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ORIGINAL PAPER

Gender Differences in HIV/HSV-2: Evidence from a School Support Randomized Controlled Trial Among Orphaned Adolescents in Kenya

Hyunsan Cho[1] · Michelle E. Deming[1] · Ju-Hyun Park[2] · Bonita Iritani[3]

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Abstract

Women and girls are disproportionately affected by HIV and other sexually transmitted infections (STIs) such as Herpes Simplex Virus type-2 (HSV-2) in Sub-Saharan Africa (SSA). Given this gender disparity and women's vulnerability to HIV/STIs, prevention efforts often target women, but relatively little attention has been paid to compare whether HIV interventions produce equal program effects across gender. The purpose of this study is to examine whether the school support intervention had equal program effects on study outcomes and biomarkers by gender among orphaned adolescents in Kenya. A randomized controlled trial was conducted to test whether keeping orphaned boys and girls in school reduced risky sexual behaviors and prevented HIV/HSV-2 infection in Kenya (N = 835). We collected four annual surveys and biomarkers measures of HIV and HSV-2 at Time 1 and Time 4. Regression analysis and multi-level linear mixed models were conducted, and *t* test with Satterthwaites' method for each regression coefficients was used to compare program effects by gender. There were substantial gender differences on risky sexual behaviors, HSV-2 infection, and gendered ideologies prior to intervention implementation. The school support intervention had significant gender-specific program impacts on HSV-2. The intervention females experienced a 36% increase in HSV-2 infection while intervention males experienced a 23% decrease after 3 years of program implementation. Differential program effects by gender on attitudes toward abstaining from sex were also found. More scientific research is needed to test whether HIV interventions produce equal program impacts by gender. Prevention programs should recognize gender-specific program effects and address individual, relational, and contextural factor that reinforce the gender disparity in HIV/HSV-2 risk.

Keywords Orphans · School support · Kenya · HIV/herpes simplex-virus type-2

Introduction

HIV/AIDS continues to be a significant public health and social problem afflicting Sub-Saharan Africa (SSA) [38] In SSA, females aged 15–24 years account for 25% of all new HIV infections compared to 12% of same age males in 2016 and AIDS-related illnesses are the leading cause of death for women aged 15–44 [19]. Women and girls are disproportionately affected by HIV and represent the fastest growing demographic in the HIV epidemic through sexual encounters with heterosexual partners [15, 19, 34]. While young women are biologically more susceptible to HIV [12] and Herpes Simplex Virus Type 2 (HSV-2) [36], young women's vulnerability is also exacerbated by limited educational and economic opportunities, gender power inequities, and gender-based norms [14, 38]. For example, females in SSA tend to engage in sexual relationships with age-disparate partners [27, 31], engage in transactional sex [26], and experience

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✉ Hyunsan Cho
hyunsan@mailbox.sc.edu

Michelle E. Deming
demingm@email.sc.edu

Ju-Hyun Park
juhyunp@dongguk.edu

Bonita Iritani
iritani@pire.org

[1] Department of Health Promotion, Education, and Behavior, Arnold School of Public Health, University of South Carolina, Columbia, USA

[2] Department of Statistics, DongGuk University, Seoul, Korea

[3] Pacific Institute for Research and Evaluation, Chapel Hill, NC 27516, USA

difficulties negotiating safe sex, sexual violence, sexually transmitted infections including HIV [11, 12, 21, 25]. In particular, orphans in SSA compared to their non-orphaned counterparts are more vulnerable to these risks, which contribute to their higher HIV risk [30, 43].

Subsidizing school support or cash transfer programs to boost schooling against the HIV epidemic have received tremendous attention in SSA especially for young girls and women [42]. However, the association between education and HIV risk in SSA has shown conflicting evidence over time. While higher HIV infections were found among more educated people in the early HIV epidemic [8, 13], later studies indicated that education acted as a social vaccine against HIV risk [2, 3, 9, 18]. A recent study conducted in SSA found that young women in school had lower odds of HIV infection in three out of nine countries in the Demographic and Health Survey data [28]. Findings from the school fee support or cash transfer intervention trials were also mixed. Most RCTs either providing direct school fee support or cash transfers have not found an impact on HIV/HSV-2 infection [5, 17, 33] except one Malawi study which reduced HIV/HSV-2 infection among high school females [1]. Although cash transfer interventions in South Africa did not have an effect on HIV incidence, they reported that young women who attended more school days and stayed in school had lower incidence of HIV and HSV-2 infection [41].

Rosenthal and Levy [37] applied *the Four Bases of Gendered Power* to address women's risk of HIV infection [35]. This theoretical framework underscores the complex interplay of accepted gendered ideologies and power differentials that exist at structural and interpersonal levels that affect women's lives. The four bases of power include (i) *Force* which increases women's risk through sexual violence (e.g., sexual abuse, rape, assault) and reflects women's negotiation power within their relationships due to fears of or threats of violence [15, 38]; (ii) *Resource control* which indicates education, employment, poverty, economic dependence, and institutions that favor men over women [6, 37]; (iii) *Social obligations* which refers to the responsibilities of women and provision of care to partners and/or children that are consistent with social norms indicating that women are expected to care for others; (iv) *Consensual ideologies* which denotes socially prescribed "scripts of behavior" that include adopting gendered norms, roles, and stereotypes that reinforce and recreate gendered differences and in turn legitimate gender inequality [35].

The conceptual framework of the four bases of gender power was used to guide our analyses in evaluating program effects of the school support intervention trial conducted in Kenya. This RCT provided direct school fees among orphaned males and females in Kenya, and its null program impact on HIV/HSV-2 incidences was already published [5]. Compared to other studies exclusively focused on female participants [1, 17, 33], this study had a unique advantage of assessing gender difference and gender-specific program effects of the intervention. First, the concept of *Resource control* was inherent in the intervention design because school fees were provided in order to increase educational resources. Second, the concept of *Social obligations* was achieved by using two measures of attitudes about wife beating and a gender equity scale. Third, *Consensual ideologies* were operationalized to include survey measures such as number of sexual partners, attitude towards abstaining from sex because of moral beliefs and negative consequences, and early sex. Last, the construct of *Force* was operationalized by variables such as unwanted first sex, condom use, and transactional sex. The objective of the intervention was to improve educational outcomes (i.e., resource control), reduce negative gender ideologies (e.g., regarding wife beating and gender equity), reduce sexual risky behaviors (e.g., unwanted sex, transactional sex, unprotected sex), and reduce HIV/HSV-2 incidence among intervention participants compared to controls.

The purpose of this study was to 1) examine how orphaned males and females differ from each other on gendered norms, sexual behaviors, and biomarkers of HIV/HSV-2 infection; and to 2) investigate whether or not a school support intervention produced equal program impacts on these outcomes. We expected differential program effects, specifically that female orphans would benefit more from the school support intervention than males based on a previous intervention study demonstrating this result [10]. This study fills a critical gap in existing scientific evidence by comparing program effects by gender from a school support trial to reduce HIV/HSV-2.

Methods

Study Design and Setting

A cluster RCT was conducted in Siaya County in western Kenya. In 2011, 26 primary schools with at least 20 orphans in Grades 7 and 8 per school were selected. Orphans were defined as individuals who had lost one or both parents to death from any cause. All orphans in these schools were invited to participate in the study (n = 923); eligibility criteria were to complete a survey and biomarker testing at Time 1. Stratified randomization procedures were conducted assigning 13 schools to the intervention (n = 411 students) and 13 to the control group (n = 426 students) using a random number generator (equal allocation, stratified by school enrollment). The trial was powered to detect small effect sizes on the primary study outcomes of HIV/HSV-2. All study participants were enrolled in school at Time 1. The

retention rate was very high (98% in Times 2–3 and 90% in Time 4), which was not different by study condition The study procedures and method have been described in detail [5].

Intervention

The study provided students in intervention schools with school uniforms and payment of secondary school fees. Nurse research staff members also visited schools to monitor intervention study participants' school attendance and to assist them with resolving absenteeism problems. Support continued from 2011 to 2015 or until the student dropped out of school [16].

Human Subjects Protection

All study participation was voluntary. Written informed permission from a surviving parent or custodial guardian and written assent from all participants was obtained. The institutional review boards of the Pacific Institute for Research and Evaluation (U.S.) and Moi University (Kenya) approved all study procedures. Participating schools in the control condition were provided cash incentives ($24 annually to use for their school development projects) and participants received small incentives ($3) for participating in the survey and biomarker testing. The original trial was registered at clinicaltrials.gov (ID: NCT01501864).

Biomarkers of HIV/HSV-2 Infection

We conducted serologic testing to detect antibodies against HIV/HSV-2 as biomarkers of infection at the 2011 and the 2014 timepoints. At Time 1, venous blood samples were collected; whole blood was used immediately for HIV antibody testing, and serum was prepared for HSV-2 serology. At Time 4, blood was obtained by finger stick; whole blood was used for HIV antibody testing, and dried blood spots (DBS) were prepared for HSV-2 serology. We applied the manufacturer's cutoff (1.0) for HSV-2 infection. HIV/HSV-2 incidence, defined as a positive test at Time 4 from participants who were negative at Time 1, were used as binary outcomes.

Survey Measures

We conducted an annual survey using audio computer-assisted self-interview (ACASI) on personal digital assistant devices for 2011-2014. All measures except the biomarkers came from self-reported survey responses. We measured school absence, *sexual debut* ("Have you ever had sexual intercourse?"), *transactional sex* (The first/last time you had sexual intercourse, did you receive/give favors, gifts, or money in return for sex?"), *age of sexual debut* ("How old were you when you had sexual intercourse for the very first time?"), *age of first sex partner* ("How old was the person you first had sexual intercourse with?"), *unwanted first sex* ("The first time you had sexual intercourse, did you want it to happen?"), *number of sexual partners* ("In total, how many different people have you had sexual intercourse about 12 months?"), and *condom use in the last year* ("Of the time you have had sexual intercourse in the past 12 months, how often did you or your partner use condoms?"). The *Gender Equity index* (Cronbach alpha = 0.67) was comprised of five items (e.g., "Education is more important for boys than for girls") with higher scores indicating more equitable attitudes. *Wife Beating endorsement* (Cronbach alpha = 0.53) was a count of yes responses to five items (e.g., "Is it okay for a husband to beat his wife if she argues with him?") with higher scores indicating more endorsement of wife beating. Three scales measured attitudes towards sex: *Disagree with Early sex* (Cronbach alpha = 0.72) was comprised of three items (e.g., "I believe people my age should get as much sexual experience as they can."). *Abstaining from sex because of negative consequences* (Cronbach alpha = 0.63) was a count of yes response to four items (e.g., "I don't want to have because I do not want to get a disease."), and *Abstaining from sex because of moral values* (Cronbach alpha = 55) was count of yes response to six items (e.g., "I think it is wrong to have sex before marriage."). These four attitudes towards sex were all measured with higher scores indicating more conservative attitudes.

Statistical Analyses

First, descriptive analyses of the study sample were conducted. We examined gender differences using *t* tests for continuous variables and Rao-Scott Chi square tests for categorical variables on the main demographic and risky sexual behaviors stratified by each study condition from Time 1 to Time 4. Second, using the final outcomes at Time 4, we conducted a logistic regression analysis for binary outcomes (e.g., school dropout at Time 4) and a general regression analysis for a continuous outcome (e.g., number of sexual partners at Time 4) with a random effect to account for potential correlations among orphans nested in the same schools. Third, for outcomes such as *gender equity* and the *wife beating index*, which were measured over four times throughout the study, we used a two-level linear mixed model accounting for correlations among measurements of outcomes due to two sources: orphans sharing the same school environments at the first stage and measurements repeatedly observed on the same orphans over time. Since the likelihood ratio test within the framework of a linear mixed model is not well defined, a *t* test for each regression coefficient was conducted with Satterthwaites's method for

degrees of freedom [20]. This test demonstrated whether the intervention effect differed by gender, while a Wald-type 95% confidence interval was provided for gender-specific intervention effects. Covariates of age and socio-economic status measured by number of assets was included in each statistical model. Statistical analyses were performed using R 3.5.1 [7].

Results

Sample Characteristics and Gender Difference at Time 1

Table 1 showed that total study enrollment at Time 1 was 835. About half were females (48%) and the mean age was 15 years old. Baseline equivalences at Time 1 ($p < .05$) between intervention and control group were reported (for detailed information, see [5]) and these baseline equivalences held true when stratified by gender (data not shown here). However, there were significant gender differences on demographics and study outcomes at Time 1. We found that female participants were younger, more likely to be paternal-orphaned, reported higher SES, and were more likely to be absent from school due to illness. Compared to males, fewer females reported sexual experiences (17.5% females vs. 26.4% males) and among those who were sexually active, females reported older age at sexual debut and similar age sexual partner than males.

Gender Difference on Outcomes from Time to Time 4

Table 2 demonstrated gender differences on study outcomes from Time 1 to Time 4. *Biomarkers of HIV/HSV-2 Infection:* For HIV infection, there were minimal increases from Time 1 to Time 4 for both genders regardless of study condition (e.g., for intervention females from 1.0 to 1.2%; for intervention males from 1.4 to 1.5%). For HSV-2 infection, there were sharp increases from Time 1 to Time 4 for both genders as well as for both study conditions. HSV-2 infection increased from 5.6 to 39.5% among intervention females, 4.9 to 29.1% among control females, 2.8 to 27.1% among

Table 1 Sample characteristics: gender difference at time 1

N = 835	Female (N = 403, 48%) Mean/frequency	Male (N = 432, 52%) Mean/frequency	Gender difference Rao-Scott Chi square/*T* test (p-value)
Demographic variables			
Age in 2011	14.6 (1.46)	15.0 (1.60)	**−3.03 (p = 0.003)**
Grade in 2011			
7th	237 (58.8%)	256 (59.3%)	0.02 (0.89)
8th	166 (41.2%)	176 (40.7%)	
Orphaned status			**7.70 (p = 0.02)**
Paternal	224(55.6%)	203(46.7%)	
Maternal	41(10.2%)	60(13.9%)	
Double orphan	130 (32.3%)	161 (37.3%)	
SES (asset)	4.02 (1.93)	3.66 (1.89)	**2.67 (p = 0.008)**
Number of school absence[a]	2.13 (2.01)	2.20 (2.07)	−0.76 (0.44)
Reasons for school absence (% of yes)			
Lack of uniform	140 (4.8%)	168 (8.9%)	1.61 (p = 0.20)
Lack of school fees	328 (81.6%)	351 (1.2%)	0.02 (p = 0.90)
Because of illness	368 (91.3%)	360 (83.3%)	**15.91 (p < .0001)**
Had to work or care for someone in home	61 (15.1%)	89 (20.6%)	3.5 (p = 0.06)
Did not have supplies	280 (69.6%)	305 (70.8%)	0.07 (p = 0.79)
School was too far away	156 (38.8%)	146 (33.8%)	1.71 (p = 0.19)
Sexual behaviors			
Ever had sexual intercourse	70 (17.5%)	114 (26.4%)	**7.69 (p = 0.006)**
Age of the first sexual intercourse	14.8 (1.2)	13.9 (1.2)	**3.04 (p = 0.003)**
Age of the first sexual partner	14.9 (2.2)	12.7 (1.5)	**7.5 (p < .0001)**

Significant gender difference was shown in bold

[a] 1 = Never; 2 = Once or twice; 3 = Once a month or less; 4 = 2 or 3 days a month; 5 = More than 3 days a month

Table 2 Gender difference on study outcomes from time 1 to time 4: bivariate analyses

Outcome	Female				Male				Gender difference Rao-Scott Chi square/T-test (p-value)			
	Time 1	Time 2	Time 3	Time 4	Time 1	Time 2	Time 3	Time 4	Time 1	Time 2	Time 3	Time 4
HIV infection												
Int	1.0%	–	–	1.2%	1.4%	–	–	1.5%	0.13 (p = 0.72)	–	–	0.08 (p = 0.78)
Control	1.5%	–	–	1.7%	0.9%	–	–	1.0%	0.27 (p = 0.60)	–	–	0.38 (p = 0.54)
HSV − 2 infection												
Int	5.6%	–	–	39.5%	2.8%	–	–	27.1%	1.99 (p = 0.16)	–	–	**6.92 (p = 0.01)**
Control	4.9%	–	–	29.1%	1.8%	–	–	34.5%	3.00 (p = 0.08)	–	–	1.06 (p = 0.30)
School dropout												
Int	–	4.7%	13.3%	10.5%	–	4.3%	7.1%	5.0%	–	0.04 (p = 0.85)	4.27 (p = 0.04)	**3.97 (p = 0.04)**
Control		12.2%	13.6%	23.4%		9.4%	17.5%	18.8%	–	0.83 (p = 0.36)	1.15 (p = 0.28)	1.23 (p = 0.27)
Number of sexual partners last year												
Int	–	–	1.5	1.1	–	–	1.9	1.9	–	–	− 0.94 (p = 0.37)	**− 3.36 (p = 0.003)**
Control			1.4	1.8			2.0	2.2	–	–	− 1.73 (p = 0.09)	− 1.16 (p = 0.25)
Unwanted first sex												
Int	63.6%	62.5%	46.2%	72.0%	43.4%	58.6%	60.0%	61.8%	3.33 (p = 0.07)	0.16 (p = 0.69)	1.63 (p = 0.20)	1.446 (p = 0.23)
Control	67.6%	80.0%	70.7%	82.3%	44.1%	61.2%	55.2%	54.2%	**4.83 (p = 0.03)**	3.52 (p = 0.06)	2.61 (p = 0.11)	**12.26 (p = 0001)**
Condom use in the last year												
Int	18.8%	33.3%	57.9%	8.3%	54.6%	28.6%	9.1%	10.0%	**11.1 (p = 0.001)**	0.09 (p = 0.76)	**8.18 (p = 0.004)**	0.07 (p = 0.79)
Control	43.8%	26.7%	66.7%	16.7%	53.9%	75.0%	42.9%	4.2%	0.41 (p = 0.52)	**4.85 (p = 0.03)**	2.37 (p = 0.12)	2.11 (p = 0.15)
Transactional sex												
Int	52.9%	34.2%	23.1%	24.0%	43.2%	31.4%	24.4%	38.7%	**19.2 (p = <.000)**	**6.49 (p = 0.02)**	2.83 (p = 0.09)	**7.57 (p = 0.01)**
Control	10.9%	12.1%	10.0%	6.6%	23.7%	18.0%	8.6%	17.8%	**4.43 (p = 0.04)**	2.11 (p = 0.15)	**4.32 (p = 0.04)**	**7.15 (p = 0.01)**
Gender equity												
Int	3.5	3.8	3.9	4.0	2.9	3.3	3.5	3.4	**6.05 (p < .000)**	**5.44 (p < .000)**	**5.35 (p < .000)**	**6.76 (p < .000)**
Control	3.3	3.7	3.8	3.8	2.9	3.2	3.4	3.3	**5.31 (p < .000)**	**5.23 (p < .000)**	**4.74 (p < .000)**	**5.66 (p < .000)**
Wife beating endorsement												
Int	1.64	1.68	1.72	1.71	1.69	1.72	1.76	1.76	**− 2.17 (p = 0.02)**	**− 2.24 (p = 0.03)**	**− 2.21 (p = 0.03)**	**− 3.22 (p = 0.001)**
Control	1.67	1.70	1.73	1.71	1.71	1.73	1.76	1.76	− 1.90 (p = 0.06)	− 1.60 (p = 0.11)	− 1.75 (p = 0.08)	**− 3.06 (p = 0.002)**
Disagree with early sex												
Int	4.00	4.44	4.42	4.70	4.13	4.42	4.43	4.54	− 1.35 (p = 0.18)	0.28 (p = 0.78)	− 0.06 (p = 0.15)	**2.46 (p = 0.01)**
Control	4.01	4.39	4.31	4.40	4.19	4.38	4.39	4.41	**− 2.25 (p = 0.02)**	0.04 (p = 0.96)	− 1.01 (p = 0.31)	− 0.19 (p = 0.85)
Abstaining from sex because of moral beliefs												
Int	0.87	0.91	0.88	0.88	0.82	0.86	0.83	0.86	**1.99 (p = 0.05)**	**2.75 (p = 0.01)**	**2.17 (p = 0.03)**	1.21 (p = 0.23)
Control	0.81	0.87	0.90	0.90	0.85	0.88	0.80	0.89	− 1.69 (p = 0.09)	− 0.28 (0.78)	**3.66 (p = 0.00)**	0.54 (p = 0.59)

Table 2 (continued)

Outcome	Female				Male				Gender difference Rao-Scott Chi square/T-test (p-value)			
	Time 1	Time 2	Time 3	Time 4	Time 1	Time 2	Time 3	Time 4	Time 1	Time 2	Time 3	Time 4
Abstaining from sex because of consequence												
Int	0.96	0.96	0.91	0.93	0.92	0.94	0.87	0.91	**2.14 (p = 0.03)**	1.28 (p = 0.20)	1.32 (p = 0.19)	0.45 (p = 0.66)
Control	0.95	0.94	0.97	0.94	0.96	0.96	0.86	0.91	− 1.10 (p = 0.27)	− 1.09 (p = 0.27)	**4.26 (p < .000)**	1.46 (p = 0.15)

Significant gender difference was shown in bold

Gender Equity: the higher the score, the more equitable attitude; Wife Beating Endorsement: the higher the score, the more endorse wife beating

Disagree with early sex; Abstaining from sex because of moral beliefs; Abstaining from sex because of negative consequences: The higher the score, the more supportive of abstaining from sex

intervention males, and from 1.8 to 34.5% among control males. Significant gender differences (39.5% of females vs. 27.1% of males) were only found among the intervention group at Time 4 (p = 0.01).

Self-reported Outcomes: All study participants were enrolled in school at Time 1. Regarding *school dropout*, intervention group were significantly less likely to drop out at every time point compared to the control group among both genders. Significant gender differences among the intervention group participants were found at Time 3 (13.3% for females vs. 7.1% for males, p = 0.04) and at Time 4 (10.5% for females vs. 5.0% for males, p = 0.04). Among those who were sexually active, intervention males reported a higher *number of sexual partners* than intervention females (1.9 vs. 1.1, p = 0.4) at Time 4. Control females were more likely to report experiences of *unwanted first sex* than control males at Time 1 (67.6% of females vs. 44.1% of males, p = 0.03) and Time 4 (82.3% of females vs. 54.2% of males, p = 0.001). *Condom use in the last year* fluctuated overtime, showing inconsistent patterns of condom use by gender and by study condition. For *transactional sex*, gender differences were significant at almost every time point. Although more intervention females reported that they engaged in transactional sex than intervention males at Time 2 and 3, more control males also reported that they engaged in transaction sex than control females at Time 1 and 4. For the *gender equity index*, females reported greater endorsement of gender equity than males at each time regardless of group (p < .001). There were significant gender differences in the endorsement of *Wife beating* overtime especially among intervention group participants, indicating intervention females consistently reported lower acceptance of wife beating than males. In regard to the attitude *Disagree with early sex,* significant gender differences were found at Time 1 and Time 4, which showed mixed patterns. There were significant gender differences on their attitude towards both *Abstaining from sex because of moral value* and *Abstaining from sex because of negative consequences* at some of the time points indicating that females were more likely to support attitudes towards delaying sex than males.

Intervention Effect on Study Outcomes by Gender at Time 4

Table 3 shows the analytic results of intervention effects on the final outcomes at Time 4. Logistic regression analyses on new HIV incidence was not conducted due to the overall low HIV prevalence among participants in this study. We found that females in the intervention group had increased HSV-2 incidence with odds ratio (OR) of 1.57 (Confidence interval (CI of 0.87–2.84 while males in the intervention group had lower rates of HSV-2 with OR of 0.69 (CI of 0.44–0.48). Although the intervention had no significant effects on

Table 3 Intervention effect on study outcomes by gender at time 4: logistic/regression analyses

Concept	Outcome	Female	Male	Difference in program effects by gender
		Effect[a] (95% CI)	Effect[a] (95% CI)	*T* test[b] (p-value)
Biomarker	HSV-2 incidence	1.57 (0.87, 2.84)	0.69 (0.44, 1.06)	**−2.42 (0.016)**
Resource control	School dropout	**0.34 (0.12, 0.88)**	**0.24 (0.11, 0.48)**	−0.84 (0.40)
Force	Transactional sex	0.48 (0.20, 1.10)	0.37 (0.11, 1.05)	−0.44 (0.66)
Force	Unwanted first sex	0.57 (0.23, 1.42)	1.44 (0.71, 2.95)	1.56 (0.12)
Force	Condom use	3.24 (0.29, 90.52)	0.41 (0.02, 6.64)	−0.74 (0.46)
Consensual ideology	Number of sex partners	−0.70 (−1.49, 0.10)	−0.24 (−0.89, 0.40)	0.80 (0.42)

Significant intervention effect was shown in bold

[a]Odds ratio for binary outcomes and regression coefficient for a continuous outcome (multiple sex partners), adjusted for age and socioeconomic status at baseline (Time 1) in multiple generalized regression models accounting for the design of the study

[b]*t* test statistic with Satterthwaites's method for degrees of freedom for the difference in the intervention effects by gender

HSV-2 incidence at the significance level of 0.05 for each gender, results indicated that the effects were significantly different by gender (p = 0.016) while analyses adjusted for orphans' age and SES at Time 1. The intervention also had statistically significant effects on school dropout rates for both genders; the OR was 0.34 (CI of 0.12–0.88) for females and 0.24 (CI of 0.11–1.05) for males, however, these positive program impacts were not significantly different by gender (p = 0.40). Except for HSV-2 incidence, we did not find any significant differences in program effects by gender on other study outcomes.

Intervention Effect on Study Outcomes by Gender at Follow-Up Timepoints

Table 4 showed the results of linear mixed modeling. The intervention showed no significant impacts on by gender on the *Gender equity* scale at each time point. For the *Wife beating* endorsement index, intervention females tended to endorse wife beating more at Time 3 and Time 4 (regression coefficient = 1.02 at Time 3 and 1.30 at Time 4) than did control females whereas there were no significant effects among males. There were no gender differences in program effects on the *wife beating* endorsement index (p = 0.45 and 0.21 at Times 3–4, respectively). Regarding attitude about '*Disagree with early sex*', intervention group participants of both genders were more likely to disagree with early sex at Time 4 compared to controls (regression coefficient of 0.87 among female vs. 0.64 for males), but these effects did not differ by gender (p = 0.56). For the attitude towards '*Abstaining from sex because of negative consequences'*, the intervention had a negative impact on females' attitudes (coefficient = −0.28) but a positive impact on male's attitude (coefficient = 0.24) at Time 3. It indicated that intervention females were less likely to support the attitude of abstaining from sex because of negative consequences (e.g., "I do not want to have sex because I don't want to get pregnant, disease, AIDS"), while intervention males were more likely to support this attitude compared to their controls. This differential program impact by gender was significant at Time 3 (p < .0001). Similarly, intervention females were less likely to support the attitude of *Abstaining from sex because of belief* (e.g., "it is wrong to have sex before marriage") while intervention males were more likely to support this belief (−0.39 among females vs. 0.42 among males) compared to their controls indicating significant gender differences in program effect (p < 0.001). It also demonstrated that intervention females continuously remained less supportive of *'Abstaining sex because of moral belief*' at Time 4 (−0.44, CI of −0.76 to −0.11)

Discussion

This current study offered a unique opportunity to examine whether orphaned females and males who were recipients of school fees benefitted equally or not from the well implemented school support trial. Given the heightened vulnerabilities among females in SSA, we expected that the program effects would be at least similar or greater among females compared to males. However, our hypothesis was not supported in this study.

First, as presented in Tables 1, 2, we found pre-existing gender differences among 7th and 8th graders in primary schools on socio-demographic factors, sexual behavioral outcomes, and HSV-2 infection prior to the intervention, and the differences continued to last over time. A higher proportion of males than females reported initiating sexual activities earlier, and with more sexual partners. Overtime, a high proportion of study participants reported experiencing

Table 4 Intervention effect on study outcomes by gender at follow-up timepoints: 2-level linear mixed models

Concept	Outcome	Time 2			Time 3			Time 4		
		Female	Male	Difference in program effect by gender	Female	Male	Difference in program effect by gender	Female	Male	Difference in program effect by gender
		β (95% CI)	β[a] (95% CI)	*t* test[b] (p-value)	β (95% CI)	β[a] (95% CI)	*t* test[b] (p-value)	β (95% CI)	β[a] (95% CI)	*t* test[b] (p-value)
Social obligation	Gender equity	−0.21 (−1.12, 0.71)	−0.05 (−1.09, 0.99)	0.23 (0.82)	0.09 (−0.82, 1.00)	0.16 (−0.88, 1.19)	0.09 (0.93)	0.35 (−0.60, 1.29)	0.08 (−0.97, 1.14)	−0.36 (0.72)
Social obligation	Wife beating index	0.73 (−0.09, 1.55)	0.33 (−0.63, 1.29)	−0.62 (0.54)	**1.02 (0.21, 1.84)**	0.53 (−0.43, 1.49)	−0.76 (0.45)	**1.30 (0.45, 2.15)**	0.47 (−0.51, 1.44)	−1.26 (0.21)
Consensual ideology	Disagree with early sex	0.18 (−0.35, 0.71)	0.33 (−0.21, 0.86)	0.39 (0.70)	0.33 (−0.20, 0.87)	0.37 (−0.17, 0.90)	0.09 (0.93)	**0.87 (0.32, 1.42)**	**0.64 (0.10, 1.18)**	−0.59 (0.56)
Consensual ideology	Abstaining from sex because of negative consequence	0.04 (−0.14, 0.23)	0.12 (−0.12, 0.37)	0.51 (0.61)	**−0.28 (−0.46, −0.09)**	**0.24 (−0.00, 0.49)**	**3.32 (<0.001)****	−0.11 (−0.31, 0.09)	0.21 (−0.05, 0.47)	1.850 (0.064)
Consensual ideology	Abstaining from sex because of moral beliefs	−0.07 (−0.36, 0.23)	0.13 (−0.23, 0.48)	0.84 (0.40)	**−0.39 (−0.69, −0.10)**	**0.42 (0.06, 0.77)**	**3.43 (<0.001)****	**−0.44 (−0.76, −0.11)**	−0.01 (−0.39, 0.36)	1.67 (0.10)

Significant difference in program effect by gender was shown in bold

**$p < 0.01$

[a]Regression coefficient adjusted for age and socioeconomic status at baseline (Time 1) in multiple regression models accounting for the design of the study

[b]*t* test statistic with Satterthwaites's method for degrees of freedom for the difference in the intervention effects by gender

unwanted first sex and transactional sex among sexually active participants, which might be attributed to the dominant local context in Kenya. Other studies have shown that early sexual debut in adolescence and transactional sex (i.e., giving small gifts or favors for sexual intercourse) among males are normative within this local context [24, 29].

Second, although the intervention had significantly reduced school dropout rates for both genders, we found a larger positive program effect among males than females. That is, the intervention reduced the dropout rate by 73.4% among males and 55.1% among females compared to their controls. Although females were given the same educational opportunity in this study, females may not have been able to fully benefit from the intervention due to gender-based barriers such as *social obligations* (e.g., taking care of young siblings, domestic chores) and normative gender-based practices that prioritize men's educational achievement over young women's advancement.

We found differential program effects by gender on HSV-2 incidence in an unexpected direction. More intervention females became infected with HSV-2 than control females (33% of intervention vs. 25% of controls), while fewer intervention males became infected than control males (25% of intervention vs. 33% of controls) during the study. This finding contradicted a Kenya uniform subsidy intervention study which found that uniforms combined with HIV education reduced HSV-2 prevalence among girls, but not boys [10]. However, this uniform subsidy study did not include biomarker testing at baseline, thus failing to establish HIV/HSV-2 infection prior to the program implementation. Although all our study participants were initially recruited from day schools at the primary level, some male and female participants enrolled in boarding schools at the secondary level. Interestingly, we found the lowest HSV-2 incidence among males who were enrolled in boarding school compared to ones who were in day schools (21% of boarding schools vs. 28% of day schools), whereas there was no difference among females by type of school (34% vs. 35%). Thus, for male adolescents, schools, particularly boarding school, played a protective role preventing them from being HSV-2 infected through engagement of risky sexual behaviors. It suggested male adolescents in school might not have had resources to offer any gifts to their sexual partners compared to controls who dropped out of school and participated in paid labor. However, it is puzzling to understand that the school support intervention produced negative program effects among females. HSV-2 infection is a clear biomarker of risky sexual intercourse because it is very rare for HSV-2 to be transmitted other than through sexual activity. We expected that intervention girls who stayed in school would be less likely to engage in transactional sex for basic needs (e.g., school fees, food) since the school fee provision relieved some economic burden for them. This assertion was based on the paradigm of 'transactional sex for basic needs' [40], which considered women as vulnerable victims of sexual relationships for economic dependence. Stoebenau et al. [40] provided additional paradigms on transactional sex which included 'sex for improved social status' and 'sex and material expressions of love.' Following this paradigm, young women as sexual agents engaged in transactional sex with peers, and older, employed men for attaining middle-class statue, luxury life style, and 'consumer culture' due to the influence of western culture [29, 40]. Peer pressure in school might exist among females who are more exposed to modern culture than control girls who dropped out of school earlier. We expected that increased school attendance would have linked to more equitable attitudes about gender roles, better knowledge of HIV risk, more bonding with pro-social peers, and lower likelihood of sexual risk-taking behaviors among females. However, school girls had a longer time between their first sexual debut and stable relationship, more peer pressure for a higher standard of living, and may have more liberal sexual beliefs which might lead to continued risky sexual behaviors [23, 40]. Our study findings about gender-specific effects on attitudes toward abstaining from sex seemed to support this. That is, females were more likely to endorse *wife beating* and less likely to support *'Abstaining from Sex because of moral beliefs or negative consequences'* than males. Negative effects on HSV-2 infection and attitudes toward abstaining from sex among females all signaled that schooling alone did not automatically convert into protective behavioral outcomes or ideologies necessary to address these cultural practices or social norms embedded in this area within a somewhat short time period. However, our explanations for opposite program effects on HSV-2 infection remain speculative, which warrants further studies to examine main routes of transmission of STIs by further research addressing transactional sex, sexual violence, and relationship dynamics. In addition, we found conflicting associations among attitudes and ideologies. For example, those participants who reported higher scores on gender equity endorsed more permissive attitudes towards wife beating. These conflicting ideologies might be due to the gap in their normative ideologies and widespread cultural practices embedded among individuals within this local context.

Our sample is limited to Luo orphaned youth in the Nyanza area where HIV prevalence is high and cultural practices such as widow cleansing and wife inheritance were practiced [32], which has limited generalizability. Although ACASI can be expected to help reduce bias, self-reported survey measurement of sexual risk was found to be inconsistent with biomarker measurement [4, 5, 22]. Since the intervention was to pay for school fees, there may have been certain levels of social desirability bias among intervention study participants. Despite a sharp increase in HSV-2 infection among all study participants,

it was not feasible to examine the mode of transmission without collecting a full history of sexual partners. In 2013, the Kenya government committed to "Comprehensive and rights-based sex education for adolescents and young people" and tried to increase the number of schools that offered this education [39]. Our school support trial was a structural intervention altering the context, rather than individual intervention targeting the individual behavior change. We did not collect the contents of health education curriculum at each school. However, since all 26 primary schools were under one educational district in Siaya County, they were all exposed to the same level of sexual education curriculum regardless if they belonged to intervention schools or control schools.

In sum, we learned from our intervention that providing school fees alone did not produce equal effects across genders, which demonstrated less beneficial program effects among females. The findings signify more research needs to be conducted to examine gender-specific program impacts. Critical gaps in current knowledge are understanding the onset and transmission mode of STIs, and relational and social contexts that reinforce the gender disparity in HIV/HSV-2 risk. HIV prevention interventions would benefit from gathering information about how STIs are transmitted, characteristics and types of sexual partners (e.g., age, polygamy, serostatus of STI infection, casual, concurrent, long-term relations), and relational factors (e.g., power-imbalances, intimate partner violence, and negotiating power). Interventions should be inclusive of both genders but gender-specific intervention for males as well as females are all necessary. Given rapid increases in HSV-2 incidence from primary school students over a three- year period, intervention strategies targeting younger adolescents (i.e., less than 15 years) are recommended before these orphaned adolescents engage in HIV risk behaviors and acquire STIs. Therefore, we argue that structural intervention such as school support must be coupled with other prevention strategies that address power and gender inequality using theoretical frameworks. These interventions also need to be multi-layered by incorporating individual, relational, and community levels to address the drivers of the HIV/HSV-2 epidemic.

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