0.189)*
Covariance	0.63 (0.193)*	0.17 (0.068)*

\* - significant at 5% level (p<0.05)

**Figure 1a: Simultaneous confidence intervals for country effects for mistimed fertility among HIV-positive women – variance components model (Model 0) and final model**



**Figure 1b: Simultaneous confidence intervals for country effects for unwanted fertility among HIV-positive women – variance components model (Model 0) and final model**





### Annex(i): A summary description of variables included in the study

Variable	Description
<b>Outcome Variable</b>	
Unintended fertility	Pregnancy intendedness, classified as: 1=wanted then (wanted); 2=wanted later (mistimed); and 3=wanted no more (unwanted)
<b>Woman/Individual level characteristics</b>	
HIV status	Respondent's HIV sero-status, coded as: 1=positive and 0=negative
Knowledge of HIV status	Knowledge of HIV status, based on questions on previous HIV testing and receipt of results, coded as 1=yes; and 0=no.
Age group of respondent	Age group of woman respondent, classified into three broad categories: 15-24; 25-34 and 35+ years.
Marital status	Current marital status classified as: never married; currently married or in union; and previously married (widowed, divorced or separated)
Parity/birth order	Birth order of index birth, classified as: 0-1; 2-3; 4-5 and 5+.
Current residence	Urban/rural residence, coded as 1= rural ; 0=urban
Educational attainment	Highest education level, coded into three categories: no education; primary level; and secondary or higher.
Wealth quintile	Household wealth quintile based on DHS index <sup>2</sup> classified into quintiles: poorest; poorer; middle; richer; richest.
Child survival status	Survival status of index child classified as: alive; dead; or unborn
HIV/AIDS stigma	HIV/AIDS stigma index <sup>3</sup>
HIV/AIDS knowledge	HIV/AIDS awareness index <sup>4</sup>
<b>Contextual Country - level factors (start here)</b>	
Prevalence of HIV	Percent of women of reproductive age who are HIV-positive - ranges from 0.4% for Niger to 31.1% for Eswatini.
Coverage of HIV testing	The proportion of respondents previously tested for HIV - ranges from a low of 0.11 for Guinea to a high of 0.82 for Burundi.
HIV/AIDS stigma	Mean stigma index - ranges from 0.49 for Namibia to 3.82 for Guinea
HIV/AIDS knowledge	Mean awareness index, ranges from 6.12 for DRC to 9.46 for Eswatini
Prevalence of Contraceptive	Percent of women of reproductive age using contraceptives at time of survey – ranges from 7.1% for Gambia to 50.2% for Namibia
Mean fertility	Mean children ever born as reported by women respondents - ranges from 1.89 in Lesotho to 3.96 in Niger.
Women's education	Mean completed years of schooling for women respondents - ranges from 1.7 (Niger) to 8.95 (Zimbabwe).
GDP in '000'	GDP per capita in '000' based on World Bank estimates <sup>5</sup> for 2011-14, ranging from 0.54 for DRC to 14.64 for Gabon.

<sup>2</sup> Rutstein, S.O and Johnston, K. (2004). *The DHS Wealth Index*. DHS Comparative Reports No.6. ORC Macro, Calverton, Maryland USA.

<sup>3</sup> Derived from individual HIV/AIDS stigma index based on three questions on whether respondent: (i) would care for a relative with AIDS; (ii) would buy vegetables from vendor with AIDS; and (iii) felt that someone with AIDS should be allowed to continue teaching. Individual additive score ranges from 0 (no stigma) to of 6.

<sup>4</sup> Derived from individual HIV/AIDS comprehensive knowledge index based on 11 questions on awareness of how HIV is transmitted and how to prevent infection. Individual additive score ranges from 0 (least knowledge) to 11 (maximum).

<sup>5</sup> World Bank (2016). "GDP per capita 2011-2014, PPP (current international \$)", *World Development Indicators database*. <http://data.worldbank.org/indicators>. Accessed 27 February 2016)

**Annex (ii) Comparison of percent distribution of unintended fertility among HIV-positive and HIV-negative women between study sample and current pregnancy by background characteristics**

Background Characteristic	Study sample				Current pregnancy			
	HIV-negative		HIV-positive		HIV-negative		HIV-positive	
	Mistimed	Unwanted	Mistimed	Unwanted	Mistimed	Unwanted	Mistimed	Unwanted
Age group								
- 15-24	32.2	4.5	37.0	14.4	31.5	3.1	34.6	7.9
- 25-34	22.4	6.2	25.5	15.9	23.3	6.6	29.7	14.1
- 35+	13.7	19.3	17.6	29.2	16.7	22.8	21.9	31.4
Marital status								
- never married	55.5	11.1	41.2	26.0	60.8	7.5	41.7	16.7
- currently mar.	20.2	8.0	23.7	15.6	22.2	7.4	26.9	13.9
- Previously mar.	28.6	14.9	23.3	24.4	36.9	19.6	42.5	25.0
Parity								
- 0-1	30.8	4.1	30.9	11.1	28.4	2.8	28.1	5.9
- 2-3	25.0	4.7	26.8	14.8	26.2	4.9	29.1	16.0
- 4-5	20.8	8.7	26.0	22.6	22.7	11.0	39.8	18.5
- 6+	16.3	19.7	18.9	36.8	20.2	24.0	22.0	50.0
Sex of hhold head								
- Male	22.2	8.0	25.2	16.4	24.1	7.0	29.9	11.8
- female	28.6	11.1	28.2	22.4	32.0	10.4	29.8	22.1
Residence								
- urban	28.2	7.9	28.3	14.9	28.8	7.0	31.3	10.5
- rural	21.6	9.0	24.9	21.8	24.3	8.0	28.7	19.1
Education level								
- none	14.6	6.6	17.1	16.7	16.8	6.5	23.7	14.0
- primary	27.2	12.0	25.7	22.7	30.4	11.3	31.8	21.7
- secondary+	33.3	7.6	29.9	15.7	33.4	4.8	30.1	9.0
Wealth index								
- poorest	20.6	8.7	24.5	20.4	23.4	7.5	30.5	16.8
- poorer	23.2	8.9	26.4	19.8	26.1	8.1	37.1	19.8
- middle	23.6	9.4	28.0	18.3	26.7	8.0	31.0	19.4
- richer	25.5	8.3	26.4	20.8	28.4	7.9	22.9	14.5
- richest	25.5	7.8	26.3	15.2	23.5	6.5	30.9	6.6
Child survival								
- dead	18.6	8.4	22.3	21.0	N/A	N/A	N/A	N/A
- alive	23.4	8.9	26.3	19.1				
- unborn	25.7	7.7	29.9	15.0				
Total	23.6	8.7	26.4	18.8	25.7	7.7	29.9	15.0

All bivariate associations above are significant at 1% level (Chi-Square  $p < 0.01$ )

**Annex (iii): Bivariate correlation of mistimed, unwanted and overall unintended pregnancy (based on current pregnancies) by country-level characteristics (n=25 countries).**

Country-level characteristic	Correlation coefficient and significance	Mistimed pregnancies	Unwanted pregnancies	Unintended pregnancies
Proportion of current pregnancies unwanted	Pearson Correlation	.254	1	
	Sig. (2-tailed)	.210		
Proportion of current pregnancies unintended	Pearson Correlation	.832**	.748**	1
	Sig. (2-tailed)	.000	.000	
HIV prevalence	Pearson Correlation	.495*	.325	.526**
	Sig. (2-tailed)	.010	.106	.006
Prop. in country tested for HIV	Pearson Correlation	.663**	.419*	.695**
	Sig. (2-tailed)	.000	.033	.000
Mean HIV/AIDS stigma in country	Pearson Correlation	-.578**	-.494*	-.680**
	Sig. (2-tailed)	.002	.010	.000
Mean HIV/AIDS awareness in country	Pearson Correlation	.544**	.579**	.705**
	Sig. (2-tailed)	.004	.002	.000
Country mean fertility based on CEB	Pearson Correlation	-.611**	-.164	-.514**
	Sig. (2-tailed)	.001	.422	.007
Country contraceptive prevalence	Pearson Correlation	.701**	.482*	.758**
	Sig. (2-tailed)	.000	.013	.000
Country mean years of completed education	Pearson Correlation	.722**	.321	.679**
	Sig. (2-tailed)	.000	.110	.000
GDP per capita	Pearson Correlation	.365	.094	.305
	Sig. (2-tailed)	.067	.646	.130

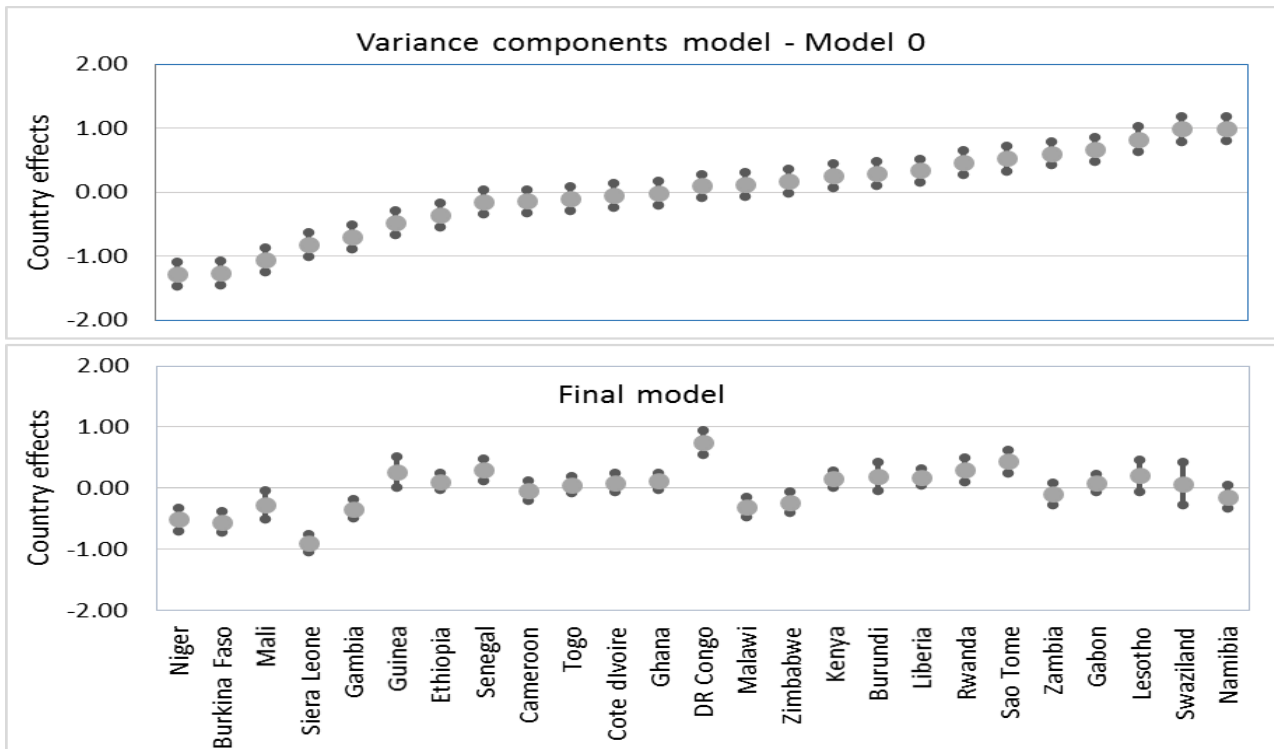
**Annex iv: The predictors of unintended fertility among HIV-negative women in SSA: Average Relative Risks (RR) of mistimed and unwanted (versus wanted) births (n=83838).**

Explanatory variables (Ref. category in brackets)	Mistimed fertility			Unwanted fertility		
	RR	95% CI		RR	95% CI	
<i>Individual-level factors</i>						
Know HIV status (no)						
Yes.	0.76	[0.69, 0.83]	*	0.79	[0.69, 0.91]	*
Age group (15-24 years)						
25-34	0.53	[0.50, 0.56]	*	0.67	[0.60, 0.75]	*
35+	0.27	[0.24, 0.29]	*	1.18	[1.03, 1.35]	*
Marital status (Never married)						
Currently married	0.23	[0.21, 0.24]	*	0.15	[0.13, 0.17]	*
Previously married	0.35	[0.31, 0.39]	*	0.33	[0.29, 0.39]	*
Parity (0-1)						
2-3	1.41	[1.33, 1.50]	*	1.96	[1.73, 2.22]	*
4-5	2.09	[1.93, 2.27]	*	5.41	[4.64, 6.31]	*
6+	2.97	[2.63, 3.28]	*	16.2	[13.7, 19.2]	*
Residence (urban)						
Rural	0.94	[0.89, 1.00]	*	0.81	[0.74, 0.88]	*
Education level (none)						
Primary	1.43	[1.34, 1.53]	*	1.35	[1.22, 1.48]	*
Secondary+	1.62	[1.50, 1.74]	*	1.27	[1.12, 1.43]	*
Household wealth (poorest)						
Poorer	1.15	[1.07, 1.23]	*	1.15	[1.04, 1.27]	*
Middle	1.15	[1.07, 1.23]	*	1.33	[1.20, 1.47]	*
Richer	1.10	[1.02, 1.18]	*	1.25	[1.12, 1.39]	*
Richest	1.03	[0.94, 1.12]	ns	1.31	[1.15, 1.49]	*
Child survival status (alive)						
Dead	0.88	[0.76, 1.01]	ns	0.74	[0.61, 0.91]	*
Unborn	1.23	[1.15, 1.30]	*	1.61	[1.47, 1.77]	*
<i>Country-level factors<sup>\$</sup></i>						
HIV prevalence	1.19	[0.98, 1.43]	ns	2.25	[1.46, 3.49]	*
HIV testing coverage	1.11	[1.03, 1.19]	*	1.18	[0.99, 1.40]	ns

\* - significant at 5% level (p<0.05)

\$ - measures re-scaled to ease interpretation: a unit is equivalent to 10 percentage points

**Annex v – Figure 2a: Simultaneous confidence intervals for country effects for mistimed fertility among HIV-negative women – variance components model (Model 0) and final model**



**Annex v – Figure 2b: Simultaneous confidence intervals for country effects for unwanted fertility among HIV-negative women – variance components model (Model 0) and final model**

