THE SOCIOECONOMIC CORRELATES OF HIV/AIDS KNOWLEDGE AND CONDOM USE IN MADAGASCAR

A Thesis

Presented to the Faculty of the Graduate School

of Cornell University

In Partial Fulfillment of the Requirements for the Degree of

Master of Science

by

Josée Randriamamonjy

January 2006

ABSTRACT

We estimate the determinants of HIV/AIDS knowledge and related behavior (use of condoms) among women in Madagascar, a country where prevalence remains low but conditions are ripe for a rapid increase in infections. In both rural and urban areas, more educated and wealthier women are more likely to know about means of preventing infection, less likely to have misconceptions about transmission, and more likely to use condoms. Community factors such as availability of health centers and access to roads also lead to greater HIV knowledge. However, most of the large rural-urban difference in mean knowledge is due not to location per se but to differences in schooling and wealth; rather than simply being geographically targeted, AIDS education efforts must be designed to target and be understood by uneducated and poor subpopulations.

BIOGRAPHICAL SKETCH

Josée Randriamamonjy holds a Master of Arts in Economic Policy Management (Diplôme de Hautes Etudes en Gestion de la Politique Economique) from the Centre d'Etudes et de Recherches sur le Developpement International (CERDI) - Auvergne University – France. She also received a Master of Arts in Economics from Antananarivo University – Madagascar. Before she came to Cornell University, she was responsible for the Malagasy Modeling Service at the National Department of Statistics (INSTAT) in Madagascar, and the principal collaborator of the "Participation and Poverty Project" with the Cornell Food and Nutrition Policy Program (FCNPP). Since October 2003, she is a Research Analyst in the Food Consumption and Nutrition Division of the International Food Policy Research Institute (IFPRI) in Washington DC.

ACKNOWLEDGMENTS

This study involved a large amount of effort and time from many people. First and foremost my thanks go to David Sahn and Christopher Barrett, my advisors; Peter Glick, a researcher at the Cornell Food and Nutrition Policy Program (CFNPP), for the substantial guidance and assistance I received from them. In addition I consulted Staffs from the "Comité National de la Lutte contre le Sida", the Health Department, the U.S. Agency for International Development (USAID), and, PSI (Population Services International) in Madagascar. I thank them all for the background information they provided. I extend my appreciation to the Macro International Inc. which gave me access to the data from the Demographic and Health Surveys (DHS).

I am grateful to the USAID and the Cornell Institute for African Development (IAD) for their financial support, the Ithaca Presbyterian Church for the resources to research supplies.

Last but not least, I thank my entire family for their patience and wholehearted support. This work is dedicated to each and every one of them.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

CHAPTER 1

INTRODUCTION

HIV prevalence appears to be very low in Madagascar compared with other countries in sub-Saharan Africa. According to UNAIDS/WHO epidemiological model estimates,, the adult HIV prevalence rate in the country was 0.3 percent by the end of 2001 compared to 9 percent in sub-Saharan Africa and up to 25 percent in the adjacent countries in the Southern African region (UNAIDS, 2002). However, there are some important warning signs both that HIV prevalence may be higher than estimated, and that Madagascar is ripe for a rapid increase in HIV infections. Most important are the high prevalence of sexually transmitted infections (STI) that share modes of transmission and behavioral risk factors with HIV and the lack of knowledge on how to prevent infection, described further below. A recent study in Madagascar showed that 82 percent of female sex workers had at least one sexually transmitted infection (FHI/USAID, 2001), making Madagascar's STI prevalence rate in excess of that in most high HIV prevalence countries. STIs are not just an indicator of risk behavior; they also directly make people biologically susceptible to HIV, and as reported by Cohen et al. (1996), thus are also associated with acquisition of HIV and higher rates of incidence and prevalence.

Another major risk factor in Africa are patterns of simultaneous multiple partnerships and a variety of cultural practices that encourage promiscuity (Boerma, 2002). In the Malagasy context, it is difficult to generalize about sexual attitudes and behavior because in some parts of the country or within some particular ethnic groups,

multi-partnership is socially accepted while for other parts or for other ethnic groups, this is not the case.

Further, widespread poverty, high illiteracy, limited access to health and social services, and an increasingly mobile population, are present in Madagascar, adding to the potential for explosive future growth of HIV infections. Madagascar is one of the least developed countries in the world; approximately three-quarters of the population live below the poverty line (Stifel, Paternostro, and Razafindrovanona 2001). According to 2001 household survey data, 48 percent of Malagasy population has never had classroom instruction, and only around 1 in 10 Malagasy has attended secondary school or beyond. Results from the 1997 DHS data reveal a high infant mortality rate of 96 deaths per thousand live births (The DHS report, 1997). Considerable internal migration, including temporary movements of male workers to find temporary or even seasonal employment at Madagascar's multiple mining sites in the interior of the country, along with the regular arrival of cargo boats from high HIV risk countries (Médecin du Monde, 2001; KAP surveys, 1999), also represent important risk factors for the spread of HIV infection on the island.

Madagascar began implementing activities to combat HIV/AIDS as early as 1988. However, these efforts are considered to have been generally ineffective (USAID 1999). However, the new government that emerged at the end of the political crisis in 2002 has made a greater commitment to tackle the HIV/AIDS epidemic. The newly elected President Marc Ravalomanana established and chaired a new institutional structure - Le Comité National de la Lutte contre le Sida - for the national coordination of HIV programs. Among the key planks of this effort is the identification of groups vulnerable to HIV and the provision of appropriate services

and education to these groups, reducing high-risk behaviors and the low rate of treatment for STIs. Efforts are also being made to increase he access to and utilization of condoms (Plan Strategique National 2001-2005).

These prevention efforts will be enhanced by greater insight into the household and community level determinants of HIV related knowledge and behaviors in Madagascar. This will help both to identify vulnerable subpopulations and to devise well-targeted policies to improve HIV knowledge and reduce risk behaviors. We address this need through our econometric analysis on the Madagascar Demographic and Health Survey (DHS) collected in 1997. We estimate the determinants of several forms of HIV knowledge as well of condom use among women age 15-49. The DHS is the only nationally representative survey that provides information on HIV/AIDS knowledge and sexual behavior in Madagascar. These surveys have been carried out in other countries in Africa as well and have been used to analyze HIV knowledge and behavior in a number of them (Blanc, 2000; Cogneau, 2001; Gersovitz, 2000). However, we exploit the unique opportunity to supplement these data with matched information on local health and other infrastructure in the communities where the DHS was carried out. Our source for this information is Madagascar's 2001 Commune census. Use of these additional data allows us both to investigate the potentially important effects of public health and communication infrastructure on knowledge and behavior, and to obtain more accurate estimates of the effects of individual of household factors such as schooling and wealth that may be correlated with such community level characteristics.

This remainder of this paper is organized as follows: Section 2 describes the sample and the data. Section 3 presents our empirical approach in order to know what

the determinants of HIV/AIDS prevention knowledge and condom use are. Section 4 analyses the results of the modeling, and section 5 presents some implications of our findings and concluding remarks.

CHAPTER 2

DATA

The Malagasy DHS was conducted between September and December 1997 by Institut *National de la Statistique* of Madagascar with the technical assistance of Macro International. The weighted sample in the DHS survey is designed to be representative nationally and follows a two-stage cluster-sampling technique: the first stage at the commune level and the second stage at the household level. The DHS consists of two types of questionnaires: an individual questionnaire for women of reproductive age (15-49), and a household questionnaire. 7,060 women who are members of 7,171 households were surveyed. In addition to standard DHS type information on topics such as reproductive behavior, contraception, vaccination history, and mother and children's health, the individual questionnaire has a section particularly designed to evaluate knowledge, attitudes and behavior with regard to HIV/AIDS. Included are questions about the means of transmission, means of prevention, and perceptions of the risk of getting AIDS. The household questionnaire provides information about the socio-demographic characteristics of the household. Since the DHS does not contain information on incomes or expenditures, we use data on household durables and assets, including ownership of radio, TV, refrigerator, bicycle, motorcycle and car, and the major source of drinking water (piped or surface water relative to well water), toilet facilities (flush, pit toilet or latrine), and main material of the floor (high quality and low quality) to construct an asset index following the methodology of Sahn and Stifel (2003).

We merge the DHS with commune level information obtained from the Commune Census carried out over a three-month period in 2001 as part of collaborative efforts between the Ilo Program of Cornell University[1], the Malagasy Rural Development Research Institute (known by the acronym of its Malagasy name, FOFIFA) and National Statistics Institute (INSTAT). The country's 1392 communes are the lowest administrative level above the village or community[2]; in rural areas they typically encompass about 10 villages. Communes also correspond to the primary sampling unit of the DHS survey. Data collection focused on infrastructure and availability of services: presence of health centers and schools, presence of national and regional roads in the commune, availability of national and regional TV and radio reception—all factors that to some degree may be expected to impart information about HIV/AIDS to residents of the commune.

Although the commune census collected these data for both urban and rural areas, we only use this information in estimations for the rural sample. There is no meaningful variation within the urban sample since the infrastructure in urban areas is relatively highly developed--almost all urban communes, for example, have paved roads, national TV reception, and nearby health facilities.

Researchers have often noted concerns about large-scale surveys and the validity of responses to questions about sexual knowledge and practices (Gersovitz et. al 2000). A comparison of descriptive results with several separate small-scale surveys

[1]Information about *Ilo* can be found at http://www.ilo.cornell.edu/. For a description of the commune census, see http://www.ilo.cornell.edu/ilo/data.html

[2] We drop 10 out of 270 clusters for which no correspondence between the two surveys was found. This adjustment leads to a sample reduction from 7060 to 6876 women.

in Madagascar shows an overall consistency of responses across surveys. The same questions used in the DHS on knowledge of means of HIV transmission, for example, were asked in the survey conducted by the Programme National de Lutte contre les Maladies Sexuellement Transmisible et le SIDA to a sample of 396 young people of 10-29 years old living in Toamasina and Tulear provinces. Similar results to the DHS were found (PNLS, 1998).[3] Likewise, the result of another survey by Population Services International (2001) conducted among 2440 adolescents in Toamasina on the socioeconomic determinants of condom use are consistent with those we report below using the DHS. While this consistency across data sources is reassuring, it obviously does not eliminate the possibility of biases that may be common to all surveys. We do, however, gain further confidence in the data by the fact that there are only a handful of missing responses (i.e., refusals) on the HIV/AIDS knowledge and condom use questions in the DHS. We might expect a high rate of refusals to correspond to a high rate of inaccurate or misleading answers among those who do agree to answer these questions; therefore, finding such a low rate inspires further confidence in the data. Lastly, it should also be noted that the discussion about response reliability usually concern questions about the individual's own sexual behavior; there may be less of a problem when it comes to questions about HIV knowledge, which are less personal. Still, as with all such surveys, the possibilities of misreporting should be kept in mind.

[3] The PNLS (1998) document reported, for instance that only 38% of the respondents gave the correct negative answer when asked whether AIDS can be transmitted by kissing, and only 19% responded correctly that mosquito bites do not transmit AIDS (Table 1.3 pp. 9). Those results are consistent with those we discuss below for the DHS data.

CHAPTER 3

METHODOLOGY

In this paper we are interested in specifying the relationship between binary dependent variables representing HIV/AIDS knowledge and sexual practice (use of condoms), on the one hand, and a set of individual, household and community characteristics on the other. The first outcome we model is whether the respondent can correctly identify one or both of the two main primary means of HIV prevention in an environment like Madagascar: use of condoms and having just one sexual partner. The second outcome is whether the respondent correctly rejects both?? of the two most common local misconceptions about AIDS: that transmission can occur through mosquito bites and kissing, and that a healthy-looking person cannot have HIV/AIDS. The third outcome we model is behavioral: whether sexually active women have ever used a condom[4]. Although the DHS asks separately whether the individual has used a condom for pregnancy prevention or to prevent disease transmission, we consider condom use for either purpose the more relevant outcome from a prevention standpoint; however, results for the alternative of considering use of condoms for disease prevention only will be discussed as well since it provides particular insight into whether women are motivated to use condoms to avoid infection.

[4] We also estimated this model on the sample of all women 15-49 whether sexually active or not, but the parameters are nearly identical. The only exception was the age coefficients, which capture the impact of maturity on initiation of sexual activity.

Since the outcomes are discrete binary indicators we estimate their determinants using probits.[5] . The index function equation for the probit is similar for each model and is as follows (for the *i*th observation):

$$Y_i = \beta_0 + \sum_h \beta_{1h} AGE_{hi} + \beta_2 PRIMARY_i + \beta_3 SECNDRY_i + \beta_4 AGEDUC_i + \sum_k \beta_{5k} REL_{ki} + \sum_l \beta_{6l} PROV_{li} + \sum_m \beta_{7m} RELH_{mi} + \beta_8 RADIO_i + \beta_9 ASI_i + \beta_{10} CLINIC + \beta_{11} NROAD + \beta_{12} PROAD + \varepsilon_i$$

Individual and household level determinants

AGE$_{hi}$ is a vector of dummy variables representing age group. Years of primary schooling (up to 5) and secondary schooling (up to 7) are entered separately to allow for differences in the effect of education by level. There is a fairly long list of reasons to expect those who are better schooled to have attained more awareness of HIV and how it can be prevented. Educated people are likely to have better access to many sources of health and HIV-related information: they are more likely, for example, to read the newspaper or to visit private or public health services where HIV-related information is dispensed. If information comes through channels they already use, the costs of obtaining HIV/AIDS information will be low for them. That is, education and health information inputs may be complements in the production function for health knowledge, though the opposite may also occur: if messages are designed to be understood by the uneducated, schooling and health information may be substitutes. Further, as Becker (1993) has pointed out, those who have devoted more time and resources to education have already made larger investments in the future. Since their

[5] For the knowledge outcomes, an alternative to simple binary probits would be to use ordered probit to estimate the probabilities of knowing none, one and both prevention methods (or having none, one, and two misconceptions). However, results were very similar to those for the simpler binary probits we present. t.

future stream of earnings, hence consumption and utility, is higher, they have greater incentives to protect their health and insure their longevity by gathering or being attentive to information about HIV prevention. Greater investment in education may also be a reflection of a low discount rate, which again would incline those with an education to seek information and change behaviors to insure their longevity.

Finally, at least in younger cohorts, those who went to or stayed in school may have been exposed to school-based HIV/AIDS programs. It is not clear whether this would be important in our sample, since even the youngest observations (those age 15-20) were in school before the implementation of major school-based HIV/AIDS education programs were implemented in Madagascar. Nevertheless, to capture this possibility, we include an interaction term for age and education $AGEDEC_i$; a negative sign would be consistent with the provision of HIV information in school, since only younger educated women would have been exposed to such school-based information.

With respect to the relation of schooling to condom use, a number of studies (Filmer 1998, Messersmith et al, 1994 and Stan Becker et al. 1997) show that education increases condom use, in particular with non-regular partners. The pathways from schooling to use of condoms are potentially complex, and it should be noted that in terms of risk behaviors overall, the effects of schooling are ambiguous. More educated people typically have more sexual partners. In part this reflects the higher income of better-educated individuals: many studies of developing countries show that the number of partners is increasing in income (Blanc, 2001; Filmer 1998, Carael, 1995). Our models control for income (or more precisely, wealth), but education may have independent effects on preferences for multiple partners and

possibly also, frequency of intercourse with these partners (De Walque 2002). This may lead to greater use of condoms by the better educated (even controlling for income) via having a larger number of partners (on which the Madagascar DHS does not collect data), in addition to education effects through the information access and processing pathways just noted. In addition, among women especially, a higher level of schooling may enhance bargaining ability within parternship(s), making it easier for them to persuade a partner to use a condom. (Blanc et al., 1996 - WHO, 1998). More generally, education is thought to impart a sense of efficacy, that is, belief in ones' ability to change behavior (Martin and Juarez 1994. For each of these reasons, we would predict that more schooling increases the probability of condom use in our sample, though as noted this does not mean that other risk behaviors (number of partners, number of acts of intercourse) also decline.

Among other covariates, ASI_i *is* an index of the household assets (described in the previous section) and is designed to capture the economic status and well being of the household. Studies undertaken by the World Bank's thematic group on health, based on analysis of household data in the DHS found that knowledge of HIV/AIDS prevention is distinctly higher among the better-off than among the disadvantaged in almost 23 countries with available data (Davidson R. Gwatkin et. al. 2001). In part, correlations of wealth and knowledge outcomes may occur through the association of wealth with education. Even controlling for education, wealth or income should be correlated with access to HIV related information, e.g., though ownership of a radio or use of health cares practitioners. Furthermore, the rate of time preference is higher for poorer people (perhaps because their poverty lowers their life expectancy; see Lawrence 1991). If as a result the poor discount future consumption more heavily than the well off, they would be expected to invest less time or money in gathering health

information. They would also be expected to engage in more risky behaviors. And the rich are more likely to act upon and receptive to messages about HIV/AIDS, and adjust their behavior accordingly.

$RADIO_i$ is a dummy variable, which takes on the value of 1 if the respondent listens to the radio daily. It is intended to capture the individual's exposure to the mass media information about HIV/AIDS that have been routinely broadcast in Madagascar since mid-1990's Although inclusion of this type of variable is standard in studies of HIV (and more generally, health) knowledge, one should be aware of the potential for endogeneity: individuals who listen to the radio may also be relatively willing or able to absorb messages they hear on it, as well as to seek out HIV information in other, unmeasured, ways. Therefore one must be careful is assigning a causal interpretation to the estimate on this variable.

REL_{ki} is a vector of dummy variables for religion. Adherence to a religion and religious behavior is another individual characteristic that is recognized in the literature as influencing sexual behavior and knowledge (Gupta, 2000). As seen in appendix table 1, Christianity is dominant: Catholics represent 33% and 40% of the rural and urban population, while Protestants make up 38% and 47%. 'No religion' is next in importance, followed by Islam and traditional religion. , $PROV_{Ii}$ is a series of *faritany* (province) dummies.

Community level determinants

Most existing studies of the determinants of HIV knowledge analyze only individual level or household level determinants such as we have been discussing, e.g., education and wealth. There are two concerns with this standard methodology. First,

from a policy perspective we are also explicitly interested in the impacts of factors such as the proximity of health and education services on HIV knowledge; these services potentially important policy levers for improving knowledge and changing behaviors. Second, these and other community level factors (for example, presence of NGO health workers, and social networks that influence the spread of information) are likely to be correlated with individual or household level covariates; this would imply standard omitted variable biases in the estimates on the latter in models that do not include such controls. For example, if communities in which individuals tend to be educated also tend to have better developed public health services for disseminating health information, the (presumed positive) estimate of the effect of schooling on HIV knowledge will be upwardly biased. In our estimations we address these concerns in two ways.

First, we add to the basic models several local level infrastructure variables (distance to roads and health clinics). As discussed in the previous section, we do this for the rural samples only. *CLINIC* is defined as the distance in kilometers from the commune's administrative center to nearest commune where a facility is available (it equals zero for facilities located in the surveyed commune). This variable represents a proxy for the access to and availability of health infrastructure. *NROAD and PROAD* are dummy variables for the presence of national and regional roads, respectively, in the commune. We would expect HIV/AIDS related information to disseminate more quickly to communities served by well- trafficked road networks, and proximity to means of travel should also affect behaviors[6].

[6] Though not necessarily positively, as is well known: in Africa, the HIV virus spread early along truck routes.

Our second approach to dealing with potential biases from the correlation of individual factors with community level characteristics is to estimate community fixed effects models by adding dummies for each community (survey sample cluster or commune) to the basic specification.[7] The fixed effects specification eliminates bias caused by any (linear) unobserved community level factors enter linearly in the index function.[8] Since the model with community dummies in effect relies on within-cluster variation of the regressors and outcomes to estimate the parameters, the community infrastructure variables (which are fixed within the community) do not enter these models. The fixed effects model therefore cannot provide information on the effects of specific community variables, unlike the previous approach, but unlike the first model it controls for both observed and unobserved community level factors.

[7] The probit index function in eq 1 (excluding the community infrastructure dummies) is expanded to include the terms $\Sigma\alpha_j d_j$. where d_j is a cluster dummy variable equal to 1 for observations in the cluster and 0 otherwise, and α_j is the cluster fixed effect.

[8] The results will not be unbiased if the unobservable enter non-linearly, that is, if they interact with included individual level covariates—for example, if the response to the presence of a local program to dispense HIV information depends on wealth or education. As the earlier discussion makes clear, this process cannot be ruled out and this should be kept in mind in evaluating the estimates.

CHAPTER 4

RESULTS

DESCRIPTIVE ANALYSIS

Basic statistics on knowledge and practices are reported in Table 1. First we note that the proportion of women who have ever heard of AIDS (not shown in table) is high in urban areas (87%) but much less so in rural areas (62%), where approximately four-fifths of the population resides. These rates of knowledge are actually quite low compared to nearly universal awareness reported for other countries in sub-Saharan Africa (Glick and Sahn 2004). As the table indicates, prevention knowledge is also much higher among urban women, but even for them is not very high: 61% of all urban women can identify the at least one of the two means of prevention, condom use and having one partner. Among those who have heard of AIDS, the share is still only 70%. Only 29% of rural women (and less than half of rural women who are aware of AIDS) can identify one of the prevention methods. This pattern repeats for the misconceptions variable (middle columns of the table). Only 27% of rural women and 51% of urban women know that the disease does not pass among people by kissing and mosquito bites and that a healthy-looking person can transmit HIV/AIDS.

Table 1 Percentage of women who know about AIDS prevention, have no misconception on AIDS, and have ever used condom.

	AIDS prevention knowledge [a]		No misconception of HIV/AIDS [b]		Condom use by sexually active women		N
	Rural	Urban	Rural	Urban	Rural	Urban	
Total	29.2	61.2	27.0	51.2	1.5	9.6	7060
Age group							
Age15_19	21.6	52.9	24.0	50.4	1.0	9.1	1553
Age20_24	29.9	62.6	28.6	48.9	2.2	13.5	1325
age25_29	31.9	62.6	25.6	50.4	1.2	11.2	1196
age30_39	34.4	67.8	29.8	53.7	1.8	9.0	1856
age40_49	26.9	58.6	26.0	51.9	1.1	5.4	1130
Education level							
No education	9.6	18.7	10.7	20.0	0.1	1.9	1499
Primary	27.6	45.1	25.2	36.7	1.0	5.9	3662
Post primary	64.0	81.1	57.6	67.7	5.9	14.1	1897
Religion							
Christian	36.2	66.2	32.5	55.4	1.9	10.5	5327
Islam	51.4	86.6	22.3	51.4	4.6	17.8	50
No religion	9.2	20.9	12.3	19.5	0.7	3.3	296
Traditional religion	20.2	26.0	18.7	18.9	0.2	0.0	1377
Province of residence							
Antananarivo	37.1	70.6	30.0	56.2	1.3	9.1	2387
Fianarantsoa	19.3	34.2	19.4	29.0	1.9	6.0	1432
Toamasina	37.5	68.1	32.2	53.1	2.6	9.1	1007
Majunga	19.8	61.8	24.9	55.0	0.5	10.2	852
Tulear	15.7	44.5	14.1	39.0	1.3	13.4	876
Antsiranana	50.8	66.2	53.6	75.5	1.3	12.1	506

a: knowledge that using condoms and/or having one sexual partner is a main means of prevention. Sample includes all women, whether they have heard of AIDS or not.
b: No common misconceptions about AIDS: correctly identifies as incorrect both that a healthy-looking person cannot have the virus and that transmission can occur by mosquito bites and kissing. Sample includes all women, whether they have heard of AIDS or not.

The descriptive evidence points to age and education as being associated with differentials in knowledge. By and large there appears to be an inverted U-shaped profile by age, with knowledge as measured by either outcome variable lower among 15 to 19 year-olds and among 40-49 year olds. Knowledge appears to increase very sharply with educational attainment.

The table also points to large differences by province (*faritany*) in HIV knowledge. For example, Fianarantsoa and Tulear, the two poorest provinces, score lowest on both indicators, for both rural and urban areas. This descriptive analysis does not allow us to say whether these differences reflect differences in mean levels of education or wealth, in the development of public health and education infrastructure, or the placement of information campaigns. Still, it suggests the need for regional targeting of prevention campaigns to reduce disparities in HIV/AIDS knowledge.

The last 2 columns of Table 1 report the share of sexually active women reporting ever having used a condom. Condom use is very low: only 10 percent of urban women in this group have ever used a condom—and this proportion is still five times higher than for rural women. It is likely that this rural-urban gap reflects differences both in knowledge and availability of condoms; it may also reflect differences in the probability of having non-regular partners, which we cannot assess with our data. Since the proportion of women who have used condoms is so low in rural areas, the multivariate analysis will consider urban women only. For urban areas, note that the share of women using condoms is highest among the 20-24 age group and then decreases with age. It also increases with educational attainment.

MULTIVARIATE ANALYSIS

Determinants of HIV prevention knowledge

Tables 2 and 3 present results from the probit model of knowledge of one or two of the main means of preventing infection in rural and urban areas, respectively. Note that the sample for estimation is all rural or urban women, including those who have not heard of AIDS; these individuals are grouped with other women who cannot identify either of the two prevention methods.[9] In addition to the probit parameter estimates, we calculate and report the associated marginal effects—that is, the change in probability of knowing at least one of the means of prevention resulting from a unit change in the explanatory variable, along with their t-statistics. The marginal effects are nonlinear functions of the parameter estimates and the levels of the explanatory variables. We evaluate the change in the probability at the means of the independent variables. For the case of dummy independent variables, the continuous marginal effect is not meaningful, so we calculate instead the change in probability associated with a change from 0 to 1 in the value of the dummy variable.

[9] The structure of the DHS is such that respondents who say they have never heard of AIDS are not asked about transmission or prevention.

Table 2 Rural women 15-49: Determinants of knowledge of the condom use and/or one partner as a main HIV/AIDS prevention methods

	No cluster fixed effects		With cluster fixed effects		With community covariates	
	Marginal effect	Coefficient	Marginal effect	Coefficient	Marginal effect	Coefficient
Age						
Age20_24	0.098	0.295*** [4.05]	0.116	0.345*** [4.17]	0.101	0.302*** [4.10]
age25_29	0.104	0.312*** [3.56]	0.119	0.351*** [3.86]	0.110	0.328*** [3.73]
age30_39	0.170	0.508*** [4.92]	0.183	0.540*** [5.02]	0.172	0.512*** [4.89]
age40_49	0.142	0.417*** [3.60]	0.155	0.448*** [3.40]	0.145	0.425*** [3.55]
Education						
Years of primary education	0.075	0.238*** [7.96]	0.069	0.217*** [6.14]	0.073	0.232*** [7.49]
Years of post primary education	0.051	0.162*** [4.61]	0.051	0.162*** [4.03]	0.048	0.154*** [4.32]
Education age interaction	-0.001	-0.002* [-1.86]	0.000	-0.001 [-1.03]	0.000	-0.001 [-1.54]
Listen to the radio	0.138	0.418*** [7.85]	0.133	0.403*** [7.09]	0.132	0.400*** [7.39]
Religion						
Islam	0.040	0.121 [0.46]	0.112	0.322 [1.35]	0.054	0.163 [0.63]
No religion	-0.166	-0.601*** [-7.69]	-0.152	-0.545*** [-5.95]	-0.169	-0.617*** [-7.25]
Traditional religion	-0.054	-0.183*	-0.088	-0.309**	-0.056	-0.191*

Table 2 (Continued)

		[-1.75]		[-2.26]		[-1.78]
Province of residence						
Fianarantsoa	-0.030	-0.097 [-0.72]	-0.249	-1.000*** [-12.03]	-0.009	-0.030 [-0.21]
Toamasina	0.111	0.330*** [3.19]	0.067	0.201*** [4.45]	0.137	0.402*** [3.15]
Majunga	0.037	0.114 [0.99]	0.060	0.181*** [2.55]	0.083	0.249* [1.81]
Tulear	0.049	0.151 [1.17]	0.301	0.823*** [9.20]	0.063	0.192 [1.37]
Antsiranana	0.342	0.925*** [9.64]	0.445	1.201*** [11.08]	0.345	0.934*** [9.59]
Relationship to the head						
Head	-0.023	-0.076 [-0.98]	-0.033	-0.107 [-1.30]	-0.029	-0.094 [-1.17]
Daughter of head	-0.012	-0.039 [-0.58]	-0.010	-0.032 [-0.46]	-0.007	-0.022 [-0.33]
Other relationship to the head	-0.056	-0.190** [-2.13]	-0.054	-0.181* [-1.78]	-0.055	-0.185** [-1.98]
Household asset index	0.106	0.337*** [3.42]	0.069	0.218*** [2.78]	0.097	0.310*** [3.04]
Commune Characteristics						
Distance to clinic					-0.026	-0.082** [-1.97]
Access to provincial road					0.024	0.075 [0.79]
Access to national road					0.064	0.201 [2.54]***
Constant		-1.494 [-12.60]		-1.807 [-17.90]		-1.657 [-11.40]

Table 2 (Continued)

Log-Likelihood	-2190.91	-1993.93	-2091.07
Number of Observations	4669	4373	4472

Standard errors are adjusted to account for correlations across observations within clusters

*Significant at 10%; **significant at 5%; ***significant at 1%

.

Table 3 Urban women 15-49: Determinants of knowledge of condom use and/or one partner as a main HIV/AIDS prevention methods

	No cluster fixed effect		With cluster fixed effect	
	Marginal effect	Coefficient	Marginal effect	Coefficient
Age				
Age20_24	0.067	0.183*	0.074	0.213*
		[1.71]		[1.76]
age25_29	0.078	0.214*	0.065	0.186
		[1.71]		[1.39]
age30_39	0.147	0.407***	0.131	0.384**
		[3.15]		[2.79]
age40_49	0.135	0.379***	0.110	0.324**
		[2.44]		[1.98]
Education				
Years of primary education	0.089	0.236***	0.084	0.233***
		[7.90]		[6.51]
Years of postprimary education	0.059	0.156***	0.058	0.161***
		[4.59]		[4.18]
Education age interaction	-0.001	-0.002**	-0.001	-0.002**
		[-2.13]		[-2.01]
Listen to the radio	0.134	0.352***	0.095	0.260
		[5.10]		[3.21]***
Religion				
Islam	0.181	0.549	0.117	0.361
		[1.21]		[0.84]
No religion	-0.180	-0.460***	-0.223	-0.580
		[-3.18]		[-2.97]
Traditional religion	-0.212	-0.540*	-0.336	-0.870***
		[-1.79]		[-3.1]
Province of residence				
Fianarantsoa	-0.108	-0.279	-0.359	-0.937***
		[-1.43]		[-16.17]
Toamasina	0.141	0.397***	0.210	0.678***
		[2.89]		[4.81]
Majunga	0.050	0.135	-0.279	-0.726***
		[1.21]		[-6.89]
Tulear	-0.106	-0.273*	-0.052	-0.142
		[-1.74]		[-0.83]
Antsiranana	0.087	0.240	0.129	0.396***
		[1.50]		[5.51]

Table 3 (Continued)

Relationship to the head				
Head	-0.070	-0.181*	-0.091	-0.243**
		[-1.65]		[-2.09]
Daughter of head	-0.072	-0.188**	-0.103	-0.279***
		[-1.95]		[-2.70]
Other relationship to the head	-0.099	-0.256**	-0.154	-0.408***
		[-2.28]		[-3.25]
Household asset index	0.025	0.065**	0.020	0.057
		[2.05]		[1.44]
Constant		-0.947		-0.601
		[-6.03]		[-3.96]
Log-likelihood		-1207.62		-1119.70
Number of Observations		2370		2317

"Standard errors are adjusted to account for correlations in across observations within clusters"
*Significant at *10%; **significant at 5%; ***significant at 1%

For both rural and urban areas, the age dummies are generally highly significant, indicating that older women in each of the other age groups are more knowledgeable about HIV prevention than the young women age 15-20, the base category. There is some suggestion, consistent with the descriptive statistics, of a modest inverse U-shaped pattern. This is seen more clearly in Figures 1a and 1b, which calculate the predicted probabilities by age and education at the mean of all other covariates (and accounting for the interaction term of age and education). Filmer (1998) found similar patterns in some cases in his multi-country study; for others he reports a flat knowledge-age profile. The age-education interaction is negative in both the rural and urban samples, meaning that the impact of education on knowledge decreases with age One explanation is that for younger women education has more impact because this group received some instruction related to HIV/AIDS—though as noted above, even for this group such programs were probably not widely available at the time of their schooling.

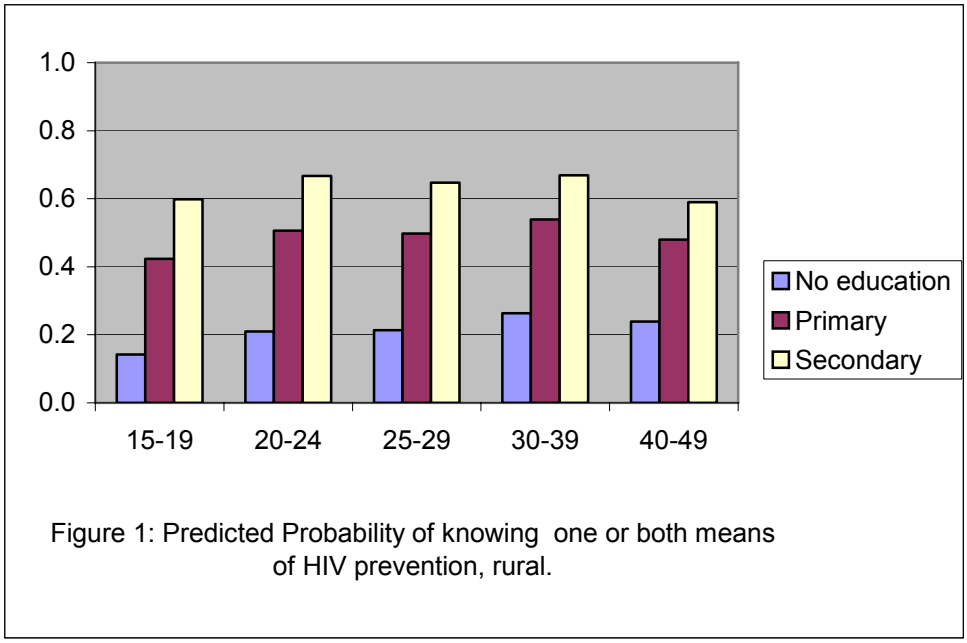

Figure 1: Predicted Probability of knowing one or both means of HIV prevention, rural.

Note: Primary columns refer to 5 years of primary education, and post-primary to 4 years of secondary schooling.

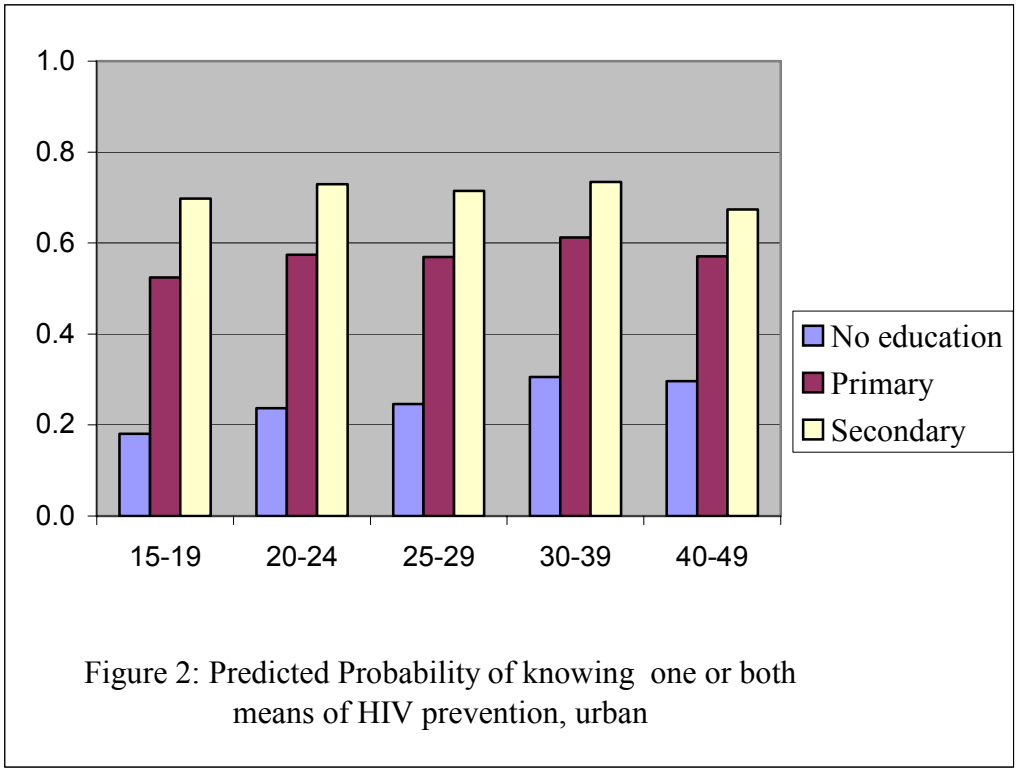

Figure 2: Predicted Probability of knowing one or both means of HIV prevention, urban

Another possibility is that there is depreciation of the human capital acquired in school, so that older women are less able to absorb information than younger women with the same schooling attainment.

Not unexpectedly, however, there is a strong positive effect of education *per se* on the probability of knowing HIV/AIDS prevention methods. This finding is consistent with the result of studies in other countries in Africa (Blanc, 2000). Likelihood ratio tests reject the equality of the coefficients on years of primary and post-primary education for both rural and urban areas ($p=0.011$ and $p=0.014$, respectively), indicating a significantly larger incremental impact of primary education. With regard to differences across areas, the point estimates of the marginal effect of primary education and post-primary in rural areas are not significantly different from those of urban areas ($p=0.57$ for primary and 0.60 for post-primary education). This equivalence may seem surprising given that, as noted earlier, education is thought to be associated with greater contact with various sources of information about AIDS, and these sources are presumably rarer in rural areas. In fact, however, there are no real priors regarding differences in education effects between rural and urban areas. As noted, the educated may be more active in seeking out information. Thus where information is relatively less accessible (rural areas), being educated may make more of a difference than where information is readily available from many sources, even to those who do not actively seek it out (urban areas). Alternatively, the main effect of schooling may come through the mechanism of greater information processing ability, and this may be similar for rural and urban women.

It should be noted that in absolute terms the effect of schooling is in all cases quite large. In rural areas, for example, the impact of an additional year of primary education is 0.06,[10] implying that a woman with completed primary schooling (5 years) has nearly a 30% greater probability of being aware of one of the two main prevention methods than a woman with no education. In proportional terms, a primary-schooled woman is twice as likely to be aware of one of the means of prevention. The effect of an additional year of secondary schooling is about 0.034, and a woman with 4 years of secondary education is about 2.5 times as likely as an uneducated woman to know about prevention methods. The benefits of primary and secondary schooling are similar in urban areas.

The asset index has a positive and significant effect on prevention knowledge, in keeping with our expectations. Unlike for education, the marginal impacts are greater in rural areas than urban areas, at the 0.10 significance level (p=0.09). The rural-urban difference may be interpreted using similar reasoning as above with regard to education, that is to say, in terms of relative scarcity and differential access to information in rural areas. As noted, information on HIV is probably harder to come by in rural areas. In the absence of significant public efforts to reach the general rural population, such information as is available will likely be transmitted through means used disproportionately by wealthier rural residents, such as health centers, newspapers, or radio. In urban areas information in contrast is probably more generally accessible: poor urban residents usually have greater access to health services than their rural counterparts, are probably more likely to know someone or someplace with a TV or radio, and may be exposed to more information simply

[10] This calculation takes into account the negative age-education interaction (it assumes the sample median age) so is slightly less than the reported marginal effect for primary school years.

because social networks are denser in cities and towns. This would tend to reduce the advantage to having more income in urban as compared with rural areas, leading to a larger knowledge/wealth gradient in the latter. Note that unlike the case of schooling, this effect would not be offset by any possible complementarities with information (which is more plentiful in urban areas) in the production of health knowledge.

Daily listening to the radio is strongly and significantly associated with HIV prevention knowledge, and the effects are similar in rural and urban areas ($p= 0.32$). This points to the potential effectiveness of HIV prevention information disseminated through this medium, but as discussed above, we need to be cautious in making such causal inferences because of the possibility that radio listening and HIV knowledge are jointly determined. The marginal impacts may be smaller in urban areas because urban residents are able to get information from a wider array of alternative sources, including through denser social networks.

Other variables that are significant in these models include religion and province of residence. The base category for the former is 'Christianity" including both Catholics and Protestants; for HIV knowledge and the other dependent variables we could not reject equality of the effects of these two faiths. Women who report having no religion or are practicing traditional religion are significantly less likely than the Christian women to know about HIV/AIDS prevention methods. This may be because institutions such as churches, or social networks that revolve around organized religion, are important in the spread and dissemination of AIDS/HIV knowledge. Being a Muslim is strongly associated with prevention knowledge. The

Muslim community, which as noted is very small in Madagascar, may be particularly cohesive, facilitating information exchange among its members.

With regard to the province of residence, our results are consistent with the descriptive data presented above. Women who live in Antsiranana or Toamasina have more knowledge than in the excluded province of Antananarivo, while those who live in Fianarantsoa or Tulear (the poorest provinces) have less knowledge. It is intriguing that these regional differences remain even after controlling for differences in mean levels of schooling and wealth. With regard to the findings for urban Antsiranana and Taomasina, both of these are port cities where international communication should lead to greater exposure to HIV knowledge (and unfortunately, to the virus as well) than even in capital city Antananarivo, which is inland. Antsiranana port, where traffic of foreign military naval is concentrated, has had particularly intense HIV/AIDS awareness campaigns (Kruse and Behets, 2001). The rural probit results showing the greatest prevention knowledge among women in this province suggest that the information diffuses to the surrounding rural zones

The second set of estimates in Tables 2 and 3 adds cluster dummies to the models to control for community fixed effects. For both rural and urban areas the magnitudes of our estimates on key individual characteristics—such as those relating to age and education-- are generally quite robust to the inclusion of the community fixed effects controls. The interaction term between age and education, however, is no longer significant in the model for rural areas.

Next, for the rural sample, instead of cluster dummies, we add several community infrastructure variables. The last two columns of Table 2 give the marginal

effects and coefficients of this model, which includes the distance to the nearest clinic and information on the presence of national and provincial roads. An increase in the distance to health clinics reduces the probability that a woman knows about HIV prevention methods. Presumably this reflects the role of health facilities in providing HIV prevention information[11], though it may also be the case that exposure to public health services makes individuals generally more sensitized to the benefits of learning about health and illness prevention. The coefficient on the presence of a national road in the commune is positive and significant, in keeping with the notion that transportation networks are a means by which outside influences and information spread. The inclusion of these community variables does not materially affect the estimates of individual variables and household assets. This is consistent with the results of the fixed effects model and confirms again the robustness of the key individual level coefficients in our models.

Determinants of not having common HIV/AIDS misconceptions

Tables 4 and 5 present results from probit models for not having misconceptions about HIV/AIDS transmission. The dependent variable equals 1 if the individual correctly answers the questions regarding possible infection status of healthy-looking people and the role of mosquito bites and kissing in HIV transmission. The results of the 'no misconception' models for the most part are qualitatively very similar to those for prevention knowledge presented above, so our discussion of these estimates can be brief. The large positive impact of education on the probability of avoiding misconceptions about AIDS is similar to its effects on prevention knowledge, and is consistent with other studies that have considered the

[11] Note that the services provided by local clinics in all or almost all cases probably do not include testing and counseling services, which were, and remain, rare in rural areas of the country,.

determinants of AIDS misconceptions (Gregson et. al. 1998; Ingham 1995; Vandermooretele and Delamonica 1999). An additional year of primary education raises the no-misconceptions probability in rural areas by 4.8 percentage points; for a year of post-primary schooling the effect is 4%. As with prevention knowledge, we find no significant rural-urban differences in the marginal effects either of primary education or post-primary education ($p=0.75$ and 0.74 respectively).

Table 4 Rural women 15-49: Determinants of having no common misconceptions about AIDS transmission (infection status of healthy- looking people, mosquito bites and kissing).

	No cluster fixed effect		With cluster fixed effect		With community covariates	
	Marginal effect	Coefficient	Marginal effect	Coefficient	Marginal effect	Coefficient
Age						
Age20_24	0.048	0.153** [2.19]	0.057	0.179** [2.40]	0.044	0.138** [1.94]
age25_29	-0.003	-0.009 [-0.10]	0.004	0.014 [0.15]	-0.006	-0.021 [-0.23]
age30_39	0.067	0.212** [2.50]	0.084	0.263*** [2.84]	0.066	0.208** [2.45]
age40_49	0.081	0.251** [2.38]	0.093	0.287** [2.50]	0.083	0.255** [2.39]
Education						
Years of primary education	0.054	0.178*** [5.86]	0.053	0.174*** [5.24]	0.057	0.187*** [6.11]
Years of postprimary education	0.045	0.147*** [3.83]	0.044	0.145*** [3.61]	0.046	0.150*** [3.82]
Education age interaction	0.000	-0.001 [-0.77]	0.000	0.000 [-0.47]	0.000	-0.001 [-0.91]
Listen to the radio every day	0.124	0.386*** [7.68]	0.115	0.360*** [6.57]	0.121	0.376*** [7.25]
Religion						
Islam	-0.187	-0.944*** [-6.07]	-0.103	-0.396* [-1.75]	-0.183	-0.901*** [-5.60]

Table 4 (Continued)

No religion	-0.120	-0.432*** [-5.82]	-0.115	-0.416*** [-4.60]	-0.120	-0.431*** [-5.45]
Traditional religion	-0.103	-0.389*** [-3.54]	-0.078	-0.285** [-2.44]	-0.101	-0.377*** [-3.59]
Province of residence						
Fianarantsoa	0.025	0.081 [0.75]	-0.138	-0.511** [-2.19]	0.041	0.130 [1.12]
Toamasina	0.111	0.335*** [3.31]	-0.007	-0.023 [-0.10]	0.125	0.374*** [3.31]
Majunga	0.177	0.515*** [4.64]	0.003	0.010 [0.04]	0.213	0.612*** [5.18]
Tulear	0.067	0.209 [1.52]	0.090	0.275 [1.07]	0.062	0.192 [1.31]
Antsir	0.440	1.194*** [9.68]	-0.085	-0.308 [-1.22]	0.436	1.183*** [9.66]
Relationship to the head						
Head	0.039	0.123 [1.58]	0.031	0.099 [1.19]	0.036	0.114 [1.43]
Daughter of head	0.038	0.122** [2.16]	0.049	0.156** [2.38]	0.031	0.099* [1.81]
Other relationship to the head	-0.048	-0.165* [-1.72]	-0.053	-0.183* [-1.72]	-0.053	-0.184* [-1.89]
Household asset index	0.097	0.319*** [4.53]	0.060	0.197** [2.12]	0.090	0.293*** [4.08]
Commune Characteristics						
Distance to clinic					-0.017	-0.055*** [-2.63]
Access to provincial road					0.012	0.039 [0.50]
Access to national road					0.061	0.197***

Table 4 (Continued)

			[2.83]
Constant	-1.466	-0.839	-1.585
	[-12.4]	[-3.83]	[-11.0]
	-	-	-
Log-likelihood	2212.12	2052.92	2112.73
Number of Observations	4669	4465	4472

"Standard errors are adjusted to account for correlations in across observations within clusters"

*Significant at 10%; **significant at 5%; ***significant at 1%

Table 5 Urban women 15-49: Determinants of having no common misconceptions about AIDS transmission (infection status of healthy- looking people, mosquito bites and kissing).

	No cluster fixed effect		With cluster fixed effect	
	Marginal effect	Coef.	Marginal effect	Coef.
Age				
Age20_24	-0.053	-0.134	-0.058	-0.147
		[-1.31]		[-1.36]
age25_29	-0.030	-0.076	-0.073	-0.182
		[-0.58]		[-1.30]
age30_39	0.011	0.029	-0.041	-0.103
		[0.24]		[-0.75]
age40_49	0.094	0.236	0.015	0.039
		[1.49]		[0.22]
Education				
Years of primary education	0.068	0.170***	0.051	0.127***
		[4.77]		[2.88]
Years of postprimary education	0.056	0.142***	0.050	0.125***
		[4.05]		[3.35]
Education age interaction	0.000	-0.001	0.000	-0.001
		[-1.09]		[-0.50]
Listen to the radio every day	0.089	0.225***	0.062	0.156**
		[3.00]		[1.97]
Religion	-0.296	-0.816***	-0.322	-0.879***
Islam		[-3.23]		[-3.07]
	-0.168	-0.428***	-0.236	-0.607***
No religion		[-3.23]		[-2.81]
	-0.380	-1.141***	-0.386	-1.116***
Traditional religion		[-3.77]		[-3.82]
Province of residence				
Fianarantsoa	-0.051	-0.128	-0.181	-0.458***
		[-0.68]		[-9.82]
Toamasina	0.106	0.269**	0.146	0.377***
		[2.18]		[8.63]
Majunga	0.139	0.354***	0.146	0.377***
		[3.09]		[8.63]
Tulear	-0.014	-0.034	-0.176	-0.446***
		[-0.23]		[-4.62]
Antsiranana	0.370	1.091***	0.406	1.322***
		[7.67]		[5.18]

Table 5 (Continued)

Relationship to head				
Head	0.007	0.018	-0.028	-0.071
		[0.16]		[-0.62]
Daughter of head	-0.001	-0.002	-0.044	-0.110
		[-0.02]		[-1.22]
Other relationship to the head	-0.005	-0.012	-0.061	-0.153
		[-0.13]		[-1.59]
Household asset index	0.009	0.024	0.002	0.004
		[0.83]		[0.12]
Constant		-0.976		-0.065
		[-6.07]		[-0.41]
Log- likelihood		-1362.61		-1278.75
Number of Observations		2370		2312

"Standard errors are adjusted to account for correlations in across observations within clusters"

*Significant at 10%; **significant at 5%; ***significant at 1%

Unlike with the previous outcome, the impacts of primary and post-primary education on the "no misconceptions" probabilities are not significantly different in either the rural (p=0.36) or urban (p=0.38) cases.

As with prevention knowledge, we find that: the level of the household's assets has a significant and positive effect on not having misconception about AIDS transmission, with larger marginal effects in rural areas than urban areas (p=0.062); daily listening to the radio is associated with greater knowledge with statistically equivalent effects in rural and urban areas (p=0.18); commune characteristics--distance to clinics and the presence of a national road--have similar positive effects as before; and inclusion of the cluster fixed effects has little impact on most of the household and individual covariate estimates.

However, a few differences are seen. In rural areas, age has increasing effects on the probability of not having misconceptions, rather than showing an inverted U

shape. In urban areas, interestingly, there is essentially no impact of age at all in the misconception models. Also, for both areas, the interaction of age and education is not significant. Finally, while there was no statistical difference between Christian and Muslims for prevention knowledge, all non-Christian categories, including Muslims, are more likely than Christians to have misconceptions about the transmission of HIV/AIDS.

Determinants of condom use

Table 6 presents estimates of the determinants of having ever used a condom for women in urban areas. Higher educational attainment, regular exposure to radio, and asset ownership are significant influences on condom use. Note for schooling that a year of primary has the same effect as a year of secondary (p=. 42). With regard to the asset index result, previous research from developing countries has found that higher income individuals are more likely to use condoms (Blanc, 2000; Filmer 1998, Carael, 1995). As noted, this may reflect a positive link between incomes and having multiple sex partners; an additional explanation would be that the cost of condoms discourages their use by poorer individuals. In the model without controlling for community fixed effects we see a positive and significant impact of assets on condom use, but the coefficient falls sharply and becomes completely insignificant in the fixed effects specification (last two cols. of Table 6; note this is in contrast to the robustness of the schooling and other estimates). Hence there may be unmeasured community level characteristics that both affect the probability of condom use and are correlated with level of wealth. It is likely, in particular, that the supply of condoms is highly variable across cities and towns throughout the country, a variability that in turn may be related to average levels of household economic status and other variables in the community.

While others have reported associations of condom use and the frequency of attending religious services (Gupta, 2000), we do not find any significant effect of religious affiliation, even though as seen above being Christian has a large positive impact on knowledge. The discrepancy may reflect the teachings of the church on contraception, or perhaps that Christians tend to have fewer sexual partners, hence less need for condoms. As in the other models, statistically there was no difference in the effects of being Catholic and Protestant. Spouses of the head (the left out relation category) have the lowest probability of condom use, indicating, unsurprisingly, that currently married women are less likely to have used condoms than single women.

We also ran the condom use model after redefining the dependent variable to equal 1 only where the woman reported using a condom for 'disease prevention'; i.e, not including contraceptive use. Only 4% of sexually active women in urban areas report having used a condom for this purpose. The results by and large are similar to the previous model, but post-primary schooling is no longer significant, suggesting that the effect of being well educated on overall condom use comes primarily through the contraception motive.

Table 6 Determinants of Condom Use in Urban Areas

	No cluster fixed effect		With cluster fixed effect	
	Marginal effect	Coef.	Marginal effect	Coef.
Age				
Age20_24	0.045	0.192	0.069	0.245
		[1.07]		[1.18]
age25_29	0.012	0.049	0.021	0.077
		[0.28]		[0.39]
age30_39	0.011	0.051	0.009	0.034
		[0.36]		[0.22]
age40_49	-0.021	-0.101	-0.048	-0.190
		[-0.58]		[-0.99]
Education				
Years of primary education	0.034	0.157***	0.032	0.122**
		[3.73]		[2.53]
Years of postprimary education	0.013	0.057***	0.014	0.053***
		[3.56]		[2.81]
Listen to the radio	0.048	0.222**	0.049	0.191
		[1.93]		[1.47]
Religion				
Islam	0.107	0.399	0.116	0.378
		[1.10]		[0.79]
No religion	-0.045	-0.225	-0.030	-0.117
		[-1.03]		[-0.42]
Province of residence				
Fianarantsoa	-0.040	-0.198	-0.087	-0.378***
		[-1.13]		[-5.82]
Toamasina	-0.009	-0.041	-0.106	-0.464***
		[-0.35]		[-6.25]
Majunga	0.002	0.011	-0.061	-0.253***
		[0.06]		[-4.45]
Tulear	0.010	0.047	-0.102	-0.461***
		[0.31]		[-4.55]
Antsiranana	0.022	0.095	-0.136	-0.692***
		[0.58]		[-8.29]
Relationship to the head				
Head	0.013	0.058	0.012	0.046
		[0.45]		[0.33]
Daughter of head	0.024	0.106	0.014	0.051
		[1.03]		[0.43]

Table 6 (Continued)

Other relationship to the head	0.011	0.048	-0.008	-0.029
		[0.37]		[-0.20]
Household asset index	0.017	0.075**	0.005	0.018
		[2.08]		[0.50]
Constant		-2.007		-1.299
		[-9.51]		[-5.96]
Log-likelihood		-774.31		-767.02
N		1898		1668

"Standard errors are adjusted to account for correlations in across observations within clusters"
*Significant at 10%; **significant at 5%; ***significant at 1%

Rural-urban gaps in knowledge controlling for education and wealth

The descriptive statistics presented at the start of this section revealed very large rural-urban disparities in knowledge of HIV prevention methods and in the prevalence of misconceptions about HIV/AIDS. To what extent to these gaps remain once we take into account differences by location in schooling and other covariates? To assess this, we calculated predicted rural and urban probabilities using the rural and urban parameter estimates and the pooled (rural and urban) sample mean values of all regressors. Variances of the predicted probabilities were derived using the delta method. Knowledge of HIV prevention methods remains higher in urban and rural areas even controlling for differences in regressors ($p<.001$). However, the gap in the predicted probabilities is only 10%, or about one-third the difference in the mean values in Table 1. For the misconception case, the predicted rural-urban difference is similarly dramatically reduced relative to the uncontrolled means. The observed mean difference is about 24%, and only 4% of the difference is due to being rural or urban. Here the difference is not even statistically significant ($p=.20$).

These comparisons suggest that women in rural areas lack appropriate knowledge of HIV/AIDS not because of (or only because of) where they live, but

because of their characteristics, namely their low levels of schooling and income. This does not change the imperative of targeting rural populations for information campaigns. However, such programs need to be tailored to account for the lack of education and resources of the audience rather than simply transplanted from urban environments. To take one possible example, information dissemination based around health or maternity clinics may be ineffective for poor rural women who rarely visit such facilities.

CHAPTER 5

CONCLUSIONS AND POLICY IMPLICATIONS

We have analyzed the determinants of knowledge regarding HIV/AIDS prevention and of common misconceptions about virus among women in rural and urban areas of Madagascar, as well as the determinants of condom use among women in urban areas. Among the factors considered, education plays a key role in shaping HIV knowledge and behavior, in keeping with finding from many other studies. In Madagascar the education effects, especially for primary schooling, are large. Our estimates imply that in both rural and urban areas a woman with a completed primary education is twice as likely as a woman with no schooling to know one or more means of HIV prevention.

With respect to methodology, this study has gone beyond most previous studies of the determinants of HIV related knowledge and behavior to assess the role, not just of individual and household factors, but also of community level characteristics. Proximity to health facilities and roads in rural areas increase HIV/AIDS knowledge. This is useful information from a policy perspective, but in methodological terms as well the results should be of some interest to others working in this area. We find that the estimates on key individual level factors (education, age) do not appear to be significantly biased in estimations that lack community controls. This was confirmed in alternative specifications including community fixed effects.

The results indicate that regardless of location (urban or rural) factors such as schooling and wealth matter for in accessing or understanding information about HIV/AIDS. It is therefore important to target the less educated and poorer part of the population in campaigns against AIDS rather than simply focusing on urban or rural status. This implication was confirmed by comparisons of predicted probabilities of having HIV prevention knowledge or having no common misconceptions that controlled for differences in individual or household characteristics.

The very large gap in HIV knowledge between those with and those without an education presents several challenges for policymakers. One answer to increasing awareness of AIDS prevention, of course, is to increase the level of education in the population. Enrollments have been on the rise in recent years in Madagascar (See Glick and Razakamanantsoa 2001). Clearly, however, this is a long-term solution. Illiteracy remains high in Madagascar (some 25% of women in the DHS have had no formal instruction) so there is a clear need for public information campaigns to reach those without schooling or with very little schooling. Our estimates are consistent with the less educated having less access to sources of information and/or the ability to process or act on this information. If both factors are operative, the challenge is to devise mass media and other campaigns that both reach the less education and that contain messages that are easily understood; obviously the sources of HIV information available at the time of the DHS were failing on one or both counts.[12]

Further, the integration of sexual education and health programs into school curricula will be an important means of imparting HIV information to the young. The

[12] To the extent that the less educated are also less likely to engage in high risk behavior (e.g., multiple partners) and to live in areas where prevalence is very low, the urgency of targeting this group as opposed, say, to more sexually active urban groups is somewhat lessened. The next round of the DHS in Madagascar will provide information on sexual and risk behaviors that will help address these questions.

most likely place to do this would seem to be secondary (lower and upper) school, but in very poor countries like Madagascar secondary enrollments are often very low – currently less than a fifth of secondary age Malagasy children attend secondary school (See Glick and Razakamanantsoa 2001). Secondary school-based programs thus may increase the knowledge gap between the educated and uneducated (a divide that closely mirrors that between non-poor and poor). To have an impact in terms both of coverage and reducing educational and income disparities, in school programs would need to begin at the primary level. Even at this level, however, a non-trivial share of poor rural children would be missed through non-enrollment and very high dropout rates prevailing in the country.

Conditional on caveats regarding simultaneity issues, our results suggest that spreading information via radio broadcast may be highly effecting at increasing HIV/AIDS knowledge, especially in rural areas where there are fewer alterative sources of information. It also is a means of reaching the illiterate or poorly educated who could not be reached through other media or the formal health care system. Finally, the descriptive and econometric results also indicate large disparities in knowledge by region (province). Hence there is a need to target AIDS education efforts geographically beyond the broad cut of rural vs. urban location. Some of these regional discrepancies may reflect cultural or ethnic differences that public campaigns must incorporate.

While our study presents new and unique findings that are of relevance both to researchers and policymakers in Madagascar and elsewhere in sub-Saharan Africa, we are unable to investigate one very important issue: how knowledge and behavior is changing over time (if at all), and the determinants of these changes. Understanding

which groups—by for example, age, location, and education—are gaining knowledge fastest and or adjusting their behavior the most, and which are lagging behind, is of great importance for policy. Analysis on upcoming rounds of the Madagascar DHS will allow us to address these questions.

APPENDIX

Sample Characteristics	Rural (N = 4684)		Urban (N = 2376)	
	Means	Standard deviation	Means	Standard deviation
Age	0.217	0.412	0.228	0.420
Age15_19	0.188	0.391	0.187	0.390
Age20_24	0.172	0.377	0.163	0.370
age25_29	0.267	0.443	0.252	0.434
age30_39	0.156	0.363	0.170	0.376
age40_49				
Education	2.468	1.929	3.745	1.785
Years of primary education	0.445	1.250	2.137	2.780
Years of post primary education	0.303	0.460	0.636	0.481
Listen to the radio every day				
Religion	0.707	0.455	0.876	0.329
Christian	0.007	0.082	0.008	0.089
Islam	0.231	0.422	0.102	0.303
No religion	0.055	0.228	0.013	0.115
Traditional religion				
Province of residence	0.296	0.457	0.444	0.497
Antananarivo	0.231	0.421	0.132	0.338
Fianarantsoa	0.144	0.352	0.138	0.345
Toamasina	0.126	0.332	0.107	0.309
Majunga	0.127	0.333	0.118	0.322
Tulear	0.076	0.264	0.062	0.240
Antsiranana				
Relationship to the head	0.580	0.494	0.477	0.500
Spouse of head	0.109	0.311	0.112	0.316
Head	0.211	0.408	0.256	0.437
Daughter of head	0.099	0.299	0.151	0.358
Other relationship to the head	-0.283	0.440	0.722	1.354
Household asset index				
Commune Characteristics	1.113	6.874		
Distance to clinic (km)	0.437	0.496		
Access to provincial road	0.352	0.478		
Access to national road				

* Sample of sexually active women

REFERENCES

Becker, G. 1993, *Human Capital: A Theoretical and Empirical Analysis with Special Reference to Education*, 3rd Edition, The University of Chicago Press.

Becker, S., Ashraf, L. 1997, Husband-Wife Communication on Family Planning and Couple's Current Contraceptive Use in Kenya. *International Family Planning Perspectives*, 23(1): 15-20.

Blanc, A.K., 2000, The relationship between sexual behavior and level of education in developing countries. Report prepared for UNAIDS.

Blanc, A.K., Wolff, B., Gage, A.J., Ezeh, A.C., Neema, S. and Ssekamatte-Ssebulbe, J., Calverton, MD, 1996, *Negotiating Reproductive Outcomes in Uganda*. Macro International Inc, and Institute of Statistics and Applied Economics (Uganda).

Boerma, J., Urassa, M., Nnko, S., Ng'weshemi, J., Isingo, R., Zaba, B., and Mwaluko, G., 2002, *Sociodemographic context of the AIDS epidemic in a rural area in Tanzania with a focus on people's mobility and marriage* STI 2002; 78: i97-i105.

Carael, M., 1995, *Sexual Behaviour and AIDS in the Developing World,* J. Cleland and B. Ferry, eds. *Academy Press*, Washington, D.C. 1996.

Calverton, MD, Macro International 1998, Madagascar Demographic and Health Survey 1997, Macro International Inc.

De Walque, D., 2002, *How Does the Impact of an HIV/AIDS Information Campaign Vary with Educational Attainment? Evidence from Rural Uganda*. University of Chicago.

Filmer, D., 1998, *The socioeconomic correlates of sexual behavior: A summary of results from an analysis of DHS data.*

Focus Development Association, 2000, *Comportement des jeunes en matière de sexualité*. Madagascar.

Gersovitz, M., 2000, HIV epidemic as seen through the Demographic and Health Surveys. Report for the CSAE Conference, Oxford University, 4/9-10/00.

Gersovitz, M., Jacoby, H., Seri Dedy, F., and Goze Tape, A., 1998, The Balance of Self- Reported Heterosexual Activity in KAP Surveys and the AIDS Epidemic in Africa, *Journal of the American Statistical Association*, vol. 93, pp. 875-883.

Glick, P., Sahn, D., 2004, *Changes in HIV/AIDS Knowledge And Testing Behavior In Africa: How Much and for Whom?* Cornell University Food and Nutrition Policy Program Working Paper #168, Ithaca, NY. http://www.cfnpp.cornell.edu

Gregson, S., Zhuwau, T., Anderson, R.M., Chandiwana, S.K. 1998, *Is there evidence for behaviour change in response to AIDS in rural Zimbabwe?* Social Science and Medicine. Vol.46. No.3: 321-330.

Gupta, N., 1999, *Adolescent fertility behavior: Trends and Determinants in Northeastern Brazil*. Family Planning 1999; 25[3]: 125-130.

Gupta, N., 2000, *Sexual initiation and contraception use among adolescent women in Northwest Brazil.* Family Planning 2000; 31[3]: 228-238.

Gwatkin, D.R., Deveshwar-Bahl, 2001, *Inequalities in knowledge of HIV/AIDS prevention: An overview of socio-economic and gender differentials in developing countries.* World Bank. Study for the Population Services International.

Ingham, R, 1995, *AIDS: knowledge, awareness and attitudes. Sexual Behaviour and AIDS in the Developing World*. J. Cleland and B. Ferry, eds. Taylor and Francis, London.

Direction Generale de la Jeunesse, Madagascar 1999, *Rapport sur les Enquetes CAP (Connaissances, Attitudes, Pratiques) sur la Santé de la Reproduction des Adolescents.* Ministère de la Jeunesse et des Sports – Direction Generale de la Jeunesse, Madagascar, FNUAP.

Gonzales, G., Ranorolalao, E., Ravalondrazana, C, 1998, *Evaluation des Activités d'IEC sur les MST/SIDA auprès des Jeunes de 10 à 29 ans des Régions de Toliary et de Toamasina*. PNLS (Programme National de Lutte contre les MST et le SIDA).

Kruse, N., Behets, F., 2001, *Recherches opérationnelles conduite à Diégo-Suarez pour ameliorer la prévention et la prise en charge des IST chez les travailleuses du sexe à Madagascar.* Ministry of Health, Family Health International, Population Council USAID, Madagascar.

Lawrance, Emily, 1991, Poverty and the Rate of Time Preference: Evidence from Panel Data, *Journal of Political Economy,* 99 [3]: 54-77.

Martin, T., Juarez, F., 1994, Women's Education and Fertility in Latin America: Exploring the significance of education for women's lives, *DHS Working Paper*, No.10. Macro International Inc, Maryland.

Medecins du Monde, 2001, *Lutte contre les MST/SIDA dans les villes d'Antananarivo et Tuléar*. Programme National de Lutte contre les MST et le SIDA.

Medecins Sans Frontières, 1999, *Etudes qualitatives des connaissances, croyances et comportements, en matière de MST/SIDA.*

Messersmith, L.J., Kane, T., Odebiyi, A. and Adewuyi, A., 1994, *Patterns of sexual behaviour and condom use in Ile-Ife, Nigeria: implications for AIDS/STD prevention and control.*

Pact Madagascar, 2002, *Analyse et recommendations sur la capacités des organisations de la societé civile face à la lutte contre le VIH et le SIDA*.

Paternostro, S., Razafindravonona, J. and Stifel, D, 2001, *Changes in poverty in Madagascar: 1993-1999,* Cornell University Food and Nutrition Policy Program Working Paper 120, Cornell University Ithaca, NY.
http://www.cfnpp.cornell.edu/images/wp120.pdf

Projet Multisectoriel de Prévention des IST/SIDA, 2002, *Plan Strategique National 2001-2005*. Projet Multisectoriel de Prévention des IST/SIDA - Madagascar.

PSI (Population Services International), 2001, *Connaissances, Attitudes, Pratiques des jeunes de 15 a 24 ans de Tamatave en matière de planification familiale, de prévention et de traitement des IST/SIDA*, PSI Madagascar.

Rafalimanana, A., Randrianantoandro, S., Andriamahenina, R., Ravelo, A., Razafimandimby, J., 2002, *Rapport d'études sur les comportements, attitudes et pratiques liés à la sexualité, les maladies IST/VIH/SIDA des hommes et des femmes de 18 à 49 ans travaillant dans les zones franches d'Antananarivo et d'Antsirabe.*

Ravaozanany, N., Rabenoro, M., Razafindrabe, L., 2002, *Genre et comportement sexuel*. PMPS, World Bank, Madagascar.

Sahn, D. and Stifel, D., 2003 *Exploring Alternative Measures of Welfare in the Absence of Expenditure Data*, Review of Income and Wealth 49(4): 463-489

Joint United Nations Programme on HIV/AIDS (UNAIDS), 2002, report on the global HIV/AIDS epidemic, UNAIDS/02.26E: 190-201

United Nations, 2001, *HIV/AIDS: Awareness and behavior*. New York, United Nations.

USAID Population, Health and Nutrition Programs/HIV/AIDS Division, and IMPACT (Implementing AIDS Prevention and Care Project), 1999, Key Talking Points: Madagascar and HIV/AIDS.

Vandemoortele, J.J., Delamonica, E.E, 1999, *AIDS Conspires Against the Poorest*. New York, UNICEF.

WHO (World Health Organization) 2001, Department of Reproductive Health and Research (RHR), *Programming for male involvement in reproductive health.* Report of the meeting of WHO Regional Advisers in Reproductive Health.