Perceived Risk of HIV/AIDS Infection and Mental Well-being in Rural Malawi

Ning Hsieh[1]
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Abstract

Previous studies have shown that people living with HIV/AIDS have worse mental health than HIV-negative people both in developed and developing contexts. However, little has been done on the HIV/AIDS epidemic and the mental health of the general population who may or may not have the disease. This is of particular importance in areas where the epidemic is extremely prevalent. In this paper, I examine the relationship between the perceived risk of HIV/AIDS infection and mental well-being among the general population in rural Malawi, a country with some of the highest HIV prevalence in Africa and the world. I examine how the relationship of interest is conditional on social support individuals have, as well as on the extent to which their community stigmatizes HIV/AIDS. By analyzing longitudinal data from Malawi Diffusion and Ideational Change Project, I find that the perceived risk of HIV infection has a negative relationship with the 12-item mental component scale (MCS-12) but not with overall life satisfaction (SWB). This relationship is neither influenced by the potential amount of social support individuals have nor by the extent to which HIV/AIDS is stigmatized in their community. Implications of these findings will be considered and discussed.

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[1] Population Studies Center, University of Pennsylvania, 3718 Locust Walk, Philadelphia PA 19104, USA. E-mail: hsiehn@sas.upenn.edu.

Introduction

Mental health has been linked to HIV infection in studies of developed as well as developing countries. People living with HIV/AIDS (PLWHA) are generally subject to higher prevalence of mental illness. In North America, it has been shown that HIV-related stigma is associated with low social support, poor mental health, and poor physical health (Logie & Gadalla, 2009). Mental conditions such as depression, anxiety, and stress disorder, and psychosocial factors related to HIV/AIDS such as experience of stigma and lack of trust in the healthcare system or government, are further linked to poorer medication adherence and risk behavior in the studies of the US and Western Europe. The psychological attributes associated with HIV infection therefore have important implications in health outcomes, quality of life, and further transmission of HIV (K. Whetten, Reif, R. Whetten, & Murphy-McMillan, 2008).

In the developing-country context where HIV prevalence is much higher, such as sub-Saharan Africa, studies also indicated that PLWHA tend to have more mental health problems than HIV-negative people in general (Brandt, 2009; Freeman, Nkomo, Kafaar, & Kelly, 2008). Although relevant studies are still limited and the body of research remains fragmented in terms of its methodology, sampling design, and targeted population, the importance of mental well-being in influencing the quality of life for PLWHA has been attracting more research attention and calling on provision of mental health services in AIDS programs in recent years (Collins, Holman, Freeman, & Patel, 2006).

In contrast to the increasing research on the mental well-being of PLWHA, little has been done on HIV/AIDS epidemic and the mental health of the general population, however.

In countries where HIV prevalence remains low, transmission tends to be restricted to specialized communities and the well-being of the majority of population is not significantly affected. It is therefore justifiable to focus more on the mental health and treatment of the HIV-positive (and their primary caregivers). But in countries where the population is seriously inflicted with HIV/AIDS, where AIDS has become a common cause of death in one's social network, and where the perceived risk of being infected is high among the general population, the concern for population mental health needs to be addressed. Policy intervention should be developed if a significant proportion of the population is chronically subject to low level of mental well-being because of events such as continuous worry about being infected, loss of family members, and pessimism about the community's future due to HIV/AIDS pandemic. In 2000, mental disorders were identified as the leading cause of disability burdens in the world as a whole. Even in Africa, where the disability burden is mainly due to communicable, maternal, perinatal, and nutritional conditions, mental and neurological disorders account for 18% of years lost due to disability (YLDs). This burden of disease is predicted to rise rapidly in the future (WHO, 2001). Since prior studies have shown that HIV/AIDS influences individual mental well-being through psychosocial pathways such as disease stigmatization and insufficient social support, it is important to understand how people living in a high-prevalence context are mentally affected. The mental consequences of HIV/AIDS may add to the burden of disease among the population.

This paper examines the relationship between the perceived risk of HIV/AIDS infection and mental well-being using data from rural Malawi, one of the Sub-Saharan African (SSA) countries with high HIV prevalence. I examine whether an individual's subjective assessment of her/his probability of being infected is related to her/his mental well-being, measured by the 12-item mental component scale (MCS-12) of the short form health survey (SF-12) and

global life satisfaction (SWB[2]). In addition, I examine how the association between the perception of infection and mental well-being is conditional on social support individuals have, as well as on the extent to which their community stigmatizes the disease.

The study makes three contributions. First, the potential impact of HIV/AIDS on the mental health of a general population within the context of HIV/AIDS epidemic is measured. I examine how individual mental well-being changes with awareness of HIV infection probabilities. This has important implications for individual-level as well as population-level quality of life in a high HIV-prevalence context. Second, in contrast to the majority of the previous research that studied HIV/AIDS and mental health using cross-sectional analyses with small samples (Brandt, 2009), I use longitudinal data containing a larger number of observations and fixed-effects approaches to deal with potential endogeneity problems. This analytical strategy allows more rigorous investigation of causal relationships. Third, the study uses two mental well-being outcome measures—MCS-12 and SWB, which are correlated but conceptually distinct. Both of them are reliable and valid indicators of well-being and quality of life[3] although they potentially capture different dimensions of well-being. Examination and comparison of their relationships to perceived risk of HIV infection shows how the disease perception influences different domains of well-being.

The study finds that the individual perceived risk of HIV infection has significant negative relationship with the 12-item mental component scale (MCS-12) but not with the overall life satisfaction (SWB).

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[2] Many studies that used a similar measure named it subjective well-being (SWB) although Diener argued that life satisfaction is only one of the three elements of subjective well-being. There will be more discussion on this in the Data & Methods section.
[3] Note that neither are diagnostic tools for mental disorders such as depression.

How could HIV perception possibly relate to mental well-being?

The importance of perception

Given actual HIV status, an individual's perception of her/his infection probability can also influence mental well-being. When access to HIV testing is limited or when people have doubts about its accuracy, individuals assess their HIV status by heuristics based on factors such as their own sexual behaviors, spouse's or partner's sexual behaviors, incomplete knowledge about the disease, and observation on the mortality in their community due to AIDS (Kohler, Behrman, & Watkins, 2007; Watkins, 2004). Because the subjective assessments are often subject to bias and overestimate the probability of being infected when the actual HIV status is negative (Anglewicz & Kohler, 2009), false concerns and worries about infection may lead to lower levels of psychological well-being. The data of *Malawi Diffusion and Ideational Change Project* (MDICP) in 2006 show that among the HIV-negative, only 68% are certain that they are not infected even though the true prevalence rate is about 7-8%. In contrast, the other 32% perceive a risk of infection, and a majority of them (around 70%) believe the likelihood is over 20%. Since HIV/AIDS is well-known for its devastating impact on personal and family life, how people perceive their risk of infection may influence their state of mind, especially when the information is limited.

Even when individuals are tested and have received their results, their perceived HIV statuses can still be inconsistent with the actual statuses. A significant proportion of HIV-positive individuals who have received their results report a low probability of being infected in MDICP. The discrepancy between the actual and perceived probabilities can be attributed to several reasons: (a) Respondents do not believe their test results. (b) They forget

the results especially when the disease is asymptomatic and they continue to stay healthy. (c) They are embarrassed to reveal the truth to the interviewers (Delavande & Kohler, 2009; Thornton, 2008). The data show that around 24% of the HIV-positives who received their test results in 2006 reported their probability of infection as 0% while another 26% reported a less than forty percent likelihood of being infected in 2008. If reality is constructed by the situation people believe or perceive they are in, it is reasonable to expect that the subjective perception of infection has equivalent or even more direct effects on individual's emotions and mental conditions than the objective testing result does.

Stigma

According to previous studies, which are mostly from the angle of western societies, the perceived risk of infection is potentially connected with poorer mental conditions in part because HIV/AIDS is a stigmatized disease. The disease is associated with deviant and immoral behavior such as infidelity, promiscuity and drug abuse, which is an individual's responsibility. It is contagious, threatening to the community, leads to an undesirable form of death, and not well understood, especially by those with limited health care resources (Alonzo & Reynolds, 1995; Herek, Capitanio, & Widaman, 2003). Internalization of stigmas is significantly related to depression, anxiety, and hopelessness for people living with HIV/AIDS (Lee, Kochman, & Sikkema, 2002; Simbayi et al., 2007). For those who are uncertain of their HIV status, perceiving oneself as being at risk is about living with the fear of moving into the real stigmatized category—being tested positive. The fear of loss of personhood and normal life, and the fear of rejection or abandonment by one's social networks in the future are able to "pre-realize" the stigma effect of HIV/AIDS on the psychological well-being (Alonzo & Reynolds, 1995).

However, this story of stigmatization might not be true in the Malawian context. In rural Malawi, although local religious leaders frequently discuss HIV-related issues, abstinence, and fidelity in the congregation, and although in some instances adultery/promiscuity is blamed for putting one's faithful spouse in the risk of HIV infection and one's children in the risk of being orphaned, the stigmatization of PLWHA is rare. In the pandemic of the disease, it is also recognized that there are many innocents (i.e. faithful spouses and children) infected with HIV in addition to adulterers, and that the disease is not a simple indicator of sexual sin. (Trinitapoli, 2006). In addition, according to MDICP-4 in 2006, the majority of the respondents agreed that most people in their villages are comfortable around someone with HIV/AIDS (83%), that a female teacher living with HIV/AIDS should be allowed to continue teaching in the school (93%), and that they would buy fresh vegetables from a vendor with HIV/AIDS (92%). Almost 98% of the respondents disagreed to expel people living with HIV/AIDS from their church/mosque. Even though more than half of the respondents (53%) agreed that people in their community feel those who got HIV from adultery deserve it, there seems to be no strong signs of stigmatizing or discriminating people with the disease. Therefore, the influence of stigma on mental well-being might be limited in the Malawian context.

Social support

Empirical studies show that social support, such as material aid and the availability of others to discuss personal issues and to bolster one's sense of self-worth, helps PLWHA cope with the disease and improves their psychological well-being. It is a buffer to stress-related crises such as depression. (Lee et al., 2002; Lia, Leea, Thammawijayab, Jiraphongsab, & Rotheram-Borusa, 2009; McDowell & Serovich, 2007). Although there is no empirical study of populations including the HIV-negative who perceive themselves as probable to be

infected, a similar logic could be applied—social support may help individuals overcome the psychological struggle over the threat of HIV/AIDS, such as relieving the fear/worries of potential infection and loss of normal life (e.g. being financially dependent and unable to raise one's children) and providing information of AIDS prevention. Stronger social support from one's network and wider community is expected to ameliorate the negative mental impact of perceived risk of HIV infection. That said, the perceived risk would have weaker psychological ramifications when social bonds are more secured through external support. But social support may not affect the general population as strongly as PLWHA since the latter have HIV/AIDS and could be more emotionally vulnerable.

Data and Methods

Data

The data are from the fourth and fifth waves of *Malawi Diffusion and Ideational Change Project* (MDICP-4 and MDICP-5), which were collected in 2006 and 2008 respectively. MDICP is a panel survey project conducted in three distinctive districts of rural Malawi: Rumphi (Northern region), Mchinji (Central region), and Balaka (Southern region). The first wave was in 1998, sampling 1,541 ever-married women aged 15-49 and 1,061 spouses. The second wave in 2001 re-interviewed the original respondents and included their new spouses if they were remarried between 1998 and 2001. The third wave in 2004 recruited 1,500 adolescents aged 15-25, in addition to the original sample and their new spouses. In 2006, all respondents from previous waves in 1998, 2001 and 2004 were included in the sample, along with all spouses of 2004 adolescents, and any new spouses to respondents in the original sample. In 2008, approximately 800 parents of the respondents in 2006 were included, and as

with previous waves, all previous respondents and new spouses were also included in the study.

The sampling design of MDICP is not representative of the national population of rural Malawi, but the sample characteristics closely match those of the rural population of the Malawi Demographic and Health Survey (DHS). The response rate (measured by the percentage of respondents who were successfully interviewed) in all waves is above 65%, with 68% in 2006 and 67% in 2008. The attrition rate (measured by the percentage of respondents who were successfully interviewed in the previous wave but not interviewed in the current wave) is around 24% between 2006 and 2008. The major reason for attrition is migration.

MDICP is one of the few panel studies on HIV/AIDS attitudes, sexual behaviors, and disease risk management in the SSA context that also include data of mental well-being and quality of life. The dataset is especially suitable to study the association between HIV risk perception and mental health because it provides rich information of sexual behaviors, marital behaviors, and other demographic, socioeconomic, and health conditions, which are all related to the association of interest. In addition, its longitudinal feature and decent size of sample give more advantages to this study compared to other datasets. Since research on HIV/AIDS and mental health in the SSA context is still new and few, and to the best of my knowledge there is no relevant study in Malawi, the findings of this study are therefore valuable not only for Malawi itself but also for cross-national comparison in the future.

Attrition

Since the sample attrition between MDICP-4 (2006) and MDICP-5 (2008) is not low, it

is possible that the analytical results will be biased by the attrition effect. That is, the estimated relationship between the variables of interest—the perceived probability of infection and mental well-being—may be stronger or weaker among people who were not re-interviewed in 2008. Table 1 compares the descriptive statistics of some relevant variables to this study between the re-interviewed and the non-reinterviewed. It shows that the non-reinterviewed individuals tend to be younger, more likely to be male, unmarried, and to reside in the central region, have worse health, a higher rate of HIV infection, and a higher perceived probability of being infected, and be more likely to stay outside the village for more than one month in the past twelve months. On the other hand, the number of lifetime sex partners and sex partners in the past twelve months, economic conditions (measured by the percentage of owning assets such as bed with mattress, TV, bike, pit latrine, and metal roof), mental well-being (measured by MCS-12 and SWB), and the number of living children are not significantly different by the status of being re-interviewed or not.

[Table 1 about here.]

Although the difference in characteristics by attrition status is not substantial in magnitude except for age, gender, marital status, and the rate of being HIV-infected, there is concern that attrition may still bias the coefficient estimates in the regression models. Therefore, I ran a preliminary regression of mental well-being on a list of variables that are theoretically relevant using the data from MDICP-4. The regression was conducted separately for the re-interviewed and the non-reinterviewed sample in order to compare the coefficient estimates by attrition status. The results show that there might be differences in the coefficient estimates of some of the variables when MCS-12 is used as the mental well-being measure (Table 2), and the joint test (Chow test) on the hypothesis that the coefficients are

equal by the attrition status is rejected at 10% significance level. However, there is no significant difference when SWB is used as the well-being measure (Table 3). I use weighted least squares for the fixed-effects analysis of MCS-12 to correct the coefficient estimates which may be biased by sample attrition (Fitzgerald, Gottschalk, & Moffitt, 1998)[4].

[Table 2 & 3 about here.]

Analytical sample

I restricted my analyses to the currently married or cohabiting women and men in 2006 and 2008 because this population is of interest in a study of HIV and mental status for several reasons. First, married individuals are at a higher risk of contracting HIV and are more worried about becoming infected. Factors such as extramarital relationships, higher frequency of sexual intercourse, and unprotected sex within marriage raise the infection risk for the married (Anglewicz & Kohler, 2009; Gray et al., 2001; Tawfik & Watkins, 2007). Second, there is a consensus from studies in developed countries that people are mentally better-off when in a stable union (Argyle, 1999; Blanchflower & Andrew, 2004; Frey & Stutzer, 2001; Stutzer & Frey, 2006; Waite & Lehrer, 2003; Zimmermann & Easterlin, 2006). Although there have been no comparable studies in Africa to reach a similar conclusion, this paper at this stage still distinguishes the married from the non-married when studying the mental responses to the AIDS threat. Lastly, since those who were married/cohabited in both years account for more than 85% of the overall sample due to the high marriage and remarriage rates in Malawi, I do not have sufficient number of observations on the

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[4] Weight= Prob (attrition | X)/ Prob (attrition | X, Z). X= subset of personal characteristics that are also used in the mental well-being equation. Z is a set of auxiliary variables which help predict the probability of attrition. Z includes HIV status, whether stayed outside the district for more than one month in the past 12 months, whether spouse usually stays in the village, how comfortable the respondent was when being asked about sexual partners, number of children, and whether being a village committee member. The missing values in these Z-variables are replaced by the mean of the sample.

non-married or non-cohabited people to make a powerful comparison. Therefore, the analytical results may only be generalized to the married/cohabited population. In order to examine the effect of perception, independent of the true HIV status, on psychological well-being, the analyses are also restricted to individuals whose HIV status did not change between the two waves of survey. Although I attempted to examine how change in true HIV status is associated with fluctuations in well-being, the number of people whose status changed over time between MDICP-4 and -5 is so small that it is impossible to analyze statistically. The final sample size for the fixed-effects models is 981 women and 756 men[5].

Methods

I use the fixed-effects model to control for unobserved heterogeneity across individuals. The fixed-effects approach deals with problems arising from omitted variables that do not change over time as well as endogeneity between the dependent variable and its predictors. This strategy allows me to evaluate the causal relationships between the dependent and independent variables of interest more rigorously. I analyze whether change in the perceived probability of getting infected affects change in the level of mental well-being when factors that are also theoretically and empirically relevant to mental well-being, such as physical health, wealth, and other unobserved time-invariant variables are controlled. Finally, the results of panel analyses using fixed-effects are compared with those of cross-sectional analyses to evaluate the bias from unobserved heterogeneity.

To explore whether the amount of social support and the stigma of HIV/AIDS influence the relationship between the perceived probability of infection and mental well-being, these two elements and their interaction with HIV perception will be added to the models following

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[5] For SWB, however, the coefficient estimates are identified based on discordant observations over time, which include only 260 women and 158 men.

the baseline specification. Because the stigma measure is only available in the 2006 data, it will enter the equations just through the interaction with HIV perception. Since economic resources, social status, marriage, sexual norms and social control differ by gender in Malawi (Bingenheimer, 2010; Porter et al., 2004; Reniers, 2008; Tawfik & Watkins, 2007), women and men may respond to and cope with their perceived risk of infection differently. Therefore, the analyses will compare women and men. The fixed-effects model is:

$$Y_{it} = \beta_1 \cdot perception_{it} + \beta_2 \cdot social\ support_{it} + \beta_4(perception_{it} \times social\ support_{it})$$
$$+ \beta_5(perception_{it} \times stigma_i) + \beta_3 X_{it} + f_i + \varepsilon_{it}$$

where Y_{it} is the mental well-being measure, either MCS-12 or SWB, by individual i at time t. X_{it} a vector of individual time-varying characteristics such as health, wealth, and sexual and marital behaviors. f_i is a vector of unobserved fixed factors that determine mental well-being. ε_{it} is a random, normally or logistically distributed, disturbance term that affects well-being by individual i at time t.

Variables[6]

Dependent variables

The 12-item Mental Component Scale (MCS-12) is a mental health summary measure calculated from the SF-12[7] health survey. It emphasizes four dimensions of mental well-being—vitality, social functioning, role limitation due to emotional problems, and

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[6] For descriptive statistics, see Appendix A.
[7] The survey is adapted to the context of Malawi. Therefore, one of the twelve questions was changed from "Does your health now limit you in climbing several flights? If so, how much?" to "Do you have any health problems that limit you in carrying out strenuous activities? (For example, carrying heavy loads, working on the farm, pounding maize, or digging a pit latrine.) If so, how much?"

mental health status—and also includes another four concepts of physical well-being—physical functioning, role limitation due to physical problems, bodily pain, and general health (Gandek et al., 1998; Ware Jr, Kosinski, & Keller, 1996). There are six questions directly related to mental well-being in SF-12. One of them is to measure vitality: "how much of the time during the past 4 weeks did you have a lot of energy". One is to measure social functioning: "during the past 4 weeks, how much of the time has your physical health or emotional problems interfered with your social activities like visiting with friends, relatives, etc". Two are related to role limitation due to emotional problems: "during the past 4 weeks, (1) have you accomplished less than you would like and (2) did you do your work or other activities less carefully than usual, as a result of any emotional problems such as feeling depressed or anxious". The other two have to do with mental health status: "how much of the time during the past 4 weeks have you (1) felt calm and peaceful and (2) felt downhearted and depressed". The score of MCS-12 is calculated following the scoring algorithm provided by (Ware Jr et al., 1996). The lower the resulting summary score, the lower the mental well-being. It has been widely used and proved to be psychometrically robust across different countries and populations (Adams, Boscarino, & Galea, 2006; Caperchione, Lauder, Kolt, Duncan, & Mummery, 2008; Gandek et al., 1998; C. Jenkinson et al., 1997; Kudielka et al., 2005; Trivedi, Ayotte, Edelman, & Bosworth, 2008).

The distributions and trends in MCS-12 are presented in Figure 1. The kernel distribution of MCS-12 scores slightly shifts leftward between 2006 and 2008 for both women and men, which indicates to worsening mental health for the sample. The mean scores decreased by 1.48 for women and by 0.30 for men from 2006 than 2008. In both years, women have lower scores than men do generally. The decrease in MCS-12 can be further visualized in the distribution of change in MCS-12 over time (Figure 2). The hump on the

left-hand side of the distribution demonstrates the deterioration of mental health. The lower degree of deterioration for men is shown by a more highly-concentrated distribution around zero.

[Figure 1 about here]

[Figure 2 about here]

Life satisfaction (SWB) is a one-item subjective assessment of overall well-being or quality of life. Although subjective well-being measures three aspects--life satisfaction, positive affect, and lack of negative affect[8], many studies only used a single aspect such as life satisfaction and happiness to measure it (E. Diener, 1994; E. Diener et al., 2003; E. Diener & Suh, 1997). In this study, I also use life satisfaction as a proxy for subjective well-being due to data availability, but it should be noted that life satisfaction by itself is not a complete measure for global well-being. It is more of a cognitive judgment of one's life and less of a reflection of one's emotional/affective status (Andrews & Withey, 1976; Ed Diener, 2009). The question I use to measure life satisfaction in this study is standard: "I am interested in your general level of well-being or satisfaction with life. How satisfied are you with your life, all things considered—very satisfied, somewhat satisfied, satisfied, somewhat unsatisfied, or very unsatisfied." For simplicity, in the regression analysis I convert this five-categorical measure into a binary variable by combining the first two categories and the latter three categories into one category, respectively[9]. SWB is a widely used indicator of

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[8] Affect refers to moods and emotions, such as pleasantness as positive affect and depressed as negative affect. The three components of subjective well-being are inter-correlated but still remain some degree of independence (E. Diener, Oishi, & Lucas, 2003; Lucas, E. Diener, & Suh, 1996).
[9] There is no direct estimation procedure for fixed-effects ordered logistic models in statistical packages. To get around this technical problem, Allison (2009) suggests using a hybrid model by creating a mean variable over time and a deviant-from-mean variable in each point in time for every time-variant independent variable. All the mean and deviance variables enter the right-hand-side of the equation with a set of time variables and other time-invariant controls. The estimation results of this study based on the "hybrid" model do not show major difference from those based on the fixed-effects binary logistic model. Therefore, I will just present the latter for

well-being or quality of life in many surveys such as World Values Survey across 81 countries and General Social Survey in the US (Kahneman & Krueger, 2006).

The distribution of SWB, unlike that of MCS-12, shows a general trend of improvement in well-being over time for both genders (Figure 3). For women, the most dramatic change is at the decrease in the percentage of the "satisfied" and the increase in the percentage of the "somewhat satisfied." For men, although the somewhat/very unsatisfied slightly increased overtime, there is a more significant rise in the percentage of the "very satisfied." The different trend between MCS-12 and SWB could be attributed to the fact that MCS-12 captures more of the emotional/affective dimensions of mental well-being such as vitality, social difficulty and role limitation due to emotional problems, and mental status including feeling of peace and depression, while SWB captures the cognitive judgement of well-being—life satisfaction. Their concepts are correlated but different. The data used in this study show that their correlation is 0.24 in 2006 and 0.22 in 2008.

[Figure 3 about here]

Independent variables:

The perceived probability of HIV infection is measured by the likelihood respondents think they are currently infected with HIV. Respondents were given 10 beans and asked to pick a number of beans to reflect the likelihood of infection. One bean represents one chance out of 10. Zero beans reflect certainty that no infection occurred, and ten beans reflect certainty that infection occurred. The answer to the question can be interpreted as a subjective probability. This innovative measurement has been demonstrated as valid in rural Malawi

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simplicity.

where levels of literacy and numeracy are low (Delavande & Kohler, 2009). Figure 4 presents the distribution of the perceived probability of infection across time and by gender. For both women and men, the proportion of people who think they have no chance of being infected dramatically dropped between 2006 and 2008. Women's mean perceived risk increased from 1.20 to 1.87 and men's from 0.71 to 1.42 (# beans out of 10). This trend is also demonstrated in Figure 5, which shows the asymmetric shape of the distribution of change in perceived risk. In general, women have higher perceived risk than men in both years.

[Figure 4 about here]

[Figure 5 about here]

Social support is a constructed index integrating the frequency of religious participation, attendance to drama performances, funerals, and weddings, and political participation[10]. Religious participation includes two measures--when the last time respondents went to church or mosque (in the last week, last month, last 2-6 months, or more than 6 months or never) and the number of other religious activities attended in the last month (e.g. Bible/Koran study, visiting the sick, choir, and evangelical work). Church or mosque is a venue for people to meet, socialize, and/or obtain emotional as well as material support. Although it is also an institution exerting social control with its standards of morality (especially sexual mores in the era of HIV/AIDS prevalence), adultery and promiscuity are not seen as deviant in general though are discouraged by religious leaders. Therefore, religious participation could be more of a source for social support than social control in the eyes of individuals with increased perceived risk of HIV infection. The frequencies of

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[10] The index is constructed by principal component analysis (PCA) to combine seven variables associated with social support. The higher the index, the stronger the support. The Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy for the seven variables in PCA is close to 0.6. KMO takes values between 0 and 1, with higher values indicating that overall the variables have a lot in common to warrant a PCA analysis.

attendance to drama performances, funerals, and weddings are the number of times been to those social scenes in the past month or year. Lastly, political participation includes two aspects--number of times attending political meetings in the past year and whether or not being a member of a village committee (e.g. health committee, AIDS committee, and farmer's group). In hypothesis, I expect that higher social support would buffer the negative impact of the perceived risk of infection on mental well-being.

Though the degree of HIV/AIDS stigmatization in the community may contribute to the negative relationship between HIV perception and mental well-being, in rural Malawi where the disease is rarely stigmatized, the effect of stigma may not be as strong as studies in other societies stated. The level of stigmatization is a binary variable. One indicates the respondents agree with both of the following statements (which represents a higher level of stigmatization): "people in your village feel that those who got AIDS through sex have gotten what they deserve" and "religious leaders in your community feel that those who got AIDS through sex have gotten what they deserve". Since the stigma-related questions are only available in the 2006 survey, I measure the effect of HIV/AIDS stigma using its interaction with the perceived risk of HIV infection in the fixed-effects model, assuming the level of stigmatization in the community did not change between 2006 and 2008.

Other control variables include physical health, respondents' and their spouse's sexual behavior, respondents' perception of how their social network is affected by HIV/AIDS, and household wealth. These variables are either related to HIV perception or mental well-being or both. Specifically, physical health is measured by the SF-12 Physical Component Scale (PCS-12), which is calculated following a similar scoring algorithm as used for MCS-12. PCS-12 controls for negative effects of poorer physical conditions on mental well-being

(Alonzo & Reynolds, 1995; Blanchflower & Oswald, 2004; Easterlin, 2003; Kahneman, Krueger, Schkade, Schwarz, & Stone, 2004). Since sexual behaviors affect how individuals assess their HIV-infection probabilities (Anglewicz & Kohler, 2009; Watkins, 2004) as well as psychological well-being (Blanchflower & Oswald, 2004; Kahneman et al., 2004; Laumann, Gagnon, Michael, & Michaels, 2000), I control for the number of respondents' sex partners in the past 12 months and whether respondents suspect or know their spouse had more than one sex partner in the past 12 months. Also, the perception of the HIV/AIDS situation in one's social network may affect both the perceived risk of infection and mental well-being. This control variable is represented by respondents' answers to the following question: "overall, how many people known to you do you suspect have died from AIDS in the past 12 months". Lastly, the household wealth is measured by whether the respondent's household owns various kinds of assets[11] and the perceived likelihood of relying on financial assistance from family members in the next 12 months[12].

Results

12-item Mental Component Scale (MCS-12)

The fixed-effects linear models show that the perceived probability of HIV infection is negatively related to mental well-being measured by MCS-12 for both women and men (Table 4.1 for women & Table 4.2 for men). For women, the baseline model (Model 1) reports that for every 10% increase in the perceived probability (represented by every one more bean), the score of MCS-12 drops by around 0.56 points. For men, every 10% increase

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[11] These includes pit latrine, mosquito net, radio, bike, glass lamp, table and chairs, bed with mattress, metal roof, sofa set, oxcart, sanplat latrine, cell phone, television, motorcycle, electricity, cows, goats, and poultry.
[12] The wealth index, as the social support index, is calculated using principal component analysis (PCA). It combines 18 asset-ownership indicators and 1 indicator of expected financial situation. The Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy is between 0.83 and 0.85.

in the perceived probability is associated with decrease in MCS-12 by 0.68 points (Model 5). Though this marginal effect seems stronger for men, the 95% confidence interval does not show significant difference by gender[13].

Following the baseline models, I include the social support index into the regression (Model 2 for women & Model 6 for men). Taking the variables into consideration, however, does not change the effect of HIV perception on MCS-12. The marginal effects of the perceived probability are still very close to the baseline results for both women and men. Also, the social support index is positively correlated with mental well-being though the coefficient is not significant.

To further explore whether there is a buffering effect from social support, that is, whether the support can ameliorate the negative impact of HIV perception on mental well-being, I include the interaction between social support and HIV perception. If the coefficient of the interaction term is significantly positive, then there might exist a buffering effect. Models 3 and 7 present the results of the interaction for women and men, respectively. For both women and men, however, social support that is represented by religious participation, attendance to social events, and political involvement does not seem to help alleviate the negative effect of HIV perception on mental well-being. A higher frequency of social activities may not provide enough emotional relief as individuals are worried, depressed, or anxious about being infected with the disease.

To look at whether the relationship between the perceived probability of infection and mental well-being conditions on the degree of stigmatization in the respondent's community,

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[13] Women's 95% CI= (-0.878, -0.185). Men' 95% CI= (-1.014, -0.227).

I introduce the interaction between HIV perception and the level of stigmatization (a dummy variable) into Models 4 and 8 for women and men, respectively. A negative coefficient of this interaction term would demonstrate that living in a context with HIV/AIDS being more stigmatized may lead to a stronger negative association between HIV perception and mental well-being. However, the results show that for both genders, the community level of disease stigmatization does not significantly change the association between the perceived risk of infection and mental well-being. That said, individuals who live in a community with higher stigmatization of HIV/AIDS do not psychologically suffer more than those who live in a lower-stigmatization context, given they perceive the same risk of infection. This result corresponds to previous studies in Malawi which showed that stigmatization of and discrimination against PLWHA are rare in this generalized epidemic. As a result, the negative relationship between perceived risk of infection and mental well-being is probably not mediated through HIV/AIDS stigmatization.

[Table 4.1 & 4.2 about here]

Subjective well-being (SWB)

There is no significant relationship between HIV perception and SWB been found in all of the models (Table 5.1 for women & Table 5.2 for men). This means that how individuals perceive their probability of being infected with HIV is not related to their assessment of life satisfaction. The interaction terms between HIV perception and social support as well as HIV perception and the degree of stigmatization are generally not significant either. Since the models of SWB are identified with a relatively small sample size, the coefficient estimates tend to have higher standard errors and be less robust. As a result, the interpretation of the results requires more caution.

[Table 5.1 & 5.2 about here]

Discussion

In summary, I found that individual perceived risk of being infected with HIV has strong negative relationship with 12-item mental component score (MCS-12), but it has no significant relationship with life satisfaction (SWB). There are several explanations for this disparity. First, MCS-12 and SWB are two instruments measuring different domains of well-being and quality of life. MCS-12 focuses on four dimensions of mental well-being—

vitality, social functioning, role limitation due to emotional problems, and mental health status, while SWB is a more global assessment of one's life condition. Although they are moderately correlated (with correlation coefficient less than 0.25 in MDICP-4 and -5), MCS-12 tends to reflect more of an individual's emotional and affective component of well-being, whereas SWB tends to capture the cognitive component of well-being since it does not include the assessment of positive affect and negative affect. As a result, the responses of these two measures to one's perception of HIV infection can be different. The results of this study show that HIV perception has a significant influence on emotional/affective well-being. However, it may not significantly change how individuals judge their level of satisfaction with life. In sum, the different results derived from the analyses using these two instruments are likely the result of differences in the contents of measurement. Another reason for the differential results is that SWB is a categorical variable, in the longitudinal analyses it is more difficult to capture more subtle changes in well-being over time. The fixed-effects model only considers within-person variation, and there is not enough this kind of variation in my sample. The number of individuals who shift from

"satisfied" to "unsatisfied" or the reverse over time is only 260 for women and 158 for men. Therefore, the estimation of the SWB equation could be less precise and needs to be interpreted with some caution.[14] Furthermore, single-item measures tend to be less reliable over time than multi-item measures. SWB, measured by a single item, is likely to be subject to a higher probability of measurement error that cannot be averaged out (Ed Diener, 2009).

Regarding whether social support functions serves as a buffer between the perceived risk of HIV infection and mental well-being, the results are negative. Participation in more activities in several social settings does not help ameliorate the negative relationship between HIV perception and mental well-being, either measured by MCS-12 or SWB. This is inconsistent with earlier findings regarding social support and mental health of PLWHA (Johnson et al., 2001; Lia et al., 2009; McDowell & Serovich, 2007; Serovich, Kimberly, Mosack, & Lewis, 2001; Silver, Bauman, Camacho, & Hudis, 2003). It implies that the potential social support from contacts in the social settings such as church/mosque, weddings, performance venues, funerals, and political/community meetings may not provide extra emotional relief from fear, worries, and anxiety about infection. The lack of evidence for buffering effects may also show that the general population is not as vulnerable as PLWHA, either physically, emotionally, and economically. Therefore, the availability of social support is relatively less crucial and imperative for the general population than for PLWHA, who have been proved to benefit from social support. On the other hand, this insignificant result might also be attributed to the fact that the variable is a rather crude proxy for social support. It is unable to measure the quality as well as content of social interaction in those activities. For example, it is impossible to know whether an individual can get any HIV/AIDS-specific

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[14] I also tried another binary variable for subjective well-being, which codes one as life satisfaction increased and negative one as it decreased between 2006 and 2006 based on the original five-categories subjective well-being measure. Although the sample size is twice larger, the results still show that there is no significant relationship between HIV perception and SWB.

resources, either informational, emotional, or material support from the social settings. Also, having more contacts with people in the public sphere may not mean one can get necessary support for private matters as s/he needs it, especially when facing the threat of HIV/AIDS. These limitations may partially explain why the index of social support only provides little buffering effect for both women and men in rural Malawi. To further confirm the influence of social support in this context requires more sophisticated indicators, such as having someone to share emotions when feeling depressed, worried, or anxious and having someone to discuss private issues.

The study also finds that the HIV-stigmatization level in the respondent's community does not affect the strength of association between the perceived risk of infection and mental well-being. Unlike previous studies which found that internalization of stigmas is significantly related to depression, anxiety, and hopelessness for PLWHA in developed societies (Lee et al., 2002; Simbayi et al., 2007; Stutterheim et al., 2009), there is little evidence to show the mental ramifications of the internalization of stigma among the general population in rural Malawi, where the level of stigmatization is likely to be low.

A major methodological advantage of this study is the estimation of fixed-effects models which control for the endogeneity and causal ambiguity in the cross-sectional models used in previous research. The fixed-effects estimates are indeed different from the cross-sectional estimates both in 2006 and 2008[15]. Table 6 compares the coefficient estimates of these two strategies using the marginal effects of HIV perception on MCS-12 as an example. It shows that for women the cross-sectional estimates in both years tend to be lower than their fixed-effects counterparts. For men, the cross-sectional estimates in 2006 are higher while

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[15] The complete cross-sectional results will be provided upon request.

those in 2008 are lower than the fixed-effects estimates. Since cross-sectional analyses do not control for unobserved time-invariant heterogeneity such as personality and community characteristics, they are more likely to suffer from estimation bias. This study shows that the cross-sectional models may either underestimate or overestimate the association between HIV perception and mental well-being.

[Table 6 about here]

Furthermore, it should be noted that the attrition-adjusted estimates using weighted regression in the MCS-12 equation are in fact quite close to the unadjusted estimates for both genders (not shown). Therefore, the potential attrition bias due to sample selection based on observables should not be a major concern. This is consistent with several earlier findings, which concluded that sample attrition in longitudinal surveys does not distort the estimates in a significant way (Alderman, Behrman, Kohler, Maluccio, & Watkins, 2001; Falaris, 2003; Fitzgerald et al., 1998).

Conclusion

Although there has been research of the mental health of PLWHA, there is still little understanding of the mental health and well-being of general populations living with an HIV-epidemic. The wide prevalence of HIV/AIDS changes individuals' perceptions and levels of worries about being infected, their social networks (due to sick and deceased friends and family members), and their expectations about the future, which are all potentially associated with their mental health, well-being, and/or quality of life. At the same time,

different cultural contexts can provide various customs, strategies, and attitudes to cope with the changes brought by the epidemic, given their different sexual and marital practices, sexual and gender norms, family relationships and social support, knowledge and attitudes toward HIV/AIDS, and so on. This study examines the relationships between mental well-being, perceived risk of infection, social support, and HIV stigmatization of the general population in rural Malawi. Future studies will benefit the understanding of this subject through examining other indicators of mental well-being and quality of life, given that each indicator has its own strengths and weaknesses in measuring various aspects of well-being. This will also help pinpoint the specific domains of life that are affected by the perceived risk of HIV infection. Moreover, future studies need more direct and sophisticated measures for social support to confirm whether social support and which channels of social support can/cannot significantly alleviate the psychological burdens of risk perception for people living with an HIV epidemic.
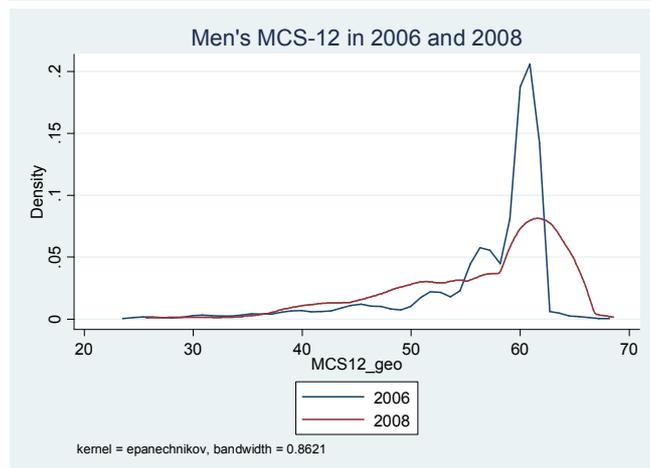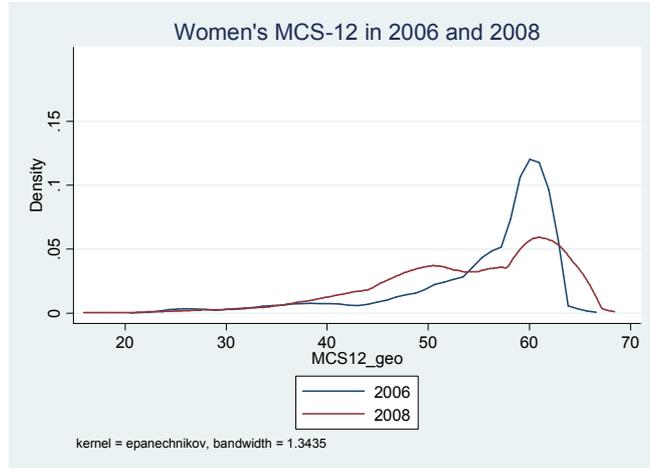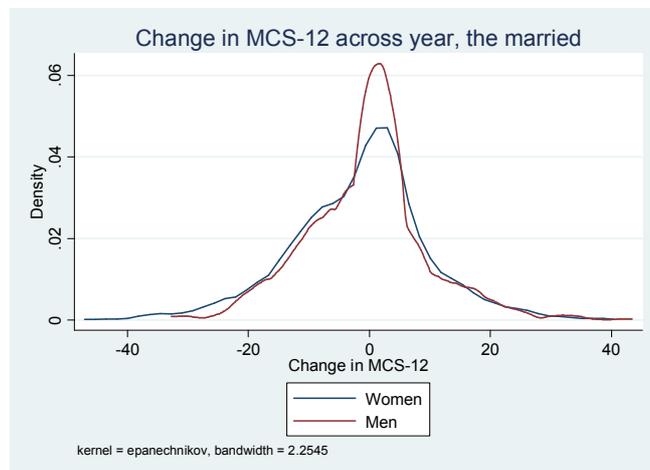
Figure 1

Figure 2

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Women's SWB, %

Men's SWB, %
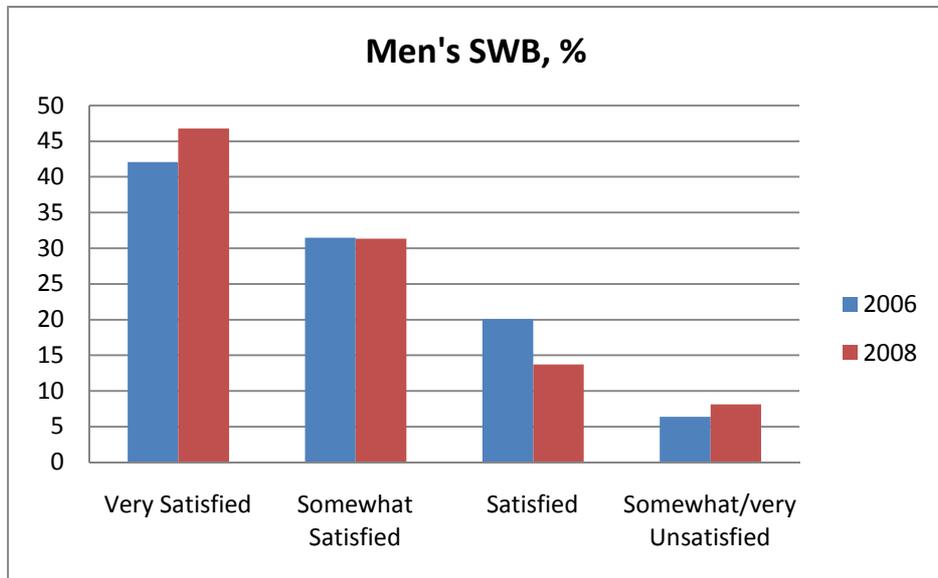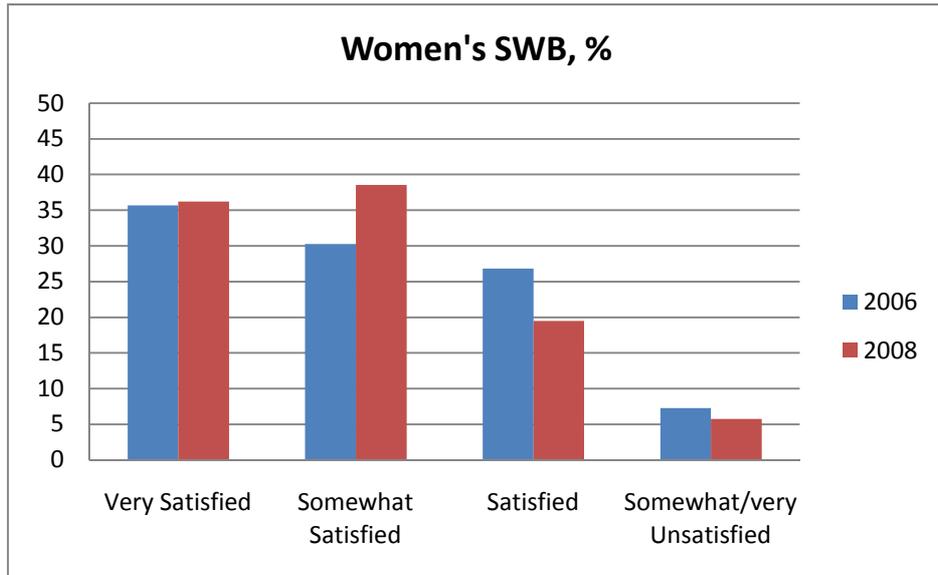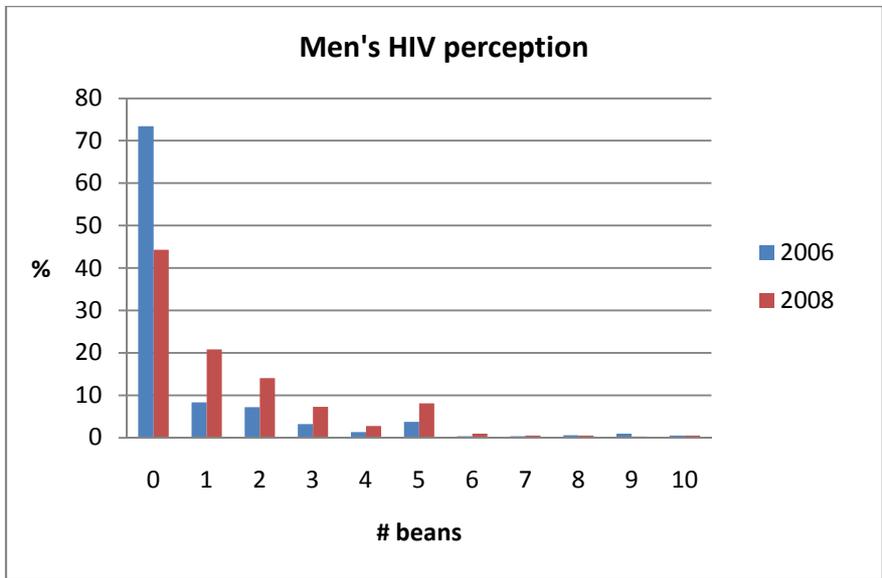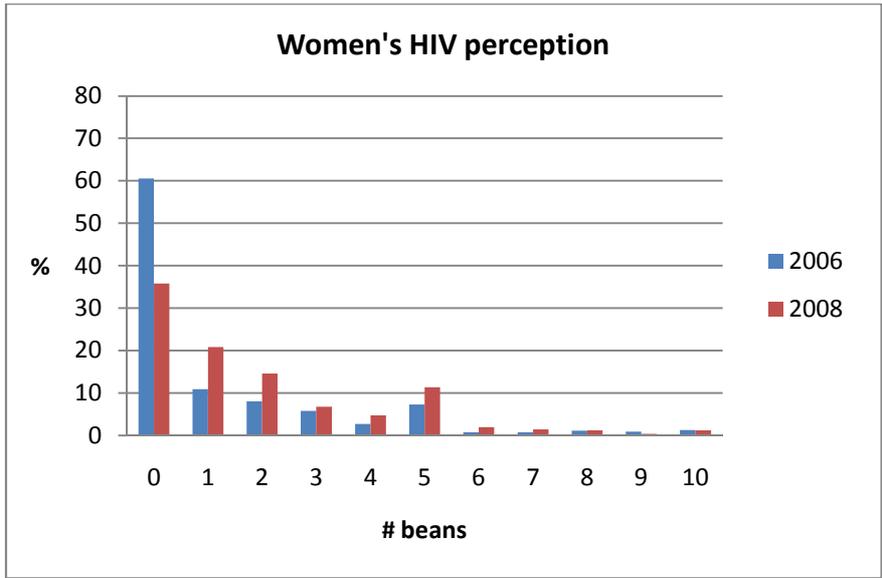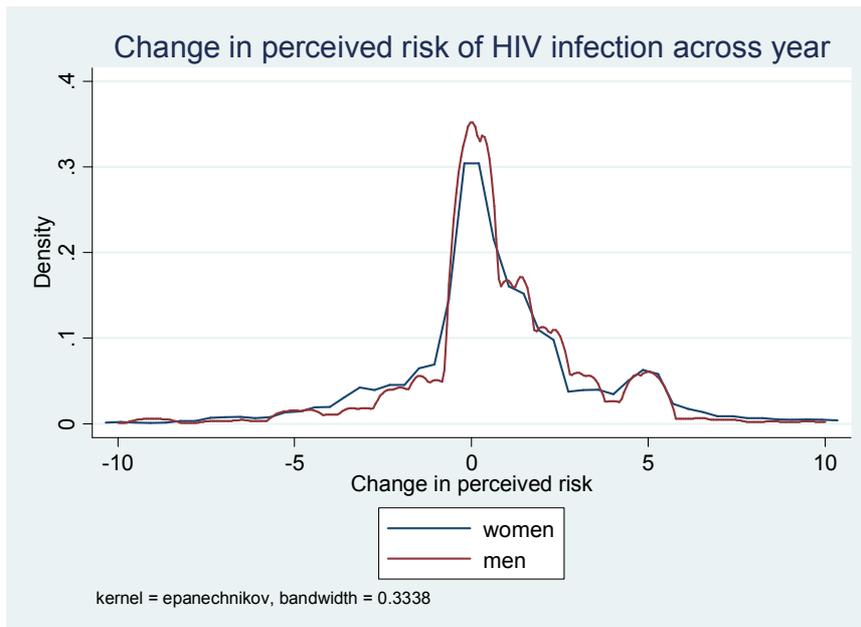
Figure 3

Figure 4

Figure 5

Table 1: Summary statistics by attrition status

Variable	Reinterviewed			Not Reinterviewed			Difference	
	N	Mean	S.D.	N	Mean	S.D.	Difference	P-value
Age	1970	36.02	15.23	478	34.04	16.58	1.97	0.013
Sex	2169	0.40	0.49	576	0.49	0.50	-0.09	0.000
Marital status								
Married	2169	0.92	0.27	576	0.89	0.32	0.03	0.019
Never married	2169	0.00	0.04	576	0.00	0.04	0.00	0.844
Separated	2169	0.01	0.10	576	0.03	0.17	-0.02	0.000
Divorced	2169	0.03	0.18	576	0.04	0.19	0.00	0.827
Widowed	2169	0.03	0.17	576	0.03	0.18	0.00	0.579
Region								
North	2169	0.33	0.47	576	0.30	0.46	0.03	0.145
Central	2169	0.31	0.46	576	0.38	0.48	-0.06	0.003
South	2169	0.36	0.48	576	0.33	0.47	0.03	0.149
PCS-12	2156	52.45	7.27	570	51.66	8.65	0.79	0.028
HIV+	1811	0.05	0.22	396	0.11	0.31	-0.06	0.000
# Life time sex partners	2166	3.05	4.38	575	3.05	3.18	0.01	0.974
# Sex partners last year	2094	1.09	0.85	550	1.13	0.65	-0.03	0.372
Household owns								
Bed with mattress	2084	0.23	0.42	527	0.25	0.43	-0.02	0.368
TV	2088	0.02	0.14	527	0.02	0.13	0.00	0.606
Bike	2087	0.58	0.49	528	0.56	0.50	0.02	0.525
Pit latrine	2088	0.87	0.33	528	0.88	0.32	-0.01	0.479
Metal roof	2089	0.13	0.34	528	0.12	0.33	0.01	0.404
HIV perception (# beans)	2156	1.05	1.97	572	1.31	2.32	-0.26	0.006
MCS-12	2156	55.50	8.05	570	55.14	8.37	0.36	0.347
SWB								
Very satisfied	2163	0.37	0.48	575	0.38	0.48	0.00	0.878

Table 1: Summary statistics by attrition status (continued)

Variable	Reinterviewed			Not Reinterviewed			Difference	
	N	Mean	S.D.	N	Mean	S.D.	Difference	P-value
Somewhat satisfied	2163	0.31	0.46	575	0.30	0.46	0.01	0.645
Satisfied	2163	0.24	0.43	575	0.22	0.42	0.02	0.313
Somewhat unsatisfied	2163	0.06	0.24	575	0.09	0.28	-0.02	0.051
Very unsatisfied	2163	0.01	0.07	575	0.01	0.09	0.00	0.313
Ever lived elsewhere 6+ months since age 15	2084	0.42	0.49	527	0.44	0.50	-0.02	0.378
Stayed elsewhere 1+ months in the past 12 months	2087	0.11	0.32	528	0.15	0.35	-0.03	0.035
# Living children	2040	4.29	2.66	504	4.17	3.05	0.11	0.407

Table 2: Comparison of coefficient estimates by attrition status, MCS-12

Dependent variable: MCS-12	Re-interviewed	Non-reinterviewed
HIV perception (# beans)	-0.460 ***	0.067
	0.109	0.207
HIV+	1.619	-2.350
	1.289	1.920
HIV perception * HIV+	-0.657 *	-0.542
	0.316	0.475
Health (PCS-12)	0.327 ***	0.331 ***
	0.028	0.053
Marital status (ref: married/cohabited)		
Separated	-3.426 +	1.567
	2.038	2.430
Divorced	-2.262 *	0.474
	1.024 **	1.840
Widowed	-3.561	-3.340
	1.141	2.450
Economic situation		
HH has metal roof (Y=1)	0.097	0.398
	0.596	1.409
HH has radio (Y=1)	0.516	-1.441
	0.493	0.989
HH has bike (Y=1)	-0.167	0.259
	0.436	0.912
Residential area (ref: north)		
Central	0.162	1.083
	0.503	1.055
South	0.248	-0.705
	0.494	1.102
Age	-0.036 *	-0.009
	0.016	0.035
Sex	0.751 +	2.076 *
	0.428	0.905
Constant	39.024 ***	38.045 ***
	1.779	3.633
N	1548	313
R-squared	0.155	0.223

 +p<0.1; *p<0.05; ** p<0.01; *** p<0.001. Standard errors are below coefficients.

Table 3: Comparison of coefficient estimates by attrition status, SWB

Dependent variable: SWB	Re-interviewed	Non-reinterviewed
HIV perception (# beans)	0.961	0.937
	0.031	0.059
HIV+	0.924	0.91
	0.351	0.575
HIV perception * HIV+	0.971	0.971
	0.094	0.147
Health (PCS-12)	1.09 ***	1.087 ***
	0.009	0.019
Marital status (ref: married/cohabited)		
Separated	1.032	0.691
	0.678	0.507
Divorced	0.787	0.252 *
	0.239	0.152
Widowed	1.153	0.281 +
	0.396	0.213
Economic situation		
HH has metal roof (Y=1)	1.44 *	1.086
	0.267	0.484
HH has radio (Y=1)	1.157	1.127
	0.174	0.373
HH has bike (Y=1)	1.171	0.755
	0.155	0.228
Residential area (ref: north)		
Central	5.366 ***	5.72 ***
	0.902	2.022
South	3.031 ***	5.288 ***
	0.449	1.951
Age	0.989 *	0.988
	0.005	0.011
Sex	1.316 *	1.338
	0.177	0.408
Constant	0.011 ***	0.018 ***
	0.006	0.021
N	1548	313
R-squared	272.341	80.866

 +p<0.1; *p<0.05; ** p<0.01; *** p<0.001. Standard errors are below coefficients.

Table 4.1: Fixed-effects linear regression on Mental Component Scale (MCS-12), married women in rural Malawi

Dependent variable: MCS-12	Women			
	Model 1	Model 2	Model 3	Model 4
HIV perception (# beans)	-0.564 ***	-0.552 ***	-0.56 ***	-0.635 ***
	(0.167)	(0.168)	(0.170)	(0.235)
Health (PCS-12)	0.105 *	0.107 *	0.106 *	0.103 *
	(0.0595)	(0.0600)	(0.0598)	(0.0596)
Social support		0.0471	0.155	0.171
		(0.306)	(0.385)	(0.387)
Sexual behaviors				
# Sex partners in the past year	2.680	2.678	2.648	3.375
	(2.185)	(2.183)	(2.193)	(3.051)
Spouse has 1+ sex partners (Y=1)	0.422	0.404	0.399	0.306
	(0.802)	(0.808)	(0.809)	(0.815)
Perception on community				
# Died from AIDS in the past year	-0.121	-0.123	-0.127	-0.142
	(0.132)	(0.136)	(0.136)	(0.137)
Wealth	0.913 **	0.909 **	0.912 **	0.905 **
	(0.389)	(0.403)	(0.404)	(0.407)
HIV perception * Social support			-0.0497	-0.0443
			(0.110)	(0.112)
HIV perception * Stigma				0.177
				(0.324)
Constant	47.46 ***	47.38 ***	47.47 ***	46.99 ***
	(3.773)	(3.817)	(3.809)	(4.423)
N	981	981	981	981
R-squared	0.041	0.040	0.040	0.041

* p<0.1, ** p<0.05, *** p<0.01. Standard errors in parentheses.

Table 4.2: Fixed-effects linear regression on Mental Component Scale (MCS-12), married men in rural Malawi

Dependent variable: MCS-12	Men			
	Model 5	Model 6	Model 7	Model 8
HIV perception (# beans)	-0.682 ***	-0.659 ***	-0.663 ***	-0.786 ***
	(0.181)	(0.181)	(0.191)	(0.238)
Health (PCS-12)	0.0284	0.0275	0.0277	0.0347
	(0.0723)	(0.0763)	(0.0763)	(0.0771)
Social support		0.149	0.140	0.135
		(0.229)	(0.252)	(0.252)
Sexual behaviors				
# Sex partners in the past year	0.312 *	0.314 *	0.314 *	0.31 *
	(0.165)	(0.170)	(0.170)	(0.170)
Spouse has 1+ sex partners (Y=1)	-0.131	0.0790	0.0811	0.248
	(1.007)	(1.011)	(1.011)	(1.024)
Perception on community				
# Died from AIDS in the past year	0.0932	0.0763	0.0764	0.0710
	(0.151)	(0.154)	(0.154)	(0.155)
Wealth	0.660 *	0.731 **	0.731 **	0.778 **
	(0.356)	(0.359)	(0.359)	(0.359)
HIV perception * Social support			0.00670	0.0139
			(0.0559)	(0.0572)
HIV perception * Stigma				0.297
				(0.376)
Constant	54.79 ***	54.76 ***	54.75 ***	54.34 ***
	(3.947)	(4.163)	(4.163)	(4.208)
N	756	756	756	756
R-squared	0.044	0.045	0.045	0.047

* p<0.1, ** p<0.05, *** p<0.01. Standard errors in parentheses.

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Table 5.1: Fixed-effects logistic regression on life satisfaction (SWB), married women in rural Malawi

Dependent variable: SWB	Women			
	Model 9	Model 10	Model 11	Model 12
HIV perception (# beans)	1.021	1.017	1.015	1.037
	(0.0509)	(0.0510)	(0.0512)	(0.0658)
Health (PCS-12)	1.071 ***	1.072 ***	1.072 ***	1.079 ***
	(0.0169)	(0.0170)	(0.0170)	(0.0178)
Social support		0.999	1.065	0.997
		(0.0956)	(0.135)	(0.132)
Sexual behaviors				
# Sex partners in the past year	1.272	1.267	1.226	6.336e+06
	(0.754)	(0.753)	(0.731)	(6.337e+09)
Spouse has 1+ sex partners (Y=1)	1.017	1.012	1.007	0.968
	(0.249)	(0.249)	(0.248)	(0.246)
Perception on community				
# Died from AIDS in the past year	1.033	1.034	1.032	1.034
	(0.0431)	(0.0436)	(0.0439)	(0.0455)
Wealth	1.112	1.173	1.175	1.192
	(0.119)	(0.132)	(0.132)	(0.137)
HIV perception * Social support			0.975	0.975
			(0.0322)	(0.0337)
HIV perception * Stigma				1.002
				(0.107)
N	260	260	260	260
Log likelihood	-172.284	-168.453	-169.147	-162.099

* $p<0.1$, ** $p<0.05$, *** $p<0.01$. Standard errors in parentheses.

Table 5.2: Fixed-effects logistic regression on life satisfaction (SWB), married men in rural Malawi

Dependent variable: SWB	Men			
	Model 13	Model 14	Model 15	Model 16
HIV perception (# beans)	0.996	0.982	0.960	0.964
	(0.0635)	(0.0649)	(0.0672)	(0.0810)
Health (PCS-12)	1.060 **	1.058 **	1.058 **	1.057 **
	(0.0249)	(0.0254)	(0.0253)	(0.0256)
Social support		1.153	1.058	1.042
		(0.126)	(0.139)	(0.137)
Sexual behaviors				
# Sex partners in the past year	0.842	0.806	0.770	0.773
	(0.249)	(0.245)	(0.238)	(0.238)
Spouse has 1+ sex partners (Y=1)	0.700	0.664	0.694	0.745
	(0.269)	(0.266)	(0.279)	(0.304)
Perception on community				
# Died from AIDS in the past year	0.921	0.928	0.926	0.930
	(0.0647)	(0.0677)	(0.0674)	(0.0682)
Wealth	1.001	0.994	1.002	1.043
	(0.145)	(0.146)	(0.147)	(0.157)
HIV perception * Social support			1.050	1.049
			(0.0589)	(0.0580)
HIV perception * Stigma				1.009
				(0.157)
N	158	158	158	158
Log likelihood	-109.592	-106.647	-105.953	-104.336

* $p<0.1$, ** $p<0.05$, *** $p<0.01$. Standard errors in parentheses.

Table 6: Comparison of cross-sectional (CS) and fixed-effects (FE) estimates of HIV perception on MCS-12

Model	Women		Men	
	CS	FE	CS	FE
2006 (baseline + social support)	-0.264 *	-0.552 ***	-0.708 ***	-0.659 ***
	0.137	0.168	0.173	0.181
2008 (baseline + social support)	-0.432 ***		-0.500 **	
	0.157		0.189	
2006 (+ social support interaction)	-0.269 *	-0.56 ***	-0.795 ***	-0.663 ***
	0.138	0.17	0.184	0.191
2008 (+ social support interaction)	-0.427 ***		-0.512 **	
	0.158		0.200	
2006 (+ stigma)	-0.112	-0.635 ***	-0.890 ***	-0.786 ***
	0.182	0.235	0.769	0.238

* p<0.1, ** p<0.05, *** p<0.01. Standard errors in parentheses.

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Appendix: Summary statistics

Table A1: Summary statistics for married women, rural Malawi, 2006 and 2008

Variable	2006			2008		
	Obs	Mean	Std. Dev.	Obs	Mean	Std. Dev.
Mental component score (MCS-12)	1025	55.40	7.94	812	53.70	8.95
Life satisfaction/ SWB (1=satisfied)	1027	0.67	0.47	928	0.75	0.43
HIV perception (# beans)	1023	1.20	2.09	1029	1.87	2.17
Health (PCS-12)	1025	52.12	7.23	812	52.01	6.62
Social support	1026	-0.24	1.06	1021	-0.06	1.11
Sexual behaviors						
# Sex partners in the past year	1006	1.01	0.19	981	1.01	0.38
Spouse has 1+ sex partners (Y=1)	1030	0.31	0.46	1030	0.45	0.50
Perception on community						
# died from AIDS in the past year	1026	1.99	2.28	1016	1.99	2.21
Wealth	958	0.00	1.88	1017	-0.02	1.90
Age	905	35.40	11.65	1030	36.13	11.78
Education (ref: no school)						
Primary	1030	0.63	0.48	1030	0.66	0.47
Secondary and above	1030	0.07	0.26	1030	0.07	0.25
Residential Area (ref: central)						
South	1030	0.33	0.47	1030	0.33	0.47
North	1030	0.35	0.48	1030	0.35	0.48
Stigma (1=living in a high-stigma community)	1020	0.42	0.49	1030	0.35	0.48

Table A2: Summary statistics for married men, rural Malawi, 2006 and 2008

		2006			2008	
Variable	Obs	Mean	Std. Dev.	Obs	Mean	Std. Dev.
Mental component score (MCS-12)	784	56.59	7.05	588	56.00	7.76
Life satisfaction/ SWB (1=satisfied)	787	0.74	0.44	654	0.79	0.41
HIV perception (# beans)	787	0.71	1.64	787	1.42	1.84
Health (PCS-12)	784	53.58	6.35	588	53.20	6.06
Social support	784	0.40	1.62	776	0.40	1.16
Sexual behaviors						
# Sex partners in the past year	770	1.30	1.26	765	1.35	1.71
Spouse has 1+ sex partners (Y=1)	790	0.03	0.18	790	0.18	0.39
Perception on community						
# died from AIDS in the past year	787	1.99	2.25	777	2.25	2.71
Wealth	749	0.25	1.95	777	0.21	1.93
Age	632	41.91	12.67	790	42.90	12.85
Education (ref: no school)						
Primary	790	0.67	0.47	790	0.69	0.46
Secondary and above	790	0.15	0.36	790	0.16	0.36
Residential Area (ref: central)						
South	790	0.34	0.47	790	0.34	0.47
North	790	0.35	0.48	790	0.35	0.48
Stigma (1=living in a high-stigma community)	781	0.41	0.49	781	0.41	0.49

Table A3: Summary statistics of changes in variables between 2006 and 2008, rural Malawi

Variable	Women			Men		
	Obs	Mean	Std. Dev.	Obs	Mean	Std. Dev.
Mental component score (MCS-12)	810	-1.65	11.20	586	-0.47	9.92
Life satisfaction/ SWB (1=satisfied)	926	0.08	0.63	652	0.04	0.57
HIV perception (# beans)	1022	0.68	2.75	784	0.72	2.43
Health (PCS-12)	810	-0.05	8.39	586	-0.50	7.48
Social support	1017	0.19	1.32	770	0.01	1.72
Sexual behaviors						
# Sex partners in the past year	958	0.01	0.43	747	0.05	2.06
Spouse has 1+ sex partners (Y=1)	1030	0.14	0.54	790	0.15	0.43
Perception on community						
# died from AIDS in the past year	1012	-0.02	2.98	774	0.26	3.13
Wealth	947	-0.04	1.18	736	-0.03	1.20

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