

HIV/AIDS Risk Behaviors as a Response to Mortality: Predictions From Life History Theory

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Abstract

This paper uses life history theory to examine the relationship between mortality and HIV/AIDS risk behaviors in the developing world. The data come primarily from aggregate Demographic and Health Surveys (DHS) for 54 countries. Life history theory predicts that increased extrinsic mortality will lead to higher engagement in HIV/AIDS risk behaviors. To test this prediction, I examine the relationship between two measures of mortality (death rate, and life expectancy at birth excluding deaths from HIV/AIDS) and several measures of HIV/AIDS risk behaviors (ages at first sex and marriage, total fertility rate, ideal number of children, and age-specific cumulative fertility and desire for more children). Multivariate regression analysis is used to control for potential confounding variables. The results generally support the predictions, with stronger support for females than for males.

[Key words: HIV/AIDS risk behaviors; mortality; fertility; life history theory]

Introduction

HIV/AIDS prevalence has reached record high levels throughout the world, particularly in developing countries (UNAIDS 2006). HIV/AIDS is the fourth leading cause of death worldwide, and the leading cause in sub-Saharan Africa; the epidemic has lowered life expectancy at birth by literally decades in many countries (Ashford 2006; Lamprey et al. 2006). As a result, increasing attention has been given to prevention and education efforts in the fight against HIV/AIDS. Health behavior models suggest that increased knowledge of the pathways of infection and of the disease itself will lead to more realistic perceived HIV/AIDS risk, which will in turn reduce engagement in high risk behaviors (Catania et al. 1990; Neff and Crawford 1998; Rosenstock et al. 1994). Thus education is seen as a key component in the prevention of HIV infection.

While public health campaigns have met with some success in linking knowledge with reduced high risk behaviors (e.g., Cohen 2004; Stoneburner and Low-Beer 2004), the lack of success preventing HIV/AIDS risk behaviors in developing countries is notable (Caldwell 1999; Lamprey et al. 2006). Despite knowledge of HIV/AIDS, individuals, especially youth, typically underestimate their personal risk of HIV/AIDS (see, for example, Anderson et al. 2007). Furthermore, HIV/AIDS knowledge and perceived risk of HIV infection often show little or no correlation with engagement in high risk sexual behavior (e.g., Anderson et al. 2007), suggesting that knowing which behaviors are associated with risk of HIV infection does not necessarily lead to avoidance in those behaviors.

These results present a puzzling question that public health officials have a difficult time answering, namely, why do people who know that engagement in certain behaviors may lead to infection with HIV and a potentially fatal illness nonetheless continue to engage in those

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behaviors? This paper will present an alternative solution to this problem, derived from life history theory. Using cross-cultural data, I will test two predictions derived from the hypothesis that local mortality rates and life expectancy influence engagement in HIV/AIDS risk behaviors.

Life history theory

HIV/AIDS risk behaviors are closely related to life history traits, the key maturational and reproductive characteristics that define the life course. The study of life history traits (such as age at sexual maturity, age-specific mortality and fertility schedules, timing of first reproduction, lifespan, etc.) is known as life history theory (e.g., Hill and Hurtado 1996; Stearns 1992). Life history traits tend to follow predictable patterns. For example, species that are short-lived typically begin reproduction relatively early and have offspring more frequently, while long-lived species delay reproduction and reproduce fairly slowly (Harvey and Zammuto 1985; Stearns 1992). Culture and ecology contribute to significant variation in life history traits across human populations, even in the absence of modern birth control (e.g., Wood 1994). Human life histories nonetheless follow a typical primate pattern: for our body size, humans exhibit a markedly long pre-reproductive juvenile period, followed by a long adulthood characterized by widely spaced births (e.g., Hill and Kaplan 1999; Kaplan et al. 2000).

Many factors favor earlier reproduction over delayed reproduction. All else being equal, individuals who reproduce earlier leave more descendents, while those who delay reproduction leave fewer descendents. Delayed reproduction is thus associated with lower long-term fitness and a greater probability of lineage extinction (Low et al. 2002, 2003). One key variable that may influence the patterning of life history traits is *extrinsic mortality*, that is, mortality caused by sources of mortality generally not under the organism's control (Stearns 1992). Under

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conditions of high mortality and low life expectancy, earlier reproduction is favored because the individual may not survive to older ages. When mortality rates are low, individuals can delay reproduction and invest resources in themselves, furthering the development of a long lifespan. This model has been used to explain variation in life history traits across species (Promislow and Harvey 1991), but can also explain different demographic patterns across human populations (e.g., Chisholm 1993; Quinlan 2007; Wilson and Daly 1997). Geronimus (1996b) and Wilson and Daly (1997), using urban American samples, found that fertility is higher and earlier when actual or perceived life expectancy is lower. Although earlier reproduction is associated with poorer health outcomes in the long run (Geronimus 1996a; Mirowsky 2005), these future costs are discounted by the reduced probability of surviving long enough to incur them.

Mortality might be expected to influence fertility patterns in humans even more strongly than in other mammals, because human offspring have very long periods of dependency on their parents (Kaplan et al. 2000; Lancaster 1991). As a result, adult mortality will decrease an individual's fitness not only by depriving that individual of future reproductive opportunities, but also by jeopardizing the survival of existing young children. Thus, human life histories may have been selected to respond to local mortality pressures, adjusting sexual behavior and fertility in adaptive patterns to maximize future reproductive success (Chisholm 1993; Wilson and Daly 1997). These responses are not necessarily conscious; nor does their existence deny the important role of culture in shaping human fertility patterns. Indeed, cultural patterns and fertility preferences may help reinforce fertility patterns that are optimal in view of local mortality rates. For example, pronatalist beliefs, urging high fertility and early marriage, may reflect cultural knowledge about high mortality rates, especially infant mortality.

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Life history theory and HIV/AIDS risk behavior

The timing of sexual maturation and first intercourse, the frequency of sex and of reproduction, and the number of sexual partners are life history traits that influence exposure to sexually transmitted infections (STIs) such as HIV. The fact that many aspects of sexual behavior are life history traits allows us to bring life history theory to bear on high risk sexual behaviors. Risk behaviors, like all aspects of human behavior, are embedded in a complex social and cultural matrix. They are not simply the result of individual decision making processes; cultural preferences, past behaviors, family and social obligations and economic necessity are a few of the many factors that influence an individual's decision to engage in risk behaviors. Life history theory predicts that higher levels of extrinsic mortality will be associated with earlier reproduction. This may translate into greater engagement in HIV/AIDS risk behaviors such as earlier and more frequent intercourse, greater number of partners, and unprotected intercourse. Life history theory thus provides a novel perspective on HIV/AIDS risk behaviors: while other theories of sexual behavior view mortality as a potential outcome of engaging in high risk sexual behavior, life history suggests that mortality may be a *cause* of life history traits such as patterning of sexual behavior, as well as an *outcome* of such behaviors.

Relatively little work has examined the relationship between mortality and HIV/AIDS risk behaviors. Wilson and Daly (1997), using data from Chicago, found that women in neighborhoods with lower life expectancy and higher mortality had higher fertility at earlier ages. Heath and Gant (2004; Gant et al. in press) used data from 157 countries to test the hypothesis that engagement in risky sexual behavior is an adaptive response to high mortality rates. They found that age-specific fertility of women 15-19 years old (their proxy for risky sexual behavior) was negatively correlated with life expectancy and positively correlated with

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infant mortality rate. DeRose and colleagues (DeRose and Klein 2005; DeRose 2006), using data from Kenya and Zambia, found that although HIV infection suppresses individual fecundity, community-level HIV prevalence was associated with higher fertility within marriage, suggesting that local HIV rates may influence marital fertility rates.

These previous studies have all focused solely on women, and all used only one variable to measure engagement in HIV/AIDS risk behaviors. The current study will include both men and women and use multiple measures of sexual behaviors. The following predictions are derived from the hypothesis that extrinsic mortality has an influence on sexual behaviors (and thus on HIV/AIDS risk behaviors), leading to earlier and more rapid reproduction.

Prediction 1: High risk HIV/AIDS sexual behaviors will be positively correlated with death rate.

Prediction 2: High risk HIV/AIDS sexual behaviors will be negatively correlated with life expectancy at birth.

I will test these predictions using demographic variables that are proxies for HIV/AIDS risk behaviors. The variables will include early sexual activity (measured by age at first sex and age at first marriage), fertility (total fertility rate and age-specific cumulative fertility), and desired fertility (ideal number of children and age-specific percentage of respondents desiring additional children). Because HIV/AIDS is transmitted in the developing world primarily through heterosexual intercourse, early sexual activity is an important HIV/AIDS risk behavior. In an uncertain environment, individuals who reproduce earlier are more likely to leave descendents than individuals who postpone reproduction. While fertility is not necessarily closely linked to HIV/AIDS risk behaviors (for example, in cultures where strictly monogamous unions are enforced, in which case high fertility need not increase risk of HIV infection),

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individuals in countries with higher fertility rates are likely to engage in earlier and more frequent unprotected sexual intercourse, increasing the risk of HIV infection. Fertility preferences are not themselves a form of HIV/AIDS risk behavior, but may track people's willingness and desire to engage in unprotected sex (as well as reflect cultural preferences for high or low fertility).

Proximate vs. ultimate causation

Evolutionary biologists distinguish between proximate causation, the mechanism that allows an organism to exhibit a behavior or trait, and ultimate causation, the reason the behavior or trait evolved. This is in essence a distinction between how traits function versus why they occur. Life history theory explains traits at the ultimate, not proximate, level, while other theories may focus on the proximate mechanisms by which the relationship could occur (i.e., explaining how it occurs but not why). For example, people engage in sex because it feels good; the behavior releases certain neurological and hormonal signals that are perceived as pleasurable. This is a proximate explanation. The complex physiology and behaviors involved in sexual intercourse evolved in order to produce offspring, e.g., genetic descendants. This is an ultimate explanation. The two are not contradictory; they explain the phenomenon at different levels.

This is not to deny that there are other potentially valid alternative explanations at the ultimate level for HIV/AIDS risk behaviors. Cross-sectional data can demonstrate correlations but cannot prove a causal relationship between two variables exists; an omitted or unobserved variable may be driving the observed relationship between these variables. For example, it is possible that poverty causes both greater incidence of high risk sexual behavior and higher levels mortality, for such reasons as lack of quality birth control and medical care.¹ If this is the case,

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an observed association between measures of sexual behavior and mortality/life expectancy will not be causal. To partially control for this, I will therefore perform multivariate regression analysis, controlling for income and other potential confounding variables to see whether the predicted relationship between mortality and sexual behavior remains once these background factors are controlled for.

Methods

The data used in this analysis come from the Demographic and Health Surveys (DHS), which have been collected in developing countries since the 1980s. Each DHS is a complete nationally-representative cross-sectional household survey focusing on population and health indicators. DHS questionnaires are designed to be consistent across countries to facilitate cross-cultural comparisons. The DHS targets women (ages 15-49 in most countries), but many DHS surveys also include a male module, asking questions of male household members ages 15-59.

Data were compiled from STATcompiler (www.statcompiler.com), an on-line database providing aggregate summary data (at the national level) for virtually every indicator collected by the DHS. The sample used for analysis contains the most recent survey for every country available on-line (as of June 2007) that collected at least one survey between 1996 through 2005. The final sample contains 54 countries, all of which contain data collected from females. In addition, 34 of these countries included a male module as well.² (Sample size is smaller for some variables.) Overall, the surveys used in this analysis interviewed a combined total of 668,364 women and 109,090 men living in 652,209 households, with each country contributing, on average, interviews with 12,377 women and 3,208 men.

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The DHS provides aggregate data (at the level of the country) for each of the dependent variables used in this analysis. Aggregate data are used because measures of mortality and life expectancy, key independent variables, are available only at the national level. More geographically fine-grained mortality measures would be desirable (for example, at the level of the province or county or local equivalent), but are not widely available for most developing countries.

Proxies for HIV/AIDS risk behaviors include several DHS variables averaged across the life course. *Age at first sex* measures the median age at first sexual intercourse for women ages 25-49 and men ages 25-54. *Age at first marriage* is the median age at first marriage for women ages 25-49 and men ages 25-54. *Total fertility rate (TFR)* measures the expected fertility rate women 15-44 would expect to experience based on current age-specific fertility rates. TFR is not available for men. *Ideal number of children* is the ideal number of children for women ages 15-49 and men ages 15-59.

Additionally, several proxies for HIV/AIDS risk behaviors are available in the DHS as age-specific variables, with separate measures for ages 15-19, 20-24, and so forth. These will be analyzed in separate models, with age controlled for. *Cumulative fertility* measures the average number of children ever born to women ages 15-49 and men ages 15-59, in five year age groups. *Percent wanting more children* combines three mutually exclusive measures of desired fertility available in the DHS, asked for women only: wants more children soon (within the next two years), wants more children later (more than two years from now), and wants more children (unsure of timing). Summing these three items together creates a variable that measure the percentage of women (ages 15-49, in five year age classes) who desire an additional child, regardless of the time frame.

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In addition to the DHS variables, several additional variables were collected from other sources. These variables are available at the level of the country, but not by age or sex. Two variables are used as proxies of mortality: death rate, and life expectancy excluding HIV/AIDS. *Death rate* (or gross death rate) is the number of deaths per 1,000 population, and was obtained from the *Demographic Yearbook* (United Nations 2002, 2003, 2007), matched to year closest to the DHS survey used for each country. *Life expectancy excluding deaths from HIV/AIDS* is the expected lifespan of a person who experiences the age-specific mortality rates observed cross-sectionally for each country, excluding deaths from HIV/AIDS. This variable is defined as “the average number of years a person would have been expected to live in the absence of AIDS-related mortality” (United Nations 2005:1), and is calculated for the years 2000-2005. Life expectancy excluding HIV/AIDS is used rather than overall life expectancy because in countries with high HIV/AIDS prevalence, life expectancy has dropped dramatically, sometimes by decades (Lamprey et al. 2006). There is thus circularity in using life expectancy that includes death from HIV/AIDS to examine sexual behavior if life expectancy is driven in part by HIV infection. Using a cause-deleted measure of life expectancy provides a stronger argument for a causal role of life expectancy on high risk sexual behaviors (see Wilson and Daly 1997).

Several other control variables, collected from sources besides the DHS, are available at the national level. *Per capita income* is measured by per capita gross national income in purchasing power parity (GNI PPP) for each country. This variable was obtained from the *World Population Datasheet* (Population Reference Bureau 2000, 2001, 2004), matched to the year closest to the DHS survey for that country, converted to real (1998) U.S. dollars and then logged. A dummy variable indicated whether the country was located in sub-Saharan Africa, an important control variable since HIV/AIDS prevalence is much higher in that region of the

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world. Year of the DHS survey which provided the data used in the study was also added to the models. Lastly, all statistics are weighted by population size, obtained from the United Nations (2005). Failure to weight the data would result in countries with very small populations having the same statistical influence on our understanding of global HIV patterns as large countries. All analyses were done with STATA SE v. 10.0.

Results

Summary statistics for variables that are not age-dependent are presented in Table 1, weighted by population size. The top panel shows dependent variables from the DHS, presented separately by gender. Age at first sex is 18.3 for women and 19.0 for men. For women, average age at first marriage is roughly the same as age at first sex, while for men first marriage typically occurs about five years after first sex. Total fertility rate (TFR) is 3.34. Ideal fertility for women is in line with actual fertility, with women desiring about 3.2 children. Men, in contrast, desire about 1.4 children more than women do, on average. Among the independent variables, the average death rate is 9.8 deaths per 1,000 population while life expectancy at birth, excluding deaths from HIV/AIDS, is 63.6 years. Mean per capita income is nearly \$1500. Of the 54 countries in the sample, 29 (53.7%) are in sub-Saharan Africa; when weighted for population size, sub-Saharan African countries constitute 21% of the sample. The average year the survey took place was 2001.

[Table 1 about here]

Average values for the age-specific variables are plotted in Figures 1 and 2.³ Age-specific cumulative fertility (Figure 1) is higher for women than men from ages 20-29 through 35-39, reaching parity at ages 40-44. After 45-49 men continue to keep having children and their

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fertility increases; the DHS does not collect data on women over 49 though female fertility is unlikely to rise beyond that age. Figure 2 plots the percentage of women who indicated they desired additional children, by age. The levels fall with age, though still remain fairly high given the actual fertility rates seen in Figure 1. For example, by ages 25-29 women have already had 2.26 children, yet 46.1% of them desire more children. Women ages 35-39 have had 3.98 children, with 17.68% desire additional offspring.

[Figures 1, 2 about here]

Table 2 presents correlations between the non-age-dependent variables and mortality measures, separately by gender. For females, every single variable is significantly and highly correlated with both death rate and life expectancy, and in the predicted directions. When mortality is high and life expectancy low, women have sex and get married at younger ages, and both have and desire more children than when mortality is low and life expectancy high. For males, however, death rate is significantly correlated only with ideal number of children (though the correlation between age at first sex and death rate is marginally significant), while life expectancy is significantly correlated with both age at first sex and ideal number of children. Although male age at first sex is significantly correlated with life expectancy and marginally correlated with death rate, these correlations are in the opposite of the predicted direction (and also in the opposite of the observed direction for women).

[Table 2 about here]

Correlations between age-specific variables and death rate are presented in Figure 3, while correlations between age-specific variables and life expectancy are presented in Figure 4. The correlation between women's cumulative fertility and death rate is high (between .6 and .7) and highly significant ($p < .001$) for every age (Figure 3), as predicted. For men, the correlation

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is negative for ages under thirty, though only marginally so for ages 15-19 ($p = .0583$) and not significant for ages 20-24. Correlations are positive and significant for men at all other ages ($p = .037$ for ages 25-29, and $p < .01$ for ages 30-59). The percentage of women wanting more children is also positively and significantly ($p < .001$) correlated with death rate, as predicted.

The correlation between women's cumulative fertility and life expectancy is negative and highly significant for every age, as predicted (Figure 4). For men ages 15-19, the correlation is positive and marginally significant ($p = .097$), which is contrary to predictions. For men ages 20-29 the relationship is not significant, while for ages 30-59 the correlations are significant ($p < .01$) and negative, as predicted. For both death rate and life expectancy, the correlations with cumulative fertility are much weaker for men than for women up to ages 30-34; after ages 35-39 the correlations are roughly equal for men and women. The percentage of women wanting more children is negatively and significantly ($p < .001$) correlated with life expectancy, as predicted.

[Figures 3, 4 about here]

Table 3 presents results from multivariate regression analysis. Each row of the table represents a separate statistical model, with the dependent variables (specific proxies for HIV/AIDS risk behaviors) in the left hand column. Regression coefficients for death and life expectancy (excluding deaths from HIV/AIDS) are shown in the table; each model also controls for survey year, logged per capita income, and a sub-Saharan Africa dummy. Regressions of age-specific variables (cumulative fertility and percent wanting more children) also control for age and age-squared. For women, death rate is negatively associated with age at first marriage, while it is positively associated with total fertility rate and cumulative fertility. Life expectancy at birth (excluding deaths from HIV/AIDS) is a significant predictor of every proxy measure of female HIV/AIDS risk behavior under consideration. All coefficients for women are in the predicted

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direction. For men, death rate is not significantly associated with most variables, with only the model of age-specific cumulative fertility being significant (and positive, as predicted). Life expectancy is significantly and negatively associated with three of the four variables under consideration, both ideal and cumulative fertility and age at first sex. The signs for ideal and cumulative fertility are in the expected direction but the sign for age at first sex is in the opposite direction of what was predicted.

[Table 3 about here]

Discussion

This paper tested two predictions regarding the relationships among death rate, life expectancy, and HIV/AIDS risk behaviors, using data from 54 developing countries. Each prediction received some support from the data, though in general, predictions were more strongly met for life expectancy (Prediction 2) than for death rate (Prediction 1). Also, predictions were more strongly supported for women than for men. Simple correlations suggest that when death rate is high, HIV/AIDS risk behaviors (early sex and marriage, higher actual and desired fertility) are also high. The opposite is generally true for life expectancy: proxies for HIV/AIDS risk behaviors are more common when life expectancy is low.

These results changed only slightly in multivariate regression analysis controlling for income and other background factors, suggesting that the relationships between mortality and high risk behaviors are not simply driven by poverty. The relationship between death rate and risk behaviors loses significance in multivariate models for four specific variables: age at first sex, ideal number of children and age-specific cumulative fertility for women, and ideal number

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of children for men. For life expectancy, every relationship that was statistically significant in simple correlations retained significance in multivariate models.

The statistically significant correlations and regression coefficients were all in the directions predicted by life history theory, with one exception. The relationship between age at first sex and life expectancy was predicted to be positive—countries with longer lives should have later age at first sex. This prediction was supported for women. For men, however, the relationship was negative and statistically significant; men living in countries with longer average lifespans have sex earlier, not later. It is unclear why the prediction should be supported for women but contradicted for men. Interestingly, most of the male-specific and female-specific variables (for those available for both men and women) are significantly correlated with each other.⁴ However, age at first sex for women is not correlated with age at first sex for men ($r = .051$, $n = 29$, $p = .7929$). The proximate pathways by which men and women become sexually experienced apparently differ in these sample countries. As noted above, first sex is closely tied to first marriage for women, while for men first intercourse precedes marriage by over five years (Table 1). Yet other variables, such as desired fertility, exhibit large gender differences in average values but show very similar relationships with mortality, so the unexpected relationship between life expectancy and first sex for men cannot be explained away as simply due to gender differences in the age at first sex. This is certainly an area that deserves further consideration and examination.

Limitations

Several limitations of this study should be addressed. As noted previously, although life history theory predictions are based on explanations of ultimate causality, the cross-sectional

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nature of the DHS data makes it impossible to test causal relationships. The relatively small size of the dataset (54 countries, with fewer cases for many analyses) limits statistical power and thus the strength of the conclusions. The use of aggregate data may also confound relationships between variables, as millions of people are represented in a single data point. Future work should take advantage of micro-level datasets to compare relationships between variables across individuals rather than across nations. However, it may be difficult (especially in developing countries) to match existing survey datasets to localized vital statistics on mortality or HIV/AIDS prevalence within those countries.

On a similar note, although the DHS provides age- and sex-specific measures of several risk behavior variables, the proxies of mortality used in this paper are not categorized by either age or sex. This is an important drawback, because mortality risks change throughout the life course, and are often considerably higher among young males than any other adult group. Unfortunately, reliable age- and sex-specific mortality rates are not available for many nations. Life expectancy can be calculated for different ages (not simply at birth) or separately by gender. However, data on age- and sex-specific life expectancy excluding HIV/AIDS are not currently available by country.

Conclusions and Future Directions

Life history theory makes an important contribution to the study of HIV/AIDS risk behaviors by focusing on relationships not apparent from other theoretical perspectives. For example, while other theories of sexual behavior view mortality as a potential outcome of engaging in high risk sexual behavior, life history proposes a bi-directional relationship, with mortality both a cause and an outcome of high risk behaviors. The results in this paper are

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consistent with this prediction: when mortality is high and life expectancy low, people tend to engage in higher rates of HIV/AIDS risk behaviors, potentially leading to further increased mortality.

An approach drawn from life history theory may help explain why HIV/AIDS public health information campaigns have not met with universal success. Many health behavior models assume that once people learn the facts about HIV infection risk, they will modify their behavior accordingly. However, although many studies have demonstrated that people in developing countries have learned the facts of HIV/AIDS, these people nonetheless often do not modify their behaviors to reduce their personal risk. A life history theory perspective suggests there are trade-offs between behaviors that will increase personal survival versus increasing fertility and reproductive success. If individuals are using proximate cues of high mortality and low survival to guide long-term decision making, and if HIV/AIDS prevalence and mortality are high, then they may severely discount the future payoffs to changing their behavior. In other words, the perceived benefits to behavior change may not exceed the current costs of changing behavior, if the perceived probability of surviving to experience the long-term benefits is low. These cost/benefit calculations and decisions to modify behavior need be made neither consciously nor in the absence of cultural preferences and guidelines, and many questions remain regarding the proximate mechanisms by which people assess mortality risks and fertility outcomes.

Several potential policy implications may emerge from this theoretical perspective. The life history model calls attention to the often unquestioned assumption that as local HIV prevalence (and subsequent mortality) increases, engagement in high risk behaviors will decrease of its own accord. While some studies have found that knowing somebody who died of HIV/AIDS is associated with reduced engagement in HIV/AIDS risk behaviors (Anderson et al.

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2007), other studies have found no or inconsistent support for this (Camlin and Chimbwete 2003; Macintyre et al. 2001). In contrast, life history suggests that increased AIDS-related mortality may lead somewhat counterintuitively to increased levels of high risk sexual behavior, rather than decreased engagement in risky behavior. It is important not to be complacent and assume that a potential benefit of rising mortality will be an increase in safe sex. If rising mortality results in greater engagement in high risk behaviors, realizing this in advance may allow public education and intervention programs to respond accordingly. Further empirical and modeling analysis should examine this prediction in more detail.

Life history theory may also offer concrete suggestions on how to change behaviors even in the face of increased HIV/AIDS prevalence. For example, if HIV/AIDS prevalence increases but mortality declines (through widespread use of antiretroviral drugs, for example), one unintended (but beneficial) result may be a decrease in high risk behaviors as life expectancy increases. This unforeseen consequence is not predicted by other health models, to the best of my knowledge. Proximate cultural factors influencing the acceptability or cost of high risk behaviors may also influence the relationship between HIV/AIDS risk behaviors and mortality (for example, by altering the cost, availability or acceptability of condoms). Thus we would expect the magnitude of the effect of mortality on high risk HIV/AIDS behaviors to differ across developed and less developed nations. Mortality rates are predicted to have less of an effect on risk behaviors in more developed countries because the mortality costs of engaging in such behavior are less, due to such factors as greater availability of antiretroviral drugs or lower prevalence of other untreated sexually transmitted infections that influence HIV transmission (see Oster 2005). This prediction has not yet been empirically tested.

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In conclusion, life history theory presents a novel perspective on cross-cultural patterns of HIV/AIDS risk behaviors by linking them to concrete measures of mortality. The model presented here should receive further empirical scrutiny and theoretical development before contributing to policy. If supported by further research, life history theory may make a valuable addition to our understanding of why people engage in risky sexual behaviors across the life course in the era of HIV/AIDS.

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Notes

1. Evidence for a link between poverty or socioeconomic status and risk of HIV infection is inconclusive, though it is commonly assumed that poverty leads to greater engagement in HIV risk behaviors (Wojcicki 2004).
2. The counties (and most recent survey dates) included in the DHS sample are listed below. Every country has a female module; countries with male modules are marked with an asterisk. Armenia (2005)*, Bangladesh (2004), Benin (2001)*, Bolivia (2003)*, Brazil (1996)*, Burkina Faso (2003)*, Cambodia (2000), Cameroon (2004)*, Chad (2004)*, Colombia (2005), Comoros (1996)*, Cote d'Ivoire (1998/99)*, Dominican Republic (2002), Egypt (2005), Eritrea (2002), Ethiopia (2005)*, Gabon (2000)*, Ghana (2003)*, Guatemala (1998/99), Guinea (2005)*, Haiti (2000)*, India (1998/99), Indonesia (2002/2003)*, Jordan (2002), Kazakhstan (1999)*, Kenya (2003)*, Kyrgyz Republic (1997), Lesotho (2004)*, Madagascar (2003/2004)*, Malawi (2004)*, Mali (2001)*, Mauritania (2000/2001)*, Morocco (2003/2004), Mozambique (2003), Namibia (2000)*, Nepal (2001)*, Nicaragua (2001), Niger (1998)*, Nigeria (2003)*, Peru (2000), Philippines (2003)*, Rwanda (2005), Senegal (2005)*, South Africa (1998), Tanzania (2004)*,

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Togo (1998)*, Turkey (1998)*, Turkmenistan (2000), Uganda (2000/2001)*, Uzbekistan (1996), Vietnam (2002), Yemen (1997), Zambia (2001/2002)*, and Zimbabwe (1999)*.

3. The sample sizes for Figure 1 are $n = 54$ countries for women, $n = 32$ for males ages 15-54 and $n = 25$ for males ages 55-59. For Figure 2 the sample size is $n = 54$ countries for all ages.

4. The correlation between age at first marriage for women and men is marginally significant ($r = 0.3202$, $n = 33$, $p = 0.0693$), while male and female ideal fertility ($r = 0.9792$, $n = 32$, $p < 0.0001$) and age-specific cumulative fertility ($r = 0.9556$, $n = 224$, $p < 0.0000$) are highly correlated in the sample countries.

Figure 1. Cumulative fertility, by age and gender

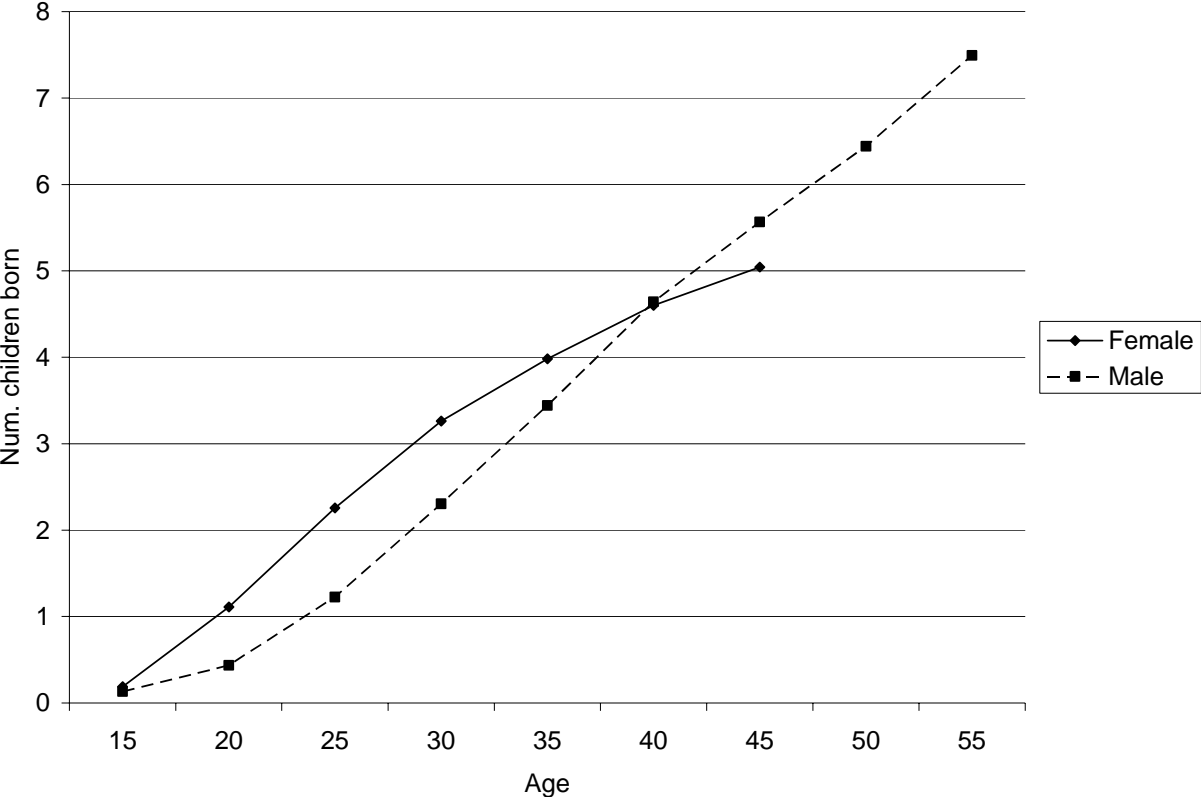
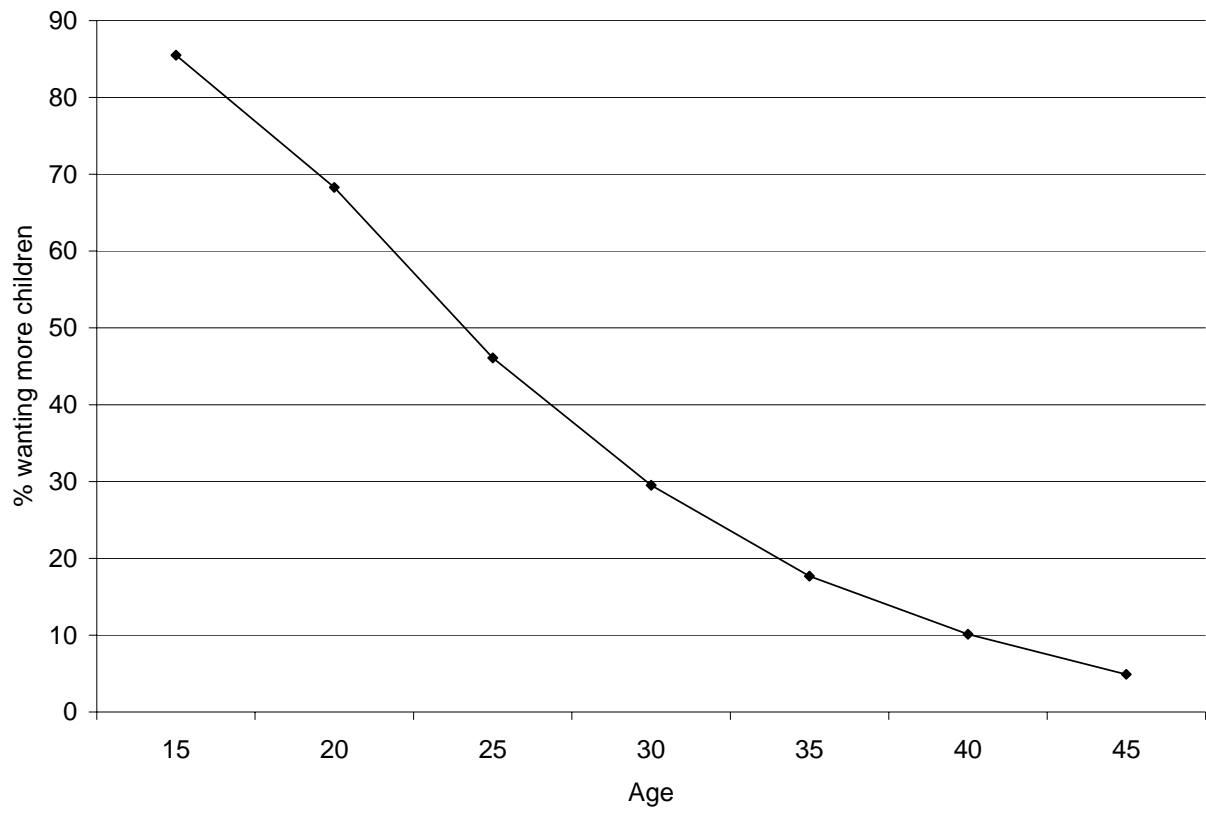


Figure 2. Percentage of women wanting more children, by age



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Figure 3. Correlations between cumulative fertility and death rate, by gender

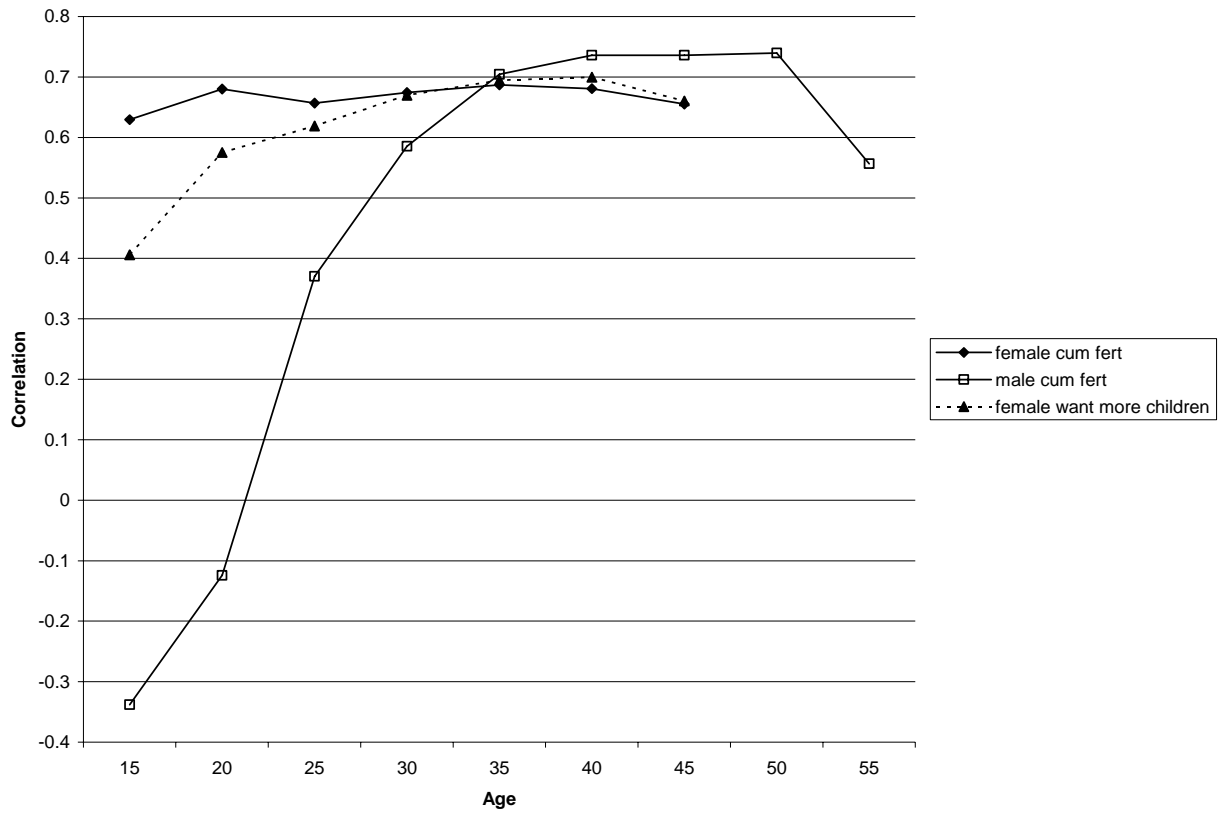
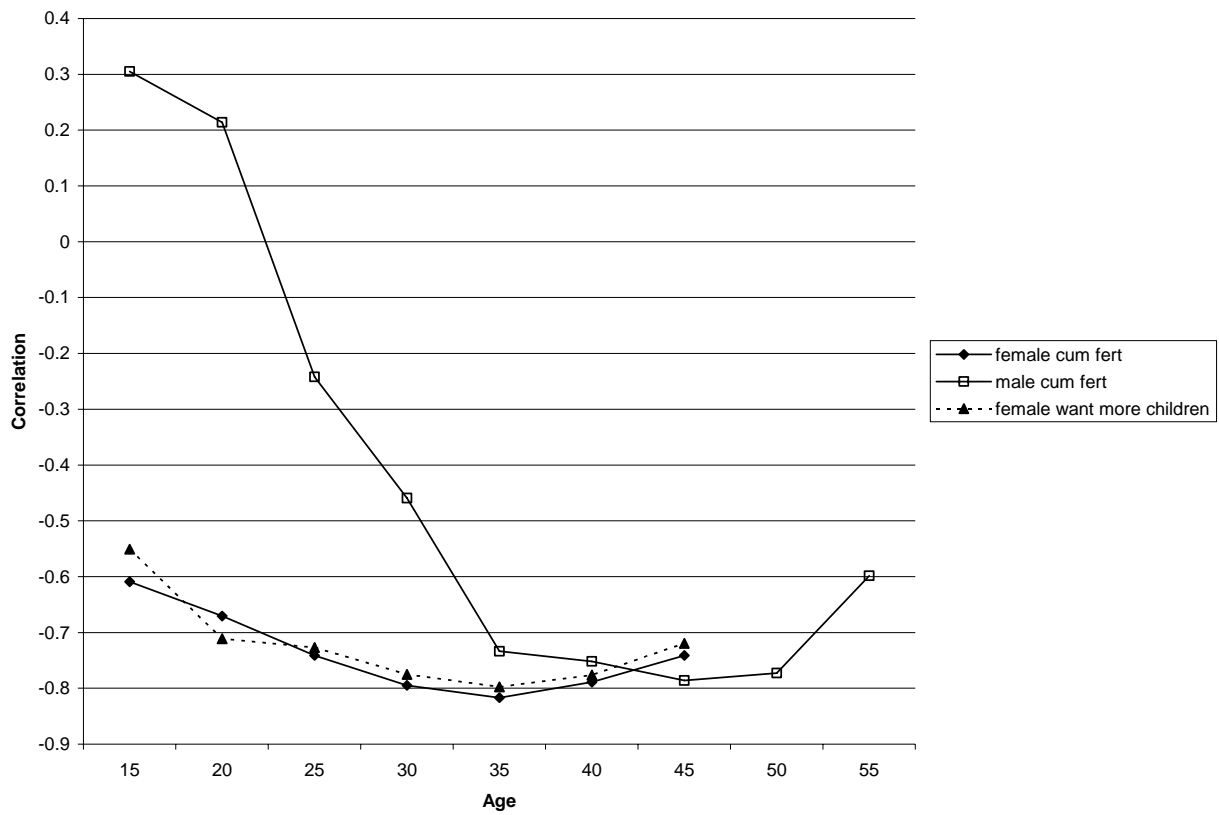


Figure 4. Correlations between cumulative fertility and life expectancy, by gender



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Table 1. Descriptive statistics for variable used in analysis

A. Dependent variables (gender-specific)	Female			Male		
	<i>Mean</i>	<i>Std. dev.</i>	<i>N</i>	<i>Mean</i>	<i>Std. dev.</i>	<i>N</i>
Age at first sex	18.345	1.742	45	19.030	1.671	31
Age at first marriage	18.262	2.088	54	24.146	1.166	33
Total fertility rate	3.341	1.177	54			
Ideal number of children	3.219	1.288	54	4.631	2.309	32
 B. Independent variables						
	<i>Mean</i>	<i>Std. dev.</i>	<i>N</i>			
Death rate	9.810	3.744	54			
Life expectancy without HIV/AIDS	63.620	5.922	54			
Per capita income (\$1998)	\$1,483.97	\$1,474.24	54			
Per capita income (logged)	6.819	1.006	54			
Sub-Saharan Africa	0.211	0.412	54			
Survey year	2001.12	2.85	54			

Table 2. Correlations between fertility measures and mortality

	Female				Male			
	<i>Death rate</i>		<i>Life expectancy</i>		<i>Death rate</i>		<i>Life expectancy</i>	
Age at first sex	-0.7919	***	0.8196	***	0.3290	+	-0.5319	**
Age at first marriage	-0.3902	**	0.5761	***	-0.0150		-0.1666	
Total fertility rate	0.8289	***	-0.8295	***				
Ideal number of children	0.7709	***	-0.8615	***	0.7562	***	-0.9349	***

+ p < .10, * p < .05, ** p < .01, *** p < .001

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Table 3. Selection coefficients from multivariate regressions of sexual behaviors predicted by mortality

Dependent variables	Female			Male		
	<i>Death rate</i>	<i>Life expectancy</i>		<i>Death rate</i>	<i>Life expectancy</i>	
Age at first sex	-0.107	0.107	*	0.081	-0.145	*
Age at first marriage	-0.307	0.344	***	-0.164	-0.003	
Total fertility rate	0.103	-0.088	**			
Ideal number of children	0.028	-0.153	***	0.100	-0.283	***
Cumulative fertility [‡]	0.065	-0.066	***	0.094	-0.046	*
Percent wanting more children [‡]	0.087	-1.286	***			

+ p < .10, * p < .05, ** p < .01, *** p < .001

Each model controls for survey year, logged per capita income, and whether the country is in sub-Saharan Africa.

‡ also controls for respondent's current age (in five year classes)