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Research Article

Concern Regarding the HIV/AIDS epidemic and Individual Childbearing: Evidence from Rural Malawi

Claire M. Noël-Miller

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Research Article

Concern Regarding the HIV/AIDS epidemic and Individual Childbearing: Evidence from Rural Malawi

Claire M. Noël-Miller [1]

Abstract

I examine if and how rural Malawians alter their childbearing as a consequence of concern regarding the HIV/AIDS epidemic. The paper is motivated by the debate which opposes two ideas regarding the childbearing effect of high HIV infection rates and heightened AIDS mortality: one, the acceleration of childbearing as individuals find themselves under time pressure to meet their reproductive goals and two, the decrease in childbearing as parents opt to avoid the risk of transmitting the virus. I find some evidence to support the hypothesis of reduced childbearing in the presence of high levels of worry regarding HIV/AIDS. However, this finding does not seem to apply to younger women, who are perhaps subject to relatively stronger childbearing promoting norms.

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1. Introduction

The HIV/AIDS epidemic has had a devastating impact on the mortality and life expectancy of communities in which prevalence remains high (Boerma, Nunn, and Whitworth 1998; Ainsworth and Over 1997; Nicoll, Timaeus, Kigadye, Walraven, and Killewo 1994). Despite the difficulty of accurately measuring deaths from AIDS, the mortality and life expectancy consequences of the epidemic have dominated demographic research on the topic. This paper considers a perspective that has so far received much less attention from the research community by focusing on the relationship between the HIV/AIDS epidemic and childbearing. I examine whether and how rural Malawians alter their childbearing as a consequence of concern about the HIV/AIDS epidemic in a setting where an estimated 16% of the adult population carries the HIV virus (Note 1) (UNAIDS and WHO 2000).

The present research is embedded in a larger debate, which opposes two competing ideas for the childbearing effects of the HIV/AIDS epidemic. On one hand, researchers have raised the possibility that men and women at high risk of becoming infected with HIV or already infected may attempt to increase their pace of childbearing (Temmerman et al. 1994; Gregson 1994). This hypothesis is based on the defining role played by reproduction in shaping adult personal and social identities, particularly in the African context. The speculation has been that upon becoming aware of a heightened risk of infection, individuals would attempt 'to accomplish unmet reproductive goals, knowing that they will not live a normal life span' (Setel 1995: Abstract). However, interest has also been expressed for the idea that the HIV/AIDS epidemic will exert a downward pressure on childbearing as individuals faced with the disease opt to reduce their fertility out of fear for a possible transmission of the virus and concern for their children's future care (Gregson, Zhuwau, Anderson, and Chandiwana 1997; Aka-Dago-Akribi, Desgrees Du Lou, Msellati, Dossou, and Welffens-Ekra 1999; Setel 1995; Ntozi and Tashobya 1998; Rutenberg, Biddlecom, and Kaona 2000). Under a 'natural fertility regime' where childbearing is assumed non-volitional and conscious control of fertility does not exist, explanations for the fertility reducing effect of HIV/AIDS rely on the classical proximate determinants, primarily coital frequency.

This debate is relevant insofar as it points to one of the three broader theoretical pathways for a relation between the HIV/AIDS epidemic and childbearing (Note 2), namely individual behavioral changes. Childbearing and the HIV/AIDS epidemic may for instance be related through insurance and replacement strategies, a delayed age at marriage or start of sexual activity, increases in divorce or separation rates, modifications in levels of condom use and increased abstention from sex, all resulting from the fear of infection (Zaba and Gregson 1998). The second theoretical pathway is through biological determinants. There exists convincing evidence based on population surveys that those who are sero-positive are less likely to bear children than those who are sero-negative (Gray 1997; Gregson, Zaba, and Hunter 2002). These biological determinants include increased partner mortality, increased menstrual disorders, decreased production of spermatozoa and reduced coital frequency due to decreased libido (Zaba and Gregson 1998). Finally, changes in the age structure at the population level due to excess mortality among high-risk groups can potentially add to the childbearing impact of the HIV/AIDS epidemic (Zaba and Gregson 1998).

Characteristics of the impact of the HIV/AIDS epidemic on childbearing have a number of consequences for comprehending aggregate demographic trends in affected areas. Particularly, knowledge of the childbearing impact of the HIV/AIDS epidemic is important because of the latter's close relationship to the rate of population growth. A change in the population age structure due to age-selective mortality of individuals in their reproductive years is likely to result in a slight initial decline in the crude birth rate (assuming that the proportional decline in the number of births is greater than the proportional decline in the total number of person years lived). However, this trend will be sustained in the long run only if reductions in the underlying total fertility rates are also sustained. In addition, childbearing changes due to the HIV/AIDS epidemic are likely to influence the process of fertility transition and to complicate our conceptualization of it (Caldwell, Caldwell, and Quiggin 1989).

This paper explores the implications of the HIV/AIDS epidemic on individual childbearing. The dataset on which this research is based does not contain information on HIV status or on AIDS deaths. Nonetheless, the respondents are well aware of the epidemic: most are familiar with the symptoms of AIDS, know someone who has died of AIDS (i.e. with these symptoms), are aware of how HIV is transmitted, and know their own behavior and enough about their spouse's behavior to understand whether or not they are at risk (Watkins 2003; Smith and Watkins 2003; Smith this issue; Zulu and Chepngeno this issue; Schatz 2002). As I show later, when asked whether they were worried that they might 'catch AIDS' (the distinction between HIV and AIDS is blurred in the rural Malawian context) only a small fraction of all respondents reported that they were not worried at all, and nearly two thirds said they were 'worried a lot'. Some of those who are worried may well be infected: since few are tested for HIV, however, they do not have clinical confirmation. Others, infected or not, may perceive they are already infected, either as a result of their own sexual behavior or what they know or suspect about their spouse. They may also perceive that they are at great risk of infection and death in the future. And still others perceive that they are not at risk, perhaps because they have not themselves engaged in extramarital sex and believe their husband has been faithful. It is reasonable to hypothesize that these differences in worry would have an effect on childbearing (for a similar argument that perceptions of levels of child mortality rather than the actual levels are primary in influencing childbearing, see Montgomery and Casterline 1996 and Montgomery 1999).

The following sections summarize the evidence to date for the interaction between HIV/AIDS and childbearing and propose a methodology for analyzing the association between individual childbearing and heightened concern about HIV infection and AIDS death in rural Malawi. I conclude with a discussion of my results.

2. What do we know about the association between HIV/AIDS and childbearing?

The now emerging body of literature exploring the childbearing effects of the HIV/AIDS epidemic has most commonly been summarized according to the basic distinctions in interactive pathways already mentioned: effects of the epidemic (1) at the individual biological level, (2) at the individual behavioral level and (3) at the compositional level (UN Population Division 2002). In the following review of the literature I adopt a similar approach while distinguishing between individual biological and individual behavioral mechanisms through which the HIV/AIDS epidemic might affect fertility. I also distinguish between studies in which HIV status is known to researchers only, those in which HIV status is also known to respondents, and those in which HIV status is known to neither researcher nor respondent.

It is important to know that overall, there is little empirical evidence on the impact of heightened mortality from AIDS on childbearing in sub-Saharan Africa. In fact, demographic modelers of the impact of the HIV/AIDS epidemic have too commonly assumed no childbearing response to HIV/AIDS. For instance, a report titled *The AIDS Epidemic and its Demographic Consequences* (UN and WHO 1991) presents seven mathematical models for the demographic consequences of the spread of the HIV/AIDS epidemic, none of which include a fertility response.

Biological mechanisms are thought to account for most of the fertility effect of HIV/AIDS on already infected individuals. In a review of the evidence for the fertility impact of the epidemic in Uganda, Zambia and Tanzania, Zaba and Gregson (1998) conclude that in non-contracepting populations, the fertility of HIV-infected women is substantially lower than that of HIV-negative women. From the studies reviewed (Carpenter et al. 1997; Gray et al. 1998; Fylkesnes, Ndhlovu, Kasumba, Musonda, and Sichone 1998), the authors estimate a 25-40% loss in fertility among infected women and a reduction of approximately 0.4% in the total fertility rate with each percentage point increase in female HIV prevalence figures. Similar results were found by other researchers in the Democratic Republic of Congo (Ryder et al. 1991), in Uganda (Sewankamboo et al. 1995) and in Rwanda (Allen et al. 1993). In addition, they find that the fertility of HIV-positive women varies with age: young HIV-positive women do not seem to experience any loss in fertility and the reduction in cumulated fertility becomes more severe as women age. An interesting result of this research points to the primary role of fetal losses through miscarriages, spontaneous abortions and stillbirths resulting from infection with HIV and co-infection with other sexually transmitted diseases (STDs), particularly syphilis (Bracher and Santow 2001; Gregson et al. 1997; De Cock, Zadi, and Adjorlolo 1994; Langstone et al. 1995). Moreover, HIV-infected women typically experience reductions in their sexual drive as well as reductions in fecundability and a possible decrease in the production of spermatozoa or damage to sperm morphology and function in their infected male partners (Gray et al. 1998; Crittenden, Handelsman, and Stewart 1992; Krieger et al. 1991; Gresenguet, Belec, Herve, Massanga, and Martin 1992).

While researchers recognize biological effects as being primarily responsible for reduced fertility among HIV infected individuals, there remains some uncertainty regarding possible confounding behavioral effects (Zaba and Gregson 1998). The bulk of the research on the childbearing-related behavioral effects of HIV infection reflects the basic fact that in sub-Saharan Africa, most who do become aware of their seropositive status will do so late in the progression of AIDS symptoms. They are thus not likely to remain well long enough to significantly alter their childbearing-related behavior. By and large, the research supports the hypothesis that childbearing-related behavior of HIV infected individuals does not depend on their knowledge of being seropositive (Heyward et al. 1993). A number of studies have found that condom use for instance is not altered after individuals become aware of their HIV infection (Lutalo et al. 2000; Temmerman et al. 1990). A qualitative study conducted by Aka-Dago-Akribi and colleagues (1999) in Côte d'Ivoire concludes that HIV positive women who are aware of their condition report no intention of modifying their sexual behavior. Finally, there exists no convincing evidence that periods of breastfeeding and of post-partum abstinence are modified by the awareness of an HIV positive status. Because of the difficulties associated with measuring direct behavioral changes due to an HIV positive status, researchers have focused their attention on variations in childbearing intentions. This segment of the literature reports on the ambiguity in changes of childbearing desires that accompany knowledge of one's HIV positive condition. The study by Aka-Dago-Akribi and colleagues (1999) is partially representative of a small set of studies highlighting women's desire to continue childbearing after they are informed of being HIV infected (Lutalo et al. 2000; Temmerman et al. 1990; Rutenberg et al. 2000). In this study, a pregnancy was thought to symbolize a woman's own health or at least her capacity to bear a healthy child (Ankrah 1991). Fear of abandonment by husband and community was frequently cited as a motivation for avoiding any suspicion of HIV infection (Maman 1999). Even among HIV-discordant couples in which both partners were aware of each other's status, couples chose to have more children, despite the risk of transmission to the uninfected partner and the child, in order to avoid the danger of rejection by the community (Aka-Dago-Akribi et al. 1999). However, more common are studies which report on the negative or inexistent effects of the HIV/AIDS epidemic on childbearing desires (Gregson et al. 1997; Setel 1995; Ntozi and Tashobya 1998; Rutenberg et al. 2000). Rutenberg and colleagues (2000) summarize the main motivations for desiring fewer children as being related to fears that continued reproduction will worsen one's health and that the virus will be transmitted to the child. Additional worries have to do with parents' ability to insure children's social and material well-being once they are no longer able to care for them (Setel 1995).

While the studies of differences in fertility between those who are aware of their HIV positive status and known to be so by the analyst versus those who are HIV negative provide us with important background, it is particularly important to explore fertility and HIV/AIDS in contexts where sero-status is not known to the researcher and is unlikely to be known to the respondent--the typical situation in sub-Saharan Africa. In these contexts, although they may not know this with certainty, most individuals are HIV-negative and thus remain exposed to the risk of contracting the virus, therefore potentially experiencing some degree of worry associated with this risk.

Several studies have suggested that even in areas where HIV prevalence is relatively high and individuals perceive a high risk of infection, such as Tanzania, social and economic forces remained the primary motivation for continued childbearing (Setel 1995). In Zimbabwe, where HIV prevalence is also relatively high, empirical findings do not support the idea that the HIV/AIDS epidemic has been leading to an acceleration of childbearing. Gregson and colleagues (1997) found that close to half of their respondents opted for delaying their next pregnancy because of HIV/AIDS and in order to facilitate the body's recovery from previous childbearing (a behavior not necessarily related to HIV/AIDS).

Regarding the sexual exposure of non-infected individuals researchers have focused on issues of formation and dissolution of marital or stable unions. While contradictory results have been found for the effects of the epidemic on the timing of marriage, the bulk of the empirical evidence is in support of a postponement of age at marriage due to the fear of engaging in sexual activity and possibly contracting HIV (Asiimwe-Okiror et al. 1997; Mukiza-Gapere and Ntozi 1995). A competing hypothesis which has received less support points to the possibility of earlier marriage with the intent of reducing risks of HIV transmission due to pre-marital sexual promiscuity. This is primarily because marriage is not generally perceived as a reliable guarantee of sexual fidelity, particularly by women. Both the hypothesis that separation or divorce would be used as protection against an infected partner or avoided as part of a trend towards more fidelity and stability have been raised, but research on this topic remains inconclusive (Mukiza-Gapere and Ntozi 1995). However, some agreement seems to have been reached that the epidemic is exerting downward pressure on probabilities of remarriage following either widowhood or divorce, due to fears that the new spouse may be infected (Caldwell 1997).

In addition, there exists very limited and disputed evidence of a decline in extra-marital sexual activity and changes in contraceptive use due to the threat of HIV infection (Ng'weshemi et al. 1996). In spite of the methodological difficulties associated with attributing condom use to the threat of HIV infection alone, researchers have established a link between self-evaluation of the risk of infection or HIV/AIDS awareness and increased condom use (Gregson et al. 1997; Lutalo et al. 2000; Agha 1998; Agha, Kusanthan, Longfield, Klein, and Berman 2002; Meekers, Klein, and Foyet 2001; Mehryar 1995). The effect on childbearing, however, is still to be established since, as Gregson and others find, increased condom use could partially be in replacement of previously preferred contraceptive methods and/or limited only to unstable sexual relations (Gregson et al. 1997; Meursing and Sibindi 1995).

3. Data source and context

The present analysis is based on the ongoing Malawi Diffusion and Ideational Change Project's (MDICP) longitudinal dataset collected by Watkins and collaborators from the University of Pennsylvania in 1998 and 2001 (Note 3). The MDICP goal is to explore the ways in which social networks change beliefs and behavior regarding childbearing, family planning and the HIV/AIDS epidemic in rural Malawi (Watkins et al. 2003). The project is based on the idea that social interaction and ideational diffusion are important determinants of reproductive attitudes and behavior.

The study took place in three rural Traditional Authorities (local administrative units) of Malawi: (1) Rumphi district, located in the Northern part of the country, (2) Balaka district, located in the Southern region and (3) Mchinji District, situated in the Central part of the country. The rural districts were selected with the aim of overlapping with the sites of several previous surveys in order to insure comparability over time. In each Traditional Authority, villages were randomly selected and exhaustive listings of all households in these villages were established. From these households, eligible female respondents and their husbands or partners were randomly selected.

The MDICP interviewed ever-married women of childbearing age (15-49) and their husbands or partners divided equally across the three regions. This analysis focuses solely on the 1200 female respondents of the study who were interviewed both in the first data collection round (Malawi 1) and in the second data collection round

(Malawi 2). The data were obtained in face-to-face interviews conducted by Malawian interviewers in the home of the respondent. Interviewers used paper questionnaires administered in the language in which the respondent felt the most comfortable answering. For further information on the characteristics distinguishing the rural communities where the data were collected as well as aspects of sample selection and data quality, the reader is referred to the introduction to this volume.

4. Methods and models

I use conditional probabilities and multivariate ordered cumulative logit regression to estimate the relationship between worry regarding HIV/AIDS and the number of children born to a respondent between Malawi 1 and Malawi 2.

The number of children that were born to a woman between rounds of data collection was determined by using the woman's responses to the following question asked in both surveys: "Can you give me the total number of children you have given birth to?". The number of births between 1998 and 2001 was obtained by subtracting the figure indicated in Malawi 1 from that indicated in Malawi 2. Because this process produced unrealistically high and low values (Note 4), I opted for limiting the possible range for the number of births to values between 0-3 and set all other data points to missing (the frequency missing was 172 or 14.3% of the sample). In other words, a woman was 'permitted' to have had from no to three additional children between data collection rounds (Note 5). Table 1 summarizes the distribution of the sample according to the respondent's number of births between Malawi 1 and Malawi 2.

Table 1: *Sample distribution of respondents by number of births between Malawi 1 and Malawi 2.*

Number of births between 1998 and 2001	Number of women	Percent
0	345	33.56
1	480	46.69
2	160	15.56
3	43	4.18
Total	1028	100

The measure of the explanatory variable of key interest, i.e. a respondents concern regarding HIV/AIDS, was obtained by using the answers to the question 'How worried are you that you might catch AIDS' posed in Malawi 1. The respondent was given a choice between four possible answers: 'not worried at all', 'worried a little', 'worried a lot' and 'don't know'. Table 2 presents the sample distribution according to the responses that were obtained for this question in Malawi 1. Six respondents did not provide an answer (0.5% of the sample).

Table 2: *Sample distribution of respondents by degree of worry about HIV infection in Malawi 1.*

Degree of Worry	Number of women	Percent
Not worried at all	206	17.25
Worried a little	251	21.02
Worried a lot	735	61.56
Don't know	2	0.17
Total	1194	100

The first three options in the table above were transformed into a set of dummy variables and the 'not worried at all' option was set as the reference category.

Three important notes must be made regarding the respondent's reported level of concern relative to HIV/AIDS. First, this is a *worry* variable and not a *risk* variable (Note 6). In the 2001 MDICP round of data collection, respondents were asked about their risk: how likely they thought it was that they were already infected with HIV. Those who responded that it was not likely, were further asked how likely they thought it was that they would be infected in the future i.e. their worry regarding HIV infection. The questions about risk were closely related to the questions about worry. 'Worry' is preferable here because it is a more emotional concept, and thus arguably closer to the emotions and psychological factors that would lead women to delay, or hurry up childbearing. Second, a caveat must be made regarding the issue of reliability of the respondents' answers. Due to the sensitivity of the topic, virtually all questions related to HIV/AIDS are bound to suffer from misreporting. Third, for reasons of simplicity, intensities of concern regarding a possible HIV infection are assumed to be independent of childbearing between Malawi 1 and Malawi 2.

Tables 3 and 4 present proportions having a given number of births between 1998 and 2001 by age of the respondent in 1998 and proportions reporting a given degree of worry in 1998 by age of the respondent in 1998 respectively. These proportions are obtained by using a sub-sample of 1021 respondents with data on all three of the age, number of births and worry regarding HIV infection variables.

Table 3: *Proportions of women having a given number of births between 1998 and 2001 by age of the respondent in 1998.*

	Age in 1998			
Number of children born in 1998-2001	**15-24**	**25-34**	**35-44**	**45+**
0	14.41	31.65	51.63	65.88
1	61.26	49.30	30.49	25.88
2	21.92	13.73	13.41	2.35
3	2.40	5.32	4.47	5.88
Total	100	100	100	100
Sample size	333	357	246	85

Table 4: *Proportions of women reporting a given degree of worry in 1998 by age of the respondent in 1998.*

	Age in 1998			
Degree of worry in 1998	**15-24**	**25-34**	**35-44**	**45+**
Not worried at all	19.22	16.53	19.11	15.29
Worried a little	23.12	22.69	16.26	16.47
Worried a lot	57.66	60.78	64.63	68.24
Total	100	100	100	100
Sample size	333	357	246	85

The data reported in Table 3 indicates that the number of births obtained between Malawi 1 and Malawi 2 varies with age. Specifically, the number of births obtained between 1998 and 2001 is inversely related to age such that the older the respondent, the larger the probability of having had no additional children between both rounds of data collection.

Table 4 on the other hand displays strong intensities of worry across all ages. The proportion having some level of worry fluctuates roughly between 81% and 85% across the four age groups, indicating that only a minority of women are not worried at all. In addition, it seems to be the case that with increasing age low intensities of worry evolve into higher levels of worry.

Table 5 describes relationships between number of births during 1998-2001 and degree of worry about HIV/AIDS by age category. It presents estimates of the conditional probability of having a given number of births for each age group. The probabilities reported are conditional on a particular worry level. The age variable is chosen here as a control because it appeared as important in determining a woman's additional number of births in the preliminary analyses just presented.

Table 5: *Probabilities of having 0, 1, 2 or 3 births during 1998-2001 conditional on a degree of worry regarding HIV/AIDS infection, by age of the respondent.*

Conditional probability that respondent's number of births between 1998 and 2001 is:

	Age 15-24				Age 25-34				Age 35-44				Age 45+			
Conditional on:	0	1	2	3	0	1	2	3	0	1	2	3	0	1	2	3
Not at all worried	0.16	0.63	0.20	0.02	0.15	0.61	0.15	0.08	0.36	0.38	0.17	0.09	0.69	0.23	0.00	0.08
Worried a little	0.16	0.58	0.23	0.03	0.40	0.48	0.07	0.05	0.53	0.33	0.15	0.00	0.57	0.36	0.00	0.07
Worried a lot	0.14	0.62	0.22	0.03	0.33	0.47	0.16	0.05	0.56	0.28	0.12	0.04	0.67	0.24	0.03	0.05
Sample size	333				357				246				85			

If the hypothesis of increased childbearing were to be supported by the analysis of conditional probabilities, one would expect to see a decrease in the conditional probability of having no children as worry about HIV/AIDS increases. On the other hand, if the hypothesis of reduced childbearing were to be confirmed, one would expect to find that the conditional probability of having zero births increases with the level of worry.

An analysis of the conditional probabilities presented in Table 5 indicates that different intensities of worry are associated with different probabilities of having a given fertility outcome between Malawi 1 and Malawi 2. Generally speaking, the data seems to support the hypothesis of a reduced number of births with increased worry. Particularly in the age ranges 25-34 and 35-44, the conditional probability of having no births increases as the level of worry increases. Conversely, the conditional probabilities of having 1, 2 or 3 births tend to decrease with increases in the degree of concern. These results seem to indicate that, particularly between ages 25 and 44, higher worry regarding HIV/AIDS is associated with lower probabilities of having additional children between Malawi 1 and Malawi 2. It must also be noted that the reduction in childbearing associated with relatively high levels of worry seems to be very strong. In the middle age groups, movement from 'no worry at all' to 'worried a lot' results in a 25-30% decrease in the conditional probability of having at least one child, a strikingly strong effect.

The conditional probabilities displayed in the 15-24 age panel of Table 5 carry a very different message. While worry seems to be negatively associated with the number of births occurring to older women during 1998-2001, it does not seem to matter to the fertility outcome of women in this youngest age group. Conditional probabilities of having had no children between Malawi 1 and Malawi 2 remain roughly constant across all degrees of the worry condition, suggesting that the reduction in childbearing associated with increased worry is not characteristic of this youngest group. This result may at least partially be explained by the existence of powerful childbearing promoting social and personal demands on women at lower parity.

Finally, I should note that, given the small sample size of the 45+ age group, I have chosen to ignore the results in the corresponding age panel, but have displayed them here for completeness.

Table 5 should not be taken as definite evidence for a causal relation between intensity of worry regarding HIV infection and number of births in the interval between Malawi 1 and Malawi 2. Both ‘childbearing’ and ‘worry’ may be associated because of their common link to another trait of the respondent which is not considered in this analysis, for instance the behavior of the husband. Women suspicious of their husband engaging in extra-marital sex might be subject to higher worry of contracting the HIV virus. At the same time they might experience a lower frequency of intercourse due to reduced sexual interest in them, which would explain their lower fertility.

In the following paragraphs of this paper, I use multivariate ordered cumulative logit regression to model the association of worry about the HIV/AIDS epidemic with the number of births during 1998-2001 with an aim to confirm the preliminary evidence in support of the childbearing-reducing hypothesis.

Table 6 presents the results of the regression analysis. The dependent variable is the number of births obtained between 1998 and 2001. Seven models are displayed, each one controlling for an additional set of factors derived from standard theoretical understandings of the determinants of fertility. All control variables are Malawi 1 variables since the models measure the effect of characteristics present in Malawi 1 on subsequent childbearing. The figures reported in Table 6 are odds ratios modeled over the higher end of the 0-3 scale for the potential number of births obtained between 1998 and 2001.

Model 1 displays exclusively the variables of interest, namely the worry variables. While this model undoubtedly suffers from omitted variable bias (Note 7) it, however, provides results consistent with those previously obtained. Indeed, the presence of worry seems to be associated with a statistically significant decrease in the number of

Table 6: *Multivariate Ordered Cumulative Logit Regression of number of births between Malawi 1 and Malawi 2 on levels of worry, Odds Ratios.*

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Worry variables							
Not worried at all	---	---	---	---	---	---	---
A little worried	0.674**	0.644**	0.646**	0.654**	0.696	0.701	0.713
Very worried	0.674**	0.687**	0.545***	0.556***	0.623*	0.629*	0.611*
Exposure to the risk of pregnancy							
Age		0.960***	0.951***	0.949***	0.959**	0.960**	0.960**
Married in both Malawi 1 and Malawi 2		1.449**	1.398*	1.420*	1.461**	1.459	1.637**
Husband present in both Malawi 1 and Malawi 2		0.687	0.983	0.978	0.967	0.966	1.018
Parity		0.894***	0.903***	0.899***	0.860**	0.860***	0.860***
Social and cultural characteristics							
Catholic			1.220	1.196	1.053	1.051	1.043
Moslem			2.804***	2.534***	1.995**	1.948**	1.930**
Protestant / other religion	---	---	---	---	---	---	---
Traveled outside the district 6^{+} months since age 15			1.044	1.071	1.113	1.121	1.154
Education level & opportunity cost of time							
Ever attended school				0.818	0.712	0.695	0.742
Usage of family planning							
General usage among community					0.989	0.990	0.990
Used FP in Malawi 1					0.885	0.907	0.896
HIV/AIDS social networks							
# of people chatted with about HIV/AIDS						0.998	0.999
AIDS network index						0.979	0.994
Woman's income & household's asset value							
Earns income							1.016
Financially independent							1.399
Household items index							0.916
Generalized maximum rescaled R^2	0.007	0.127	0.163	0.164	0.156	0.153	0.160
Pr>Chi^2 test for proportional odds assumption	0.462	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001

--- Reference category.
*p-value ≤0.10, **p-value ≤0.05, ***p-value ≤0.01

births obtained. In addition, as previously predicted, the reduction in between-surveys fertility associated with worry is fairly large. For any dividing point we choose on the 0-3 scale for the possible number of children born to a respondent between Malawi 1 and Malawi 2, there is a 100*(0.674 – 1) or 32.6 percent decrease in the odds of being above versus being below that dividing point for individuals reporting moderate or high levels of worry as compared to individuals reporting no worry at all. The reported p-value for the chi-square test of the proportional odds assumption (i.e. the restriction imposed on the data in order to fit a cumulative ordered multinomial logit model) supports the assumption that the effect of worry on the logit is identical, regardless of the point of dichotomization.

Subsequent models attempt to control for potential additional confounding effects on the number of births between Malawi 1 and Malawi 2. Model 2 controls for a woman's exposure to the risk of pregnancy by using a linear form of the age variable (Note 8), the woman's parity, an indicator that she was married or in a stable relationship in both Malawi 1 and Malawi 2 and an indicator that her husband or partner was present in both Malawi 1 and Malawi 2. The last two variables serve as a rough proxy for exposure during the interval. The significance, signs and the order of magnitude of the worry variables are conserved in Model 2. Except for 'husband present in both data collection rounds', all of the controls for exposure to the risk of pregnancy seem to affect the number of births obtained between 1998 and 2001. The effect of age is consistent with the results of Table 3 and of the analysis of conditional probabilities.

Model 3 controls for social and cultural variables including religion, tribe and region. However, due to high correlation between these variables, I choose to retain only the religion variables. Indeed, roughly speaking, the Southern region consists of five ethnic groups, the two predominant ones being the Yao and the Chewa. Most inhabitants of this part of the country are Moslem and/or practice indigenous religions. The central part of Malawi is populated mainly by Chewa who practice a wider range of religions, including Catholicism. Finally, Northern Malawians tend to be Tumbuka and typically practice Protestantism. Table A1 (Appendix A) presents a correlation matrix for the religion and tribe variables. The results of Model 3 show that the Moslem variable is highly significant and has a strong positive effect on the number of births between surveys. In this model, the coefficients on the worry variables remain significant and retain their negative sign. Note, however, that Model 3 presents a noticeably stronger effect of 'being very worried' (45.5% reduction in the odds of being at the higher end of the scale for the number of births versus being at the lower end of the scale) than of 'being a little worried' (35.4% reduction).

Model 4 controls for the educational experience and the opportunity cost of a woman's time by including a variable tracking whether she ever attended school.

School attendance has a negative effect on the odds of having a higher number of births versus having a lower number of births, but is not significant. The coefficients of the worry variables remain virtually identical to those in Model 3.

Model 5 controls for the effect of family planning by including variables for the general usage in the woman's community and for a woman's usage in Malawi 1. Again, this last variable was the best available proxy for usage during the interval. As would have been expected, women using family planning in 1998 experienced a reduction (-11.5%) in the odds of having a relatively large number of births between surveys versus having a relatively small number of births between surveys. Importantly, while both the worry variables have retained their sign and their magnitude, only the 'very worried variable' remains marginally significant at the .05 level (p-value 0.06).

Model 6 controls for the availability of and integration in HIV/AIDS social networks. The MDICP dataset contains information on whether or not the respondent has talked with her husband or partner about HIV and on the number of people she has 'chatted with about HIV'. In addition, I create an HIV/AIDS network index which tracks the number of positive responses to questions inquiring whether the respondent has ever a) heard a talk at the clinic/hospital about protection against HIV/AIDS, b) heard a radio program about protection against HIV/AIDS, and c) been visited by health personnel in her home with information about protection against HIV/AIDS. Because the AIDS network index is strongly correlated with the 'talked with husband about HIV' variable (see Table A2 in Appendix A), I drop the latter variable in Model 6. The control variables introduced in this model do not seem to have much of an effect on the number of births Malawi 1 and Malawi 2. In addition, the 'very worried' variable remains strongly associated with a reduction in the odds of being at the higher end of the number of births scale as opposed to being at the lower end of this scale (37.1% reduction) and is marginally significant at the .05 level (p-value 0.06). On the other hand, the 'worried a little' variable remains statistically insignificant with, however, a relatively large magnitude.

Model 7 is the full model. In addition to the classical control variables previously introduced, it takes into account a woman's income and her household's asset value. Besides variables tracking whether or not the respondent earns some income and is financially independent, I create an index for the household's asset value. This items index is a count of the number of positive responses to a series of questions inquiring whether the household possess a bed with mattress, a radio, a bicycle, a pit latrine and a paraffin lamp. Once again, the effect of these control variables is not statistically significant. Nevertheless, the 'very worried' and the 'worried a little' variables of interest have retained their magnitude and sign characteristics in this last model. Higher intensities of worry are associated with strong decreases in the odds of having a larger number of births between 1998 and 2001 as opposed to having a smaller number of births in the same time frame (the decrease in the odds is 28.7% and 38.9% for the 'worried a little' and 'worried a lot' variables respectively). Finally, while the 'worried a little' variable does not reach statistical significance, the 'very worried' variable is marginally significant at the 0.05 level with a p-value of exactly 0.05.

The results just presented are at least partially confirmed when the worry and childbearing variables are modified or measured in a slightly different fashion. Table 7 presents odds ratios obtained from fitting multivariate ordered cumulative logit regressions (Models A and B) and logistic regression (Model C) to three different models where such alternative measures of worry and childbearing are considered. For all three of these models, the control variables are identical to those considered in Model 7 (see Table 6). Models A and B in Table 7 also retain the outcome variable considered so far, i.e. the number of births obtained between Malawi 1 and Malawi 2. Model A considers the association between a dichotomized version of the worry variable and the number of births between survey rounds. In this model, the worry variable, thus opposes 'no worry' to 'some worry'. The results indicate that 'some worry' is associated with a 36.8% decrease in the odds of having a relatively large number of children in 1998-2001 versus having a relatively small number of children in that interval. Again, this coefficient is marginally significant at the .05 level (p-value 0.05). Model A thus provides some support for the results obtained using the original set of worry variables (see Model 7, Table 6).

Model B measures a woman's worry through her level of concern regarding her husband's extra-marital relationships. Dummy variables were created tracking whether the woman: a) knows, b) suspects, c) can't know and d) does not think that her husband has sexual relations with other women. The last variable ('does not think that her husband has sexual relations with other women') is used as a reference category. Interestingly, knowing, suspecting and not being able to know that one's husband has sexual relationships with other women are all associated with a negative effect on the odds of being at the higher end of the number of births scale versus being at the lower end of the scale (the odds are reduced by 16.1%, 29.8% and 9.1% for the 'know', 'suspect' and 'not able to know' variables respectively). However, none of these three variables appears to be significant. The finding that the 'know' variable is of a smaller magnitude than the suspect variable is not contradictory with the hypothesis that high levels of worry negatively influence the number of births between Malawi 1 and Malawi 2. In fact, knowing that one's husband has sexual relations with other women is not necessarily synonymous to being worried about HIV/AIDS since these sexual partners are likely to be trusted co-wives. On the other hand, the finding that the 'suspect' variable matters relatively more indicates that less legitimate extra-marital

Table 7: *Multivariate ordered cumulative logit regression (Models A and B) and logistic regression (Model C) of various measurements of the number of births obtained between Malawi 1 and Malawi 2 on alternative measures of worry, Odds Ratios.*

	Model A[a]	Model B[b]	Model C[c]
Worry variables (Model A)			
Not worried at all	---		
Some worry	0.632 *		
Worry variables (Model B)			
Knows that husband has sex with other women		0.839	
Suspects that husband has sex with other women		0.702	
Can't know whether husband has sex with other women		0.909	
Does not think that husband has sex with other women		---	
Worry variables (Model C)			
Not worried at all			---
A little worried			0.713
Very worried			0.611*
Exposure to the risk of pregnancy			
Age	0.960**	0.960**	0.960**
Married in both Malawi 1 and Malawi 2	1.634	1.632	1.637
Husband present in both Malawi 1 and Malawi 2	1.038	1.020	1.018
Parity	0.860***	0.862***	0.860***
Social and cultural characteristics			
Catholic	1.033	1.017	1.043
Moslem	1.866**	1.631*	1.930**
Protestant / other religion	---	---	---
Traveled outside the district 6+ months since age 15	1.149	1.183	1.154
Education level & opportunity cost of time			
Ever attended school	0.746	0.707	0.742
Usage of family planning			
General usage among community	0.989	0.987	0.990
Used FP in Malawi 1	0.905	0.919	0.896
HIV/AIDS social networks			
# of people chatted with about HIV/AIDS	1.000	1.000	0.999
AIDS network index	0.989	0.972	0.994
Woman's income & household's asset value			
Earns income	0.990	0.993	1.016
Financially independent	1.385	1.383	1.399
Household items index	0.919	0.913	0.916
Generalized maximum rescaled R2	0.159	0.156	0.377
Pr>Chi2 test for proportional odds assumption	<0.0001	<0.0001	N/A

--- Reference category

* p-value ≤0.10; ** p-value ≤0.05; *** p-value ≤0.01

a In Model A worry is measured as a dichotomous variable opposing 'some worry' to 'no worry'. The outcome variable is the number of births obtained between Malawi 1 and Malawi 2.

b In Model B worry is measured as a woman's level of concern regarding her husband's extra-marital relations. The outcome variable is the number of births obtained between Malawi 1 and Malawi 2.

c In Model C worry is measured with the original worry variables (see Table 6). The estimated outcome variable is a dummy variable tracking whether or not the respondent has had at least one birth since Malawi 1. The model predicts a value of 1 on the dummy variable (i.e. the respondent had a child since Malawi 1) sexual relationships, -- which are likely to involve unknown and mistrusted women and are thus potentially more worrisome to the wife--, have a greater effect on the number of births obtained between data collection rounds.

Finally, a third model (Model C) measured a woman's between-survey childbearing based on retrospective estimates of the timing of her latest birth. Using the Malawi 2 question: 'When was your last child born' I created a dummy variable tracking whether or not the respondent had had at least one birth since Malawi 1. In Model C I revert back to the original measurement of a woman's level of worry. The results of Model C indicate that women who were moderately worried in 1998 had 28.7% lower odds of having at least one child between surveys (note that the coefficient is not statistically significant). Similarly, being very worried in 1998 is associated with a reduction of 38.9% in the odds of having had at least one birth between Malawi 1 and Malawi 2. This effect is marginally significant at the .05 level (p-value 0.05). In sum, the direction of the relationship between worry and between-survey childbearing in Model C is again consistent with the hypothesis of reduced childbearing in the presence of concern regarding HIV infection elicited by previous results.

5. Discussion: Pathways for the association between HIV/AIDS worry and childbearing

Two main results emerge from this study. First, rural Malawian women's chances of having had a given number of births between Malawi 1 and Malawi 2 are related to their worry regarding a possible HIV infection. In accordance with the expectations of the hypothesis of reduced childbearing in the presence of fears related to the HIV/AIDS epidemic, I have found some evidence suggesting that women who are worried about HIV infection have smaller odds of having a relatively large number of births between data collection rounds as compared to women who reported no worry. This finding is particularly true in the case of women who indicated strong levels of concern regarding their future HIV status. The present research does not provide any support for the hypothesis of increased childbearing in the presence of worry regarding HIV infection.

Second, the finding that moderate and high levels of worry seem to be associated with reductions in childbearing should be differentiated by age. Women in the 15-24 age range seem to be less subject to the childbearing depressing effect of increased worry regarding HIV/AIDS than women in the older age categories. An ordered multinomial logit regression of the number of births between 1998 and 2001 on worry differentiating by age reveals that young women's worry is associated with *increases* in the odds of having a relatively large number of between-survey births while older women's worry is associated with a decrease in the same odds (results not shown). I have speculated that a possible explanation lies in the presence of strong childbearing promoting social norms and personal behavior among women in their early years of childbearing. It is possible that such fertility enhancing forces might include the desire for children, the socially defining role of motherhood or the inability to resist a partner's desire for children (Acsadi and Johnson-Acsadi 1990).

Given the current state of knowledge on the relationship between worry regarding HIV infection and childbearing, it is difficult to make conclusive remarks on the mechanisms underlying the reduction in childbearing associated with concern for a possible HIV infection. More research is needed in order to explore the channels through which worry affects childbearing and to establish its direct as well as indirect influences on the underlying proximate determinants of fertility.

Among all proximate determinants of fertility, concern regarding future HIV infection is most likely to lead to a lowered frequency of intercourse while individuals attempt to protect themselves against the virus. The MDICP datasets did not collect information that would allow me to specifically test this hypothesis. However, some insight can be gained from assuming that women's suspicion regarding their husband's extra-marital sexual relations serves as a predictor of their frequency of intercourse. While such an assumption ignores issues of distribution of power and social pressures in the decision to engage in sexual activity, suspicion that one's husband is unfaithful can nevertheless be thought of as a reasonable rough proxy for frequency of intercourse for the purpose of this preliminary analysis. Only 14% of those respondents interviewed in Malawi 1 who indicated not being worried about a possible HIV infection also reported knowing or suspecting that their husbands were sexually unfaithful. On the other hand, 30% of respondents with some concern that they may become infected with HIV in the future indicated that they suspected or knew their husbands to have extra-marital sexual relations. This data thus seems to indicate an association between worry regarding HIV infection and knowledge or suspicion of one's husband's extra-marital affairs which is consistent with the hypothesis of reduced frequency of intercourse in the presence of concern for becoming infected with HIV.

Other proximate determinants likely to mediate the relationship between worry regarding HIV infection and childbearing include the use of contraceptives, particularly condoms. Indeed, as the effects of the AIDS epidemic become increasingly recognized and as individuals take advice from public education campaigns, increases in the use of condoms are likely to be observed (Agha 2001; Glor and Severy 1990). Establishing the link between condom use and childbearing is, however, a delicate matter, since those most receptive to warnings about the risks of HIV infection may also be those who have earlier accepted advice regarding the desirability of family planning and births limitation. In addition, a possible pathway for the effect of worry regarding HIV infection on childbearing points to an increased number of induced abortions. This hypothesis is built on the fairly common assumption that aborted fetuses are not reported as children ever born. Increased occurrences of abortions could be related to fear that the infant will be infected or that the mother and/or relatives will be unable to provide adequately for the child. Finally, although the MDICP interviewed only ever married women, it is also possible that among non-married women, high intensities of worry would result in diminished exposure to the risk of pregnancy through reductions in the proportions of women every marrying. There is evidence that some women will respond to the HIV/AIDS epidemic by remaining single (Barnett and Blaikie 1992). However, it is difficult to isolate the impact of the HIV/AIDS epidemic on decisions to marry from that of further socio-economic development.

Notes

1. UNAIDS estimated to 800,000 the number of people living with the HIV virus in Malawi in 1999. The HIV prevalence rate among adults was estimated at 15.96% at the same date (for further information, see http://www.unaids.org/epidemic_update/report/Final_Table_Eng_Xcel.xls).

2. It is possible that even a substantial HIV/AIDS impact would be difficult to distinguish from other influences on childbearing such as urbanization, education, economic development and changes in gender roles (Notestein 1953; Thompson 1930). These processes are also liable to interact with the HIV/AIDS epidemic in determining the nature of childbearing-related behavioral changes.

3. The data can be found on the internet at the following address: http://www.ssc.upenn.edu/Social_Networks/. Additional information regarding the dataset can be found at the same address.

4. The *original* dataset that I used to generate the number of births between Malawi 1 and Malawi 2 was not purged of its implausible or improbable responses. In other words, unrealistic figures for the 'number of children ever given birth to' were not cleaned, set as missing or imputed by the survey team who collected and coded the data. On the basis of this *original* dataset, about 14% of figures that I obtained for the number of births between 1998 and 2001 were judged unrealistic. I checked the paper questionnaires in order to confirm that these unrealistic figures were not the result of coding or programming errors.

5. Negative values for the number of births between 1998 and 2001 are obviously not possible. Therefore, the lower boundary for the between survey childbearing range was set to 0. In the approximately 36 months between Malawi 1 and Malawi 2, women were 'permitted' 3 children at most. This slightly liberal figure was chosen taking into account periods of temporary sterility in the form of post-partum amenorrhea and the possibility of a woman giving birth to twins or to triplets. All values obtained from the original (raw) dataset which were outside the 0-3 range were set to missing. No imputation technique was used to remedy the missing data problem created by forcing the number of births to a 0-3 range. I made this decision in order to avoid attributing a more or less arbitrary value of replacement to a deleted data point.

6. Unfortunately, the 1998 round of data collection did not ask respondents about their HIV/AIDS risk (i.e. their probability of *currently* being infected with HIV). However, the topic was explored in Malawi 2.

7. Omitted variable bias refers to a model misspecification error whereby variables are excluded from the model, although they should in reality be included. It can potentially have fairly serious consequences since the coefficients are no longer guaranteed to be unbiased.

8. Non-linear forms of the age variables were tested for. They were, however, not retained as they appeared not to be significant.

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Appendix A

Table A1: *Correlation matrix for religion and tribe variables (Pierson correlation coefficients)*

	Catholic	Protestant	Muslim	Yao	Chewa	Tumbuka	Other tribe
Catholic	1	-0.513	-0.250	-0.193	0.068	-0.035	0.177
		(<.0001)	(<.0001)	(<.0001)	(0.019)	(0.227)	(<.0001)
Protestant	-0.513	1	-0.575	-0.535	0.217	0.342	-0.102
	(<.0001)		(<.0001)	(<.0001)	(<.0001)	(<.0001)	(0.0004)
Muslim	-0.250	-0.575	1	0.869	-0.335	-0.336	-0.132
	(<.0001)	(<.0001)		(<.0001)	(<.0001)	(<.0001)	(<.0001)
Yao	-0.193	-0.535	0.869	1	-0.361	-0.350	-0.231
	(<.0001)	(<.0001)	(<.0001)		(<.0001)	(<.0001)	(<.0001)
Chewa	0.068	0.217	-0.335	-0.361	1	-0.449	-0.297
	(0.019)	(<.0001)	(<.0001)	(<.0001)		(<.0001)	(<.0001)
Tumbuka	-0.035	0.342	-0.336	-0.350	-0.449	1	-0.288
	(0.227)	(<.0001)	(<.0001)	(<.0001)	(<.0001)		(<.0001)
Other tribe	0.177	-0.102	-0.132	-0.231	-0.297	-0.288	1
	(<.0001)	(0.0004)	(<.0001)	(<.0001)	(<.0001)	(<.0001)	

Note: p-values are in parenthesis.

Table A2: *Correlation matrix for integration in HIV/AIDS social networks (Pierson correlation coefficients)*

	Talked with husband about HIV	Number of people chatted with about HIV	HIV/AIDS network index
Talked with husband about HIV	1	0.090 (0.002)	0.216 (<.0001)
Number of people chatted with about HIV	0.090 (0.002)	1	0.122 (<.0001)
HIV/AIDS network index	0.216 (<.0001)	0.122 (<.0001)	1

Note: p-values are in parenthesis.

Table A3: *Correlation matrix for woman's income and household's asset value (Pierson correlation coefficients)*

	Livestock Index	Household Items Index	Earns Income	Financially Independent
Livestock Index	1	0.343 (<.0001)	0.085 (0.003)	0.032 (0.267)
Household Items Index	0.343 (<.0001)	1	0.030 (0.307)	-0.0.10 (0.718)
Earns Income	0.085 (0.003)	0.030 (0.307)	1	0.160 (<.0001)
Financially Independent	0.032 (0.267)	-0.010 (0.718)	0.160 (<.0001)	1

Note: p-values are in parenthesis.