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HIV/AIDS Knowledge and Sexual Behavior of Female Young Adults in the Philippines

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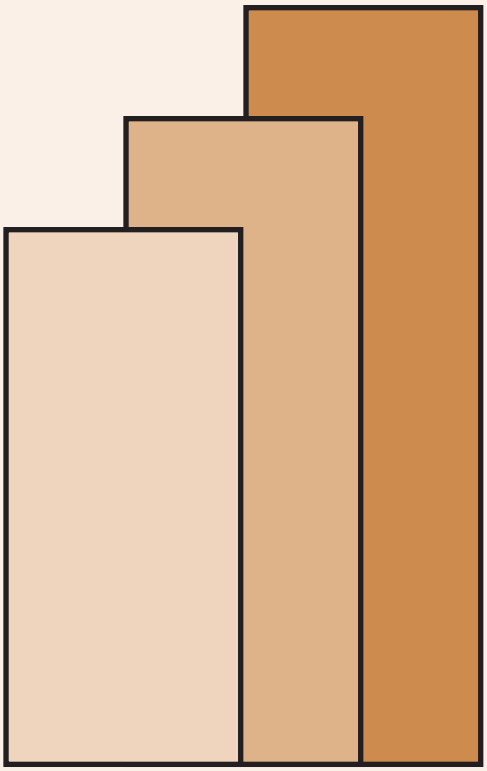

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Abstract

The impact of sex education on various behavioral outcomes has been well-studied in the literature. However, these studies fail to account for the simultaneity between knowledge demand and sexual behavior, leading to inconsistent effect estimates using simple comparison of means from randomized control interventions. A theoretical model of sexual behavior and STI information demand is proposed to motivate the discussion. We show that the effect of STI knowledge on sexual behavior depends on how information affects the expected cost from sexual activity. We provide empirical evidence using Philippine data that increasing HIV/AIDS knowledge delays sexual initiation, limits sexual activity, and increases condom-use among some sub-population of female young adults.

JEL Code: I12, I21
Keywords: Health behavior, Sex education

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1 Introduction

Reproductive health issues, including government-sponsored mandatory sex education, have always been a contentious issue in Catholic-majority Philippines. While artificial family planning methods have been introduced in the country through various government programs since the 1960s (Herrin 2007), it was not until in 2012 that legislation mandating comprehensive reproductive health services was passed in Congress. Supporters of the legislation underscore the expected benefits from a nationwide family planning program, including reduced exposure to sex-related risks and unwanted pregnancy. In contrast, critics, in addition to their moral objections, claim that family planning programs, especially mandatory comprehensive sex education, lead to earlier sexual initiation and higher rate of sexual activity among young adults.

Theoretical and empirical studies available in the literature support both these competing claims. For instance, Oettinger (1999), and Tremblay and Ling (2005) show how stochastic ordering of agents' discounted expected utility from abstinence and sexual activity lead to different sexual behaviors in response to increased information. Recent empirical evidence in the literature support a more positive view of sex education on young adult behavior, while those using results from earlier sex education programs have more cautious interpretations. For instance, Fonner et al. (2014) reviewed 64 studies in low- and middle-income countries and found that students who received school-based sex education interventions have greater HIV knowledge, higher propensity of condom use, and fewer sexual partners, among others. Abstinence-only interventions appear to be not as effective however in shaping precautionary sexual behavior compared to comprehensive school-based sex education (Fonner et al. 2014; Kirby 2008). On the other hand, Oettinger (1999) showed that US teens who were enrolled in sex education classes in the 1970s and 1980s have earlier sexual initiation on average. Ku et al. (1992), using a 1988 nationally representative survey of never-married teenage men living in the United States, found that enrollment in sex education classes is associated with higher knowledge and better attitude about AIDS, but is not always correlated with safer sexual behavior.

This research attempts to weigh in on this policy question in the Philippines using a nationally representative survey of reproductive-aged women in the country. While the effects of sex education programs in the Philippines have been documented in the literature, the programs that had been studied were specific small-scale interventions, and were not geared towards young adults, in particular, but to high-risk populations (Morisky et al. 2004, 2005, 2006).[1] Results of our analysis show that

[1] An exception is the study by Aplasca et al. (1995) on high school students

increasing HIV/AIDS knowledge delays sexual initiation, limits sexual activity, and increases condom-use among some sub-population of females.

While the conclusions drawn from the analysis are not very different from other recent studies, this paper departs from the literature in a number of directions. First, a theoretical model of precautionary health investment and demand for health information is proposed to motivate the discussion. Unlike in the models by Oettinger (1999) and by Tremblay and Ling (2005), which derive their results by incorporating stochasticity in pregnancy or in sexually transmitted disease (STD) status, the results of this paper's theoretical model are driven by the uncertainty of information regarding the treatment costs of sexually transmitted infection (STIs). While fecundability is stochastic, its ordering is more or less constant over the menstrual cycle (Colombo and Masarotto 2000), and appears predictable over season (Lam et al. 1994) and age (Wood and Weinstein 1988). A similar argument may be made of STD contraction. Policy-wise, programs targeting variability of information related to sexual risks could be more tractable as fecundability is largely nature-driven.

Second, a weakness in the identification strategy used in randomized control studies is highlighted. If knowledge and behavior are simultaneously determined then simple comparison of means does not provide a consistent estimate of the effect of sex education on sexual behavior even if interventions are randomized. An instrumental variable strategy to identify the effect of increased knowledge, brought about by positive interventions, on sexual behavior is proposed instead.

The rest of the paper is organized as follows. In the next section, we outline a simple model of sexual behavior and analyze the effect of increasing information on expected sexual behavior. In Section 3, we highlight a possible inconsistency in treatment effect estimates from randomized control trials when outcomes are simultaneously determined, and propose an alternative strategy to estimate the effect of knowledge on sexual behavior. We likewise present the data used in our analyses in this section. In Section 4, we discuss our estimation results. Finally, we summarize the results and provide a conclusion in the last section.

2 Theory

In this section, we propose a theoretical model that captures the relationship between sex education and sexual behavior among individuals. Unlike in the earlier models by Oettinger (1999) and by Tremblay and Ling (2005), we explicitly account for the simultaneity between the demand for information about STIs and the degree of protection acquired against such diseases. Similar to these earlier studies, we show that the relationship between sex education and sexual behavior varies with how additional information affects the expected net benefits of sexual intercourse. Following Oettinger (1999), we narrowly define sexual activity to include only intercourse. We likewise abstract from the more complex issues of STI coinfections, pregnancy risk, and interdependence of utility between partners.

Consider a one-shot mating market. An individual will engage in sexual activity if the expected utility of intercourse, denoted by $E[V_1]$, is greater than that to be gained from abstinence, denoted by V_0. For simplicity, we will initially assume that there exists a market that pools all individuals wanting to engage in intercourse, and match the individuals by pairs randomly. We will relax this assumption

later when we introduce a market for STI information.

Suppose in this simple mating market that an STI-free individual is at risk of being infected with some probability θ. If an individual gets infected, (s)he pays $p = \overline{p}e^{-x}$ for STI treatment, where x is drawn from a zero-mean normal distribution with variance given by σ^2. In the real world, random variation in treatment costs may arise for instance from differences in severity of STI, preference over treatment regimes, etc., which the individual does not observe until (s)he contracts STI.

As precautionary measure, an individual may invest on a health device I priced at s per unit to reduce his (her) exposure to the disease by $f(I)$, where f is assumed to be a sigmoid function, at least twice differentiable and increasing in I. In addition, we likewise assume that $f(0) = 0$ and $\lim_{I\to\infty} f(I) = 1$ to ensure that $f(I)$ is bounded between $[0, 1]$, and to characterize the nature of investing in the health device at the limit. An individual may also buy STI information K, priced at r per unit, which lowers the expected cost, as well as reveals the true cost, of treatment. Information lowers expected costs of STI by improving treatment efficiency. Alternatively, with more information, individuals may be able to segment the mating market, allowing them to identify and engage in a submarket where the risk of infection is lower. With $K \geq 0$, the cost of STI treatment is given by $\overline{p}e^{-(g(K)+xh(K))}$, where $g(K)$ and $h(K)$ are concave functions, with $g, h \geq 0$, $g' > 0$, $g(0) = 0$, $h' < 0$ and $\lim_{K\to\infty} h(K) = 0$. The functions $g(K)$ and $h(K)$ correspond to the risk-altering and risk-revealing roles of sex education, respectively, that have been identified in the literature (Oettinger 1999; Tremblay and Ling 2005).

Suppose w is the money-metric indirect utility derived from sexual intercourse devoid of any costs associated with STI treatment and precautionary investments. The expected utility from sexual activity may thus be expressed as

$$E[V_1] = w - rK - sI - \theta \int [1 - f(I)]\overline{p}e^{-(g(K)+xh(K))}dx \tag{1}$$

The individual's maximization problem may be seen as a two-stage process. First, the individual maximizes his (her) expected utility from sexual intercourse (1) by choosing the level of precautionary investment I and STI information K, subject to prevailing prices and STI risk. Second, the individual then compares the expected utility from sexual intercourse with that from abstinence, and decides to forego abstaining whenever $E[V_1] > V_0$.

Approximating the above expected utility by a second-order Taylor expansion around $E[x] = 0$, it is trivial to show that any internal solution from maximizing $E[V_1]$ by selecting K and I requires the following Euler condition to hold.

$$\frac{f'(I)}{1 - f(I)} = \frac{s}{r}\frac{2g'(K) - 2h(K)h'(K)\sigma^2 + g'(K)h(K)^2\sigma^2}{2 + h(K)^2\sigma^2} \tag{2}$$

The right-hand side of the equation captures the additional reduction in exposure to STIs brought about by the additional precautionary investment on health device I, captured by the expression $f'(I)$, conditional on current exposure risk, given by $1 - f(I)$. The left-hand side of the equation is composed of two factors: the price ratio of investing in I relative to purchasing K, and the change in treatment costs arising from obtaining additional STI information.

From the Euler condition (2), we can infer the theoretical relationship between the demand for STI knowledge and for sexual risk-altering device as follows

$$\frac{\partial I}{\partial K} = \frac{s}{r}\beta(I)\varphi(K,\sigma^2) \tag{3}$$

where

$$\beta(I) = \frac{(1-f)^2}{(1-f)f'' + f'^2} \tag{4a}$$

$$\varphi(K,\sigma^2) = \frac{g''\gamma_1 - h'^2\gamma_2 - h''\gamma_3 - g'h'\gamma_4}{\gamma_5} \tag{4b}$$

$$\gamma_1 = 4 + h^4\sigma^4 + 4h^2\sigma^2 \tag{4c}$$

$$\gamma_2 = 4\sigma^2 + 6h^2\sigma^4 \tag{4d}$$

$$\gamma_3 = 4h\sigma^2 + 2h^3\sigma^4 \tag{4e}$$

$$\gamma_4 = 2h\sigma^2 + h^3\sigma^4 \tag{4f}$$

$$\gamma_5 = (2 + h^2\sigma^2)^2 \tag{4g}$$

The above equation is instructive of how sexual behavior may change with additional STI knowledge. We may decomposte the above relationship as the confluence of three factors: the relative-price effect, the risk expsoure effect, and the treatment cost effect. The relative-price effect, s/r, captures the contribution of differences in prices between obtaining STI information and changing sexual behavior, in this case buying a device that lowers STI exposure. The risk exposure effect, $\beta(I)$, on the other hand, captures the indirect impact of having more STI knowledge on the risks of contracting STI. These two factors, by construction, are both always positive.

The last factor, $\varphi(K,\sigma^2)$, describes how obtaining more STI knowledge changes the cost of STI treatment, which may be decomposed further as the sum of three factors: the risk-altering, the risk-revealing, and the interaction effects of STI information on sexual behavior. Note that by construction the factor $g''\gamma_1$ is strictly negative, while the factor $-g'h'\gamma_4$ is always positive. The factor $-h'^2\gamma_2 - h''\gamma_3$, on the other hand, may either be positive or negative depending on the steepness and the concavity of $h(K)$, and the related weights γ_2 and γ_3.

Suppose additional STI information is purely risk-altering, i.e., $xh(K) = 0$, implying either $h(K) = 0$ for any K, $\sigma^2 = 0$, or both, then $\varphi(K,\sigma^2) < 0$. With $f(I)$ being a sigmoid function, when initial health investments are low enough, i.e., on the convex portion of $f(I)$, then precautionary investments against STI by individuals decrease with every additional unit of STI information they acquire since investing in risk-altering technology is a relatively cheaper response to STI threat. When initial health investments are high, i.e., on the concave portion of $f(I)$, then an additional unit of STI information increases precautionary health investments since closing the last units of STI risk is more cost effective when the two technologies are combined together. When information is also risk-revealing, the factor $\varphi(K,\sigma^2)$ can either be positive or negative, depending on the saliency of the risk-altering, the risk-revealing, and the interaction effects.

3 Data and Empirical Strategy

3.1 Estimation

The Euler condition (2) for an internal solution presented in the previous section highlights the simultaneity between the demand for both STI information and prevention among sexually active individuals. Failure to account for such simultaneity in estimating the impact of sex education on sexual behavior may result in biased effect estimates, even if interventions are randomly assigned.

Consider the following system of equations capturing the (linearized) relationship between STI information and precautionary sexual behavior

$$I_i = \alpha_0 + \alpha_1 K_i + u_i \tag{5a}$$

$$K_i = \delta_0 + \delta_1 I_i + \tau T_i + v_i \tag{5b}$$

where (I, K) refers to the precautionary investment-knowledge bundle of individual i. The model residuals (u_i, v_i) are assumed to be uncorrelated and have zero means. Suppose assignment to a sex education intervention $T = \{0,1\}$, with $T = 1$ being the intervention group, is randomly assigned, such that potential outcomes are independent of treatment level assignment. Suppose further that sex education directly affects acquisition of information only. It can be shown that the intervention may also impact precautionary sexual behavior – although only indirectly – through the intervention's effect on the level of STI information acquired by the individual.

Simple comparison of means using the above set-up does not capture the impact of sex education interventions on sexual behavior and on STI knowledge. Instead, the simple differences of means estimate the following:

$$E[I_i|T_i = 1] - E[I_i|T_i = 0] = \frac{\alpha_1 \tau}{1 - \alpha_1 \delta_1} \tag{6a}$$

$$E[K_i|T_i = 1] - E[K_i|T_i = 0] = \frac{\tau}{1 - \alpha_1 \delta_1} \tag{6b}$$

Although the effect of the intervention of sex education on demand for precautionary investments and for STI information may not be recovered directly from the simple comparison of means, the effect of STI information on sexual behavior may be consistently estimated using the Wald estimator (Wald 1940; Durbin 1954)

$$\alpha_1 = \frac{E[I_i|T_i = 1] - E[I_i|T_i = 0]}{E[K_i|T_i = 1] - E[K_i|T_i = 0]} \tag{7}$$

provided that sex education significantly affects the acquisition of STI information, i.e, $\tau \neq 0$.

3.2 Data

We examine the effect of STI information on the sexual behavior of female young adults in the Philippines using the 2008 Philippine National Demographic and Health Survey (NDHS) implemented by

the National Statistics Office [Philippines] and ICF Macro (2009). The NDHS is a nationally representative survey designed to provide information on population, family planning, and health. The Women's Questionnaire, which is given to women aged 15 to 49 years, was used to collect information on women's socio-economic characteristics, reproductive history, knowledge and use of family planning methods, marriage and sexual activity, fertility preferences, and awareness and behavior regarding HIV/AIDS.

An HIV/AIDS knowledge score is used as measure of STI knowledge by individuals. The score is derived by summing seven Yes/No questions on perceived symptoms and modes of contraction of HIV/AIDS. Each item is scored as 1 if the respondent's answer to the question is correct, -1 if incorrect, and 0 if the respondent did not provide an answer. Sexual behavior is measured using four indicators: (a) indicator variable for being sexually active in the past month, (b) age at sexual initiation, (c) indicator variable for having non-marital or non-cohabitating partner in the past year, and (d) indicator variable for having used condom during the last sexual intercourse. The last three sexual behavior measures correspond to the ABC of STD Prevention, i.e. (a) Abstinence, (b) Being faithful, and (c) Condom-use, developed in response to growing HIV/AIDS infection cases especially in the early 1990s (Green 2003).

Socio-economic and demographic variables are used to control for possible confounding influences on sexual behavior. Respondent's age, age-at-menarche, and marriage status are used to control for physical development, sexual awareness and cohort effects. Ahituv et al. (1996), for instance, find that age is negatively related with condom-use, probably reflecting higher demand for procreation, as well as for less high-risk transitory sexual relationships, later in the lifecycle. Menarche marks a shift to physical maturity, as well as cultural transition into adulthood (Uskul 2004). The effect of other socioeconomic factors found in the literature to be correlated with young adult sexual behavior (Burk et al. (1996); Santelli et al. (2000); Dodoo et al. (2007)), including migration, childhood residence, racial group and religion, are likewise controlled for in the econometric models. Urban status of childhood residence, ethnolinguistic group and religion of respondents are included in the survey. Migration status is proxied by the proportion of the respondent's lifetime lived in their place of residence at the time of the survey.

The analyses are limited to females aged 15 to 29 years to coincide with the legal definition of youth in the Philippines. Although the average age at sexual initiation of female young adults (Table 1) is much later than in many developed and developing countries[2], condom-use among those sexually active is low. Average HIV/AIDS knowledge score is +3 points (implying an average of about two incorrect answers out of seven questions). It is notable that while point estimates of the average HIV/AIDS knowledge score increases with age and with household wealth, the reverse is true for estimates of the statistical spread in knowledge among the sub-groups, possibly indicating some convergence in HIV/AIDS knowledge as respondents transition along these two dimensions.

[2]See for instance Bozon (2003) for recent estimates of age at sexual initiation in different countries

Table 1: Summary statistics

	All groups		Age group						Household Wealth			
			15-19		20-24		25-29		Low		High	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Sexually active in past month	0.34	0.47	0.09	0.28	0.41	0.49	0.59	0.49	0.42	0.49	0.23	0.42
Age at sexual initiation	19.00	3.01	16.22	1.56	18.48	2.23	20.01	3.25	18.53	2.88	19.91	3.04
Had higher-risk sexual intercourse in past year	0.07	0.25	0.15	0.36	0.08	0.28	0.04	0.20	0.03	0.18	0.14	0.35
Had used condom in last sexual intercourse	0.03	0.16	0.02	0.14	0.02	0.15	0.03	0.17	0.01	0.12	0.05	0.22
Age	21.44	4.40	16.90	1.44	21.97	1.42	26.98	1.41	21.49	4.49	21.39	4.29
Age at menarche	13.01	1.45	12.85	1.27	13.04	1.50	13.19	1.60	13.20	1.47	12.78	1.39
Education (years)	10.64	4.31	9.27	3.09	11.63	4.56	11.46	4.93	9.21	3.88	12.48	4.14
Household wealth index score	0.55	0.24	0.56	0.24	0.57	0.24	0.53	0.24	0.38	0.16	0.78	0.10
Proportion of lifetime living in current residency	0.59	0.43	0.69	0.41	0.55	0.43	0.50	0.41	0.64	0.42	0.54	0.43
District representative voted for HB 5043 (2008)	0.09	0.29	0.10	0.30	0.09	0.28	0.09	0.29	0.10	0.30	0.08	0.27
HIV-AIDS knowledge score	3.14	2.77	2.85	2.80	3.33	2.75	3.31	2.73	2.72	2.77	3.67	2.69

Note: Estimates are not weighted by population. Age at sexual initiation is conditional on sexual initiation. Condom-use and risky sexual intercourse are conditional on being sexually active during the relevant period. Low wealth households refer to households in the poorest three quintiles of the wealth index. Estimates by household wealth refer to population aged 15 to 24 years only.

To recover the parameters in (7), HIV/AIDS knowledge score is instrumented with district representatives's votes on House Bill (HB) 5043 or the proposed "Reproductive Health and Population Development Act of 2008" filed in the House of Representatives of the 14th Congress of the Philippines. HB 5043 seeks to provide universal access to medically safe, legal and quality health care services and information concerning reproductive health, including the provision of mandatory age-appropriate Reproductive Health Education starting from Grade 5 and the re-classification of various types of contraceptives as essential medicines and supplies under the National Drug Formulary.

Plenary vote on HB 5043 may be seen as aggregators of information in the electoral district that the vote represents, thus should be correlated with HIV/AIDS knowledge. However, this could violate the exogeneity assumption between our outcomes of interest and the instrument. A stronger assumption is thus required to identify the knowledge effects on sexual behavior. Suppose behavioral outcomes and district representative vote are independent conditional on added covariates, denoted by X_i, then (7) may be reformulated as

$$\tilde{\alpha_1} = \frac{E[I_i|T_i = 1, X_i] - E[I_i|T_i = 0, X_i]}{E[K_i|T_i = 1, X_i] - E[K_i|T_i = 0, X_i]} \tag{8}$$

An important strand of literature on legislative voting behavior proposes two types of representation. "Delegates" vote according to what the district population it represents wants, while "Trustees" use their personal judgment. In the US, for instance, legislative votes have been documented to be largely based on politicians' ideological persuasion (e.g. Kalt and Zupan (1984); Kau and Rubin (1979); Poole and Rosenthal (1996, 2007)), although pressure from local constituency and support coalitions may also be instrumental, especially when future election success is uncertain (e.g. Coates and Munger (1995); Kalt and Zupan (1984)).

If district representatives are trustees, then HB 5043 votes are independent of sexual behavior thus (7) would be enough to identify the effect of STI information on sexual behavior. On the other hand, if representatives are delegates and that plenary votes are random upon conditioning on the characteristics of the people it represents, then (8) would provide a consistent estimate of the effect of having higher levels of STI information.

3.3 Cross-study comparison

To benchmark our estimates relative to other studies, we also estimate (7) using standardized estimates of (6a) and (6b) reported in the meta-analytic study by Fonner et al. (2014) on the impact of school based sex education in low- and middle-income countries. Their study is part of a large systematic review and meta-analysis project by investigators at the Medical University of South Carolina and the Johns Hopkins Bloomberg School of Public Health, reviewing the efficacy of behavioral HIV prevention intervention in developing countries. The review by Fonner et al. (2014) follows standard systematic review and meta-analysis procedures by the Preferred Reporting Items for Systematic Reviews and Meta-analysis (PRISMA) guidelines (Moher et al. (2009)).

While Fonner et al. (2014) also analyzed the impact of sex education on the number of sexual partners and on initiation of sex, our analyses focus only on the effect of HIV/AIDS knowledge on

condom-use and self-efficacy related to HIV prevention, in which they reported estimates for both HIV/AIDS knowledge and sexual behavior in at least five studies. Fonner et al. (2014) standardized the impact estimates from different studies using Hedge's G for HIV/AIDS knowledge and HIV prevention self-efficacy, and odds ratio for condom-use.

We estimate the impact of increasing HIV/AIDS knowledge on various sexual behavior measures using an IV/Wald estimator based on the reported standardized mean outcome differences between treatment and control groups in various sex education intervention studies. More specifically, we want to estimate the following

$$\tilde{\alpha_1} = \frac{E[I_i|T_i = 1, X_i] - E[I_i|T_i = 0, X_i]}{E[K_i|T_i = 1, X_i] - E[K_i|T_i = 0, X_i]} = \frac{\vartheta}{\psi} \tag{9}$$

where $\tilde{\alpha_1}$ is our coefficient of interest. Estimates for ϑ and ψ are drawn from the published table of estimates in Fonner et al. (2014). Standard errors are based on 50,000 Monte Carlo draws from the joint distribution of ϑ and ψ. The covariance between ϑ and ψ are not reported in Fonner et al. (2014). We instead assume various correlation coefficients to estimate the covariance, which we use to estimate confidence bands. The confidence bands appear stable over a wide spread of correlation coefficients. For conciseness, we thus present estimates for the uncorrelated case only.

Descriptive summary of the studies that we use here are provided as an appendix. Of the 64 studies included in the meta-analysis by Fonner et al. (2014), we identify six studies analyzing self-efficacy, and six studies analyzing condom-use, together with HIV/AIDS knowledge. We exclude one study on condom-use where the intervention has no statistically significant impact on HIV/AIDS knowledge. Half of the studies use randomized control designs, with random assignment to intervention applied either at the individual level or at some group level, usually schools or classrooms. The studies included in our analysis are from interventions conducted in Latin America (n=3), Africa (n=3), Asia (n=3) and Europe (n=1).

4 Results

4.1 Philippines

Table 2 shows the effect of knowledge on various sexual behavior measures among females aged 15 to 29. Results suggest that for the pooled population, the average effect of increasing HIV/AIDS knowledge on various sexual behavior measures is not statistically significant, especially for the most restrictive models. However, disaggregating by age group (Table 3) reveals that HIV/AIDS knowledge, on average, lowers sexual activity, delays sexual transition and increases condoms-use among females aged 15 to 19. The effect of HIV/AIDS knowledge on sexual behavior of females aged 20 to 24 is statistically significant only in terms of condom-use. There is not enough evidence to support that for the aged 25 to 29 cohort that on average HIV/AIDS knowledge has effect on the sexual behavior measures considered.

The knowledge effects on the sexual behavior of teenagers are instructive. Based on estimates from Table 1, about 8.5 percent of teenagers are at risk of contracting STIs by not using condom

Table 2: Effect of HIV/AIDS knowledge on sexual behavior of females aged 15-29

	Model 1		Model 2		Model 3
Sexually active in past month	-0.061		-0.031		-0.024
	(0.047)		(0.030)		(0.028)
Kleibergen-Paap rank $\chi^2(1)$	12.382		11.617		13.744
N	6951		6799		6799
RMSE	0.434		0.299		0.293
Age at sexual initiation	0.554	*	0.557	*	0.448
	(0.345)		(0.367)		(0.357)
Kleibergen-Paap rank $\chi^2(1)$	9.567		8.939		8.680
N	3341		3253		3253
RMSE	3.002		2.982		2.836
Had higher-risk sexual intercourse in past year	0.014		-0.006		-0.006
	(0.026)		(0.012)		(0.013)
Kleibergen-Paap rank $\chi^2(1)$	10.244		9.611		9.393
N	3100		3018		3018
RMSE	0.247		0.087		0.087
Had used condom in last sexual intercourse	0.022	*	0.017		0.014
	(0.014)		(0.015)		(0.015)
Kleibergen-Paap rank $\chi^2(1)$	10.244		9.611		9.393
N	3100		3018		3018
RMSE	0.167		0.156		0.153
Ever had cough for at least two weeks	-0.068	*	-0.060		-0.059
	(0.044)		(0.046)		(0.042)
Kleibergen-Paap rank $\chi^2(1)$	12.382		11.617		13.744
N	6951		6799		6799
RMSE	0.397		0.389		0.384
Age	Yes		Yes		Yes
Age at menarche	Yes		Yes		Yes
Education (years)	Yes		Yes		Yes
Household wealth index score	Yes		Yes		Yes
% of lifetime living in current residency			Yes		Yes
Childhood place of residence indicator			Yes		Yes
Marital status indicator			Yes		Yes
Ethnolinguistic group indicator					Yes
Religion indicator					Yes

Note: Figures are estimated using IV/2SLS. Age is not included as a covariate in age at sexual initiation models. Condom-use and risky sexual intercourse models include only sexually active females. Standard errors clustered at the household level are reported in parentheses. Kleibergen-Paap rank statistic tests for weak identification; $\chi^2_{0.9} = 2.71$. *, **, *** indicate significance at the 10-, 5- and 1-percent alpha levels, respectively. Significance tests are based on the Anderson-Rubin Wald test, which provides correct test coverage even with weak instruments.

during sexual intercourse. Increasing HIV/AIDS knowledge by one standard deviation decreases the at-risk population by 0.5 percentage points, representing about 21,600 females aged 15 to 19. Valuing annual STI cost at USD750[3] leads to an estimate of the annual total value of HIV/AIDS knowledge intervention to the cohort of about USD0.11 million to USD1.2 million[4].

Economically disadvantaged females are especially vulnerable. Condom-use among sexually active females aged 15 to 24 years from households in the three poorest wealth quintiles is only about one percent, which is four percentage points lower than for females from richer households (Table 1). In terms of at-risk population, about 41 percent of poor females aged 15 to 24 years are at risk of contracting STDs by not using condom during sexual intercourse, compared to only about 22 percent of females from rich households. Furthermore, average HIV/AIDS knowledge among the poor is 0.35 of a standard deviation lower than that of richer female young adults.

Knowledge effect estimates for females aged 15 to 24 years old by household wealth status presented in Table 4 shows that HIV/AIDS knowledge delays sexual initiation among the poor. A one standard deviation increase in HIV/AIDS knowledge delays sexual initiation by about 1.3 years on average. The estimates also reveal that knowledge effect on condom-use is statistically significant for both poor and non-poor, although effect estimates are larger for the richer group. Focusing on the poor population, increasing HIV/AIDS knowledge by one standard deviation would lead to a decrease in at-risk population by 1.1 percentage points. This translates to an annual total cost savings from such HIV/AIDS knowledge intervention of about USD0.5 million to USD5.8 million.

The estimated cost-savings from increasing HIV/AIDS knowledge among female young adults represent a substantial amount. In 2008, for instance, the national budget allotted[5] for infectious diseases, including HIV, totaled to only USD2.0 million, while that for teacher training, including scholarships and fellowship grants, totaled to about USD21.2 million. The value of averted STDs among female young adults comprises about 5 to 290 percent of the annual infectious disease prevention endowment, and about 2 to 27 percent of the teacher training fund.

The estimates we presented could be well under-valuing the effect of increasing HIV/AIDS knowledge as the estimates only considers the value of condom-use among females, and does not include the decreased probability of cross-infection with their partner. In addition, the estimates only represent instances where both partners agree to them using condoms, and excludes females who would have used condoms but have been vetoed by her partner.

[3]Based on PHP30,000 maximum Philippine Health Insurance Corporation out-patient reimbursement for the HIV/AIDS Treatment Package (PHIC Circular No. 19, s. 2010)

[4]Based on estimates of 0.07 percent gonorrhea and 7.7 percent chlamydial infection prevalence rates among female Filipino youths. See Wi et al. (2002) for details of STI prevalence rate estimation in the Philippines.

[5]Based on the 2008 Philippine National Expenditure Program.

Table 3: Effect of HIV/AIDS knowledge on sexual behavior of females aged 15-29 by age group

	15-19 years old			20-24 years old			25-29 years old		
	Model 1 (1)	Model 2 (2)	Model 3 (3)	Model 1 (4)	Model 2 (5)	Model 3 (6)	Model 1 (7)	Model 2 (8)	Model 3 (9)
Sexually active in past month	-0.129 *	-0.073 *	-0.061 *	-0.019	-0.006	0.006	-0.119	-0.090	-0.116
	(0.111)	(0.066)	(0.050)	(0.046)	(0.028)	(0.027)	(0.174)	(0.161)	(0.195)
Kleibergen-Paap rank $\chi^2(1)$	2.425	2.226	3.438	14.579	14.073	14.850	1.260	0.807	0.698
N	2749	2699	2699	2140	2080	2080	2062	2020	2020
RMSE	0.439	0.255	0.229	0.453	0.302	0.299	0.570	0.447	0.480
Age at sexual initiation	0.689 ***	0.657 ***	0.611 ***	0.208	0.244	0.154	0.995	0.794	0.130
	(0.357)	(0.357)	(0.338)	(0.256)	(0.261)	(0.283)	(1.426)	(1.730)	(1.172)
Kleibergen-Paap rank $\chi^2(1)$	4.558	4.287	4.101	7.410	7.323	5.998	1.012	0.612	0.791
N	388	371	371	1240	1204	1204	1713	1678	1678
RMSE	2.236	2.107	1.951	2.046	2.049	1.962	3.867	3.501	2.851
Had higher-risk sexual intercourse in past year	0.026	0.012	0.017	0.035	0.000	-0.002	-0.026	-0.037	-0.029
	(0.047)	(0.009)	(0.013)	(0.036)	(0.015)	(0.017)	(0.064)	(0.060)	(0.048)
Kleibergen-Paap rank $\chi^2(1)$	5.194	4.933	4.563	6.851	6.922	5.450	1.359	0.953	1.388
N	364	347	347	1146	1113	1113	1590	1558	1558
RMSE	0.341	0.091	0.094	0.279	0.092	0.092	0.210	0.127	0.109
Had used condom in last sexual intercourse	0.013 **	0.015 **	0.016 *	0.031 ***	0.022 ***	0.018 ***	0.012	0.008	0.003
	(0.008)	(0.010)	(0.011)	(0.014)	(0.010)	(0.009)	(0.047)	(0.061)	(0.053)
Kleibergen-Paap rank $\chi^2(1)$	5.194	4.933	4.563	6.851	6.922	5.450	1.359	0.953	1.388
N	364	347	347	1146	1113	1113	1590	1558	1558
RMSE	0.137	0.140	0.137	0.167	0.137	0.131	0.174	0.168	0.166
Ever had cough for at least two weeks	-0.064	-0.059	-0.065	-0.049	-0.034	-0.021	-0.125	-0.174	-0.217
	(0.104)	(0.107)	(0.090)	(0.039)	(0.038)	(0.036)	(0.165)	(0.249)	(0.314)
Kleibergen-Paap rank $\chi^2(1)$	2.425	2.226	3.438	14.579	14.073	14.850	1.260	0.807	0.698
N	2749	2699	2699	2140	2080	2080	2062	2020	2020
RMSE	0.387	0.381	0.380	0.370	0.362	0.354	0.489	0.572	0.645

Note: See Table 2 for the covariates included in each model specification. Figures are estimated using IV/2SLS. Age is not included as a covariate in age at sexual initiation models. Condom-use and risky sexual intercourse models include only sexually active females. Standard errors clustered at the household level are reported in parentheses. Kleibergen-Paap rank statistic tests for weak identification; $\chi^2_{0.9} = 2.71$. *, **, *** indicate significance at the 10-, 5- and 1-percent alpha levels, respectively. Significance tests are based on the Anderson-Rubin Wald test, which provides correct test coverage even with weak instruments.

Table 4: Effect of HIV/AIDS knowledge on sexual behavior of females aged 15-24 by household wealth

	Low Wealth			High Wealth		
	Model 1 (1)	Model 2 (2)	Model 3 (3)	Model 1 (4)	Model 2 (5)	Model 3 (6)
Sexually active in past month	-0.073	-0.030	-0.012	-0.033	-0.020	-0.019
	(0.074)	(0.042)	(0.033)	(0.044)	(0.025)	(0.026)
Kleibergen-Paap rank χ^2*(1)*	5.340	4.826	7.497	7.896	7.789	6.903
N	2684	2632	2632	2205	2147	2147
RMSE	0.439	0.267	0.254	0.327	0.214	0.211
Age at sexual initiation	0.497 **	0.518 **	0.475 **	0.421 **	0.575 **	0.522 **
	(0.246)	(0.263)	(0.265)	(0.636)	(0.581)	(0.677)
Kleibergen-Paap rank χ^2*(1)*	11.100	9.914	8.955	1.148	1.700	1.168
N	1092	1064	1064	595	576	576
RMSE	2.388	2.405	2.294	2.296	2.446	2.268
Had higher-risk sexual intercourse in past year	0.026	0.006	0.004	0.046	-0.015	-0.017
	(0.021)	(0.004)	(0.004)	(0.114)	(0.036)	(0.031)
Kleibergen-Paap rank χ^2*(1)*	11.231	9.954	8.560	1.662	2.268	3.285
N	1037	1010	1010	473	450	450
RMSE	0.227	0.076	0.075	0.402	0.123	0.124
Had used condom in last sexual intercourse	0.009 ***	0.009 ***	0.009 ***	0.093 ***	0.055 ***	0.028 ***
	(0.004)	(0.004)	(0.005)	(0.076)	(0.039)	(0.018)
Kleibergen-Paap rank χ^2*(1)*	11.231	9.954	8.560	1.662	2.268	3.285
N	1037	1010	1010	473	450	450
RMSE	0.095	0.097	0.096	0.322	0.229	0.187
Ever had cough for at least two weeks	-0.089	-0.082	-0.073	-0.023	-0.005	-0.003
	(0.077)	(0.079)	(0.062)	(0.045)	(0.043)	(0.045)
Kleibergen-Paap rank χ^2*(1)*	5.340	4.826	7.497	7.896	7.789	6.903
N	2684	2632	2632	2205	2147	2147
RMSE	0.440	0.431	0.414	0.324	0.321	0.316

Note: See Table 2 for the covariates included in each model specification. Figures are estimated using IV/2SLS. Age is not included as a covariate in age at sexual initiation models. Condom-use and risky sexual intercourse models include only sexually active females. Standard errors clustered at the household level are reported in parentheses. Kleibergen-Paap rank statistic tests for weak identification; $\chi^2_{0.9} = 2.71$. *, **, *** indicate significance at the 10-, 5- and 1-percent alpha levels, respectively. Significance tests are based on the Anderson-Rubin Wald test, which provides correct test coverage even with weak instruments.

4.2 Sensitivity

Using district representatives' votes on HB 5043 as instrument for HIV/AIDS knowledge may capture other effects that may confound our estimates. For instance, HB 5043 votes may be correlated with other concurrent government programs that may likewise influence sexual behavior, e.g. provision of contraceptives in public health facilities, but were not controlled for in the econometric models. This would introduce bias into our knowledge effect estimates. As shown in Abrigo and Paqueo (2017), however, HB 5043 votes is not correlated with the propensity of being able to access contraceptives among females aged 15-29, which provide some credence to our exogeneity assumption.

We more formally assess this potential pathology in our estimation strategy by using a placebo outcome that is known not to be affected by HIV/AIDS knowledge. While the exogeneity assumption of the instrument may not be tested directly, a statistically significant impact of HIV/AIDS knowledge on a placebo outcome may indicate that the instrument may be capturing some unobserved effects that may also be present in our estimates. We model the effect of HIV/AIDS knowledge on the propensity of ever having cough for at least two weeks, considered to be asymptomatic of tuberculosis, using the same strategy discussed in the previous section. The estimates are reported as the last panel in each table in the previous subsection. Even for the least restrictive specifications in the analysis, the hypothesis of no effect cannot be rejected.

In addition to the above placebo tests, we also attempt to provide a bound for the potential bias, if any, of our knowledge effect estimates. More specifically, we examine the potential contribution of the correlation between HB 5043 votes and some omitted characteristics that may influence sexual behavior: the respondents' demand for contraceptives and their unmet need for family planning. Assuming that representatives are delegates that vote on the plenary depending on the vote of the population it represents then the expectation is that representatives' HB 5043 votes would be positively correlated with demand for contraceptives while negative for unmet need for family planning.

Table 5 confirms this expectation about the specified relationships. This implies that the estimates for the knowledge effect on past-month sexual activity and on high-risk sexual activity to be upper bounds if females demand contraceptives during sexual activity. On the other hand, the effect on delaying sexual initiation and on condom-use can be translated as lower bounds if females have unmet need for family planning services.

Table 5: RH Bill vote and demand for reproductive health services

	Correlation		Partial Correlation					
			Model 1		Model 2		Model 3	
	(1)		(2)		(3)		(4)	
Demand for contraceptives	0.012		0.013		0.011		0.023	***
Unmet need for family planning	-0.019	*	-0.022	**	-0.023	**	-0.026	**

Note: See Table 2 for the covariates included in each model specification.

4.3 Cross-study comparison

To compare our results relative to those from other studies, we estimate IV/Wald coefficients on the effect of increasing HIV/AIDS knowledge on sexual behavior based on standardized estimates of mean outcome difference between treatment and control groups from various studies on sex education interventions reported in Fonner et al. (2014). The IV/Wald coefficient estimates correct for the simultaneity bias that may arise when the demand for HIV/AIDS knowledge and sexual behavior are jointly determined assuming that program interventions have no direct effect on sexual behavior, but only indirectly through its effect on HIV/AIDS knowledge.

Table 6 presents the IV/Wald estimates of the effect of HIV/AIDS knowledge on condom-use (Panel A) and on self-efficacy relative to HIV prevention (Panel B) based on ten studies included in Fonner et al. (2014). Over-all, the results indicate that raising HIV/AIDS knowledge fosters sexual behaviors conducive to preventing the spread of STIs. On average, a one-standard deviation increase in HIV/AIDS knowledge increases condom-use log-odds by 0.27, and self-efficacy by 0.22 of a standard deviation. Qualitatively, these results are in line with our estimates for female young adults in the Philippines.

Table 6: Cross-study comparison

	Estimate	95% C.I.	
A. Condom-use			
Fonner et al. (2014)	0.63	0.49	0.77
Ross et al. (2007)	0.40	0.26	0.54
Walker et al. (2006)	0.28	-0.23	0.79
Maticka-Tyndale et al. (2010)	0.27	0.15	0.39
Fawole et al. (1999)	0.18	-0.11	0.47
Thato et al. (2008)	0.03	-0.30	0.36
Overall	0.27	0.15	0.39
B. Self-efficacy			
Li et al. (2008)	1.94	-134.12	138.00
Givaudan et al. (2008)	0.49	0.24	0.74
Kinsler et al. (2004)	0.44	-20.34	21.22
Kyrychenko et al. (2006)	0.39	0.12	0.66
Maticka-Tyndale et al. (2010)	0.15	0.05	0.25
Li et al. (2010)	0.14	0.06	0.22
Overall	0.22	0.10	0.34

Note: Confidence intervals are based on 50,000 Monte Carlo draws from the distribution of standardized mean differences reported in Fonner et al. (2014). Reported estimate for condom use is in change in log-odds per one standard deviation increase in HIV/AIDS knowledge. Reported estimate for self-efficacy is in change in Hedge's G per one standard deviation increase in HIV/AIDS knowledge. Overall refers to pooled average of effect estimates weighted by the estimated standard errors.

5 Conclusion

Implementing sex education programs as part of mandatory school curricula has always been a contentious issue in many developing countries. Demystifying competing claims surrounding issues about the effect of sex education is an important aspect of making sexuality and reproductive health information more accessible. While the literature is replete with evidences documenting the many beneficial impacts of sex education, the simultaneity between the demand for knowledge in STI and its prevention, and sexual behavior are often not considered.

In this study, we examine the effect of increasing HIV/AIDS knowledge on various sexual behaviors of female young adults in the Philippines. In contrast to previous studies, our empirical strategy is motivated by a theoretical model of sexual behavior where the cost of STI treatment is stochastic. We show that the impact of increasing STI knowledge on precautionary sexual behavior could either be positive or negative depending on how knowledge alters the expected cost of STI treatment. If demand for STI knowledge and sexual behavior are simultaneously determined, then simple comparison of means in an experimental set-up does not necessarily identify the effect of sex education on behavior. Using an instrumental variable strategy, results using Philippine data show strong indication that increasing HIV/AIDS knowledge among young adults results in better sexual behaviors. Specifically, we find that more knowledge delays sexual initiation, limits sexual activity, and increases condom use among some groups in the population.

The results we presented have important policy implications. We show that increasing HIV/AIDS knowledge may result in substantial cost-savings from averted STIs. When sex education is included as part of regular large-scale public school curricula, the cost of increasing STI knowledge would be trivial, implying considerable resources that could be freed for other government programs because of better sexual behaviors. We likewise document heterogeneous responses to increased STI knowledge across different populations. This highlights the need for targeted interventions adapted to particular settings for anti-STI campaigns to be effective.

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A Study description

	Fawole et al. (1999)	*Givaudan et al. (2008)*	*Kinsler et al. (2004)*	*Kyrychenko et al. (2006)*	*Li et al. (2008)*	*Li et al. (2010)*	*Maticka-Tyndale et al. (2010)*	*Ross et al. (2007)*	*Thato et al. (2008)*	*Walker et al. (2006)*
A. Study Description										
Study location	Nigeria	Mexico	Belize	Ukraine	China	China	Kenya	Tanzania	Thailand	Mexico
Sample size (Baseline)	450	2,064	150	200	374	2,237	953	9,219	522	10,954
B. Outcomes included										
HIV knowledge	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Condom use	Yes	No	No	No	No	No	Yes	Yes	Yes	Yes
Self-efficacy	No	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No
C. Methodological Rigor										
Cohort	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes
Control or comparison group	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes
Pre/Post intervention data	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Random assignment of participants into intervention	No	Yes	No	No	Yes	No	No	Yes	No	Yes
Random selection of participants for assessment	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Follow up rate of 80% or more	Yes	Yes	Yes	Yes	Yes	Yes	NR	No	NR	NR
Comparison groups equivalent on socio-demographics	Yes	NR	Yes	Yes	Yes	No	N/A	No	No	NR
Comparison groups equivalent at baseline on outcome measure	Yes	NR	Yes	Yes	No	Yes	N/A	Yes	Yes	NR

Note: The above descriptions are from Tables 1 and 2 in Fonner et al. (2014). For methodological rigor: N/A not applicable, NR not reported.