

Sexual and reproductive health knowledge among adolescents in eight sites across sub-Saharan Africa

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Abstract

OBJECTIVE To examine knowledge of menstruation, HIV and STIs other than HIV across eight sites in SSA to develop effective programmatic interventions enabling adolescents to achieve positive SRH as their transition to adulthood.

METHODS We combine data from eight Health and Demographic Surveillance Sites across sub-Saharan Africa, from an adolescent-specific survey that included 7116 males and females age 10–19 years old. We provide pooled and site-specific estimates from multiple analytic models examining the how year-specific age, school attendance and work correlate with knowledge of menstruation, HIV knowledge and knowledge of sexually transmitted infections (STIs) other than HIV.

RESULTS Many adolescents lack knowledge of menstruation (37.3%, 95% CI 31.8, 43.1 do not know of menstruation) and STIs other than HIV (55.9%, 95% CI 50.4, 61.3 do not know of other STIs). In multivariate analysis, older age, being in school and wealth are significant positive correlates of STI knowledge. Older adolescent age, female sex and being in school are significant positive correlates of knowledge of menstruation. Knowledge of HIV is high (89.7%, 95% CI 8.3, 12.7 know of HIV) and relatively similar across adolescent age, sex, wealth and school and work attendance.

CONCLUSION Knowledge of HIV is widespread across adolescents in these communities in sub-Saharan Africa, but knowledge of other dimensions of sexual and reproductive health – menstruation and other STIs in this study – is lacking especially for early adolescents (10- to 14-year olds). The dissemination of more comprehensive sexual and reproductive health information is needed within these and similar communities in SSA to help adolescents gain insight on how to make their own decisions towards positive adolescent sexual and reproductive health and protect them from risks.

keywords adolescent, sexual and reproductive health, sub-Saharan Africa, knowledge

Sustainable Development Goals (SDGs): SDG 1 (no poverty), SDG 3 (good health and well-being), SDG 4 (quality education), SDG 5 (gender equity), SDG 10 (reduced inequalities), SDG 17 (partnerships for the goals)

Introduction

The Global Accelerated Action for the Health of Adolescents (AA-HA!) [1] noted that maternal mortality is the

leading cause of death for adolescent females in low- and middle-income countries (LMIC) [2]. For male adolescents in sub-Saharan Africa (SSA), HIV is the fourth leading cause of death. These extreme outcomes can be

mitigated by improved adolescent sexual and reproductive health (SRH) knowledge.

Several high-level strategies have been promoted to improve health outcomes for adolescents, particularly those relating to SRH. The Global Strategy of Every Woman Every Child [3] now includes adolescents and is now the Global Strategy of Every Women, Every Adolescent, and Every Child, in recognition of the unique challenges faced by adolescents in working towards achieving the Sustainable Development Goals (SDGs). In particular, SDG Goal III to ‘ensure healthy lives and promote well-being for all at all ages’, Goal IV to ‘ensure inclusive and equitable quality education and promote lifelong learning opportunities for all’ and Goal V to ‘achieve gender equality and empower all women and girls’, highlight the needs for adolescents in improving their health and welfare, and their SRH.

Health improvements begin with knowledge of health. Having knowledge enables adolescents to have agency over their own bodies and protects against risky sexual behaviours (early sexual debut, sex without condoms and sex with multiple partners). The continuum of SRH knowledge acquisition builds throughout adolescence, beginning with the need for basic knowledge of the reproductive system in the early teen years and advancing to knowledge of sexual behaviour and the potential risks of sexually transmitted infection (STI) in later adolescence. In this paper, we explore how self-reported sexual and reproductive health knowledge varies across the adolescent age spectrum from 10 to 19 years of age, and how year-specific age, gender, school and work attendance, wealth and sexual experience correlate with knowledge of menstruation, HIV and STIs other than HIV.

From the adolescent’s perspective, they do not perceive themselves to be lacking in SRH knowledge [4]. Glinski *et al* [4] find that while a high percentage of adolescents across the developing world report knowledge of at least one method of contraception, they did not know that they could get pregnant the first time they had sex. Adolescents’ had an incomplete range of knowledge regarding basic sexual and reproductive health.

For older adolescents aged 15–19 years, knowledge of HIV and other sexually transmitted diseases is important to promote the use of condoms and prevent sexually transmitted disease transmission and unintended pregnancy. For younger adolescents, knowledge of reproductive health (menstruation, for example) and the implications of this for sex and reproduction are important in understanding the consequences of sexual debut.

Adolescents, acquire SRH knowledge through sex education in school, friends, parents, extended family, local organisations (including healthcare clinics) and media. School-based comprehensive sex education increases

knowledge of SRH [5–7], but not all programmes have had a positive impact on SRH behaviour. Those that did had a complementary community-based component that reinforced norms outside school (i.e. youth-friendly service training for healthcare staff, distributing condoms and community and parent involvement in curriculum development) [8,9].

Having conversations regarding SRH with parents [10–18] can have a beneficial impact on adolescent sexual behaviour [19,20], not just mothers, but also SRH-related conversations between fathers and daughters when there is good rapport [21]. Adolescents in the US express that they prefer their knowledge to come from a clinician, and that the clinician initiates the conversation around SRH [22]. But in the sub-Saharan African context, the stigma of attending clinics (especially for SRH consultation) creates a barrier for the clinician as a preferred source of SRH knowledge as African adolescents can anticipate poor treatment from providers due to stigma surrounding their attendance [23,24].

Peer-led education programmes, which aim to draw on adolescent social networks to communicate SRH information, are largely ineffective [8,25–28]. Though these programmes may result in improvements in knowledge, attitudes and intentions, few programs result in improvements on health outcomes. One review of evidence found that peer-led education mainly benefits the educator (due to training and supervision) rather than the beneficiary [8].

The infrastructure and culture to support knowledge transfer in an age-appropriate way (for 10-year olds, for 19-year olds) are often lacking. For example, poor infrastructures and accessibility of rural areas in Northern Ghana may have led to uneven distribution of reproductive health educational programmes in the country [29]. Recent Demographic and Health Survey (EDHS) data from Ethiopia indicate a decrease in HIV knowledge compared with previous EDHS findings [30].

In this paper, we explore how SRH knowledge varies across the adolescent age spectrum from 10 to 19 years of age, and how age, sex, school and work status, wealth and sexual experience intersect and are reflected in knowledge of menstruation, HIV and STIs other than HIV.

Methods

Study setting and participants

We conducted an exploratory, observational analysis based on data collected at one point in time from eight sub-Saharan African research sites. We use data from eight Health and Demographic Surveillance Sites (HDSS) in six SSA countries as part of the African Research,

Implementation Science and Education (ARISE) Network Adolescent Health Study: Burkina Faso (rural, Nouna), Ethiopia (rural, Kersa), Ethiopia (urban, Harar), Ghana (rural, Ningo Prampram), Nigeria (rural, Ibadan), Tanzania (rural, Dodoma), Tanzania (urban, Dar es Salam) and Uganda (rural, Iguanga/Mayuge). HDSSs follow geographically defined populations through regular household surveys to establish a longitudinal database of individuals and social units in the surveillance areas.

Details of the selection and socio-demographic characteristics of the eight sites are provided in the Age of Opportunity paper in this issue [31].

The ARISE Adolescent Health Study surveys were conducted in 2016 and 2017. Details of the data collection at each of the sites are documented by Berhane *et al.* [31] elsewhere [32].

Variables

Outcome measure: We focused on three questions that probed both female and males adolescents' detailed self-reported SRH knowledge: (i) menstruation knowledge – 'Have you heard of the term "menstruation" or "having one's period"?'; (ii) HIV knowledge – 'Have you heard of HIV or AIDS?'; and (iii) STI knowledge – 'Apart from HIV/AIDS, there are other diseases that men and women can catch by having sexual intercourse. Have you heard of any of these diseases?' All three questions had binary responses: 'Yes' or 'No'.

Exposure variables. To capture the pathways of knowledge level and acquisition, we included several social and demographic factors: age (in completed years at interview between 10 and 19); sex (male/female); current enrolment in school at interview (yes/no); whether the participant had worked for money in the past 12 months (yes/no); and whether the respondent's mother was alive (yes/no) and self-reported sexual debut. We also included household wealth as quintiles of the first site-specific principle component of a list of assets reported by the participant [32]. The wealth index is a relative measure of wealth, and specific to each site and not comparable across sites.

Data sources/measurement

Information from adolescent-specific surveys at six Demographic and Health Surveillance Sites (DHSS) in 2016 provided the data for the analysis in the study. The adolescent health survey was conducted under the auspices of the Africa Research, Implementation Science and Education (ARISE) Network and was not part of the routine HDSS data collection rounds. The adolescent survey included

males and females, and recruited individuals aged between 10 and 19 years old. The survey measures were standardised across the eight sites analysed in this paper and were largely based on the Global School-Based Health Survey, with some modifications described elsewhere [32]. The sampling strategy is documented in Berhane *et al.* [31].

Statistical methods

We used log binomial, random effects, Poisson regression estimation models since these provide relative risk ratios, which are more appropriate for binary outcomes when the outcome is not rare and thus odds ratios and risk ratios diverge [33]. We first estimated unadjusted models for each of the three outcomes for exposures and then adjusted models including all covariates and a dummy variable for each site to capture elements that are common to all people within each site. Higher relative-risk ratios are associated with greater knowledge about menstruation, HIV and STIs, thus reflect a greater chance of knowledge.

Summary statistics are weighted [32] to take into account over-sampling of minority population within country-specific sites, but regressions are not weighted [34]. We used a complete case analysis, dropping any observations missing values for outcomes, exposures or covariates, or missing sampling or non-response weights.

Ethical review

The ARISE Adolescent Health Study was approved by the Harvard T.H. Chan School of Public Health Institutional Review Board. Site-specific approvals were gained for all eight sites [32].

Results

A total of 7663 males and females aged 10–19 years were interviewed across the eight sites. There were 7523 valid responses (98.2%) for STIs other than HIV knowledge (Table 1). After removing observations with missing exposures ($n = 101$), covariates ($n = 133$) or sampling and response weights ($n = 173$), our final analytic sample consisted of 7116 male and female respondents aged 10–19 across the eight sites.

Two-thirds of respondents (62.7%; 95% CI 31.8, 43.1) self-reported knowing about menstruation, 89.7% (95% CI 87.3, 91.7) about HIV, and 44.1% (95% CI 38.7, 49.6) about STIs other than HIV. Table 2 shows demographic characteristics of the pooled study sample. In the pooled sample, the confidence intervals of each age in years 10–19 overlapped, indicating that across the sample age adolescents were interviewed in equal

Table 1 Deduction of the analytic sample

	Observations dropped	Sample size
Surveyed sample		7663
STI detailed knowledge		7523
No response recorded (.)	136	
Coded as 9	3	
Invalid coding (0)	1	
Social and demographic risk factors		
Invalid or missing responses	101	
Ever had sex variable included		7422
Invalid or missing responses	133	
Sample weights included		7289
Invalid or missing responses	173	
Final analytic sample		7116

proportion. Three sites were self-weighting, Ethiopia Rural (Kersa), Ethiopia Urban (Harar) and Nigeria Urban (Ibadan), and the sample means reflect the population mean. More females ($n = 3796$) than males ($n = 3320$) were in the study sample. Adolescents currently not in school accounted for 29.4% (95% CI 23.0, 36.7) of the study sample. In the study sample, 33.2% (95% CI 23.3, 44.7) had worked in the past 12 months. The mother was alive (either only mother alive, or both mother and father alive) for 95.7% (95% CI 95.0, 96.2) of the study sample. Adolescents in the study sample were evenly split across the five wealth quintiles, with 19.2% (95% CI 15.9, 23.0) of the sample in the poorest quintile and 19.8% (95% CI 15.8, 24.5) in the richest wealth quintile. Those who reported to have ever had sex made up 14.2% (95% CI 9.3, 21.2) of the study sample, which may be under-reported [35].

Table 3 shows the distribution of covariates by the outcome response. Only 14.3% (95% CI 10.6, 18.9) of 10-year olds knew about menstruation, while 70% (95% CI 64.4, 76.7) knew about HIV and only 8.5% (95% CI 6.5, 11.0) knew about STIs other than HIV. By the age of 19, nearly everyone knew about menstruation (92.3%, 95% CI 87.3, 95.5) and HIV (97.9%, 95% CI 95.7, 98.9), but still only 70.9% (95% CI 64.7, 76.3) knew about STIs other than HIV. Female adolescents were more knowledgeable with regard to menstruation (67.7%, 95% CI 60.3, 74.4) than male adolescents (56.5%, 95% CI 49.2, 63.6), but HIV knowledge was more balanced between females (90%, 95% CI 88.1, 91.7) and males (89.4%, 95% CI 86.0, 92.1), as was STI knowledge between females (45%, 95% CI 37.9, 52.3) and males (43%, 95% CI 38.6, 47.6). A greater fraction of adolescents in school had knowledge of menstruation (64.4%, 95% CI 60.0, 68.6), HIV (92.5%, 95% CI 90.6,

Table 2 N, weighted % and 95% confidence intervals, of outcome and exposure variables, by site and pooled

	%	95% CI
Knowledge of menstruation		
No ($n = 2544$)	37.3	31.8, 43.1
Yes ($n = 4280$)	62.7	56.9, 68.2
Knowledge of HIV		
No ($n = 730$)	10.3	8.3, 12.7
Yes ($n = 6382$)	89.7	87.3, 91.7
Knowledge of STIs other than HIV		
No ($n = 3980$)	55.9	50.4, 61.3
Yes ($n = 3136$)	44.1	38.7, 49.6
Age of respondent in years	Weighted %	95% CI
10 ($n = 495$)	7	3.9, 12.1
11 ($n = 585$)	8.2	6.1, 11.0
12 ($n = 813$)	11.4	10.0, 13.1
13 ($n = 893$)	12.5	11.3, 13.9
14 ($n = 909$)	12.8	11.7, 13.9
15 ($n = 775$)	10.9	9.9, 12.0
16 ($n = 807$)	11.3	10.3, 12.4
17 ($n = 682$)	9.6	8.6, 10.7
18 ($n = 735$)	10.3	8.9, 12.0
19 ($n = 422$)	5.9	4.3, 8.0
Gender		
Male ($n = 3320$)	46.7	44.0, 49.3
Female ($n = 3796$)	53.3	50.7, 56.0
In school		
No ($n = 2090$)	29.4	23.0, 36.7
Yes ($n = 5026$)	70.6	63.3, 77.0
Worked in the past 12 months		
No ($n = 4756$)	66.8	55.3, 76.7
Yes ($n = 2360$)	33.2	23.3, 44.7
Mother alive		
No ($n = 309$)	4.3	3.8, 5.0
Yes ($n = 6807$)	95.7	95.0, 96.2
Wealth quintile		
Poorest ($n = 1368$)	19.2	15.9, 23.0
Poor ($n = 1474$)	20.7	18.5, 23.2
Middle ($n = 1458$)	20.5	19.3, 21.8
Rich ($n = 1406$)	19.8	17.9, 21.8
Richest ($n = 1410$)	19.8	15.8, 24.5
Ever had sex		
No ($n = 6103$)	85.8	78.8, 90.7
Yes ($n = 1013$)	14.2	9.3, 21.2

94.1) and other STIs (47.4%, 95% CI 42.3, 52.5), compared with the fraction out of school who knew of menstruation (58.6%, 95% CI 49.2, 67.4), HIV (83%, 95% CI 78.8, 86.6) and other STIs (36.2%, 95% CI 28.0, 45.2). A greater fraction of adolescents who worked in the past year had knowledge of menstruation (64.4%, 95% CI 60.0, 68.6), HIV (92.5%, 95% CI 90.6, 94.1) and other STIs (47.4%, 95% CI 42.3, 52.5), compared

Table 3 Weighted prevalence of knowledge of menstruation, HIV and STIs other than HIV by age, gender, school and work status, wealth and sexual debut

	Knowledge of menstruation		HIV knowledge		STI knowledge	
	Yes %	Yes 95% CI	Yes %	Yes 95% CI	Yes %	Yes 95% CI
Age of respondent in years						
10	14.3	(10.6, 18.9)	70.9	(64.4, 76.7)	8.5	(6.5, 11.0)
11	21.9	(12.6, 35.3)	82.7	(78.1, 86.5)	14.5	(11.0, 18.9)
12	35	(26.4, 44.6)	82.3	(74.2, 88.2)	21.5	(16.9, 27.0)
13	51.5	(41.0, 61.9)	87.6	(82.7, 91.2)	33.8	(27.3, 41.0)
14	69	(62.0, 75.3)	92	(87.4, 95.0)	44.4	(37.9, 51.2)
15	77.2	(65.8, 85.6)	93.9	(91.5, 95.7)	53.7	(46.7, 60.5)
16	82.3	(71.1, 89.8)	93.8	(91.5, 95.5)	57.7	(52.0, 63.3)
17	87.9	(81.2, 92.4)	96	(94.0, 97.4)	65.2	(59.6, 70.5)
18	90.3	(85.8, 93.5)	96.7	(95.4, 97.7)	68.3	(62.2, 73.8)
19	92.3	(87.3, 95.5)	97.9	(95.7, 98.9)	70.9	(64.7, 76.3)
Gender						
Male	56.5	(49.2, 63.6)	89.4	(86.0, 92.1)	43	(38.6, 47.6)
Female	67.7	(60.3, 74.4)	90	(88.1, 91.7)	45	(37.9, 52.3)
In school						
No	58.6	(49.2, 67.4)	83	(78.8, 86.6)	36.2	(28.0, 45.2)
Yes	64.4	(60.0, 68.6)	92.5	(90.6, 94.1)	47.4	(42.3, 52.5)
Worked in the past year						
No	61.3	(56.1, 66.2)	88.8	(85.5, 91.5)	41.6	(35.4, 48.1)
Yes	65.5	(56.4, 73.6)	91.6	(88.4, 94.0)	49	(43.9, 54.2)
Mother alive						
No	73.6	(66.5, 79.7)	93.2	(89.9, 95.5)	47.9	(37.7, 58.3)
Yes	62.2	(56.4, 67.8)	89.6	(87.1, 91.6)	43.9	(38.6, 49.3)
Wealth quintile						
Poorest	56.4	(46.3, 66.1)	84.9	(77.6, 90.2)	33.7	(28.4, 39.4)
Poor	56.4	(51.6, 61.1)	86.9	(84.7, 88.9)	38.9	(34.6, 43.5)
Middle	63.1	(56.0, 69.7)	91.5	(89.6, 93.1)	44.1	(39.7, 48.6)
Rich	65.7	(60.8, 70.4)	92.7	(89.7, 94.8)	49.6	(43.4, 55.9)
Richest	72	(68.5, 75.2)	92.6	(89.4, 94.9)	53.9	(44.5, 63.0)
Ever had sex						
No	59.6	(53.1, 65.7)	88.8	(86.1, 91.1)	40.9	(36.1, 45.8)
Yes	82.2	(70.2, 90.1)	95.4	(93.0, 96.9)	63.4	(57.4, 68.9)

Site specific statistics provided in the Table S1.

with the fraction out of school who knew of menstruation (58.6%, 95% CI 49.2, 67.4), HIV (83%, 95% CI 78.8, 86.6) and other STIs (36.2%, 95% CI 28.0, 45.2). Of those in the poorest wealth quintile, 56.4% (95% CI 46.3, 66.1) knew of menstruation, 84.9% (95% CI 77.6, 90.2) knew of HIV and 33.7% (95% CI 28.4, 39.4) knew of STIs other than HIV. Of those in the richest wealth quintile, 72% (95% CI 68.5, 75.2) knew of menstruation, 92.6% (95% CI 89.4, 94.9) knew of HIV and 53.9% (95% CI 44.5, 63.0) knew of other STIs. The prevalence of those who had sex was low, (Table 2), but of those who had sexual debut 82.2% (95% CI 70.2, 90.1) knew of menstruation, 95.4% (95% CI 93.0, 96.9) knew of HIV and 63.4% (95% CI 57.4, 68.9) knew of

STIs other than HIV. Of those (majority) who had not had their sexual debut, 59.6% (95% CI 53.1, 65.7) knew of menstruation, 88.8% (95% CI 86.1, 91.1) knew of HIV and 40.9% (95% CI 36.1, 45.8) knew of STIs other than HIV.

In Table 4, we used a bivariate Poisson model to calculate the relative risk (chance) of (yes to) knowing about menstruation, HIV, and that there are STIs other than HIV that one can get from unprotected sex. We found that knowledge of menstruation and STIs other than HIV increased sharply with age. Participants aged 19 were 6.5 times (95% CI 5.203, 8.060) more likely to know about menstruation than their reference group (10-year olds). Those participants aged 19 were 8.4 times (95% CI 6.2,

Table 4 Bivariate predictors of SRH knowledge among adolescents in eight African sites (pooled)

	Knowledge of menstruation Unadjusted RR	HIV knowledge Unadjusted RR	STI knowledge Unadjusted RR
Age			
Reference: age 10			
Age 11	1.536*** (1.174–2.009)	1.166*** (1.090–1.248)	1.712*** (1.207–2.430)
Age 12	2.453*** (1.936–3.109)	1.160*** (1.087–1.238)	2.537*** (1.846–3.486)
Age 13	3.615*** (2.883–4.533)	1.235*** (1.161–1.313)	3.986*** (2.942–5.399)
Age 14	4.843*** (3.881–6.043)	1.297*** (1.222–1.377)	5.238*** (3.887–7.059)
Age 15	5.412*** (4.342–6.746)	1.325*** (1.249–1.406)	6.326*** (4.702–8.511)
Age 16	5.772*** (4.635–7.188)	1.323*** (1.247–1.403)	6.806*** (5.066–9.143)
Age 17	6.163*** (4.952–7.671)	1.354*** (1.278–1.436)	7.690*** (5.729–10.32)
Age 18	6.332*** (5.090–7.878)	1.364*** (1.287–1.446)	8.050*** (6.002–10.80)
Age 19	6.476*** (5.203–8.060)	1.380*** (1.302–1.463)	8.351*** (6.213–11.22)
Gender			
Reference: Male			
Female	1.199*** (1.154–1.245)	1.007 (0.991–1.023)	1.046* (0.992–1.103)
In school			
Reference: No			
Yes	1.099*** (1.054–1.147)	1.114*** (1.091–1.138)	1.309*** (1.228–1.396)
Worked in the past year			
Reference: No			
Yes	1.069*** (1.029–1.110)	1.031*** (1.015–1.048)	1.178*** (1.117–1.243)
Mother alive			
Reference: No			
Yes	0.846*** (0.787–0.909)	0.961** (0.932–0.992)	0.916 (0.813–1.033)
Wealth quintile			
Reference: Poorest			
Poor	0.999 (0.935–1.068)	1.023 (0.993–1.054)	1.156*** (1.048–1.275)
Middle	1.118*** (1.051–1.190)	1.077*** (1.048–1.107)	1.309*** (1.191–1.438)
Rich	1.165*** (1.096–1.239)	1.091*** (1.062–1.121)	1.473*** (1.345–1.614)
Richest	1.276*** (1.204–1.352)	1.090*** (1.062–1.120)	1.599*** (1.464–1.748)
Ever had sex			
Reference: No			
Yes	1.381*** (1.331–1.432)	1.074*** (1.056–1.091)	1.551*** (1.467–1.640)
Observations	6824	7112	7116

Robust ciform in parentheses.

Univariate regressions by site provided in the Table S2.

*** $P < 0.01$, ** $P < 0.05$, * $P < 0.1$.

11.2) more likely to know about other STIs than the reference group (10-year olds). Age had a small association with HIV knowledge, and those aged 19 at the time of the interview were 1.4 times (95% CI 1.302, 1.463) more likely to know about HIV than the reference group of 10-year olds.

Females were more likely (URR 1.1, 95% CI 1.154, 1.245) than males to know about menstruation, but gender differences were not significantly different (at the 95% level) for knowledge of HIV or STIs other than HIV. Those in school were more likely to know about menstruation (URR 1.099, 95% CI 1.054, 1.147), HIV (URR 1.114, 95% CI 1.091, 1.138) and STIs other than HIV (URR 1.309, 95% CI 1.228, 1.396). Those who

reported to have worked in the past year were more likely to know about menstruation (URR 1.069, 95% CI 1.029, 1.110), HIV (URR 1.031, 95% CI 1.015, 1.048) and STIs other than HIV (URR 1.178, 95% CI 1.117, 1.243), than adolescents who reported not to have worked in the past year. Those in the richest wealth quintile were more likely to know about menstruation (URR 1.276, 95% CI 1.204, 1.352), HIV (URR 1.090, 95% CI 1.062, 1.120) and STIs other than HIV (URR 1.599, 95% CI 1.464, 1.748) than adolescents who lived in households within the poorest wealth quintiles within their sites. Those who reported to have ever had sex were more likely to know about menstruation (URR 1.381, 95% CI 1.331, 1.432), HIV (URR 1.074, 95% CI 1.056,

Table 5 Multivariate predictors of SRH knowledge among adolescents in eight African sites (pooled)

	Knowledge of menstruation Adjusted RR	HIV knowledge Adjusted RR	STI knowledge Adjusted RR
Age (years)			
Reference: Age 10			
Age 11	1.495*** (1.149–1.944)	1.151*** (1.079–1.228)	1.411** (1.001–1.990)
Age 12	2.567*** (2.036–3.236)	1.171*** (1.101–1.245)	2.340*** (1.712–3.198)
Age 13	3.729*** (2.988–4.654)	1.249*** (1.178–1.324)	3.597*** (2.667–4.851)
Age 14	4.893*** (3.935–6.083)	1.301*** (1.229–1.377)	4.617*** (3.437–6.201)
Age 15	5.483*** (4.414–6.810)	1.331*** (1.257–1.408)	5.712*** (4.258–7.662)
Age 16	5.712*** (4.599–7.094)	1.321*** (1.249–1.398)	6.047*** (4.511–8.106)
Age 17	6.069*** (4.883–7.543)	1.358*** (1.284–1.437)	6.933*** (5.172–9.292)
Age 18	6.376*** (5.132–7.921)	1.373*** (1.298–1.452)	7.491*** (5.589–10.04)
Age 19	6.625*** (5.322–8.247)	1.410*** (1.331–1.494)	7.954*** (5.913–10.70)
Gender			
Reference: Male			
Female	1.159*** (1.122–1.197)	1.013* (0.998–1.029)	1.026 (0.980–1.074)
In school			
Reference: No			
Yes	1.263*** (1.214–1.313)	1.147*** (1.120–1.174)	1.625*** (1.527–1.730)
Worked in the past year			
Reference: No			
Yes	1.040** (1.005–1.076)	1.063*** (1.044–1.083)	1.176*** (1.117–1.239)
Mother alive			
Reference: No			
Yes	0.964 (0.906–1.024)	0.984 (0.954–1.015)	1.058 (0.957–1.170)
Wealth quintile			
Reference: Poorest			
Poor	1.012 (0.960–1.067)	1.029** (1.000–1.058)	1.153*** (1.060–1.256)
Middle	1.072*** (1.019–1.127)	1.061*** (1.035–1.089)	1.248*** (1.149–1.355)
Rich	1.078*** (1.025–1.134)	1.065*** (1.039–1.092)	1.295*** (1.196–1.402)
Richest	1.160*** (1.106–1.218)	1.060*** (1.034–1.087)	1.416*** (1.309–1.531)
Ever had sex			
Reference: No			
Yes	1.123*** (1.082–1.166)	1.042*** (1.022–1.063)	1.139*** (1.073–1.208)
Site			
Reference: Bukina Faso Rural (Nouna)			
Ethiopia Rural (Kersa)	1.125*** (1.041–1.216)	1.046** (1.008–1.085)	0.629*** (0.541–0.731)
Ethiopia Urban (Harar)	1.571*** (1.489–1.657)	1.176*** (1.148–1.205)	1.661*** (1.537–1.795)
Ghana Rural (Ningo Prampram)	1.279*** (1.201–1.362)	1.022 (0.986–1.059)	1.068 (0.958–1.191)
Nigeria Rural (Ibadan)	1.500*** (1.420–1.584)	1.077*** (1.045–1.110)	0.929 (0.830–1.039)
Tanzania Rural (Dodoma)	1.166*** (1.094–1.242)	1.058*** (1.027–1.091)	1.647*** (1.522–1.782)
Tanzania Urban (Dar)	1.443*** (1.368–1.524)	1.154*** (1.126–1.183)	1.613*** (1.486–1.750)
Uganda Rural (Iguanga/Mayuge)	1.273*** (1.188–1.364)	1.169*** (1.138–1.201)	1.238*** (1.117–1.371)
Constant	0.0819*** (0.0651–0.103)	0.558*** (0.518–0.600)	0.0374*** (0.0272–0.0514)
Observations	6824	7112	7116

Robust cieform in parentheses.

Multivariate regressions by site provided in the Table S3.

*** $P < 0.01$, ** $P < 0.05$, * $P < 0.1$.

1.091) and STIs other than HIV (URR 1.551, 95% CI 1.467, 1.640) than adolescents who lived in households within the poorest wealth quintiles within their sites.

Multivariate analysis, Table 5, shows that even after controlling for gender, school and work status, wealth

quintile, sexual debut and site fixed effects, age remains a strong predictor of knowledge of menstruation and STIs other than HIV, with a slight correlation with knowledge of HIV. Adolescents age 19 are more likely to know about menstruation (ARR 6.625, 95% CI 1.056, 1.091),

HIV (ARR 1.410, 95% CI 1.331, 1.494) and STIs other than HIV (ARR 7.954, 95% CI 5.913–10.70) than 10-year olds, even after controlling for school and work status, gender, wealth, sexual debut and site fixed effects. In multivariate analysis, school attendance remains an important correlate of knowledge of menstruation (ARR 1.263, 95% CI 1.214, 1.313), HIV (ARR 1.147, 95% CI 1.120–1.174) and STIs other than HIV (ARR 1.625, 95% CI 1.527–1.730). But work, wealth and sexual experience show that these factors are less important once the correlation of age and other covariates are controlled for in the estimation.

Discussion

In this paper, we explored the determinants of adolescents' knowledge of menstruation, HIV and STIs other than HIV across eight sites in sub-Saharan Africa. We examined the pooled sample of 7116 across the sites in Burkina Faso (rural, Nouna), Ethiopia (rural, Kersa), Ethiopia (urban, Harar), Ghana (rural, Ningo Prampram), Nigeria (rural, Ibadan), Tanzania (rural, Dodoma), Tanzania (urban, Dar es Salam) and Uganda (rural, Iguanga/Mayuge). Knowledge of menstruation and STIs other than HIV varied greatly across the adolescent age spectrum from age 10 to age 19, with adolescents age 19 much more likely than younger adolescents to know about menstruation and STIs other than HIV. However, HIV knowledge was much higher than knowledge of menstruation and STIs other than HIV, and this high rate of knowledge of HIV was consistent across the adolescent age spectrum.

Knowledge of HIV may be greater than knowledge of menstruation and STIs other than HIV, as it is a visible dimension of sexual and reproductive health. Menstruation can be hidden from other household members; other STIs may not have the same impact on morbidity as HIV. HIV has a high impact on morbidity and reliance on treatment that may not be as easy to hide from household members. Young adolescents may also be primary caregivers of HIV positive relatives, and this may be known within households and across peers of similar age.

Adolescents are underserved when it comes to SRH knowledge dissemination [35]. This includes knowledge of the risks of sexual debut, but also knowledge of services and products that would help them achieve positive sexual and reproductive health [36]. Taking a unified approach to SRH for adolescents would help to equalise knowledge across various dimensions of SRH, and not be limited to HIV alone [37].

Although data collection, data cleaning and analysis were conducted within a rigorous framework, this study

has some limitations. All data collected were quantitative. In many of the questions, the adolescents are requested yes/no responses. This may mean that the responses reflect a guess either way for the adolescent rather than an indication of their true knowledge. The addition of open-ended, qualitative questions in future surveys may provide a better measure of this. Furthermore, the questionnaire used in this study was not validated and therefore may be subject to measurement error. However, the majority of the questions were drawn from an extensively validated tool that has been widely used in this region [32].

The settings where data were collected at the household level could have led to under-reporting of socially undesirable behaviours among adolescents. Adolescents could fear that parents and guardians could be listening to the interviews, although the adults in the home were requested to provide privacy by leaving adolescents alone with the interviewers. However, for an overview of adolescent behaviour, the brevity and clarity of the survey enabled the participants to respond without hesitation.

From the analysis in this paper, we can interpret the results to indicate that many adolescents lack comprehensive knowledge of sexual and reproductive health across its many dimensions. Here, we compared knowledge of three dimensions: menstruation, HIV and STIs other than HIV, and found that knowledge of HIV was much greater across all ages, than the other two SRH dimensions. This finding complements other studies that found good knowledge of contraception, but poor knowledge of the likelihood of pregnancy from sexual intercourse [4].

Although these results are not generalisable to the regional or national adolescent population of any countries, they are generalisable within the sites, as the statistics are weighted to reflect the demographic composition of the sites. The sample had both urban and rural examples, and a range of sub-Saharan African countries. The overarching results could inform policy in geographically and demographically similar communities across sub-Saharan Africa to improve adolescent SRH through complete and accurate information dissemination – in and out of schools and work places.

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Supporting Information

Additional Supporting Information may be found in the online version of this article:

Table S1. 3 outcomes 8 sites.

Table S2. Univariate 3 outcomes 8 sites.

Table S3. Multivariate 3 outcomes 8 sites.

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