ORIGINAL RESEARCH ARTICLE

Why are Virgin Adolescents Worried about Contracting HIV/AIDS? Evidence from Four Sub-Saharan African Countries

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Abstract

Whether well founded or not, perceptions of one's own HIV risk have been shown by health behavior models to be an important factor in determining individuals' sexual behavior. Although empirical studies on the determinants of HIV risk perception exist, only a few have focused on adolescents who are not yet sexually active. Using data from nationally-representative surveys of adolescents, we assess the factors associated with HIV risk perception among sexually inactive adolescents in four sub-Saharan African countries at different stages of the HIV/AIDS epidemic (Burkina Faso, Ghana, Malawi and Uganda). The results show that there is no single influence on adolescents' HIV risk perception, but rather a range of individual, environmental and community factors such as schooling, knowledge about HIV, regional HIV prevalence and adolescents' social networks. These results can help better calibrate programs and policies addressing sexual and reproductive health issues among adolescents, a group that is disproportionately affected by new HIV infections. *Afr J Reprod Health 2013 (Special Edition); 17[4]: 32-50).*

Keywords: HIV/AIDS, risk perception, ordered logistic analysis, Burkina Faso, Ghana, Malawi, Uganda

Résumé

Les modèles comportementaux en santé ont démontré que, fondées ou non, les perceptions individuelles du risque vis-à-vis du VIH constituent un facteur important qui détermine le comportement sexuel des individus. Cependant, bien qu'il existe des études empiriques sur les déterminants de la perception du risque du VIH, seuls quelques-uns ont mis l'accent sur les adolescents qui ne sont pas encore sexuellement actifs. En nous appuyant sur des données d'enquêtes représentatives au niveau national, nous évaluons les facteurs associés à la perception du risque vis-à-vis du VIH chez les adolescents sexuellement inactifs dans quatre pays d'Afrique sub-saharienne à différents stades de l'épidémie du VIH/Sida (Burkina Faso, Ghana, Malawi et Ouganda). Les résultats montrent qu'il n'existe pas une influence unique de la perception du risque du VIH chez l'adolescent, mais plutôt un faisceau de facteurs individuels, environnementaux et communautaires au nombre desquels la scolarisation, les connaissances sur le VIH, la prévalence régionale du VIH et les réseaux sociaux des adolescents. Ces résultats peuvent aider à mieux calibrer les programmes et les politiques portant sur les questions de santé sexuelle et reproductive chez les adolescents, un groupe qui est touché de façon disproportionnée par les nouvelles infections à VIH. *Afr J Reprod Health 2013 (Special Edition); 17[4]: 32-50).*

Mots-clés: VIH/SIDA, perception du risque, analyse logistique ordonnée, Burkina Faso, Ghana, Malawi, Ouganda

Introduction

Health behavior models suggest that the discrepancies often observed between knowledge and behavior can be explained by the fact that behavior based on knowledge is mediated by the perception of individual risk[1,2,3]. For instance, the AIDS risk reduction model (ARRM) posits that before changing their behaviors, individuals need to recognize that they are at risk[4]. Similarly, a basic premise of the Health Belief Model (HBM) is that an individual's perception of being vulnerable to a threat along with his beliefs about the efficacy of actions he can take to reduce the risk of contracting a disease, are critical factors to explain why individuals fail to follow health recommendations[5,6,7]. For prevention policies and programs, risk perception is seen as an important

indicator of perceived susceptibility to infection and is therefore considered as an important precondition for adopting protective behaviors[2,8,3].

Recent studies have shown that adolescent' perceptions of their own HIV risk can help them resolve to engage in protective behaviors, such as delaying sexual activity, using condoms or seeking voluntary counseling and testing[9,10]. These findings have corroborated earlier studies on adolescents in a few sub-Saharan African contexts, where high HIV risk perception was associated with adoption of protective behaviors[11,12,13,14,15,8,16].

The main limitation of this literature is that although such attitudes are understandable, given individuals' past or present risky sexual behaviours[17,18,19,10], very few studies have focused on perception of HIV risk and its implications among adolescents who are not yet sexually active. In contrast to these studies, we aim to highlight the determinants of HIV risk perception among sexually inactive adolescents. Using data collected in 2004 from nationally-representative surveys of adolescents, this study aims to determine the influence of individual background characteristics, contextual factors and social networks on the perception of HIV risk among sexually inactive adolescents in four sub-Saharan countries at different stages of the AIDS epidemic: Burkina Faso, Ghana, Malawi and Uganda. This question is of great interest because of its potential significance for prevention programs and policies. Sexually inactive adolescents are indeed seen as a "window of hope" because they have great potential for avoiding risky sexual behaviors in which sexually active adolescents are already engaged. Therefore, focusing on adolescents who have not yet become sexually active is likely to be an effective approach to addressing the epidemic, particularly in high HIV prevalence countries[20].

Factors associated with HIV risk perception among adolescents

The existing literature suggests that HIV risk perception is influenced by several factors. Although this literature has mainly focused on perceptions among sexually active individuals, we review many of the factors that are likely to also influence HIV risk perceptions among sexually inactive individuals.

Abundant evidence exists as to the influence of education on HIV risk perception. Through their schooling, adolescents acquire skills that enable them to be well-informed and attentive to HIV messages[21]. Adolescents' immediate environment, their relationships with peers and other community members, and schools and religious affiliation are other important factors influencing their acquisition of knowledge, experiences and perceptions on a wide range of issues including sexual and reproductive health[22,23,24,25]. These environmental contexts of complex relationships (family, friends, peers, school, and community) are likely to influence personal beliefs and perceptions[25].

Communication is indeed one of the prime factors influencing adolescents' HIV perceptions. According to social theories, opinions and actions toward HIV/AIDS are shaped through discussions within personal communication circles[22,23,24]. Social network theories such as "social influence" similarly posit that attitudes with respect to sexual behaviors and HIV-related issues can be strongly influenced by the prevailing opinions and attitudes in an individual's social environment[26]. These include interactions and discussions with parents and other family members as well as peers about issues that are relevant or of interest[25].

Typically, adolescents share their understanding of HIV and sexual behavior within their friends' networks[27,28,29]. Studies have shown that, when shared with their network, educated adolescents' experiences may lead their peers toward a new way of thinking about their own HIV risks. This diffusion is likely to spread new views of HIV risk perceptions as well as emerging sexual behavior options in the future[30]. However, by sharing information and experience with their network members, adolescents may also overemphasize atypical events. In such cases, if individuals in the network do not have any new information that can force a re-evaluation of long-held beliefs, perceptions are likely to move away from realities[30,21]. As Lloyd[21] noted, while adolescents may be unaware of certain dangers, they also see dangers where they do not exist. Moreover, perceptual biases are likely to be exacerbated by the tendency for negative events to exert a disproportionate influence on beliefs[30].

Among other possible contextual influences, previous studies have shown that HIV risk perception is based not only on an individual's own behavior or that of his partner, but also on the level of HIV/AIDS-related morbidity and mortality within his wider community[31,9]. Knowledge of and personal ties to people who died of AIDS or who live with HIV make the epidemic a real part of adolescents' lives, which is likely to shape their perception of their own risk[30,32]. Perceptions of HIV risk formed on the basis of HIV prevalence in the immediate environment may persist even with declining HIV incidence because they may lead to a lasting perceptual frame that is resistant to revision[30].

Study setting

The epidemiological profiles of the four study countries differ with regard to HIV/AIDS prevalence and adolescents' sexual activity. This comparative approach (across and within countries) enables the identification of common patterns and associations, as well as significant differences in adolescents' sexual behaviors and countries' prevention efforts. In addition, the inclusion of data from different sub-regions of sub-Saharan Africa (East, West, and South) in different stages of the HIV/AIDS is likely to increase our understanding both of adolescents' risk for HIV/AIDS, STDs, and unintended pregnancy and of how they manage the multiple risks they face in various contexts.

Despite some signs of stabilization compared to the past decades[33], the HIV pandemic in Uganda is still at a worrying level. Estimates from the 2011 Uganda AIDS Indicator Survey[34], indicate that, among Ugandan adults, 7.3% are HIV-positive, with prevalence being higher among women at every age group except in the 40-44 age group (8.2%) than among men (6.1%). Results also show a slight increase in HIV prevalence since the 2004-05 UHSBS[35], from 6.4 to 7.3% of adults age 15-49. In the 15-19 age group, HIV prevalence is 3.0% among women and 1.7% among men[34].

In Malawi, the MDHS 2010[36] shows that 11 percent of adults age 15-49 are infected with HIV. The HIV prevalence rate is 13% among women age 15-49, while among men age 15-49 it is 8%. This prevalence rate is also higher among adolescent women age 15-19 (4%) than among adolescent men (1%).

As for Burkina Faso, the BFDHS 2010[37] shows that 1% of adults age 15-49 are infected with prevalence being higher among women (1.2%) than among men (0.8%). This prevalence rate is 0.1% among adolescent women age 15-19 while it is 0.4% among adolescent men. Finally, in Ghana, according to the 2011 HIV Sentinel survey[38], the HIV prevalence was 2.0% and 2.1% in 2010 and 2011 respectively, revealing a marginal increase of pandemic with a higher prevalence in urban sites.

Data and methods

Data sources

Data come from the National Surveys of Adolescents (NAS) carried out in 2004 in Burkina Faso, Ghana, Malawi, and Uganda. The NAS are modeled on the Demographic and Health Surveys (DHS), but have two features that make them particularly appropriate for the purposes of this analysis: first, they interviewed adolescents starting at 12 years of age (whereas the DHS only interviews respondents aged 15 years and above); and second, they included detailed questions on adolescents' characteristics and sexual behaviors.

The surveys were nationally representative and household-based. The sampling design entailed a first-stage systematic selection of census enumeration areas (EAs) and a second stage selection of households within the selected EAs based on the sampling frame and the clusters used by the National Statistical Offices for the latest Demographic and Health Surveys. All eligible de facto residents aged 12 to 19 years in each sampled household were included in the survey. Consent from a parent or caretaker was required for adolescent minors (12-17 years) before the eligible adolescent was authorized to participate in the survey.

We include in the present analysis only adolescents who reported to have ever heard of HIV/AIDS at the time of the survey, because HIV risk perception was measured only for this group. As reported in Table 1, this group represents the majority of adolescents in all countries, so that our

selection criteria are not likely to exert a significant bias in the analysis. In all four countries, among respondents who had ever heard of HIV/AIDS, considerably more than half reported that they were not sexually active at the time of the survey.

Table 1: Interviewed respondents included in the analysis, by gender and country

	Burkina Faso			**Ghana**			**Malawi**			**Uganda**		
	Boys	Girls	Total	Boys	Girls	Total	Boys	Girls	Total	Boys	Girls	Total
Total number interviewed	3016	2939	5955	2229	2201	4430	2052	1979	4031	2510	2602	5112
Has ever heard of HIV/AIDS												
Number	2610	2449	5059	2143	2112	4255	1960	1886	3846	2483	2560	5043
Percent[1]	86.54	83.33	84.95	96.14	96,0	96.07	95.52	95.3	95.41	99,0	98.42	98.65
Has ever heard of HIV/AIDS and not sexually active												
Number	1997	1729	3726	1944	1742	3686	1116	1457	2573	1677	1852	3529
Percent[2]	76.51	70.6	73.65	90.71	82.48	86.63	56.94	77.25	66.9	67.54	72.34	69.98

[1]Percent of the total number interviewed
[2]Percent of those who have ever heard of HIV/AIDS

Measurement of HIV risk perception

HIV risk perception was measured through the following survey question: *"Do you think your chances of getting HIV/AIDS are great, moderate, small, or you have no chance at all?"* This question was asked of all adolescents interviewed who reported that they had ever heard of HIV/AIDS, regardless of whether they reported being sexually active. Respondents could give an estimate of their perceived risk of HIV infection using the response options for this question, or could choose to say that they did not know what their chances were. Respondents could also indicate whether they were HIV positive. The survey question used to measure HIV risk perception in these surveys was identical to the one asked in the third phase of the Demographic and Health Surveys, and in other similar surveys that have been carried out in sub-Saharan Africa.

In all countries there were a surprisingly high proportion of sexually inactive adolescents who thought they had a high likelihood of contracting HIV/AIDS, even though they had not begun sexual activity (Table 2). Overall, 24.2% of boys and 29.1% of girls thought they had a high likelihood of contracting HIV/AIDS. When looking at individual countries, the proportion of virgin adolescents who reported that they had no chance or a small chance of getting HIV/AIDS was higher (more than 50%) in the two low-prevalence countries, Burkina Faso and Ghana, than in the two high-prevalence countries, Malawi and Uganda. Yet, even in Uganda, approximately two-thirds of adolescents of either sex perceived some risk (small, moderate or great) of contracting HIV/AIDS in the future, and more than 40% perceived a high risk. It is important to note that 5 to 15% of adolescents reported not knowing their chances of getting AIDS.

Table 2: Percentage distribution of sexually inexperienced adolescents who have ever heard of HIV/AIDS by socio-demographic characteristics, sex, and country

	Burkina Faso		**Ghana**		**Malawi**		**Uganda**		**All countries**	
	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls
Self-perceived risk of getting HIV										

Great	12.7	18.3	11.0	7.4	36.2	36.6	38.4	47.7	24.2	29.1
Moderate	7.6	4.1	6.1	4.5	5.0	6.2	13.0	10.4	8.6	6.9
Small	16.5	13.2	14.2	15.2	11.1	8.5	18.3	14.0	15.5	13.3
No chance at all	49.7	50.4	64.3	67.7	44.2	44.8	21.4	23.1	44.3	44.6
Don't know	13.4	14.0	4.4	5.1	3.4	3.8	9.0	4.8	7.3	6.1
Has HIV	0.1	0.1	0.0	0.0	0.1	0.1	0.0	0.1	0.0	0.1
Age										
12-14	49.8	51.8	46.6	51.3	59.4	56.7	60.8	63.7	53.8	56.9
15-17	38.4	39.8	38.9	38.2	30.8	34.4	29.9	29.5	34.6	34.5
18-19	11.9	8.3	14.5	10.5	9.8	8.9	9.3	6.8	11.6	8.5
Education										
None	45.1	54.0	5.6	7.1	1.7	1.9	2.0	3.4	10.1	11.6
Primary	38.8	32.5	50.1	46.2	88.0	86.0	85.7	83.1	65.8	65.0
Secondary	16.0	13.6	44.3	46.8	10.3	12.1	12.3	13.5	24.0	23.4
Has discussed AIDS with family members										
Yes	17.7	30.9	10.6	17.8	9.3	17.1	22.2	41.1	15.6	28.2
No	82.4	69.1	89.4	82.2	90.7	82.9	77.8	58.9	84.4	71.8
Has discussed AIDS with friends										
Yes	25.7	17.3	18.6	16.2	41.5	36.1	41.8	32.6	30.9	26.0
No	74.3	82.7	81.4	83.8	58.5	63.9	58.2	67.4	69.1	74.0
Thinks that a healthy looking person can have HIV										
Yes	60.4	57.1	77.4	72.3	83.4	76.5	66.5	58.8	71.7	65.8
No	29.4	31.5	18.4	21.8	14.9	22.1	28.5	37.3	23.2	29.0
Don't know	10.3	11.5	4.2	5.9	1.7	1.5	5.1	3.8	5.1	5.2
HIV prevalence in the region of residence										
Less than 2%	60.0	60.0	36.5	31.9	0.0	0.0	0.0	0.0	22.6	18.5
2-4%	27.2	19.9	63.5	68.1	0.0	0.0	16.2	15.9	32.6	29.6
4-8%	12.8	20.2	0.0	0.0	41.5	46.2	53.0	51.1	26.1	30.1
More than 8%	0.0	0.0	0.0	0.0	58.5	53.8	30.9	33.0	18.7	21.8
Place of residence										
Rural	76.7	67.9	54.6	48.7	71.9	76.4	90.4	88.5	72.9	71.2
Urban	23.3	32.1	45.5	51.4	28.1	23.6	9.6	11.5	27.1	28.8
Household wealth quintile										
Poorest	19.1	17.7	17.8	13.5	20.1	19.5	22.3	20.7	19.9	17.9
Second	17.3	14.6	18.9	18.8	17.3	20.5	24.3	24.1	20.3	20.5
Middle	20.3	18.2	22.8	22.0	18.4	17.9	16.3	16.5	19.5	18.7
Fourth	20.3	16.3	22.4	22.7	19.6	18.7	21.3	20.1	21.3	20.1
Wealthiest	23.0	33.2	18.1	23.0	24.6	23.4	15.8	18.6	19.0	22.9
Sample size	1997	1729	1944	1739	1116	1457	1676	1852	6733	6777

Analytic methods

We began the analysis by comparing the characteristics of virgin adolescents by level of HIV risk perception using the appropriate chi-square statistics to assess significance. Then we constructed two sets of ordered logistic regression models by gender: one model without interactions and one model that introduced interactions between some independent variables in order to capture differences in effects within and between sub-groups of adolescents. Modeled interactions included having discussed AIDS with friends and country of residence, having discussed AIDS with family members and country of residence, having discussed AIDS with friends and age, having

discussed AIDS with family members and age, and AIDS knowledge and age.

We present the marginal effect of changes in the interacting independent variables on adolescents' HIV risk perception. The estimation of interaction terms allowed us to infer how the effect of one independent variable on HIV risk perception varied by the magnitude of another independent variable. To test the magnitude of the interaction effects, and given that we used nonlinear models, we computed the cross derivative of the expected value of the dependent variable[39]. Therefore, statistical significance cannot be obtained directly from the coefficient of the interaction term in Table 4, but must be based rather on the estimated cross-partial derivative[40-41]. To do so, we used STATA's *lincom* command that allows the calculation of the correct interaction effects as well as their standards errors (Tables 5 and 6).

Because of small sample sizes for certain categories, analyses were also performed by combining the data from all four countries. To adjust for differences in sample sizes across countries, pooled weights for each country were generated and used in all pooled multivariate analyses.

The dependent variable in all analyses was the level of HIV risk perception categorized as follows: no, small, moderate and great chance. In the descriptive analysis, we also included respondents who reported not knowing their chances of getting HIV/AIDS; however, this group was excluded from the multivariate logistic regression analysis. The independent variables included in the analyses are described below.

Age

With regard to age, we used the classical division of adolescence into early adolescence (12–14 years), middle adolescence (15–17 years), and late adolescence (18–19 years). This grouping is used in most studies[21-42], because it is well-recognized that each age group has gender-specific physiological characteristics, socio-cultural meanings and policy implications.

Education

Adolescents who had ever attended school were asked the following question: "What is the highest level of school you have attended?" It is worth noting that contrary to the other three countries, in Ghana there was a middle level (junior secondary school) after the primary level. In order to allow comparisons between countries, primary and junior secondary schools were grouped in a same category (primary) in this country.

HIV/AIDS conversational networks

Adolescents were asked with whom they had discussed HIV/AIDS. We constructed two indicators to measure HIV/AIDS conversational networks: the first one based on answers mentioning family members and the other one based on their friends. In the first instance, we grouped answers including father, mother, brothers, sisters, and other family members as "family networks".

HIV Knowledge

To measure correct HIV knowledge we used a standard indicator, that is, accurate (yes) answers to the following question: "Is it possible for a healthy-looking person to have the AIDS virus?"

HIV prevalence in the region of residence

Given that the National Adolescents Surveys did not collect biomarker data on HIV prevalence, we measured regional HIV prevalence using data collected in other national surveys that were carried out approximately at the same time as the National Adolescents Surveys. These are: the 2003 DHS for Burkina Faso and Ghana, the 2004 DHS for Malawi and the 2004 HIV/AIDS Sero-Behavioural Survey for Uganda. From this information, we can assess the geographical distribution of adolescents by HIV prevalence (see Table 2 above). Overall, adolescents were concentrated in regions where HIV prevalence was between 2 and 4%. However, more than one out of four adolescents lived in regions where prevalence was between 4 and 8% while one in five adolescents lived in regions where HIV prevalence

was more than 8%. Focusing on each country, we found that the majority of adolescents resided in regions where HIV prevalence was less than 2% (Burkina Faso), between 2 and 4% (Ghana), between 4 and 8% (Uganda), and more than 8% (Malawi).

Other explanatory variables

Household wealth quintiles were constructed from questions about household assets, services and other facilities using the DHS' wealth index approach[43]. The other independent variables used in the models included place of residence (rural vs. urban) and country of residence.

Results

Descriptive results

Findings in Table 2 indicate that despite high levels of HIV risk perception across all countries, few adolescents had talked with a family member about HIV. There were also important gender differences, with girls being more likely than boys to talk to family members, especially in Uganda. Overall, the pooled country results show that while 15.6% of male adolescents had talked with family members on the issue, a higher proportion of females (28%) reported that they did so. On the other hand, across all countries, a higher proportion of male adolescents reported talking to friends about HIV-related matters compared to females.

The misconception that healthy-looking people cannot have HIV infection was still widespread in the four countries (Table 2). Almost one adolescent in three in Burkina and Uganda and one in five in Malawi and Ghana indicated that healthy-looking person could not be HIV positive. This misconception was more prevalent among adolescent girls than among adolescent boys in all the four countries except Burkina Faso.

Tables 4a and 4b compare the characteristics of sexually inexperienced adolescents included in the analysis by their level of HIV risk perception. Across the four countries, the level of adolescents' perceived HIV risk was higher among older adolescents of both sexes, especially in Malawi and Uganda. Thus, in Malawi, although 35% of male adolescents aged 12-14 years believed that they had a high likelihood of contracting HIV, 44% of those aged 18-19 years old held this belief. The differences were more pronounced among female adolescents: 33% of those aged 12-14 years thought they had a high likelihood of catching HIV while 57% of those aged 18-19 years thought this ($p<0.001$). The same pattern was observed among Ugandan female adolescents, where 45% of the youngest ones perceived a great risk of contracting HIV compared to 56.5% of their counterparts aged 18-19 years ($p<0.001$). It is worth noting that across all age groups and among both sexes, Ghana and Malawi had the highest proportion of adolescents who thought that they had no risk of contracting HIV.

HIV risk perception also varied by level of education across the four countries, although each country exhibited different patterns. In Ghana, among adolescents of both sexes, those without any education believed that they had a higher likelihood of contracting HIV compared to those with a high-school education. The same tendency was observed in Malawi, but only among male adolescents, for whom 69% of those without any education believed that they had a high likelihood of contracting HIV compared to 40.8% among those with a secondary school education or higher. Results showed the reverse in Uganda among adolescents of both sexes: the higher the educational level, the greater the perceived risk of catching HIV. In Burkina Faso and Ghana, adolescents of both sexes without any education were less able to estimate their likelihood of contracting HIV.

Adolescents of both sexes in Burkina Faso and Ghana, and female adolescents in Uganda, who discussed HIV-related issues with family members were significantly more likely to believe they had a great risk of catching HIV. On the other hand, having discussed HIV-related issues with friends decreased the perception of being at great HIV risk among adolescents of both sexes in Malawi and Uganda, while it increased this perception in Ghana among adolescents of both sexes.

In Burkina Faso, adolescents of both sexes who correctly reported that a healthy-looking person could have HIV/AIDS were significantly more likely to perceive themselves at great risk of

catching HIV. The same pattern was observed among Ghanaian male and Malawian female adolescents. Across all countries, adolescents of both sexes who declared that they did not know if a healthy-looking person could be HIV positive were also less capable of estimating their likelihood of contracting HIV.

The results also showed that, overall, regions with high HIV prevalence had the highest proportion of adolescents of both sexes who believed that they had a high likelihood of contracting HIV. This pattern is particularly observable in Malawi and Uganda. On the other hand, there is no clear pattern in the level of perceived risk between urban and rural areas in most of the four countries. Nevertheless, rural Ugandan male adolescents are significantly more likely to perceive great risk of contracting HIV compared to their urban counterparts.

Table 3a: HIV risk perception by selected sociodemographic characteristics: Sexually inexperienced boys

	Burkina Faso						**Ghana**						**Malawi**					
	Great	Moderate	Small	None	DK	Number	Great	Moderate	Small	None	DK	Number	Great	Moderate	Small	None	DK	Number
Age							***											
12-14	12.1	7.2	15.3	49.7	15.8	993	9.1	6.0	10.4	69.4	5.1	898	34.9	5.0	10.2	45.1	4.8	654
15-17	13.1	7.1	17.2	51.8	10.9	761	12.0	6.5	19.0	57.9	4.6	753	36.2	4.2	12.6	45.6	1.5	358
18-19	14.5	11.2	19.0	43.9	11.3	241	14.5	5.6	13.4	65.1	1.5	292	44.3	7.7	12.0	35.1	1.0	103
Education	***						***											
None	10.2	9.2	16.1	47.7	16.9	925	28.7	4.7	13.5	38.9	14.2	121	69.1	3.0	0.0	24.3	3.6	17
Primary	13.6	5.6	16.7	51.2	13.0	795	8.9	6.9	13.0	66.0	5.1	965	35.1	5.1	11.1	45.0	3.7	985
Secondary	18.0	8.1	17.1	52.4	4.5	275	11.1	5.5	15.5	65.5	2.3	857	40.8	4.7	12.5	41.0	1.1	113
Has discussed AIDS with family members	**																	
Yes	18.5	5.7	19.4	42.2	14.2	384	15.0	4.1	13.1	62.3	5.6	209	35.9	9.3	10.4	39.1	5.3	94
No	11.5	8.0	15.8	51.4	13.2	1611	10.5	6.4	14.3	64.5	4.3	1733	36.3	4.6	11.2	44.8	3.2	1021
Has discussed AIDS with friends							***											
Yes	13.7	8.9	19.3	46.9	11.2	458	17.2	7.3	16.6	52.9	5.9	374	32.5	3.5	12.7	48.6	2.6	434
No	12.4	7.2	15.5	50.8	14.2	1537	9.6	5.9	13.6	66.9	4.0	1568	38.9	6.0	10.0	41.1	4.0	681
Thinks that a healthy-looking could be HIV +	***						***											
Yes	14.5	8.9	20.5	45.7	10.4	1184	12.1	6.7	14.8	63.0	3.5	1492	36.6	5.5	11.2	43.4	3.3	913
No	11.5	6.1	11.8	58.1	12.5	584	8.8	3.9	12.3	70.8	4.2	356	35.4	2.6	11.3	47.0	3.7	180
Don't know	6.3	4.5	6.0	50.2	33.1	226	0.9	5.6	11.9	59.7	21.9	95	25.9	0.0	4.8	62.4	6.9	22
HIV prevalence in the region of residence	**						***											
Less than 2%	13.2	8.6	17.7	50.2	10.3	1107	17.3	6.8	17.3	50.8	7.8	776	0.0	0.0	0.0	0.0	0.0	0

2-4%	10.7	6.2	12.8	48.8	21.5	785	7.4	5.7	12.4	72.1	2.4	1167	0.0	0.0	0.0	0.0	0.0	0
4-8%	14.8	6.1	18.8	49.8	10.5	103	0.0	0.0	0.0	0.0	0.0	0	38.1	5.4	10.2	45.0	1.3	399
More than 8%	0.0	0.0	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0	34.9	4.7	11.7	43.7	5.0	716
Place of residence							*											
Rural	12.6	7.8	15.9	49.0	14.7	1526	9.6	5.8	14.1	65.2	5.4	1122	35.8	5.4	11.9	42.9	4.1	793
Urban	13.2	6.9	18.3	52.5	9.2	469	12.7	6.6	14.3	63.2	3.2	821	37.4	4.1	9.1	47.7	1.8	322
Household wealth quintile							*											
Poorest	10.3	8.6	14.7	50.0	16.5	399	10.6	5.3	13.1	61.9	9.2	413	33.1	8.6	10.4	43.6	4.4	226
Second	12.5	5.3	15.5	48.4	18.2	370	13.7	7.9	13.4	60.8	4.1	384	39.1	1.7	15.9	38.8	4.6	197
Middle	11.9	8.1	18.1	47.5	14.4	396	9.5	7.4	16.0	63.9	3.1	408	32.9	6.8	9.0	48.5	2.8	209
Fourth	13.8	8.2	16.0	50.6	11.5	426	10.2	5.7	12.7	69.0	2.5	397	33.8	3.5	11.1	46.5	5.1	238
Wealthiest	14.8	7.6	17.7	52.0	7.9	404	11.4	4.1	15.6	65.1	4.0	341	41.2	4.3	9.9	43.7	0.9	245
Overall	12.8	7.6	16.5	50	13.4	1995	11.0	6.2	14.3	64.3	4.4	1943	36.2	5.0	11.1	44.3	3.4	1115

Table 3a continued

	Uganda						All countries					
	Great	Moderate	Small	None	DK	Number	Great	Moderate	Small	None	DK	Number
Age	***											
12-14	36.5	11.3	18.1	23.9	10.2	1012	24.2	8.1	14.1	45.0	8.7	3557
15-17	42.7	17.0	17.0	16.6	6.8	509	24.3	9.5	17.3	42.9	6.0	2381
18-19	37.2	10.8	23.5	20.8	7.8	155	24.2	8.2	16.9	45.8	4.8	791
Education												
None	22.6	6.2	42.7	25.7	2.8	35	16.0	8.0	17.0	43.9	15.1	1098
Primary	38.0	12.6	17.8	21.7	9.9	1434	27.3	9.0	15.2	40.8	7.8	4179
Secondary	43.7	16.6	17.4	18.6	3.7	207	19.4	7.7	15.9	54.3	2.7	1452
Has discussed AIDS with family members	*											
Yes	37.2	13.0	14.7	29.7	5.3	365	28.3	9.2	14.8	40.7	7.0	1052
No	38.8	12.9	19.3	19.1	10.0	1310	23.5	8.5	15.7	45.0	7.4	5675
Has discussed AIDS with friends							***					
Yes	36.5	13.3	20.8	19.9	9.5	705	28.6	9.6	18.2	35.8	7.7	1971
No	39.8	12.6	16.4	22.5	8.6	970	22.3	8.1	14.3	48.2	7.1	4756
Thinks that a healthy-looking person could be HIV +												
Yes	41.5	14.6	18.5	20.9	4.5	1113	25.8	9.4	16.2	44.0	4.7	4702
No	34.8	9.8	18.5	21.9	15.1	476	22.8	6.8	14.8	45.3	10.5	1596
Don't know	18.2	9.1	14.2	25.3	33.3	87	9.6	6.2	10.5	45.0	28.7	430
HIV prevalence in the region of residence												
Less than 2%	0.0	0.0	0.0	0.0	0.0	0	15.6	7.6	17.4	50.6	8.9	1883
2-4%	1.9	1.7	23.2	70.6	2.6	259	6.9	5.1	14.3	68.7	5.0	2211
4-8%	45.2	11.9	17.0	12.9	13.0	913	41.3	10.1	15.6	22.7	10.3	1415
More than 8%	45.8	20.6	17.9	10.3	5.4	504	41.2	13.8	15.3	24.6	5.2	1220
Place of residence	***											
Rural	39.0	13.3	18.5	20.6	8.7	1516	26.3	9.3	16.0	40.3	8.2	4957
Urban	33.0	10.2	15.8	29.1	11.9	160	18.7	6.7	14.3	55.4	4.9	1772
Household wealth quintile	***											

Poorest	26.2	12.9	24.9	28.5	7.5	372	19.7	9.2	17.5	44.5	9.0	1410
Second	38.7	12.4	19.0	18.5	11.3	407	26.9	8.7	16.3	39.0	9.1	1358
Middle	45.9	15.1	10.0	17.7	11.4	275	23.5	9.7	13.7	45.8	7.4	1288
Fourth	39.8	11.7	19.0	22.4	7.1	356	24.0	7.9	15.2	47.1	5.8	1417
Wealthiest	45.6	13.3	15.2	18.4	7.4	266	27.2	7.5	14.9	45.3	5.2	1256
Overall	38.4	13.0	18.3	21.4	9.0	1676	24.2	8.6	15.5	44.4	7.3	6729

Note: Respondents who have never heard of HIV or who declared to already have HIV are excluded. All figures were calculated using the appropriate country survey weights, or pooled weights for all countries. Chi-square tests assess differences between level of HIV risk perception; *p<.05. **p<.01. ***p<.001.

Table 3b: HIV risk perception by selected sociodemographic characteristics: Sexually inexperienced girls

	Burkina Faso						**Ghana**						**Malawi**					
	Great	Moderate	Small	None	DK	Number	Great	Moderate	Small	None	DK	Number	Great	Moderate	Small	None	DK	Number
Age	**						**						***					
12-14	16.2	4.7	12.0	50.9	16.2	924	5.6	4.5	12.3	71.9	5.7	870	32.9	6.9	7.1	47.4	5.6	847
15-17	18.0	3.4	13.7	51.8	13.2	658	9.7	4.3	16.7	64.5	4.8	672	37.4	5.7	9.2	45.9	1.7	493
18-19	32.6	3.3	18.7	40.4	4.9	145	7.7	5.3	24.1	59.2	3.7	197	57.1	2.9	15.3	24.5	0.1	116
Education	***						***											
None	15.7	5.1	11.8	48.9	18.5	949	17.9	3.2	13.8	52.0	13.2	139	22.9	17.0	24.6	30.9	4.5	22
Primary	20.5	2.3	14.2	53.4	9.7	564	5.7	4.6	11.2	72.9	5.6	788	36.2	6.1	7.7	46.0	4.0	1243
Secondary	23.4	4.2	16.6	49.0	6.8	214	7.5	4.6	19.4	64.9	3.5	810	41.9	4.7	12.2	39.1	2.2	191
Has discussed AIDS with family members	***												*					
Yes	25.5	3.4	12.1	46.5	12.6	516	11.2	5.0	11.7	67.0	5.3	320	32.3	6.7	16.2	41.8	3.0	219
No	15.0	4.4	13.8	52.2	14.7	1210	6.6	4.4	16.0	67.9	5.1	1419	37.5	6.1	7.0	45.5	4.0	1237
Has discussed AIDS with friends							***						**					
Yes	16.2	4.4	19.0	48.7	11.7	296	6.8	4.5	26.2	60.3	2.2	297	34.6	10.9	8.8	42.1	3.5	515
No	18.7	4.0	12.0	50.8	14.5	1430	7.5	4.5	13.1	69.2	5.7	1442	37.8	3.5	8.4	46.4	3.9	941
Thinks that a healthy-looking person could be HIV +	***						***						***					
Yes	21.7	5.1	17.2	46.6	9.5	963	7.6	5.2	17.5	66.0	3.7	1250	40.3	4.1	8.2	44.3	3.1	1137
No	13.9	3.2	9.0	61.8	12.1	544	8.1	3.1	10.8	73.0	4.9	391	26.0	11.6	9.4	47.6	5.4	294
Don't know	13.5	1.4	5.0	37.9	42.2	220	2.4	0.6	3.2	70.5	23.3	97	0.0	30.4	15.7	36.9	17.0	24
HIV prevalence in the region of residence	*						***						***					
Less than 2%	18.4	4.2	14.3	49.8	13.4	1019	14.2	8.7	10.1	59.5	7.5	597	0.0	0.0	0.0	0.0	0.0	0
2-4%	15.6	3.9	11.3	46.5	22.6	567	4.2	2.5	17.6	71.6	4.0	1142	0.0	0.0	0.0	0.0	0.0	0

4-8%	20.6	3.8	11.9	56.0	7.7	141	0.0	0.0	0.0	0.0	0.0	0	32.9	10.8	11.0	40.8	4.5	562
More than 8%	0.0	0.0	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0	39.9	2.2	6.5	48.4	3.2	894
Place of residence	***						***											
Rural	18.6	4.2	12.6	47.3	17.4	1205	7.4	5.6	9.6	71.1	6.3	859	35.9	6.0	7.8	45.9	4.5	1077
Urban	17.6	3.8	14.6	56.9	7.1	522	7.4	3.5	20.6	64.5	4.0	880	39.1	6.9	11.1	41.5	1.5	379
Household wealth quintile	**						***											
Poorest	13.1	4.8	11.3	52.6	18.2	336	10.3	4.4	9.3	68.0	8.0	275	30.5	7.2	8.3	50.2	3.9	304
Second	20.9	2.4	14.9	40.8	21.1	259	9.2	6.4	10.3	69.7	4.4	319	29.8	9.6	9.2	47.1	4.3	268
Middle	19.4	4.6	12.6	46.5	16.9	304	6.3	4.8	10.4	72.1	6.4	350	39.6	5.4	7.8	43.6	3.6	264
Fourth	19.4	3.6	13.2	49.4	14.4	343	6.5	2.9	17.5	67.8	5.2	366	43.3	3.7	7.5	42.4	3.2	278
Wealthiest	18.7	4.3	13.9	56.0	7.0	485	6.1	4.3	25.2	61.6	2.8	429	40.2	4.8	9.7	41.4	3.9	342
Overall	18.3	4.1	13.2	50.4	14.1	1727	7.4	4.5	15.2	67.7	5.1	1739	36.6	6.2	8.6	44.9	3.8	1456

Table 3b continued

	Uganda						**All countries**					
	Great	Moderate	Small	None	DK	Number	Great	Moderate	Small	None	DK	Number
Age												
12-14	45.2	9.0	14.1	25.8	5.9	1172	28.3	6.8	12.1	45.7	7.2	3813
15-17	51.1	12.9	14.3	18.9	2.7	551	29.1	7.1	14.1	44.6	5.0	2374
18-19	56.5	12.2	11.9	16.3	3.2	128	34.8	6.6	18.1	37.5	3.1	586
Education												
None	30.1	10.7	9.1	46.8	3.3	66	17.9	5.7	12.2	48.7	15.5	1176
Primary	46.8	9.5	14.5	23.8	5.4	1537	33.5	7.1	12.2	41.8	5.4	4132
Secondary	57.4	15.9	12.2	13.3	1.2	248	22.7	7.0	17.0	50.2	3.2	1463
Has discussed AIDS with family members												
Yes	50.8	9.7	14.6	21.1	3.9	755	37.1	7.4	13.8	36.3	5.4	1810
No	45.6	10.9	13.6	24.5	5.4	1095	26.0	6.7	13.1	47.9	6.3	4961
Has discussed AIDS with friends	***											
Yes	46.2	12.9	14.6	22.6	3.8	604	32.9	10.0	15.8	37.2	4.2	1712
No	48.4	9.2	13.7	23.3	5.3	1246	27.8	5.8	12.4	47.2	6.7	5059
Thinks that a healthy-looking person could be HIV +												
Yes	48.4	11.4	13.9	23.4	2.8	1079	29.7	7.0	14.3	45.0	4.0	4429
No	48.2	9.0	14.4	22.7	5.7	700	30.6	7.1	12.0	43.8	6.5	1929
Don't know	31.3	8.7	11.1	22.3	26.6	72	13.8	4.6	6.6	44.9	30.0	413
HIV prevalence in the region of residence												
Less than 2%	0.0	0.0	0.0	0.0	0.0	0	16.2	6.6	12.1	54.9	10.3	1616
2-4%	22.3	8.7	10.4	51.6	7.1	285	8.9	3.9	15.6	65.2	6.5	1994
4-8%	58.9	6.5	15.6	15.2	3.8	975	48.0	7.4	14.0	26.2	4.4	1678
More than 8%	42.6	17.3	13.2	21.7	5.2	591	41.4	10.6	10.2	33.5	4.3	1485
Place of residence	***											
Rural	48.3	9.9	14.3	22.7	4.7	1641	33.3	7.4	11.8	40.7	6.8	4782
Urban	42.6	14.4	11.3	26.5	5.2	210	18.9	5.6	16.9	54.3	4.3	1991
Household wealth quintile												
Poorest	35.2	10.7	15.7	32.9	5.5	383	25.3	7.7	12.1	47.3	7.6	1298
Second	56.7	9.5	13.9	16.2	3.7	451	34.8	7.9	12.1	39.4	5.8	1297
Middle	47.5	8.9	14.1	22.9	6.5	313	27.4	6.2	11.5	47.5	7.4	1231
Fourth	50.7	9.6	14.1	20.0	5.7	364	30.5	5.6	14.1	43.7	6.1	1351
Wealthiest	46.9	13.4	12.0	24.8	2.9	340	27.2	7.1	16.0	45.7	4.0	1596
Overall	47.7	10.4	14.0	23.1	4.8	1851	29.1	6.9	13.3	44.6	6.1	6773

Note: Respondents who have never heard of HIV or who declared to already have HIV are excluded. All figures were calculated using the appropriate country survey weights, or pooled weights for all countries. Chi-square tests assess differences between level of HIV risk perception; *p<.05, **p<.01, ***p<.001.

Multivariate regression results

The multivariate regression analysis aimed to identify the personal, environmental and community factors that shaped adolescents' HIV risk perception before they became sexually active. As indicated previously, two sets of ordered logistic regression models were constructed for each sex (Table 4): a model without interactions and a model with a series of interactions between some of the independent variables.

Influence of individual characteristics (age, education, HIV knowledge) on the level of HIV risk perception

The results in Table 4 show that among both boys and girls, older age was significantly associated with higher HIV risk perception compared to young age (12-14 years) (odds ratio of 1.27 for boys of both 15-17 and 18-19 years; 1.21 and 1.77 for girls of 15-17 and 18-19 years, respectively).

Results for education were, on the contrary, significant only for boys. Male adolescents with primary or secondary education were significantly less likely to believe they had a high risk of contracting HIV compared to those without any education (odds ratio of 0.56 and 0.53 respectively for primary and secondary level); for girls the pattern was irregular and non-significant.

As for knowledge about HIV, both male and female adolescents with inaccurate HIV knowledge (that is, those who thought that a healthy-looking person could not be HIV positive) were more likely to have a lower HIV risk perception as compared to those with accurate knowledge. The same pattern was observed among both males and females who did not know if a healthy-looking person could be HIV positive or not.

Conversational networks influence on HIV risk perception

The effect of adolescents' networks on their HIV risk perception was captured through the influence of their discussions about HIV within their personal communication circles.

Friends' networks appear to be significantly associated with the level of perceived HIV risk, especially among girls: girls who discussed HIV-related issues with friends had a higher perceived risk compared to those who did not discuss the issue with friends (odds ratio of 1.23); for boys the corresponding odds ratio was 1.12 and $p<0.1$. There was also a significant and increasing influence of family networks on risk perception for both boys and girls (odds ratio of 1.24 and 1.30, respectively).

Association between characteristics of adolescents' environment (type of residence, regional HIV prevalence, household socioeconomic status, country of residence) and their HIV risk perception

The type of residence (urban vs. rural) appeared to have no significant association with the level of HIV risk perception for both boys and girls (Table 4). HIV prevalence in the region of residence, however, was significantly associated with HIV risk perception. Compared to those from regions with less than 2% HIV prevalence, adolescent boys residing in regions with an HIV prevalence of 4% or higher perceived themselves to be at higher risk. On the other hand, the odds of perceived high HIV risk were significantly lower when the HIV prevalence in the region of residence was between 2% and 4%, compared to regions with less than 2% of HIV prevalence. The same pattern was observed among girls, but to a lesser extent. There was also a significant association between household socioeconomic status and HIV risk perception among both male and female adolescents. Compared to adolescents from the poorest wealth quintile, those from the other quintiles were more likely to perceive that they had a higher risk of getting HIV.

With regard to the association between country of residence and HIV risk perception, living in Uganda was significantly associated with higher perceived risk for both boys and girls (odds ratio of 2.13 and 3.74 respectively), as compared to Burkina Faso. The same pattern was observed for boys in Ghana compared to boys in Burkina Faso (odds ratio of 1.45).

Table 4: Odds ratios for HIV risk perception among sexually inexperienced adolescents from multivariate ordered logistic regression (pooled data), by sex

	Without interactions				**With interactions**			
	Boys	P-value	Girls	P-value	Boys	P-value	Girls	P-value
Age								
12-14	1		1		1		1	
15-17	1.27	0.000	1.21	0.005	1.47	0.000	1.39	0.003
18-19	1.27	0.020	1.77	0.000	1.48	0.007	1.98	0.000
Education								
None	1		1		1		1	
Primary	0.56	0.000	0.84	0.134	0.57	0.000	0.86	0.179
Secondary	0.53	0.000	1.02	0.867	0.53	0.000	1.01	0.910
Adolescent's networks								
Had AIDS discussion with Family members	1.24	0.013	1.30	0.000	2.15	0.000	1.96	0.000
Had AIDS discussion with Friends	1.12	0.093	1.23	0.005	1.29	0.151	1.31	0.191
Knowledge: A healthy-looking person can be HIV positive								
Yes	1		1		1		1	
No	0.77	0.000	0.82	0.003	0.84	0.066	0.90	0.197
Don't know	0.45	0.000	0.61	0.001	0.48	0.000	0.62	0.012
HIV prevalence in the living region								
Less than 2%	1		1		1		1	
2-4%	0.40	0.000	0.46	0.000	0.41	0.000	0.46	0.000
4-8%	3.41	0.000	1.59	0.001	3.45	0.000	1.64	0.001
More than 8%	3.45	0.000	1.11	0.509	3.51	0.000	1.14	0.412
Type of Residence								
Rural	1		1		1		1	
Urban	0.89	0.255	0.98	0.817	0.90	0.263	0.98	0.855
Household wealth index								
Poorest	1		1		1		1	
Second	1.39	0.000	1.55	0.000	1.39	0.000	1.54	0.000
Middle	1.41	0.000	1.30	0.007	1.41	0.000	1.30	0.008
Fourth	1.32	0.003	1.61	0.000	1.31	0.004	1.59	0.000
Wealthiest	1.42	0.004	1.38	0.006	1.39	0.006	1.36	0.008
Country of residence								
Burkina Faso	1		1		1		1	
Ghana	1.45	0.000	0.84	0.129	1.41	0.008	0.89	0.435
Malawi	0.78	0.162	1.52	0.009	1.04	0.867	1.84	0.002
Uganda	2.13	0.000	3.74	0.000	2.53	0.000	4.30	0.000
Interactions								
AIDS discussion with friends in Burkina (Ref)					1		1	
AIDS discussion with friends in Ghana					1.52	0.043	1.34	0.206
AIDS discussion with friends in Malawi					0.60	0.04	0.88	0.601
AIDS discussion with friends in Uganda					0.84	0.367	0.93	0.748
AIDS discussion with family members in Burkina (Ref)					1		1	
AIDS discussion with family members in Ghana					0.68	0.106	0.65	0.069
AIDS discussion with family members in Malawi					0.53	0.099	0.49	0.006
AIDS discussion with family members in Uganda					0.51	0.001	0.65	0.032
AIDS discussion with friends among 12-14 years old (Ref)					1		1	
AIDS discussion with friends among 15-17					0.81	0.155	0.85	0.292
AIDS discussion with friends among 18-19					0.83	0.367	0.80	0.32
AIDS discussion with family among 12-14 years old (Ref)					1		1	
AIDS discussion with family among 15-17					0.74	0.083	0.91	0.522
AIDS discussion with family among 18-19					1.17	0.66	1.16	0.591
Knowledge among 12-14 years old (Ref)					1		1	
A healthy-looking person cannot be HIV positive_ 15-17					0.88	0.414	0.81	0.122
A healthy-looking person cannot be HIV positive_18-19					0.52	0.012	0.75	0.267
Don't know if a healthy-looking person can be HIV					0.83	0.531	0.87	0.673

positive_15-17								
Don't know if a healthy-looking person can be HIV positive_18-19					0.82	0.732	1.68	0.299
Total number of observations	6145		6272		6145		6272	
Cut 1	0.27	0.013	0.68	0.000	0.44	0.001	0.86	0.000
Cut 2	1.69	0.000	1.80	0.000	1.86	0.000	1.99	0.000

Interaction effects of some variables on adolescents' HIV risk perception

We estimated interaction terms to assess to what extent the effect of one independent variable on HIV risk perception depended on the change in another independent variable. We addressed the following questions, due to their programmatic implications: Is the effect of family networks on HIV risk perception the same for 12-14, 15-17, and 18-19 years old? Is the significant effect of knowledge on HIV risk perception the same for all age sub-groups? Is there any variation in the observed effects within sub-groups?

The interaction effects of some variables on adolescents' HIV risk perception are shown in Tables 6 and 7. In table 5, for all countries, the coefficients of the interaction between discussion with family members and countries (2.15, 1.46, 1.15, and 1.11, respectively for Burkina, Ghana, Malawi, and Uganda) should be interpreted using adolescent boys and girls who did not discuss HIV in Burkina Faso as the reference category (noted as 1). Given that there is no interaction term when there is no discussion, the coefficients in this table for those who did not discuss (1.41 and 0.89; 1.04 and 1.84; 2.53 and 4.30, respectively for boys and girls in Ghana, Malawi, and Uganda) are exactly the same as the coefficients obtained in Table 4 (column with interactions) for each country. In the same way, for all age groups in Table 5, the coefficients for the interaction between discussion with family members and age groups are interpreted using adolescent boys and girls who did not discuss HIV among 12-14 years old as the reference category (noted as 1). The coefficients for those who did not discuss (1.47 and 1.39; 1.48 and 1.98, respectively for boys and girls aged 15-17 and 18-19 years) are exactly the same as the coefficients obtained in Table 4 (column with interactions) for each age group. Thus, Table 5 shows that, in Burkina Faso, among both boys and girls, having had a discussion of AIDS with family networks was significantly associated with higher HIV risk perception (odds ratio of 2.15 and 1.96 respectively) compared to those who did not have any discussion. In the other countries, only Ghanaian adolescent males who had discussed AIDS with family members were significantly more likely to perceive that they had a higher risk compared to their counterparts from Burkina Faso (odds ratio of 1.46).

Table 5: Interaction effects of discussion with family members on sexually inactive adolescent's HIV risk perception

	Had discussed AIDS with family members OR (95% CI)		**Had not discussed AIDS OR (95% CI)**	
	Male	**Female**	**Male**	**Female**
Country				
Burkina	2.15*** [1.41-3.29]	1.96*** [1.36-2.81]	1	1
Ghana	1.46* [0.98-2.16]	1.28 [0.86-1.89]	1.41 [1.00-1.98]	0.89 [0.64-1.24]
Malawi	1.15 [0.58-2.28]	0.96 [0.65-1.43]	1.04 [0.60-1.79]	1.84* [1.12-3.01]
Uganda	1.11 [0.84-1.45]	1.26 [0.96-1.67]	2.53*** [1.55-4.11]	4.30*** [2.70-6.86]
Age groups				
12-14years old	2.15*** [1.41-3.29]	1.96*** [1.36-2.81]	1	1

15-17	1.58 [1.00-2.51]	1.77** [1.28-2.45]	1.47*** [1.20-1.81]	1.39** [1.11-1.73]
18-19	2.52* [1.19-5.32]	2.26* [1.21-4.21]	1.48** [1.12-1.95]	1.98*** [1.41-2.77]

Significant at: *p<0.05, **p<0.01, ***p<0.001

With regard to interaction effect between age and AIDS discussion with family networks, having had a discussion about AIDS with family members was significantly associated with higher HIV risk perception among both male and female adolescents within age groups as compared to their counterparts of 12-14 years old who did not have these discussions, except for boys aged 15-17 years. In particular, among those aged 12-14 years, both male and female adolescents who discussed HIV with family members were more likely to perceive that they had a higher HIV risk than those of the same group who did not have these discussions (odds ratio of 2.15 and 1.96 respectively for males and females adolescents 12-14 years). The same tendency was observed for the 18-19 year sub-group, where having discussed HIV with family networks was significantly associated with higher HIV risk perception for both male and female adolescents (odds ratio of 2.52 and 2.26 respectively), as compared to those aged 12-14 years who did not discuss HIV.

Table 6: Interaction effects of knowledge (a healthy-looking person could be HIV positive) and age on sexually inactive adolescents' HIV risk perception

	No, a healthy-looking person could not be HIV positive		**Don't know if a healthy-looking person could be HIV positive**		**Yes, a healthy-looking person could be HIV positive**	
	Male	Female	Male	Female	Male	Female
Age						
12-14	0.84 [0.68-1.03]	0.90 [0.74-1.08]	0.48*** [0.33-0.70]	0.62* [0.41-0.92]	1	1
15-17	0.74* [0.57-0.96]	0.72** [0.58-0.91]	0.40*** [0.24-0.66]	0.54* [0.30-0.97]	1.47*** [1.20-1.81]	1.39** [1.11-1.73]
18-19	0.44*** [0.28-0.67]	0.68 [0.40-1.13]	0.40 [0.14-1.11]	1.03 [0.42-2.58]	1.48** [1.12-1.95]	1.98*** [1.41-2.77]

Significant at: *p<0.05, **p<0.01, ***p<0.001

The interaction effects of knowledge and age on sexually inactive adolescents' HIV risk perception are presented in Table 6. Adolescents aged 15-17 years who had inaccurate HIV knowledge (that is, those who said that a healthy-looking person could not be HIV positive, or that they did not know) were significantly less likely to perceive that they had a higher risk of HIV (odds ratio of 0.74 and 0.72, respectively, for boys and girls) compared to their counterparts of aged 12-14 years who knew that a healthy-looking person could be HIV positive. The same pattern was observed for male adolescents aged 18-19 years: adolescent boys in this age group who reported that a healthy-looking person could not be HIV positive were significantly less likely to perceive that they had a higher risk of HIV (odds ratio of 0.44), as compared to their counterparts aged 12-14 years who knew that a healthy-looking person could be HIV positive. Similar results were observed among adolescents who reported that they did not know whether a healthy-looking person could be HIV positive but only for those aged 12-14 and 15-17 years: adolescents aged 12-14 years who did not know if a healthy-looking person could be HIV positive were significantly less likely to perceive a higher risk of HIV (odds ratio of 0.48 and 0.62,respectively, for boys and

girls), compared to their counterparts aged 12-14 years who knew that a healthy-looking person could be HIV positive. The same tendency was observed for adolescents aged 15-17 years (odds ratio of 0.40 and 0.54, respectively, for boys and girls).

Discussion

Data from four nationally representative surveys of adolescents carried out in Burkina Faso, Ghana, Malawi and Uganda showed that a surprisingly high proportion of sexually inactive adolescents believed that they have a high likelihood of contracting HIV in the future. This finding begs the question as to why this should be the case, since it is well known that in this region HIV/AIDS is mainly sexually transmitted.

One obvious answer would be that adolescents did not truthfully answer the survey question about having been sexually active. In other words, it could be the case that adolescents who were actually sexually active, and were thus worried about being at risk of contracting HIV/AIDS, did not want to share this information with an unknown interviewer. Given the administration of the survey in the household, the presence of other people within hearing distance, or the fear others might hear may also have influenced adolescents' responses, although all precautions were taken to avoid this circumstance.

At least a few studies in sub-Saharan Africa have shown that some reports about individual sexual behaviour could be unreliable. For example, in a study that compared reports on first sexual encounters between a standard survey and an in-depth interview in Malawi, Poulin[44] found that a significant proportion of adolescent girls who claimed in the survey to have never been sexually active reported sexual experience during the in-depth interview fielded shortly thereafter. Plummer et al[45] and Mensch et al[46], found that a significant number of women who declared that they had never had intercourse tested positive for HIV in Tanzania and Malawi, two settings where HIV infection in the overwhelming majority of cases is a result of unprotected sex. The fact that our results show higher level of perceived HIV risk among older and less educated adolescents of both sexes in the four countries leads us to further question the consistency and reliability of adolescents' responses in contexts where having sex is viewed as shameful and where virginity is one of the most important values, especially for unmarried women.

Unfortunately, absent other data sources to validate the answers given in the surveys, we cannot assess the extent to which adolescents gave truthful answers when interviewed. When we take their responses at face value, we find that adolescents' immediate environment, their interactions with peers and other community members, schools and religious membership as well as the broad socio-cultural view, seemed to constitute the main factors shaping their perceptions of HIV risk.

HIV prevalence in the region of residence was strongly associated with a high level of concern about HIV, especially where prevalence was relatively high. This finding demonstrates the influence of the social environment surrounding adolescents on their perceptions[30,26]. It is also consistent with what Bühler and Kohler[23] found in Kenya, where perceived risks were dependent on perceptions prevailing within personal close circles.

We also found that adolescents with a primary or secondary education had lower HIV risk perception than those without any education. It is also plausible that educated adolescents may have reported lower risk perceptions because they were more informed and better prepared to accurately assess their own risk profile[13].

The results showed a statistically significant interaction between HIV-related knowledge and age subgroups. This is important evidence that inaccurate knowledge combined with age leads to a greater underestimation of HIV risk perception: the older and more "ignorant" the adolescent is, the greater the underestimation of risk perception. These results are consistent with what Millstein and Halpern-Felsher[47] found in their study in the United States, where adolescents were less likely than were young adults to see themselves as invulnerable. The results also highlight the urgency of developing effective intervention programs to protect the next generations in sub-Saharan Africa from HIV by equipping young

adolescents with adequate and accurate knowledge on how to protect themselves from HIV before they experience sexual maturation and start interacting with the opposite sex[21,28].

We found that within the same age group, having discussed HIV with their family networks was significantly associated with higher HIV risk perception among both boys and girls, relative to those who had not had this discussion. This is consistent with what previous studies have shown[2,25,48]. Thus, Smith and Watkins[48] found that conversations within social networks shaped people's thoughts and feelings about HIV. Furthermore, the statistical significance of the interaction between family networks and age subgroups confirms that the influence of family networks on HIV risk perception differs according to adolescents' level of maturity. This interpretation is also consistent with previous findings suggesting that by mediating the effects of social influences, communication within the adolescent's family network about HIV/AIDS can reduce the likelihood that adolescents will engage in risky sexual behaviors[49,50,51]. DiClemente et al[52], have shown that adolescents who communicated less frequently about sexually related issues with their parents were also less likely to use condoms during their last five sexual encounters, relative to adolescents who communicated more frequently, and that they reported fewer discussions with their sexual partners about pregnancy and AIDS preventions. Adolescents who had more frequent discussions about sexual issues with their parents were more likely to feel confident in their ability to negotiate condom use or otherwise refuse sex. These findings may reflect a possible influence of discussions with parents on both adolescents' knowledge and their self-efficacy. However, as discussed previously, "social network" variables are potentially endogenous[53,54]. Endogeneity exists when reverse causality is possible between dependent and independent variables[54]. For example, having discussed HIV with friends or family members may lead to higher perceptions of HIV risk, but perceived risks among adolescents may also lead to more discussions in their social networks about HIV risk.

Conclusion

Notwithstanding the limitations mentioned above, this study provides nationally representative evidence to respond to the question as to why virgin adolescents are so worried about contracting HIV/AIDS. The response can be summarized as follow: adolescents' immediate environment, their interactions with peers and other community members, schools and religious membership as well as the broad socio-cultural view, constitute the main factors shaping their perceptions of HIV-related issues. Our results show that adolescents used their living context when assessing risk. This finding is of great interest because health behavior models fail to take into account the influence of context on perceptions and sexual behavior, giving rather more importance to individual level factors. There is therefore a need for programs and policies to always go beyond individual factors when addressing adolescents' sexual and reproductive issues. Knowing these predictors is worthy of interest, especially where adolescents' HIV risk perceptions need to be further reinforced. Thus, our findings demonstrate that despite the gradual erosion of family networks mainly due to urbanization, these networks still play a crucial role in shaping adolescents' HIV awareness, at least for those who have not yet initiated sexual intercourse. This is rather encouraging in terms of prevention strategies, which remain the best way to change the course of the AIDS pandemic in sub-Saharan African countries. We also found that inaccurate knowledge led to a greater underestimation of HIV risk perception, especially among older adolescents. This is an important result that suggests the need to equip young adolescents with adequate and accurate knowledge about HIV before they experience sexual maturation and start interacting with the opposite sex. This should be done through life skills-based education[21,28]. In particular, such education should include decision-making, problem-solving, and critical thinking skills in order to help adolescents to always keep in mind the risks and challenges they face in their everyday life. This approach seems to be the most effective way to protect the next generations in sub-Saharan Africa from the HIV pandemic.

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Contribution of authors

Georges Guiella conceived and designed the study. He also collected the data and prepared the manuscript. All the authors participated in the interpretation of data and revision of the final text. All authors approved the manuscript.

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