Descriptive Findings

Adolescent childbearing in sub-Saharan Africa:
Can increased schooling alone raise ages at first birth?

Neeru Gupta

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Abstract

This article examines whether increased years of schooling exercised a consistent impact on delayed childbearing in sub-Saharan Africa. Data were drawn from Demographic and Health Surveys conducted in eight countries over the period 1987-1999. Multiple logistic regressions were used to assess trends and determinants in the probability of first birth during adolescence. Girls' education from about the secondary level onwards was found to be the only consistently significant covariate. No effect of community aggregate education was discernible, after controlling for urbanity and other individual-level variables. The results reinforce previous findings that improving girls' education is a key instrument for raising ages at first birth, but suggest that increases in schooling at lower levels alone bear only somewhat on the prospects for fertility decline among adolescents.

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1. Introduction

Sub-Saharan Africa has some of the highest levels of adult and adolescent childbearing in the world. Since the 1980s, several countries in the region have begun a transition toward lower fertility. This has generally been accompanied by an upward trend in the age at first birth, although wide variations remain across countries and social groups. Modernisation has been claimed to be an instigator of fertility decline in many societies (Caldwell 1976, Coale 1973, Easterlin 1983). Increased education, innovations in health care, and improved communication are thought to bring about forces dissolving traditional tendencies toward large families and replacing them with individualism marked by material aspirations. In particular, a strong correlation between women's education and reduced childbearing consistently emerges from studies throughout the developing world (see, for example, Ainsworth 1994, Martin and Juarez 1995). Mboup and Saha (1998) found that in many countries of sub-Saharan Africa, women with no schooling have about two to three children more than women with secondary or higher education. It has been suggested that in areas that have not yet achieved mass schooling, changes in behaviour will be slow because of the slower pace of social interaction and diffusion, resulting in a lagging fertility decline (Lloyd, Kaufman, and Hewett 2000).

Fertility decline is due in part to delayed childbearing among younger and adolescent women. Lower fertility preferences might reduce the pressure for women to start childbearing at a young age in order to meet their family size goals. A growing body of literature on reproductive health and behaviour among the adolescent populations in sub-Saharan Africa has emerged since the late 1980s. Adolescent fertility has been increasingly viewed as a source of social and policy concern. Early childbearing has been linked to higher rates of maternal and child morbidity and mortality, truncated educational opportunities, and lower future family income. Zabin and Kiragu (1998) reviewed the evidence for the effects of early childbearing (within and outside of union) and pointed to a number of health consequences including, for the mother, higher than average levels of blood pressure, toxaemia, anaemia, bleeding, obstructed and difficult labour, premature delivery, and death. In addition, children born to teenagers are susceptible to higher incidence of low birth weight (which itself can lead to neurological problems, retardation, death), prematurity, stillbirth, and neonatal mortality.

Expanding access to formal education is generally seen as a crucial intervention for preventing early childbearing among adolescents. Policy- and decision-makers often implicitly assume a causal flow from girls' education to lower fertility. However the mechanisms through which increased schooling operate to regulate fertility levels remain less well known. The education-fertility relationship is complex. In some high fertility societies, small amounts of education may be unexpectedly linked to higher fertility, as exposure to schooling may undermine traditional practices of sexual abstinence and

prolonged postpartum breastfeeding that otherwise would have acted to delay a new pregnancy (see Bledsoe et al. 1999). Seemingly diminishing returns of education on delayed sexual activity were cited to help explain observed increases over time in levels of sexual experience among Brazilian adolescents (Gupta 2000).

This article presents a comparative perspective of determinants and trends in adolescent childbearing in sub-Saharan Africa. Data are drawn from Demographic and Health Surveys conducted in eight countries over the period 1987-1999. We examine changes over time in the likelihood of a young woman having a first birth before age 18, and investigate which sub-groups of the populations are at the forefront of trends toward declining adolescent fertility. Multiple regression analyses are performed to disentangle the independent impacts of education on age at first birth. Our main objective is to assess whether increased years of schooling have exercised a consistent impact on delayed childbearing among adolescents, net of other potentially confounding influences associated with modernisation. The intent is not to undermine any other obvious benefits of increases in girls' education.

2. Data and methods

The present study focuses on trends in age at first birth among adolescent girls in eight countries of sub-Saharan Africa: Burkina Faso, Côte d'Ivoire, Ghana, Kenya, Mali, Senegal, Tanzania, and Zimbabwe. Data are drawn from successive Demographic and Health Surveys (DHS) conducted between 1987 and 1999. The DHS is one of the largest programs producing cross-national and comparative quantitative information on fertility and reproductive health throughout the developing world. Its objectives include the expansion of the international population and health database and promotion of widespread dissemination and use of survey data among policy-makers. Information is collected from personal interviews with a representative sample of women (and increasingly men) of reproductive age. The surveys are carried out in a relatively standardised manner, though questionnaires may be translated and otherwise adapted to the programmatic needs and conditions of a specific country (ORC Macro 2001).

Each country selected had two surveys at least four years apart in order to allow for trend analysis using data from two points in time. Our study focused on early initiation of childbearing, using retrospective data compiled from young adult women on age at first birth. This enabled us to assume similar recall biases and presented a distinct advantage in analysing trends within a given age group, instead of using various cohorts from one cross-sectional database. Previous studies of survey data quality have suggested that, in general, the quality of reporting of age-related information can be considered better among younger respondents (see Blanc and Rutenberg 1990, Gage 1995, Rutstein and Bicego 1990). By

limiting our focus on respondents in the youngest age groups, we hoped to minimise the damaging bias of recall errors, which tend to be more frequent among older respondents.

Our analysis examined the probability of a young woman having a first birth before age 18. Since the period of exposure is censored for girls who have not yet completed adolescence, we included in our analysis only respondents aged 18-24 at the time of each survey. Multiple logistic regression models were used to evaluate trends and determinants of adolescent childbearing, employing the *Stata* statistical software package (StataCorp 2001). Separate models were run for each country to take account of unobserved characteristics. A generalised estimating equation (GEE) was applied to avoid the inefficient estimation of coefficients, given the two-stage DHS sampling scheme. As with many sample surveys, the DHS used stratified sampling designs: selection of area units or clusters (usually census enumeration or other well-defined geographical areas) in a single stage, normally with probability proportional to size, followed by selection of households. Standard logistic models assume that the distribution of the error term follows a binomial distribution and the outcomes are random and independent. However, in a hierarchically nested sample, respondents within the same cluster or community are likely to have similar characteristics and behaviours (due to a number of unmeasured and unmeasurable factors), implying that the outcomes are not independent. The GEE allowed us to estimate the model parameters while controlling for intra-cluster correlation (Liang and Zeger 1993).

The key hypothesis being tested was that differences in schooling patterns would be associated with changes in the risk of a girl's first birth before age 18. At the individual level, the education covariate was categorised according to no schooling, one to seven years of schooling, and eight or more years of schooling achieved. It is widely recognised that fertility decline is due in part to increased schooling. Among adolescents, while we expect higher levels of education to be associated with a lower probability of early first birth, the direction of causality is less clear. A girl may decide to delay childbearing in order to complete her formal education. On the other hand, some teenage mothers may be forced to leave school after having a child. To reduce the chances of reverse causality, we selected eight years of schooling as our cut-off point in order to minimise the numbers of adolescents who may have been obliged to leave school early because of a pregnancy. Lesser years of education, or until about the secondary level, were considered to occur too early to be influenced by childbearing.

We further considered schooling from a contextual perspective. Previous analysis for sub-Saharan Africa has suggested that community-level education influences women's fertility both among the uneducated and the better educated (Kravdal 2002). Community education was captured here by proxy through aggregating adults' individual-level responses within a sampling cluster. In particular, the indicator was measured through the proportion of adult women and men (aged 25 or over) in each cluster with eight or more years of schooling. Clusters or communities where at least 20 percent of all adults had

reached this level of schooling were considered to have higher mass schooling and socio-economic development. An exception was made for Mali where, due to small numbers of well-educated adults, the cut-off for higher status was set at 10 percent.

A number of other socio-demographic and contextual variables were included in the models as potential confounding factors: place of residence (urban/rural), mass media exposure (radio listenership), and family planning environment. The urban and rural distinction was considered important because of differences in access to health facilities, cultural beliefs, living situations, and opportunities. The variable for regular radio listenership, as representative of access to the mass media and new ideas, was measured by whether an individual reported listening to the radio at least once a week (Note 1). While residence and radio exposure referred to characteristics reported at the time of the survey, given the focus on younger respondents and the relatively short interval between interview and outcome of interest, these variables can generally be considered to closely reflect the characteristics at the time of first birth.

Another potentially influential variable on the risk of early childbearing was considered as access (physical, financial, and socio-cultural) to family planning and reproductive health care. A strong family planning program in the community could indirectly influence an adolescent's familiarity with contraception and knowledge of the health risks of early sex and childbearing. Ideally, health care access would be measured from health facility data on outreach programs and use of services by adolescents. However, the availability of such data is still limited in the DHS. Alternatively, the strength of local health programs was assessed through a proxy indicator of whether a large proportion of the adults in the community had practised family planning. This was measured through cluster-level aggregates of the number of adults (women aged 25-49 and men aged 25-54) who reported ever using modern contraceptives (Note 2). Communities where at least 50 percent of adults had used contraceptives were categorised as having a strong reproductive health care environment. Due to wide disparities and sample size constraints, for Mali the cut-off for stronger family planning environment was at least 10 percent of adults having used contraceptives, while for Zimbabwe it was set at 80 percent or more.

3. Results

3.1 Descriptive analysis

Evidence from the DHS suggested that all but one of the eight sub-Saharan African countries under observation experienced a decline in adolescent fertility between survey periods. Figure 1 presents the trends in the proportion of young women who had a first

birth before age 18 (regardless of marital status) by survey. The proportion is seen to have declined for all countries except Burkina Faso. The highest level of adolescent childbearing was observed in Mali (45 percent). In contrast, less than a quarter of girls had an early first birth in Ghana, Kenya, and Zimbabwe. Côte d'Ivoire witnessed the largest inter-survey reduction in the proportion of early first births (from 41 to 28 percent). In Mali, the difference was only marginal.
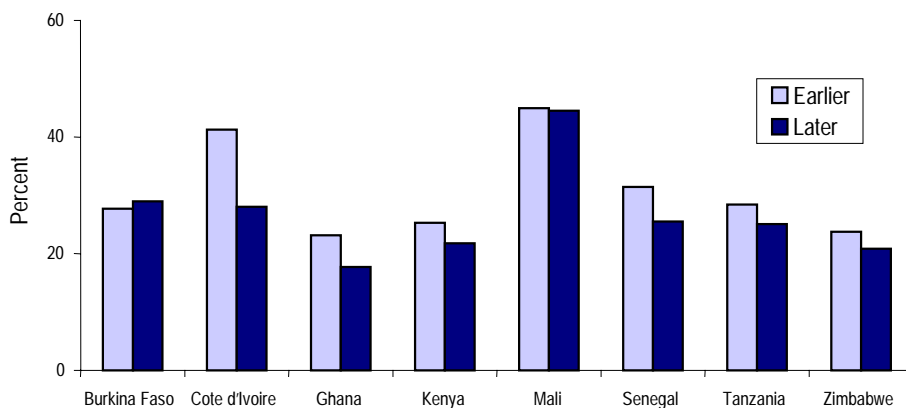
Figure 1: *Percent of young adult women (18-24 years) who had a first birth before age 18, by DHS survey period*

Large cross-national disparities were seen in the levels of girls' schooling and other socio-demographic characteristics. For example, according to the most recent survey findings, fewer than 10 percent of adolescents (ages 15 to 19) had eight or more years of schooling in Burkina Faso, Mali, and Tanzania (see Table 1). On the other hand, the majority had attained this level in Zimbabwe (66 percent) and Ghana (51 percent). Rapid improvements in schooling were noted between survey periods in Kenya, Senegal, and Zimbabwe. Burkina Faso and Ghana experienced slight decreases in the proportions of better-educated adolescents. At the same time, in Ghana, improvements were seen in terms of an increase

in the number of adolescents with one to seven years of schooling, somewhat to the detriment of the number with no education.

Table 1: *Percentage distribution of adolescent girls (ages 15-19) according to level of schooling, by DHS survey period*

Schooling	Burkina Faso		Côte d'Ivoire		Ghana		Kenya		Mali		Senegal		Tanzania		Zimbabwe	
	1993	1999	1994	1998	1993	1998	1993	1998	1987	1996	1993	1997	1991	1996	1994	1999
None	73	77	47	51	18	14	5	3	76	76	61	55	15	16	1	1
1-7 years	19	17	39	35	26	35	57	55	19	19	31	34	79	78	46	33
8+ years	8	6	14	14	56	51	38	42	5	5	8	11	6	6	53	66

With regard to other individual characteristics, the countries discussed here are predominantly rural. According to the latest DHS, the proportion of adolescents living in urban areas ranged between 21 percent in Burkina Faso to a high of 46 percent in Senegal. Exposure to mass media varied across the region. The majority listened to the radio regularly in Ghana, Kenya, Mali, and Senegal (between 51 and 68 percent across countries). In contrast, at most one-quarter reported listening to the radio in Burkina Faso and in Côte d'Ivoire.

3.2 Multiple regression analysis: determinants of changes in adolescent fertility

Table 2 displays the results from the multiple logistic regression models examining influences on fertility outcomes among young women in the region. To ease interpretation, our results are expressed in terms of odds ratios, which were calculated by exponentiating the parameters. A ratio greater than unity implies that an individual in the given category would be more likely to have a first birth before age 18 compared to a counterpart in the base category, while a ratio less than unity signals lower likelihood. Trends in the effects of schooling and other variables were analysed through interaction terms of the characteristic on the survey period. These interaction terms were used to specify how influences on the outcome changed between surveys.

Overall, not surprisingly, adolescents who were better educated were less likely to have an early first birth. In all countries, girls with eight or more years of schooling had at least 50 percent lower odds to initiate childbearing before their 18th birthday than those with no education, all else being equal. Effects of fewer years of schooling were less

consistent; only in Burkina Faso, Senegal, and Tanzania were girls with one to seven years of schooling significantly less likely to have an early birth compared to their counterparts with no schooling. In most countries (except Côte d'Ivoire), the interaction terms for education and survey period were not significant, pointing to relative stability over time in the magnitude of the influences of girls' education on delayed childbearing.

Meanwhile, after considering the effect of education, there remained a statistically significant decline between the earlier and later surveys in the risk of adolescent first birth in Côte d'Ivoire and Senegal; in the later survey, girls were 30 and 35 percent less likely to have an early birth, respectively.

Community relative education level was not found to be statistically significant in any of the countries (while controlling for intra-cluster correlation). Recall that this variable was assessed though a proxy indicator of higher proportions of adults with eight or more years of schooling within the cluster. Bivariate analyses (not shown) had suggested that girls who had not given birth before age 18 tended to live in communities where the median proportion of well-educated adults was higher. In a previous study from Zimbabwe, negative effects of aggregate education on birth rates were found to dissipate when the community's urban/rural character was included in the model (Kravdal 2000). It is likely that the education level of a community depends strongly on whether it is located in an urban or rural area.

Effects of other socio-demographic and contextual indicators were significant only in some countries. An independent association between place of residence and risk of early childbearing was significant in Côte d'Ivoire, Ghana, and Senegal: girls living in urban areas were found to be over 30 percent less likely to have a first birth before age 18 as compared to rural residents. Regular radio listening habits were inversely associated with the probability of an adolescent first birth in Côte d'Ivoire and Zimbabwe. Both countries also experienced changes in the effects between surveys; the significant interaction term suggested stronger influences of radio exposure at the time of the later survey (although results for Côte d'Ivoire may also partially reflect changes in the questionnaire wording).

The local family planning environment proved to be significantly associated with risk of an early first birth among girls in Ghana and Senegal; at the same time, the direction of the association was not consistent. In Ghana, adolescents in communities with a strong family planning environment were more likely to have had an early birth, while in Senegal they were less likely. The interaction term for Ghana was also significant, signalling changes in the effects over time, with the family planning environment becoming more protective of an early birth by the later survey period.

Table 2: *Odds ratios from the multiple regression models for the risk among girls of having a first birth before age 18*

	Burkina Faso		Cote d'Ivoire		Ghana		Kenya		Mali		Senegal		Tanzania		Zimbabwe	
Girl's years of schooling																
None (r) §	1.00		1.00		1.00		1.00		1.00		1.00		1.00		0.64	
1-7 years	0.57	**	0.85		0.75		0.76		1.16		0.60	**	0.49	***	1.00	
8+ years	0.16	***	0.47	***	0.27	***	0.23	***	0.41	*	0.09	***	0.15	***	0.19	***
Survey period																
Earlier period (r)	1.00		1.00		1.00		1.00		1.00		1.00		1.00		1.00	
Later period	1.08		0.65	**	0.64		1.21		1.11		0.70	*	0.85		0.75	
Interaction: Girl's schooling – Survey period																
1-7 years * Later period	1.29		1.11		0.91		0.90		0.61		0.87		1.01		0.84	
8+ years * Later period	2.43		0.47	*	1.38		1.11		0.54		1.80		0.95		0.66	
Community schooling level																
Lower (r)	1.00		1.00		1.00		1.00		1.00		1.00		1.00		1.00	
Higher	0.65		0.77		1.05		0.97		0.90		0.93		0.71		0.94	
Interaction: Community schooling – Survey period																
Higher * Later period	0.82		1.25		1.19		0.76		0.85		0.93		0.72		1.45	
Place of residence																
Rural (r)	1.00		1.00		1.00		1.00		1.00		1.00		1.00		1.00	
Urban	1.37		0.70	**	0.57	**	0.90		0.67		0.59	**	1.02		0.85	
Interaction: Residence - Survey																
Urban * Later period	0.49	*	0.82		1.14		1.10		1.01		0.93		1.19		0.75	
Girl's exposure to radio																
Does not listen regularly (r)	1.00		1.00		1.00		1.00		1.00		1.00		1.00		1.00	
Listens to radio regularly	0.92		0.74	**	0.99		0.86		0.96		0.85		1.01		0.70	**
Interaction: Radio exposure – Survey																
Listens to radio * Later period	0.98		1.68	**	1.11		1.03		0.96		1.03		1.01		1.71	**
Community family planning environment																
Lower (r)	1.00		1.00		1.00		1.00		1.00		1.00		1.00		1.00	
Higher	0.82		0.87		1.73	**	0.95		1.16		0.49	*	0.72		1.05	
Interaction: Community FP environment - Survey																
Higher * Later period	1.54		0.98		0.55	*	0.75		0.94		2.14		1.33		1.16	
Sample size	(3513)		(3299)		(2415)		(4630)		(3185)		(4137)		(5166)		(3549)	

Notes

* p<0.05 ; ** p<0.01 ; *** p<0.001

§ The reference category for girl's schooling is none in all countries except Zimbabwe where 1-7 years of schooling is reference.

4. Discussion

This article investigated trends and differentials in age at initiation of childbearing among adolescents in eight countries of sub-Saharan Africa, drawing on data from successive Demographic and Health Surveys. We set out to examine the levels and trends of adolescent reproductive behaviour, and determine the effects of schooling on those trends. An important advantage of using the DHS was their national representation, as many studies of adolescent behaviours refer to only students or other specific subgroups. The data suggested that, despite the brief time between surveys, there was a decline in the numbers of first births among adolescent girls in most countries. An exception was seen in Burkina Faso with a slight rise in the incidence of early first births. At the same time, large disparities were seen in the terms of the levels of early childbearing as well as levels of schooling from country to country.

Multiple regression models were used to ascertain the independent impacts of schooling and other socio-demographic and contextual variables on the fertility trends. The findings indicated that girls' education exercised strong depressive influences on the probability of early childbearing in all countries. Overall, having eight years or more of formal schooling was the only variable found to be consistently significant across countries and survey periods, pointing to education from about the secondary level onwards as the most promising catalyst toward delayed childbearing in the region. At the same time, effects of primary education were less widely influential. While improving girls' educational opportunities is reaffirmed as a key instrument for raising ages at first birth, increases in schooling at lower levels alone are found to bear only somewhat on the prospects for fertility decline among adolescents.

No independent effects of community education status on adolescent childbearing were discernible. However, other individual and contextual effects were found, although the influences were less consistently important. In some countries, girls residing in urban areas or with regular radio listening habits were less likely to have an early first birth. Community family planning environment was associated with early childbirth in two countries but the associations were not necessarily consistent across surveys. Given the reliance on information from small numbers of respondents per cluster, it is possible that our two constructions of community status from aggregated survey data may have been inadequate and should be considered further. In addition, in order to disentangle any distinct effects, there should be no causal relationship between them and the other covariates included in the models. It is likely that, for example, urbanity may itself be a stimulus for higher levels of community development.

Although in many countries the observed declines in early childbearing between the earlier and later surveys were not statistically significant after controlling for changes in girls' education and other background variables, this was not universally true. The

indicator for time-trends remained significant in Côte d'Ivoire and Senegal, with adolescents about a third less likely to have given birth around the time of the later survey.

While increasing girls' education may be critical for raising ages at first birth, it is not sufficient. Other factors appear to be at play, albeit to a lesser extent—some measured in the present research and others not, or perhaps even unmeasurable from the available survey data. In-depth analysis to understand the contributions of additional schooling on delayed childbearing, while controlling for further fixed and random effects, is left to future studies.

It should be noted that, in this article, the terms "education" and "schooling" were used interchangeably. In the models, girls' education was categorised according to the number of years of schooling completed: none, one to seven years, and eight or more years. This definition was chosen to maintain cross-national comparability, with the cut-offs meant to capture differences across levels. However, educational systems vary by country. Moreover, indicators of years of schooling generally ignore concepts of quality and skills acquisition. While the present results are useful in identifying pathways for improving adolescents' reproductive health, the need for qualitative information is also apparent. The variables considered here were only proxies of the structural changes being seen among many African populations. Little evidence is available on the impacts of school curricula, including family life education courses, on reproductive outcomes among girls at risk.

5. Acknowledgements

Notes

1. Radio was the communication medium selected here because of the diversity of development levels among the countries studied. This variable needs to be interpreted carefully since television and newspapers may be more popular among young respondents in some countries. Changes across surveys in the definition of "regular" radio listenership may also hamper comparability. In the earlier surveys for Burkina Faso, Côte d'Ivoire, Ghana and Kenya, and in both surveys for Mali, Senegal and Tanzania, respondents were asked whether or not they usually listened to the radio once a week. In the later surveys for Burkina Faso, Côte d'Ivoire, Ghana and Kenya, and for both surveys in Zimbabwe, respondents were asked whether or not they usually listened to the radio every day.

2. For assessing family planning environment, we relied on information collected from older women and men (each selected survey had an independent male module that compiled data from samples of men of reproductive age). In contrast, using a cluster-level aggregate for the proportion of adolescents having used modern contraception was not deemed a reliable indicator due to methodological and substantive reasons. To capture community-level characteristics, each cluster must have a sufficient number of respondents to make a valid assessment of the situation. In cases where we are only interested in a subgroup of the population, the number of individuals interviewed per cluster that match the criteria will likely be insufficient. Moreover, attempts to include indicators based on self-reported knowledge and practices among youth may fail to completely overcome the problems of endogeneity of current reproductive health status.

References

Ainsworth, M. (1994), Socioeconomic Determinants of Fertility in Sub-Saharan Africa. Washington, DC: World Bank.

Blanc, A. and N. Rutenberg (1990), "Assessment of the quality of data on age at first sexual intercourse, age at first marriage, and age at first birth in the Demographic and Health Surveys." An Assessment of DHS-I Data Quality. DHS Methodological Reports, No. 1. Columbia, MD: Institute for Resource Development/Macro Systems.

Bledsoe, C.H., J.B. Casterline, J.A. Johnson-Kuhn, and J.G. Haaga (eds.) (1999), Critical Perspectives on Schooling and Fertility in the Developing World. Washington, DC: National Academy Press.

Caldwell, J. (1976), "Toward a restatement of demographic transition theory." Population and Development Review, 2(3-4): 321-366.

Coale, A.J. (1973), "The demographic transition." Congrès international de la population, Vol. I., Liège, pp. 53-71.

Easterlin, R. A. (1983), "Modernization and fertility: a critical essay." In: R.A. Bulatao and R.D. Lee (eds.), Determinants of Fertility in Developing Countries, Vol. II. New York: Academic Press, pp. 562-586.

Gage, A. (1995), An Assessment of the Quality of Data on Age at First Union, First Birth, and First Sexual Intercourse for Phase II of the Demographic and Health Surveys Program. DHS Occasional Papers, No. 4. Calverton, MD: Macro International.

Gupta, N. (2000), "Sexual initiation and contraceptive use among adolescent women in Northeast Brazil." Studies in Family Planning, 31(3):228–238.

Kravdal, Ø. (2000), "A search for aggregate-level effects of education on fertility, using data from Zimbabwe." Demographic Research, 3(3). Available on URL: http://www.demographic-research.org/Volumes/Vol3/3.

Kravdal, Ø. (2002), "Education and fertility in sub-Saharan Africa: individual and community effects." Demography, 39(2): 233-250.

Liang, K. and S. Zeger (1993), "Regression analysis for correlated data." Annual Review of Public Health, 14:43-48.

Lloyd, C., C. Kaufman, and P. Hewett (2000), "The spread of primary schooling in sub-Saharan Africa: implications for fertility change." Population and Development Review, 26(3):483-515.

Martin, T.C. and F. Juarez (1995), "The impact of women's education and fertility in Latin America: searching for explanations." International Family Planning Perspectives, 21(2): 52-57.

Mboup, G. and T. Saha (1998), Fertility Levels, Trends and Differentials. DHS Comparative Studies, No. 28. Calverton, MD: Macro International.

ORC Macro (2001), Model "B" questionnaire with commentary for low contraceptive prevalence countries. MEASURE DHS+ Basic Documentation, No. 2. Calverton, MD: ORC Macro.

Rutstein, S.O. and G.T. Bicego (1990), "Assessment of the quality of data used to ascertain eligibility and age in the Demographic and Health Surveys." An Assessment of DHS-I Data Quality. DHS Methodological Reports, No. 1. Columbia, MD: Institute for Resource Development/Macro Systems.

StataCorp (2001), Stata Statistical Software: Release 7.0. College Station, TX: Stata Corporation.

Zabin, L. and K. Kiragu (1998), "The health consequences of adolescent sexual and fertility behavior in sub-Saharan Africa." Studies in Family Planning, 29(2): 210-32.