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# Exploring the linkage between exposure to mass media and HIV awareness among adolescents in Uganda

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ABSTRACT

Although HIV awareness is an important prerequisite for successful HIV prevention, the rate of HIV testing and knowledge about HIV remains critically low among adolescents in Uganda. Using Uganda's 2016 Demographic and Health Surveys, this paper investigates the linkage between mass media exposure and HIV awareness among adolescents aged between 15 and 19 years old. We perform multivariate regressions to estimate the effect of mass media (print media, radio and TV) exposure on adolescents' awareness focusing on HIV testing and HIV-related knowledge. Results suggest that the frequency of exposure to mass media increases both adolescents' likelihood to get tested for HIV and their HIV-related knowledge score. These findings imply that health educators and HIV programme planners in Uganda should take advantage of traditional mass media and deliver more HIV-related messages through television, radio, and print media in order to enhance the levels of HIV testing and HIV-related knowledge among adolescents.

## Introduction

HIV epidemic and related diseases remain the leading cause of preventable mortality among adolescents in sub-Saharan Africa [26]. Uganda is one of the most affected countries in the world with more than 1.4 million people living with HIV and 28,000 deaths of AIDS-related illnesses in 2016 [26]. Despite increasing efforts to scale up treatment initiatives and to reach 100 percent of HIV testing, the rate HIV testing is still very low in Uganda [15,14].

Empirical studies by Idele et al. [12] and Staveteig and Nybro (2013) using national survey data across sub-Saharan Africa estimate that more than three quarters of adolescents have never been tested for HIV. In a study in Uganda and Kenya, Kadede et al. [14] finds that 91%, 74%, and 45% respectively in early (10–14 years old), mid (15–17) and late (18–24) adolescents have never been tested for HIV in Uganda. This causes a serious risk for HIV epidemic spreading among adolescents since "knowledge is an important prevention factor for any disease" [13]. In addition, the report of UNAIDS [26] reveals a very poor sexual health literacy and knowledge about sexually transmitted infections including HIV among adolescents in Uganda [13] find that almost a quarter of teenagers still lack knowledge on HIV transmissions in Tanzania. To address this public health issue, mass communication plays a key role [27]. In fact, mass media is an important channel to increase an individual's knowledge about sexual health, improve the knowledge of facilities related to HIV prevention and highlight the benefits of HIV testing [19,22]. Sano et al. [22] finds that mass media increases the knowledge of HIV and facilities related to HIV testing and creates a demand for HIV testing. These results are supported by evidence in the literature which reveals that exposure to mass media such as television, radio, and print media affects individuals' risky sexual behaviours [1,16]. To this extent, Uganda, like other sub-Saharan Africa has implemented sensitization policies using mass media to inform and encourage adolescents about sexual health risks [20]. Campaigns utilize print media, radio and television to reach people in order to increase HIV knowledge, to improve sexual risk perception, to change sexual behaviour, and reduce the effect of stigmatizing attitudes towards HIV testing among adolescents.

Yet, the empirical linkage between mass media and HIV testing remains unclear. Indeed, some previous studies argue that the mass media by addressing general messages or exposing substantial amounts of sexual content can cause harmful influences on adolescents and even promote risky sexual behaviour among adolescents [3–5,7]. In contrast, another set of papers find that mass media intervention such as awareness campaigns, because of their reach and effectiveness, can be used as efficient channels to promote sexual health among adolescents [10,11,8].

Using Uganda's 2016 Demographic and Health Surveys, this paper examines the effect of mass media on HIV testing among adolescents.

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We focus on three mass communication channels: print mass media (newspapers), audio mass media (radio) and audiovisual media (television). We analyze the effects of each mass media on HIV testing and HIV-related knowledge. We build a score of HIV-related knowledge representing the number of correct answers an adolescent gave to the three questions: (i) Can someone get HIV from mosquito bites? (yes or no), (ii) Can someone get HIV by sharing food with a person who has AIDS? (yes or no); (iii) A healthy-looking person can have HIV? (yes or no).

The findings suggest that the exposure to mass media increases both adolescents' likelihood to test for HIV and their HIV-related knowledge score. The estimated average effect of mass media on HIV testing indicates that reading print media once a week increases the likelihood of an adolescent to test for HIV by 4.88 percentage points. Listening to radio at least once a week increases the probability to test for HIV by 5.79 percentage points. The estimated average effect of mass media on HIV-related knowledge suggests that, compared to adolescents who do not read print media at all, adolescents who read print media less than once a week and those who read print media at least once a week have a higher score of HIV-related knowledge of 11.9 percent and 11.4 percent respectively. Additionally, watching TV less than once a week increases the score of HIV-related knowledge by 13.8 percent while watching TV at least once a week increases the score of HIV-related knowledge by 10.9 percent. These results are consistent with findings in the literature which suggest that mass media because of their reach and effectiveness can be used as channels for increasing adolescents' knowledge about HIV and HIV testing behaviour [8,10].

The rest of this paper is structured as follows. "Background: HIV awareness campaigns through mass media in Uganda" reviews the HIV awareness programs through mass media that have been implemented in Uganda. "Data and Identification strategy" presents our data and the identification strategy. The results are presented in "Results" while "Sensibility analysis" reports the results of sensibility analyses. "Discussion and Conclusion" discusses the results and concludes the paper. Limitations and future research avenues are presented in section 7.

## Background: HIV awareness campaigns through mass media in Uganda

Early in 1986, Uganda began to implement HIV awareness and prevention campaigns to promote positive responses to HIV/AIDS epidemic through using print, text message in print media, billboards, radio, and television [2,18]. The program was referred to as the ABC[1] campaign. In 1990, the government launched another ambitious awareness campaign through mass media including the "Zero Grazing Campaign" and the "Love Carefully Campaign" to warn people about HIV/AIDS.

More recently in 2013, the government introduced the Communication for Healthy Communities (CHC), a five-year program funded by the U.S. Agency for International Development (USAID) which targets HIV awareness and related health issues in Uganda. According to the 2015 Uganda HIV and AIDS Country Progress Report [25], this program "used more than 43 Radio stations and 4 TV stations to air a minimum of 4 exposures per day on TV during prime times and a minimum of 10 exposures per day on radio". Overall, "43 talk shows per month and 12,900 monthly radio exposures were aired in 19 local languages". In addition, several mass communication topics were designed on partner reduction including "production of 02 videos/TVCs, airing of 02 daily radio spots in 19 languages and generating Disco Joker (DJ) mention scripts". Moreover, the program integrates TV and radio talking shows on HIV transmission, using messages in other materials e.g. advertising, flipcharts, grain sack charts and guides (Uganda AIDS Commission, 2016). The Communication for Healthy Communities (CHC) reach out to "millions of people" on HIV infection and prevention tools such as HIV testing through mass media channels including billboards, radio, television, and print media in Uganda [25].

## Data and identification strategy

This section describes the data we use to analyze the effect of an adolescent's exposure to mass media on her/his HIV testing and HIV-related knowledge. It also outlines our empirical method.

### *Data*

We use data from Uganda 2016's Demographic and Health Surveys, a nationally representative dataset, to examine the effect of adolescents' exposure to mass media on HIV testing and HIV-related knowledge. This database contains information about participants' age, gender, level of education, the frequency of exposure to mass Media such as print media, radio, and television, their HIV testing status and their knowledge of HIV. Our analysis focuses on two dependent variables: HIV testing, HIV-related knowledge. For HIV testing variable denotes Testing, the respondents were asked whether they have ever been tested for HIV (yes or no). We define the HIV testing variable as a dummy equal 1 if an adolescent self-reported that has ever been tested for HIV and 0 otherwise. For HIV related knowledge, we built a score of knowledge based on the respondent answer to the three following questions: (1) Can someone get HIV from mosquito bites? (yes or no), (2) Can someone get HIV by sharing food with a person who has AIDS? (yes or no); (3) A healthy-looking person can have HIV? (yes or no). The correct answer to the first two questions is "No" and the correct answer to the last question is "Yes". We define HIV related knowledge as a discrete score equals the number of correct answers the respondent gives. So, the score takes values in S = 0, 1, 2 or 3. Our explanatory interest is the exposure to mass media which were captured by three variables. The first one is the frequency of reading print media (newspapers) denoted *newspaper*. The second variable is the frequency of listening to radio (denoted *radio*) and the last variable is the frequency of watching television (denoted *TV*). These variables are categorical which take three values: 0 if the participant does not use this media at all, 1 if the frequency of using this media is" less than once a week" and 2 if the frequency of using the media is" at least once a week". We restricted our data to individuals aged between 15 and 19 years old in order to focus on adolescents. The main sample consist of 4463 adolescents.

### *Identification strategy*

We use multivariate regressions to estimate the effect of mass media (print media, radio and TV) exposure on HIV testing and HIV-related knowledge among adolescents.

#### *Mass media and HIV-related knowledge*

In this section, we estimate the effect of an adolescent exposure to mass media on the HIV-related knowledge score. The score for HIV-related knowledge is the number of correct answers by an adolescent $i$ (taking values $hks_i \in HKS = 0, 1, 2, 3$). This score is a discrete variable and then, we use a Poisson regression which is appropriate for count data analysis.

The conditional average of the Poisson model denotes $\lambda_i$ reads as follows:

[1] " Abstinence, Be faithful, use Condom if A and B fail".

$$\lambda_i = Exp\left(\beta_0 + \sum_{j=1}^{2}\beta_{1j} newspaper_{ij} + \sum_{j=1}^{2}\beta_{2j} radio_{ij} + \sum_{j=1}^{2}\beta_{3j} TV_{ij} + X_i^{'}\delta + \mu_i\right) \quad (1)$$

The likelihood function is:

$$\Pr(HKS = hks_i | newspaper_i, radio_i, TV_i, X_i) = \frac{e^{-\lambda_i}\lambda_i^{hks_i}}{hks_i!} \quad (2)$$

For our interpretation, we also estimate the marginal effects in order to evaluate the causal effect of adolescents' exposure to each mass media on the HIV-related knowledge score.

*Mass media and HIV testing*

Since $Testing_i$ the status of an adolescent $i$ regarding HIV testing is a binary variable, we use a probit regression to estimate the effect of mass media on the probability to test for HIV. Our model is given by the following equation:

$$Testing_i = \begin{cases} 1 & if\ Testing_i^* > 0 (Tested\ for\ HIV) \\ 0 & if\ Testing_i^* < 0 (Never\ tested\ for\ HIV) \end{cases} \quad (3)$$

where

$$Testing_i^* = \alpha_0 + \sum_{j=1}^{2}\alpha_{1j} newspaper_{ij} + \sum_{j=1}^{2}\alpha_{2j} radio_{ij} + \sum_{j=1}^{2}\alpha_{3j} TV_{ij} + X_i^{'}\gamma + \varepsilon_i$$

$Testing_i^*$ is the latent variable which sign determines the HIV testing status and $_i$ is a zero-mean error term. We include two dummies for each mass media considering the outcome "Not exposed at all" as the base outcome of our regression. $X_i$ includes the adolescent i's other characteristics such as his/her age, his/her gender, his/her education, his/her household's wealth index and a dummy for residence in his/her place of residence (urban area). The probability of $Testing_i = 1$ can then be written as follows:

$$P(Testing_i{=}1) = P(Testing_i^* > 0) \quad (4)$$

$$= P\left(\alpha_0 + \sum_{j=1}^{2}\alpha_{1j} newspaper_{ij} + \sum_{j=1}^{2}\alpha_{2j} radio_{ij} + \sum_{j=1}^{2}\alpha_{3j} TV_{ij} + X_i^{'}\gamma + \varepsilon_i > 0\right)$$

$$= P\left(\varepsilon_i < \alpha_0 + \sum_{j=1}^{2}\alpha_{1j} newspaper_{ij} + \sum_{j=1}^{2}\alpha_{2j} radio_{ij} + \sum_{j=1}^{2}\alpha_{3j} TV_{ij} + X_i^{'}\gamma\right)$$

$$= Đ¤\left(\alpha_0 + \sum_{j=1}^{2}\alpha_{1j} newspaper_{ij} + \sum_{j=1}^{2}\alpha_{2j} radio_{ij} + \sum_{j=1}^{2}\alpha_{3j} TV_{ij} + X_i^{'}\gamma\right)$$

where $\varphi(\cdot)$ is the normal distribution. This probability and the parameters of the model are estimated using a maximum likelihood. To deal with the potential clustering of observations at the neighbourhood level, we estimate the model using heteroskedasticity robust standard errors. For our interpretation, we estimate the marginal effect of each mass media on the probability to test for HIV.

*Descriptive statistics*

The summary of descriptive statistics is presented in Table 1. We find that 63.6% of adolescents have never been tested for HIV in Uganda. This causes a serious risk for HIV epidemic to spread among adolescents. Looking at the score related to HIV knowledge, we observe that less than a half (40.2%) of adolescents find the correct answer to all these three questions. In addition, 37.2% of them give one wrong answer, 17.7% give two wrong answers and 4.97% did not get any correct answer to all of the three questions. These statistics suggest that Ugandan adolescents also face an important problem of misconception and lack of knowledge on HIV. As far as exposure to mass media is concerned, the statistics suggest that radio is the most popular media channel among adolescents in Uganda. In fact, more than 31% listen to radio at least once a week while only 8.04% read print media at least once a week and 28.1% of adolescents have access to television at least once a week. Print media are less used than the other types of mass media with almost a third (74%) of adolescents who do not read print media at all. Finally, we observed that around 61.6% of adolescents in our sample have a primary education while 29.1% have a secondary or higher education and females represent 72% of our sample.

**Table 1**
Descriptive Statistics.

| VARIABLES | N | mean | sd | min | max |
|---|---|---|---|---|---|
| HIV testing | 4463 | 0.364 | 0.481 | 0 | 1 |
| *HIV related Knowledge Score (HKS)* | | | | | |
| HKS = 0 | 4463 | 0.0497 | 0.217 | 0 | 1 |
| HKS = 1 | 4463 | 0.177 | 0.381 | 0 | 1 |
| HKS = 2 | 4463 | 0.372 | 0.483 | 0 | 1 |
| HKS = 3 | 4463 | 0.402 | 0.490 | 0 | 1 |
| *Frequency of exposure to print media* | | | | | |
| Not at all | 4463 | 0.740 | 0.439 | 0 | 1 |
| Less than once a week | 4463 | 0.179 | 0.384 | 0 | 1 |
| At least once a week | 4463 | 0.0804 | 0.272 | 0 | 1 |
| *Frequency of exposure to radio* | | | | | |
| Not at all | 4463 | 0.481 | 0.500 | 0 | 1 |
| Less than once a week | 4463 | 0.200 | 0.400 | 0 | 1 |
| At least once a week | 4463 | 0.319 | 0.466 | 0 | 1 |
| *Frequency of exposure to TV* | | | | | |
| Not at all | 4463 | 0.567 | 0.496 | 0 | 1 |
| Less than once a week | 4463 | 0.152 | 0.359 | 0 | 1 |
| At least once a week | 4463 | 0.281 | 0.450 | 0 | 1 |
| *Education level* | | | | | |
| No education | 4463 | 0.0939 | 0.292 | 0 | 1 |
| Primary | 4463 | 0.616 | 0.487 | 0 | 1 |
| At least Secondary | 4463 | 0.291 | 0.454 | 0 | 1 |
| *Wealth Index* | | | | | |
| Poorest | 4463 | 0.197 | 0.398 | 0 | 1 |
| Poorer | 4463 | 0.143 | 0.350 | 0 | 1 |
| Middle | 4463 | 0.154 | 0.361 | 0 | 1 |
| Richer | 4463 | 0.167 | 0.373 | 0 | 1 |
| Richest | 4463 | 0.339 | 0.474 | 0 | 1 |
| *Gender* | | | | | |
| Male | 4463 | 0.280 | 0.449 | 0 | 1 |
| Female | 4463 | 0.720 | 0.449 | 0 | 1 |
| *Age* | | | | | |
| 15 | 4463 | 0.201 | 0.401 | 0 | 1 |
| 16 | 4463 | 0.218 | 0.413 | 0 | 1 |
| 17 | 4463 | 0.185 | 0.388 | 0 | 1 |
| 18 | 4463 | 0.244 | 0.429 | 0 | 1 |
| 19 | 4463 | 0.152 | 0.359 | 0 | 1 |
| *Area of residence* | | | | | |
| Rural | 4463 | 0.679 | 0.467 | 0 | 1 |
| Urban | 4463 | 0.321 | 0.467 | 0 | 1 |

## Results

*Effect of mass media on HIV-related knowledge*

Table 3 presents the results of the estimations on the impact of print media, radio and TV on HIV-related knowledge. As stated in the previous section, we present the coefficients and the marginal effects (dy/dx) for each model estimated. The first concern when using DHS data (as in most surveys data), is that participants may be selected and interviewed with unequal probability [9]. The second concern is the

**Table 2**
Probit Regression: Estimated average partial effects on adolescents' probability of HIV testing.

| VARIABLES | Model (1) | | Model (2) | | Model (3) | |
|---|---|---|---|---|---|---|
| | coef | dydx | coef | dydx | coef | dydx |
| *Exposure to print media (base = not at all)* | | | | | | |
| Less than once a week | 0.170** | 0.0609** | 0.152** | 0.0507** | 0.147** | 0.0488* |
| | (0.0704) | (0.0257) | (0.0748) | (0.0255) | (0.0746) | (0.0253) |
| At least once a week | 0.0383 | 0.0133 | 0.0246 | 0.00804 | 0.0183 | 0.00595 |
| | (0.0975) | (0.0342) | (0.101) | (0.0332) | (0.103) | (0.0335) |
| *Exposure to radio (base = not at all)* | | | | | | |
| Less than once a week | 0.148** | 0.0505* | 0.0167 | 0.00541 | 0.0131 | 0.00424 |
| | (0.0752) | (0.0259) | (0.0792) | (0.0258) | (0.0793) | (0.0256) |
| At least once a week | 0.439*** | 0.159*** | 0.166** | 0.0556** | 0.174** | 0.0579** |
| | (0.0647) | (0.0234) | (0.0772) | (0.0262) | (0.0774) | (0.0262) |
| *Exposure to TV (base = not at all)* | | | | | | |
| Less than once a week | 0.0614 | 0.0212 | 0.00784 | 0.00254 | −0.0483 | −0.0156 |
| | (0.0770) | (0.0269) | (0.0794) | (0.0258) | (0.0828) | (0.0265) |
| At least once a week | 0.310*** | 0.113*** | 0.234*** | 0.0793*** | 0.103 | 0.0341 |
| | (0.0681) | (0.0254) | (0.0712) | (0.0246) | (0.0894) | (0.0300) |
| Age | | | 0.204*** | 0.0669*** | 0.206*** | 0.0669*** |
| | | | (0.0212) | (0.00656) | (0.0212) | (0.00653) |
| Female | | | −0.431*** | −0.141*** | −0.479*** | −0.156*** |
| | | | (0.0646) | (0.0204) | (0.0674) | (0.0211) |
| *Education level* | | | | | | |
| Primary | | | 0.0871 | 0.0277 | 0.0808 | 0.0256 |
| | | | (0.123) | (0.0385) | (0.128) | (0.0399) |
| At least secondary | | | 0.343** | 0.115*** | 0.298** | 0.0990** |
| | | | (0.134) | (0.0433) | (0.139) | (0.0447) |
| *Wealth index (base = poorest)* | | | | | | |
| Poorer | | | | | 0.165* | 0.0535* |
| | | | | | (0.0948) | (0.0307) |
| Middle | | | | | 0.0127 | 0.00398 |
| | | | | | (0.0949) | (0.0298) |
| Richer | | | | | 0.0134 | 0.00420 |
| | | | | | (0.0955) | (0.0300) |
| Richest | | | | | 0.275** | 0.0913** |
| | | | | | (0.115) | (0.0382) |
| Living in rural area | | | | | 0.0177 | 0.00577 |
| | | | | | (0.0971) | (0.0316) |
| Constant | −0.733*** | | −3.911*** | | −3.963*** | |
| | (0.0444) | | (0.389) | | (0.391) | |
| Observations | 4463 | 4463 | 4463 | 4463 | 4463 | 4463 |
| F-statistic | 18.97 | | 27.35 | | 19.18 | |
| Prob > F | (0.000) | | (0.000) | | (0.000) | |

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

regional heterogeneity that may affect households' characteristics. In order to address these issues, we perform weighted Poisson estimation with stratification over the regions of residence[2]. Since we merge the male and female dataset, we apply the weights available in each dataset. The P-value for the F-test of overall significance test of all the three specifications are significant at any threshold (Prob > F = 0.000) confirming that our regression models fit the data.

Model (i) includes only the frequency of exposure to print media, radio and TV as determinants of adolescent score of HIV-related knowledge. We find that exposure to mass media increases adolescents' score of HIV-related knowledge. In fact, compared to adolescents who are not exposed to print media at all, reading print media less than once a week increases the score of HIV-related knowledge by 22.7 percent. The effect is to 20.3 percent when the frequency of reading print media is up to at least once a week. Moreover, listening to radio less than once a week increases the score related to HIV knowledge by 10.2 percent. While the effect increases to 15.2 percent for adolescents who listen to radio at least one a week. Watching television at least once a week increases adolescents' score of HIV-related knowledge by 23.3 percent and 32.1 percent for at least once a weak exposure to TV.

In Model (ii), we control for adolescents' individual characteristics such as age, gender and education level. We find that the exposure to print media and radio still have a positive effect on HIV-related knowledge. The effect of reading print media less than once a week becomes to 12.4 percent but is still significant. This effect is 12.1 percent for adolescents who are exposed to print media at least once a week. In addition, watching TV less once a week increases the HIV-related knowledge score by 17.5 percent and by 20.2 percent if the exposure is at least once a week.

In Model (iii), we control for family level characteristics such as wealth index and area of residence. The results suggest that, compared to adolescents who do not read print media at all, adolescents who read print media less than once a week and those who read print media at least once a week have a higher score of HIV-related knowledge of 11.9 percent and 11.4 percent respectively. Additionally, watching TV less than once a week increases the score of HIV-related knowledge by 13.8 percent while watching TV at least once a week increases the score of HIV-related knowledge by 10.9 percent. Overall our results suggest that exposure to print media and TV increases adolescents' knowledge about HIV transmission.

[2] Participants were from the 14 regions of Uganda: Kampala, Central, Busoga, Bukedi, Bugishu, Teso, Karamoja, Lango, Acholi, West-Nile, Bunyoro, Tooro, Ankole et Kigezi.

**Table 3**
Poisson Regression: Estimated average partial effects on adolescents' knowledge about HIV.

| VARIABLES | Model (i) | | Model (ii) | | Model (iii) | |
|---|---|---|---|---|---|---|
| | coef | dy/dx | coef | dy/dx | coef | dy/dx |
| *Exposure to print media (base = not at all)* | | | | | | |
| Less than once a week | 0.102*** | 0.227*** | 0.0565*** | 0.124*** | 0.0543*** | 0.119*** |
| | (0.0168) | (0.0379) | (0.0168) | (0.0373) | (0.0169) | (0.0374) |
| At least once a week | 0.0924*** | 0.203*** | 0.0555** | 0.121** | 0.0519** | 0.114** |
| | (0.0250) | (0.0568) | (0.0242) | (0.0541) | (0.0245) | (0.0545) |
| *Exposure to radio (base = not at all)* | | | | | | |
| Less than once a week | 0.0478** | 0.102** | 0.00323 | 0.00698 | 0.00105 | 0.00226 |
| | (0.0235) | (0.0507) | (0.0235) | (0.0508) | (0.0234) | (0.0505) |
| At least once a week | 0.0702*** | 0.152*** | 0.00818 | 0.0177 | 0.00248 | 0.00535 |
| | (0.0190) | (0.0410) | (0.0214) | (0.0462) | (0.0214) | (0.0463) |
| *Exposure to TV (base = not at all)* | | | | | | |
| Less than once a week | 0.108*** | 0.233*** | 0.0806*** | 0.175*** | 0.0633*** | 0.138*** |
| | (0.0208) | (0.0458) | (0.0205) | (0.0452) | (0.0209) | (0.0460) |
| At least once a week | 0.146*** | 0.321*** | 0.0924*** | 0.202*** | 0.0501** | 0.109** |
| | (0.0178) | (0.0395) | (0.0177) | (0.0390) | (0.0218) | (0.0474) |
| Age | | | −0.00146 | −0.00315 | −0.00132 | −0.00286 |
| | | | (0.00596) | (0.0129) | (0.00594) | (0.0128) |
| Female | | | −0.0413** | −0.0894** | −0.0627*** | −0.136*** |
| | | | (0.0167) | (0.0359) | (0.0175) | (0.0376) |
| *Education level (base = no education)* | | | | | | |
| Primary | | | 0.357*** | 0.635*** | 0.333*** | 0.602*** |
| | | | (0.0580) | (0.0876) | (0.0587) | (0.0908) |
| At least secondary | | | 0.496*** | 0.953*** | 0.457*** | 0.881*** |
| | | | (0.0585) | (0.0902) | (0.0593) | (0.0935) |
| *Wealth index (base = poorest)* | | | | | | |
| Poorer | | | | | 0.0679** | 0.139** |
| | | | | | (0.0341) | (0.0692) |
| Middle | | | | | 0.0990*** | 0.205*** |
| | | | | | (0.0332) | (0.0679) |
| Richer | | | | | 0.106*** | 0.220*** |
| | | | | | (0.0317) | (0.0645) |
| Richest | | | | | 0.122*** | 0.256*** |
| | | | | | (0.0355) | (0.0733) |
| Living in rural area | | | | | 0.0283 | 0.0611 |
| | | | | | (0.0236) | (0.0510) |
| Constant | 0.658*** | | 0.394*** | | 0.353*** | |
| | (0.0151) | | (0.119) | | (0.120) | |
| Observations | 4463 | 4463 | 4463 | 4463 | 4463 | 4463 |
| F-statistic | 34.24 | | 31.58 | | 21.89 | |
| Prob > F | (0.000) | | (0.000) | | (0.000) | |

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

*The effect of mass media on HIV testing*

Table 2 presents the results of our estimations on the impact of print media, radio and TV on HIV testing. The coefficients and the marginal effects (dy/dx) are presented for each model estimated. As in the previous section, we estimate a weighted linear probability model (LPM) with stratification over the regions of residence to control for clustering in the regions and the fact that the overall probability of selection of each household is not a constant in Table 2 indicates that the P-value for the F-test of overall significance test of all the three specifications are also significant (Prob > F = 0.000) confirming that our regression models fit the data.

In Model (1), we include only the variables of mass media as a determinant of HIV testing. The results suggest that the exposure to mass media increase adolescents' probability to test for HIV. In fact, compared to adolescents who do not read print media at all, the estimated marginal effects (dy/dx) indicate that adolescents who are exposed to print media once a week have 6.1 percentage points more probability to test for HIV. Like print media, the effect of exposure to radio on HIV testing is also positive and significant. The results suggest that adolescents who are exposed to radio less than once a week 5.1 percentage points more probability to test for HIV than those who do not listen to radio at all. This effect jumps to 15.9 percentage points for adolescents who are listening to radio at least once a week. Finally, we find that adolescents who are exposed to TV at least once a week have 11.3 percentage points more probability to test for HIV than those who do not watch TV at all.

Model (2) controls for adolescents' individual characteristics such as age, gender and education. The results suggest that reading print media once a week continue to have a positive effect (5.1 percentage points) on the probability to test for HIV. This effect is smaller than the effect obtained in Model (1) but is statistically significant. In addition, being exposed to radio less than once a week or at least once a week also has a positive and significant effect as well as being exposed to TV more than once a week. Moreover, education, age and being a female appears to increase the likelihood of adolescents to test for HIV.

Finally, in Model (3), we control for family level characteristics such as the wealth index and the area of residence. The results suggest that reading print media once a week increases the likelihood of an adolescent to test for HIV by 4.88 percentage points. Listening to radio at least once a week increases the probability to test for HIV by 5.79 percentage points. Overall, these results suggest that the exposure to mass media have a positive effect on the likelihood of an adolescent to test for his/her HIV status.

**Table 4**
Robustness check: Estimated average partial effects on HIV awareness for adolescents living in rural versus urban area.

| VARIABLES | ADOLESCENTS FROM RURAL HOUSEHOLDS | | | | ADOLESCENTS FROM URBAN HOUSEHOLDS | | | |
|---|---|---|---|---|---|---|---|---|
| | HIV testing | | HIV knowledge | | HIV testing | | HIV knowledge | |
| | coef | dy/dx | coef | dy/dx | coef | dy/dx | coef | dy/dx |
| *Exposure to print media (base = not at all)* | | | | | | | | |
| Less than once a week | 0.163 | 0.0574 | 0.00575 | 0.0140 | 0.158* | 0.0509* | 0.0786*** | 0.167*** |
| | (0.136) | (0.0483) | (0.0252) | (0.0614) | (0.0910) | (0.0301) | (0.0219) | (0.0474) |
| At least once a week | −0.129 | −0.0443 | −0.00104 | −0.00252 | 0.137 | 0.0441 | 0.0794** | 0.168** |
| | (0.174) | (0.0592) | (0.0375) | (0.0912) | (0.125) | (0.0412) | (0.0320) | (0.0700) |
| *Exposure to radio (base = not at all)* | | | | | | | | |
| Less than once a week | 0.138 | 0.0484 | 0.0869*** | 0.207*** | −0.00634 | −0.00196 | 0.0311 | 0.0651 |
| | (0.152) | (0.0531) | (0.0329) | (0.0781) | (0.0952) | (0.0294) | (0.0301) | (0.0635) |
| At least once a week | 0.147 | 0.0515 | −0.000235 | −0.000584 | 0.196** | 0.0637** | 0.00228 | 0.00472 |
| | (0.149) | (0.0524) | (0.0340) | (0.0846) | (0.0919) | (0.0305) | (0.0273) | (0.0563) |
| *Exposure to print media (base = not at all)* | | | | | | | | |
| Less than once a week | −0.472** | −0.164** | 0.127** | 0.307*** | 0.00550 | 0.00173 | 0.0387 | 0.0810 |
| | (0.213) | (0.0729) | (0.0495) | (0.115) | (0.0907) | (0.0285) | (0.0240) | (0.0507) |
| At least once a week | −0.328* | −0.115* | 0.0823* | 0.194* | 0.278** | 0.0928** | 0.0511** | 0.107** |
| | (0.187) | (0.0652) | (0.0482) | (0.110) | (0.110) | (0.0383) | (0.0255) | (0.0546) |
| Age | 0.243*** | 0.0847*** | −0.00574 | −0.0140 | 0.198*** | 0.0622*** | −2.88e-05 | −5.98e-05 |
| | (0.0441) | (0.0142) | (0.00884) | (0.0215) | (0.0239) | (0.00719) | (0.00732) | (0.0152) |
| Female | −0.445*** | −0.155*** | −0.0228 | −0.0555 | −0.473*** | −0.149*** | −0.0758*** | −0.157*** |
| | (0.152) | (0.0517) | (0.0337) | (0.0820) | (0.0789) | (0.0240) | (0.0219) | (0.0451) |
| *Education level* | | | | | | | | |
| Primary | 0.689** | 0.201*** | 0.190* | 0.400** | 0.0151 | 0.00471 | 0.342*** | 0.599*** |
| | (0.280) | (0.0669) | (0.101) | (0.194) | (0.136) | (0.0422) | (0.0645) | (0.0965) |
| At least secondary | 1.052*** | 0.331*** | 0.295*** | 0.655*** | 0.136 | 0.0436 | 0.475*** | 0.893*** |
| | (0.282) | (0.0689) | (0.100) | (0.194) | (0.153) | (0.0483) | (0.0658) | (0.101) |
| *Wealth index (base = poorest)* | | | | | | | | |
| Poorer | 0.454 | 0.121 | −0.175 | −0.365 | 0.136 | 0.0436 | 0.0755** | 0.150** |
| | (0.568) | (0.165) | (0.237) | (0.468) | (0.0965) | (0.0308) | (0.0347) | (0.0684) |
| Middle | 0.810* | 0.238* | 0.0750 | 0.177 | −0.0224 | −0.00689 | 0.0992*** | 0.200*** |
| | (0.428) | (0.130) | (0.127) | (0.300) | (0.0976) | (0.0300) | (0.0344) | (0.0683) |
| Richer | 0.614* | 0.172* | 0.0330 | 0.0764 | −0.00962 | −0.00297 | 0.108*** | 0.219*** |
| | (0.348) | (0.0939) | (0.103) | (0.235) | (0.100) | (0.0309) | (0.0335) | (0.0663) |
| Richest | 0.933*** | 0.281*** | 0.0753 | 0.178 | 0.181 | 0.0584 | 0.101** | 0.204** |
| | (0.298) | (0.0691) | (0.101) | (0.230) | (0.132) | (0.0434) | (0.0398) | (0.0803) |
| Constant | −5.577*** | | 0.637*** | | −3.763*** | | 0.321** | |
| | (0.879) | | (0.207) | | (0.436) | | (0.144) | |
| Observations | 1431 | 1431 | 1431 | 1431 | 3032 | 3032 | 3032 | 3032 |
| F-statistics | 6.12 | | 3.82 | | 15.48 | | 17.57 | |
| Prob > F | (0.000) | | (0.000) | | (0.000) | | (0.000) | |

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

## Sensibility analysis

Results of our primary estimations are predicted under assumptions of equal distribution of mass media access and HIV information related to household income and area of residence. We test the robustness of our results to the relaxation of these assumptions.

First, we test whether the spatial disparities in mass media access are a source of heterogeneity in the impact of mass media exposure on HIV testing and HIV-related knowledge. We divide our analysis sample into two sub-samples: the rural sub-sample and the urban sub-sample. We estimate the effects of our covariates of interest one sub-sample at a time. The estimated coefficients and marginal effects are reported in Table 4. The results suggest that the exposure radio and TV have a positive and significant effect on HIV awareness in rural area while the effect is smaller in urban area. Moreover, we find that the exposure to TV has a positive effect on HIV-relative knowledge in both rural and urban area.

Another concern for our identification is the potential heterogeneous impacts of mass media across children from rich and poor households. As household income are not observable in our analysis sample, we use the household wealth index to divide our analysis sample into two sub-samples: the poorer and the richer. We then estimate the effects of our covariates of interest using one sub-sample (poor versus rich) at a time. Test results reported in Table 5 reveal that print media have a positive effect on HIV related knowledge for adolescents living in rich household as well. The exposure to radio and TV appears to have a positive effect on HIV awareness among adolescents living in poor household. TV have also a positive effect for adolescents living in rich families as well.

## Discussion and conclusion

In this paper, we analyse the linkage between exposure to mass media such as print media, radio and TV and adolescents' sexual and reproductive health in Uganda. We examine the effect of mass media on HIV testing and HIV-related knowledge. We build a score for HIV-related knowledge representing the number of correct answers the adolescent gives to the three following questions: (1) Can someone get HIV from mosquito bites? (yes or no), (2) Can someone get HIV by sharing food with a person who has AIDS? (yes or no); (3) A healthy-looking person can have HIV? (yes or no). We find that almost two-thirds of adolescents in Uganda have never been tested for HIV while less than a half of them got all the correct answers to the HIV-knowledge questions. Subsequently, estimation results suggest that the exposure to

**Table 5**
Robustness check: Estimated average partial effects on HIV awareness for adolescents living in poor versus rich households.

| VARIABLES | ADOLESCENTS FROM POOR HOUSEHOLDS | | | | ADOLESCENTS FROM RICH HOUSEHOLDS | | | |
|---|---|---|---|---|---|---|---|---|
| | HIV testing | | HIV knowledge | | HIV testing | | HIV knowledge | |
| | coef | dy/dx | coef | dy/dx | coef | dy/dx | coef | dy/dx |
| *Exposure to print media (base = not at all)* | | | | | | | | |
| Less than once a week | 0.163 | 0.0574 | 0.00575 | 0.0140 | 0.158* | 0.0509* | 0.0786*** | 0.167*** |
| | (0.136) | (0.0483) | (0.0252) | (0.0614) | (0.0910) | (0.0301) | (0.0219) | (0.0474) |
| At least once a week | −0.129 | −0.0443 | −0.00104 | −0.00252 | 0.137 | 0.0441 | 0.0794** | 0.168** |
| | (0.174) | (0.0592) | (0.0375) | (0.0912) | (0.125) | (0.0412) | (0.0320) | (0.0700) |
| *Exposure to radio (base = not at all)* | | | | | | | | |
| Less than once a week | 0.138 | 0.0484 | 0.0869*** | 0.207*** | −0.00634 | −0.00196 | 0.0311 | 0.0651 |
| | (0.152) | (0.0531) | (0.0329) | (0.0781) | (0.0952) | (0.0294) | (0.0301) | (0.0635) |
| At least once a week | 0.147 | 0.0515 | 0.000235 | −0.000584 | 0.196** | 0.0637** | 0.00228 | 0.00472 |
| | (0.149) | (0.0524) | (0.0340) | (0.0846) | (0.0919) | (0.0305) | (0.0273) | (0.0563) |
| *Exposure to TV (base = not at all)* | | | | | | | | |
| Less than once a week | −0.472** | −0.164** | 0.127** | 0.307*** | 0.00550 | 0.00173 | 0.0387 | 0.0810 |
| | (0.213) | (0.0729) | (0.0495) | (0.115) | (0.0907) | (0.0285) | (0.0240) | (0.0507) |
| At least once a week | −0.328* | −0.115* | 0.0823* | 0.194* | 0.278** | 0.0928** | 0.0511** | 0.107** |
| | (0.187) | (0.0652) | (0.0482) | (0.110) | (0.110) | (0.0383) | (0.0255) | (0.0546) |
| Age | 0.243*** | 0.0847*** | −0.00574 | −0.0140 | 0.198*** | 0.0622*** | −2.88e-05 | −5.98e-05 |
| | (0.0441) | (0.0142) | (0.00884) | (0.0215) | (0.0239) | (0.00719) | (0.00732) | (0.0152) |
| Female | −0.445*** | −0.155*** | −0.0228 | −0.0555 | −0.473*** | −0.149*** | −0.0758*** | −0.157*** |
| | (0.152) | (0.0517) | (0.0337) | (0.0820) | (0.0789) | (0.0240) | (0.0219) | (0.0451) |
| *Education level* | | | | | | | | |
| Primary | 0.689** | 0.201*** | 0.190* | 0.400** | 0.0151 | 0.00471 | 0.342*** | 0.599*** |
| | (0.280) | (0.0669) | (0.101) | (0.194) | (0.136) | (0.0422) | (0.0645) | (0.0965) |
| At least secondary | 1.052*** | 0.331*** | 0.295*** | 0.655*** | 0.136 | 0.0436 | 0.475*** | 0.893*** |
| | (0.282) | (0.0689) | (0.100) | (0.194) | (0.153) | (0.0483) | (0.0658) | (0.101) |
| *Wealth index (base = poorest)* | | | | | | | | |
| Poorer | 0.454 | 0.121 | −0.175 | −0.365 | 0.136 | 0.0436 | 0.0755** | 0.150** |
| | (0.568) | (0.165) | (0.237) | (0.468) | (0.0965) | (0.0308) | (0.0347) | (0.0684) |
| Middle | 0.810* | 0.238* | 0.0750 | 0.177 | −0.0224 | −0.00689 | 0.0992*** | 0.200*** |
| | (0.428) | (0.130) | (0.127) | (0.300) | (0.0976) | (0.0300) | (0.0344) | (0.0683) |
| Richer | 0.614* | 0.172* | 0.0330 | 0.0764 | −0.00962 | −0.00297 | 0.108*** | 0.219*** |
| | (0.348) | (0.0939) | (0.103) | (0.235) | (0.100) | (0.0309) | (0.0335) | (0.0663) |
| Richest | 0.933*** | 0.281*** | 0.0753 | 0.178 | 0.181 | 0.0584 | 0.101** | 0.204** |
| | (0.298) | (0.0691) | (0.101) | (0.230) | (0.132) | (0.0434) | (0.0398) | (0.0803) |
| Constant | −5.577*** | | 0.637*** | | −3.763*** | | 0.321** | |
| | (0.879) | | (0.207) | | (0.436) | | (0.144) | |
| Observations | 1431 | 1431 | 1431 | 1431 | 3032 | 3032 | 3032 | 3032 |
| F-statistics | 6.12 | | 3.82 | | 15.48 | | 17.57 | |
| Prob > F | (0.000) | | (0.000) | | (0.000) | | (0.000) | |

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

traditional mass media such as television, radio, and print media is positively correlated to HIV testing and HIV-related knowledge among adolescents. In this context, our study highlights the importance of traditional mass media in HIV prevention.

These findings are consistent with Darteh, Amo-Adjei, and Awusabo-Asare (2014) who show that higher frequency of exposure to mass media is positively correlated with HIV testing among adolescents in Ghana. In addition, Courbet [8] and Danmadji et al., [10] also find that mass media helps to increase HIV awareness among adolescents. Indeed, mass media helps to improve sexual health in different ways. Courbet [8] shows that mass media increases sexual health knowledge through the repetition of the message and warning about high risk sexual behaviours. They also influence HIV testing by acting on the perception of risk and motivating the individual to protect themselves. The reduction of stigma by mass media was also reported to have a positive effect on the probability of being tested for HIV [10]. Other studies have also found that listening to radio improve people's sexual health knowledge [23]. These studies shade light on the role of traditional mass media in enhancing HIV awareness among adolescents in developing countries.

In the context of internet expansion in developing countries [21], the role of social media in HIV prevention is increasing. In a randomized study in Uganda, Ybarra et al. [28] find that in addition to traditional media, adolescents are also interested in accessing HIV/AIDS preventive information in new social media. They find that, of the total respondents, 45% reported ever having used the Internet while 66% of adolescent reported that they would search for information about HIV/AIDS prevention online if Internet access were free. In another study in Uganda, Mitchell et al. [17] suggest that cell phones can facilitate delivery of health promotion and HIV prevention initiatives since the rate of cell phones access is around 27% overall, 51% among students. They find that 61% of those who owned a cell phone would access a text messaging-based HIV prevention program if it were available.

Health educators and HIV programme planners in Uganda should then develop initiatives to accelerate broader Internet access to adolescents, promote text messaging-based HIV prevention in addition to delivering HIV-related messages through television, radio, and print media in order to enhance the levels of HIV testing and HIV-related knowledge among adolescents.

## Limitations

First, data concerning the specific details and the messages during

the HIV awareness campaigns in Uganda are limited. For example, we do not have information if testing messages or HIV education are prevalent. In addition, our results raise an interesting question which is not addressed in this paper: what is the influence of new growing social media on adolescents' sexual health behaviour and knowledge in developing countries? In systematic reviews, Taggart et al. [24] and Cao et al. [6] show that social media is becoming an important avenue for mass communication about HIV prevention and HIV testing. The results suggest that social media interventions become more and more effective in promoting HIV awareness. An interesting direction for future research will be to analyze the effect new media (internet) and social media on adolescents' sexual and reproductive health in developing countries.

## Appendix A. Supplementary material

Supplementary data to this article can be found online at https://doi.org/10.1016/j.srhc.2019.04.004.

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