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Prevalence and associated factors of sexually transmitted infections among adolescent pregnant women at Mbarara Regional Referral Hospital, Uganda

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Abstract

Background: Adolescents in sub-Saharan Africa shoulder a disproportionate burden of sexually transmitted infections (STIs), yet data for pregnant teenagers in these settings are sparse.

Objectives: The study estimated the prevalence of STI seropositivity and its associated factors, among pregnant adolescents at Mbarara Regional Referral Hospital (MRRH), Uganda.

Design: Hospital-based cross-sectional study.

Methods: Consecutive pregnant adolescents (10–19 years) attending the MRRH antenatal clinic or maternity ward between 1 July and 30 September 2024 were enrolled. A structured questionnaire captured socio-demographic, sexual-behavioural, obstetric, clinical and nutritional variables. Blood samples were tested for HIV (Determine™/STAT-PAK™), syphilis (Treponema pallidum haemagglutination assay) and Hepatitis B (HBsAg rapid test). The composite STI outcome was seropositivity for any infection: HIV, syphilis or HBsAg. Independent associations were examined with Firth-penalised logistic regression; adjusted odds ratios (aOR) and 95% confidence intervals (CI) are reported.

Results: Among 249 participants (median age 18 years, interquartile range 18–19), the overall prevalence of STI seropositivity was 12.1% (95% CI: 8.3–16.8). Prevalence by each STI was HIV 8.8%, syphilis 4.0% and HBV 0.4%. Multigravidae had higher odds of infection than primigravidae (aOR: 2.81, 95% CI: 1.01–7.84). Having ever used a non-barrier modern contraception tripled the odds of STI (aOR 3.04, 95% CI: 1.10–8.45), whereas marriage or cohabitation reduced risk by 63% (aOR 0.37, 95% CI: 0.14–0.96).

Conclusion: Nearly one in eight pregnant adolescents at MRRH were infected with HIV, syphilis or HBV, with these STIs more likely to be among multigravidae and former users of non-barrier contraception and less likely among married/cohabiting pregnant adolescents. These findings support integrating repeat HIV–syphilis testing, dual-method contraceptive counselling and targeted interventions for multigravidae into youth-friendly antenatal services to advance STI-elimination goals.

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Plain language summary

Sexually transmitted infections among pregnant adolescents at Mbarara Regional Referral Hospital

Pregnancy is a big step for any girl, and it can be harder if she carries a hidden sexually transmitted infection (STI), an infection that she may not see or feel. These hidden STIs: human immunodeficiency virus (HIV), syphilis and hepatitis B, can harm both mother and baby if they are not found and treated. From July to September 2024, we worked at Mbarara Regional Referral Hospital in south-western Uganda and obtained special information and small blood samples from 249 pregnant girls aged 10 to 19 years. We discovered that 30 of them (about one in every eight) had at least one infection: 22 had HIV, 10 had syphilis and one had hepatitis B. The likelihood of having these STIs was higher in girls who had been pregnant before compared to those who were pregnant for the first time. Girls who had ever used family-planning pills, injections or implants, methods that prevent pregnancy but do not block germs, also showed a three-times greater likelihood, possibly because condom use stopped after they changed to these methods. By contrast, girls who were married or living with one steady partner were less likely to be infected. In Uganda, most health centres test for HIV and syphilis only once, early in pregnancy, so new infections that appear later can be missed. Our findings recommend giving a second test later in pregnancy, teaching all girls to use condoms together with other family-planning methods, and paying special attention to adolescents who have been pregnant before. Finding and treating these hidden infections early will help teenage mothers deliver healthier babies and keep themselves safe for the future.

Keywords: HIV, hepatitis B, pregnant adolescents, sexually transmitted infection, syphilis

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Introduction

Sexually transmitted infections (STIs) are infections predominantly spread through sexual contact, including vaginal, anal and oral sex, and may be transmitted through mother-to-child transmission during pregnancy and childbirth.[1] STIs remain an unfinished agenda for global sexual and reproductive health.[2–4] Worldwide, pooled prevalence estimates among pregnant women were about 3% for human immunodeficiency virus (HIV), 5% for syphilis, and 1% for hepatitis B, climbing two-fold to four-fold in low-income countries.[5] Adolescent girls and young women (AGYW) shoulder a big share of this burden: hepatitis B/HIV co-infection is almost seven-fold higher in 15- to 24-year-olds than in older mothers,[6] and AGYW in sub-Saharan Africa contributed to 63% of all new HIV infections in 2021.[7] Local Ugandan data mirror these global patterns: the 2020–2021 Uganda Population-based HIV Impact Assessment (UPHIA) recorded a HIV prevalence of 1.7% among adolescent girls aged 15–19 years,[8] syphilis affects 5.9% of pregnant women in Kampala[9] and 3.1% of pregnant women at Mbarara Regional Referral Hospital (MRRH) were seropositive for hepatitis B surface antigen (HBsAg).[10] Nearly 25% of girls aged 15–19 years in Uganda are already childbearing, with adolescent pregnancies contributing disproportionately to adverse pregnancy outcomes[11,12]

The biological interplay of the STIs further intensifies risk. Syphilitic ulcers and immune activation ease HIV entry; a Zambia-Tanzania study showed that syphilis more than doubled HIV-acquisition risk and accelerated disease progression.[13] Maternal HBV viraemia drives vertical transmission risk as one-third of infants become infected without any maternal prophylaxis, over 80% when the maternal viral load exceeds

2×10^5 IUmL^{-1}; routine newborn vaccination plus hepatitis-B immunoglobulin trims this risk to 16%, and adding third-trimester antivirals drives the risk to <1%.[14,15] Untreated maternal syphilis increases foetal loss or stillbirth by 21%, newborn death by 9% and preterm or low-birth-weight births by 6%.[16] Taken together, the combined presence of these infections magnifies obstetric risk yet remains under-recognised in routine antenatal care.[17–19] HIV infection in pregnancy increases the risk of vertical transmission, preterm birth, low birth weight and maternal morbidity, particularly when viral suppression is not achieved.[20] Without antiretroviral prophylaxis, the vertical transmission rate ranges from 15% to 45%, which can be reduced to below 5% with optimal maternal treatment and infant prophylaxis.[21] Although this study did not assess vertical transmission, its inclusion here underscores the broader public health relevance of HIV during pregnancy.

Risk factors for STI acquisition in pregnant adolescents operate at behavioural, structural and biological levels. Behavioural risk factors such as having more than one lifetime sexual partner, a history of prior STI, substance use and being unmarried or not cohabiting have all been associated with increased likelihood of acquiring an STI in pregnancy.[22–24] In Uganda, fewer than 20% AGYW use condoms consistently, and out-of-school AGYW are more likely to have multiple partners, amplifying exposure to HIV, syphilis and other STIs.[25] Structurally, late antenatal booking among adolescent mothers tracks with low decision-making autonomy, poor danger-sign awareness, long travel and poverty.[26] Biologically, the immature cervical epithelium in adolescents displays higher pro-inflammatory cytokine levels, suggesting increased mucosal susceptibility to pathogens compared with adults.[27]

Despite these insights, critical knowledge gaps persist. Most studies aggregate adolescents with older women, focus on single pathogens or derive from urban or non-Ugandan settings, leaving little age-specific evidence on the combined burden and determinants of HIV, syphilis and hepatitis B in pregnant adolescents, particularly in rural south-western Uganda. Accordingly, this study aimed to determine the prevalence and associated factors for STI seropositivity among adolescent pregnant women at MRRH in south-western Uganda.

Materials and methods

Study design and setting

A hospital-based cross-sectional study was conducted from 1 July to 30 September 2024 in the antenatal clinic and maternity ward of MRRH, a 600-bed teaching hospital for Mbarara University of Science and Technology in southwestern Uganda. MRRH performs ≈ 11,000 deliveries annually, of which ~10 % involve adolescents. This manuscript was prepared in line with the STOBE guidelines for cross-sectional studies (Supplemental Material).[28]

Participants and recruitment

Inclusion criteria: We enrolled adolescents who met all of the following: (i) pregnant and aged 10–19 years at presentation and (ii) presented to MRRH for antenatal care, admission for delivery or management of miscarriage and medical termination of pregnancy during the study period. We included those receiving post-abortion care because miscarriage and medical termination represent part of the pregnancy continuum among adolescents and are routinely managed within the same maternity service, thereby minimising potential selection bias that could have arisen from excluding these groups. Exclusion criteria were the inability to verify date of birth (no national ID and no recall). We defined adolescents as 10–19 years, consistent with World Health Organisation and the Uganda Demographic and Health Survey (UDHS) standards used in national surveys.[12] Eligible women were enrolled by consecutive sampling until the target sample size was reached, as this method was the most feasible approach to ensure adequate recruitment within the study period given the relatively small and hard-to-reach population.[29,30]

Sample size

The sample size was estimated using the formula for comparing two proportions: $n = [(Z\alpha_{/2}\sqrt{(2P(1-2)) + Z\beta\sqrt{(P_1(1-P1) + P_2(1-P_2))}]^2/(P_1-P_2)^2}$ where $P = (P_1 + P_2)/2$, $Z\alpha_{/2} = 1.96$ (two-sided $\alpha = 0.05$), and $Z\beta = 0.84$ (power = 80%). Given a

prior STI prevalence of 11.8 % among married women (P_1)[24] and an assumed STI prevalence of 26.5% among unmarried women, with 80% power and a two-sided $\alpha = 0.05$. This yielded 224 participants, inflated by 10% for non-response to obtain 253. Although a conservative prevalence of 50% would yield the largest sample size, we used the 11.8% estimate as the most comparable regional data available and to maintain feasibility within the three-month recruitment window (Table S1, Supplemental Material).

Data collection procedures

Two trained diploma-level midwife-research assistants administered a structured questionnaire (socio-demographics, sexual-behavioural and obstetric characteristics). Venous blood (3 mL, EDTA tube) was collected and transported at room temperature to the MRRH International Organization for Standardization-certified laboratory. Laboratory assays included the following: HIV – Alere Determine™ and HIV 1/2 STAT-PAK™ rapid tests (serial algorithm), Syphilis – Treponema pallidum haemagglutination assay (TPHA) and Hepatitis B – Hepatitis B surface antigen (HBsAg) rapid test (SD-Bioline™). Syphilis – TPHA test indicates lifetime exposure and cannot differentiate previously treated syphilis from active infection. Laboratory assays were performed by trained laboratory technologists who were blinded to participants' questionnaire responses to minimise bias. All assays followed the manufacturer's instructions and internal quality-control checks. We collected additional antenatal care (ANC) clinical/nutritional measures (urinary tract infection, hypertension, anaemia, mid-upper arm circumference and random blood glucose) that we do not report or analyse in this manuscript, as they belong to a separately prespecified secondary analysis; this avoids hypothesis multiplicity within the current aims.

Variables

The primary outcome was STI seropositivity, defined as a positive STAT-Pak test (or prior HIV diagnosis), HBsAg or TPHA, three infections integrated into the ANC testing package at MRRH. Other STIs such as gonorrhoea, chlamydia, Hepatitis C, Trichomonas, HSV-2 or HPV were not included as they are currently not part of ANC standard of care in Uganda.[31] Our outcome definition was based on current serological positivity (HIV, syphilis or HBsAg) at enrolment, regardless of acquisition route. Prior STI treatment was not ascertained, apart from recording known prior HIV diagnosis, because verification from records was inconsistent, and self-reported information was prone to recall bias.

Independent variables were defined *a priori* from questionnaire responses and bedside measurements and were recoded to minimise sparse cells. Socio-demographic covariates comprised age (13–17 vs 18–19 years), marital status (single/divorced vs married/cohabiting), residence (rural versus urban), highest education (primary or less vs secondary/tertiary), employment status (unemployed/dependent versus working) and self-reported monthly income (low, middle or high tertile). Sexual-behavioural indicators included age at sexual debut (<18 vs $\geqslant 18$ years), lifetime number of sexual partners (one vs $\geqslant$ two), partner concurrency (none vs $\geqslant$ one), knowledge or prior use of HIV pre-exposure prophylaxis (PrEP; yes/no), history of transactional sex (ever/never) and ever use of modern contraception (yes/no). Ever use of modern contraception was determined through asking participants whether they had ever used any modern contraceptive method, including oral pills, injectables, implants and intrauterine devices, excluding condoms. Information on duration of use and adherence patterns (typical vs consistent use) for the contraceptives was not collected. Obstetric factors were gravidity (primigravida versus multigravida), gestational-age category at interview ($<$ 37 vs $\geqslant$ 37 completed weeks), number of ANC visits ($<$ 4 vs $\geqslant$ 4), trimester of first ANC booking (first versus later) and pregnancy intendedness (planned vs unplanned). The continuous forms of age, monthly income, gestational age and laboratory values were retained for descriptive statistics; dichotomised or ordinal forms were entered into multivariable models to minimise sparse cells. The number of ANC visits (<4 vs $\geqslant 4$) referred to the number of visits completed by the time of data collection, not those planned for the entire pregnancy. The monthly income was self-reported in Uganda shillings (UGX) and classified into tertiles based on the empirical distribution of our sample (low $<$ 20,000; middle 20,000–$<$50,000 and high $\geqslant$50,000). These cut-points are sample-specific quantiles used to rank participants relative to one another, analogous in principle to the

UDHS wealth-index quintiles, which also capture relative socio-economic status within the survey wave.[12]

Statistical analysis

Data were exported from REDCap v13.6 to Stata 18 (StataCorp, College Station, TX, USA) for analysis. Categorical variables were presented as frequencies and percentages; continuous variables as means ± standard deviation (SD) or median (interquartile range, IQR). Overall and STI-specific prevalence were reported with exact 95 % confidence intervals (CI). Covariates were screened in univariable ordinary logistic regression; variables with $p < 0.20$ or a priori confounders advanced to multivariable modelling. Because the expected events-per-parameter ratio was < 5, multivariable modelling used Firth's bias-reduced penalised logistic regression.[32] Two prespecified models were fitted: a six-variable core model (significant at $p < 0.05$ in univariable analysis) and a full model with core variables plus age group, education, occupation and age at sexual debut. Adjusted odds ratios (aOR) with profile likelihood 95 % CIs and two-sided p-values are presented. Model performance was assessed by the area under the receiver-operating characteristic curve (AUC) with 95 % CI for discrimination, and by calibration-in-the-large, calibration slope and a decile plot for observed versus predicted risk to assess calibration. Given the anticipated small number of outcome events, additional resampling procedures (e.g. bootstrapping or cross-validation) were not undertaken because they offer limited insight while inflating sampling variability in very small datasets. For sensitivity analysis, the final model was re-estimated with ordinary maximum-likelihood logistic regression; resulting aORs and CIs were compared with Firth estimates. Missing data were <3% for any variable, permitting complete-case analysis. Statistical significance was set at $p < 0.05$.

Results

Participants

A total of 253 pregnant adolescents were screened; 4 lacked complete serology and were excluded, leaving 249 participants for analysis (Figure 1). Missing values for explanatory variables were <3 % for any single variable.

Socio-demographic and sexual-behavioural characteristics

Participants had a median age of 18 years (IQR 18–19) and were predominantly married or cohabiting ($n = 203$, 81.5%), Christian ($n = 220$, 88.4%), urban-dwelling ($n = 135$, 54.2 %), had sexual debut at 17 years or less ($n = 187$, 75.1%) and educated to primary level or below ($n = 205$, 82.3%). Fewer than one in five reported ever using a modern contraceptive, excluding condoms ($n = 39$, 15.7%), and only 4.8% ($n = 12$) were aware of or had used HIV pre-exposure prophylaxis, while 4.0% ($n = 10$) acknowledged previous transactional sex (Table 1).

Obstetric characteristics

The participants were largely primigravid ($n = 205$, 82.3%), with a median gestational age of 38 weeks (IQR: 29–39). Almost two-thirds ($n = 157$, 63.1%) of the pregnant adolescents had attended ⩾4 antenatal visits, 71.5% ($n = 178$) booked for ANC in the first trimester, and 30.9% ($n = 77$) reported their pregnancy was unplanned (Table 2).

Prevalence of STIs

The overall prevalence of STI seropositivity was 12.1% (95 % CI: 8.3%–16.8%). HIV infection was frequent (8.8%), followed by syphilis (4.0); hepatitis B prevalence was lowest (0.4%) (Table 3).

Factors associated with STI seropositivity

On crude logistic-regression analyses, we identified higher odds of STI among pregnant adolescents who had ever used modern contraception, excluding condoms versus non-use of the modern contraceptives (OR: 4.74, 95 % CI: 2.06–10.92); knowledge or use PrEP versus lack of knowledge or non-use of PrEP (OR: 8.88, 95 % CI: 2.65–29.69); history of transactional sex versus none (OR 5.46, 95 % CI 1.45–20.63), and multigravidity versus prime gravidity (OR 2.72, 95 % CI 1.17–6.31) while participants who were married or cohabiting had lower odds of STI compared to those single or divorced (OR: 0.33, 95% CI: 0.14–0.75; Table 4).

In the Firth-penalised multivariable model adjusting for marital status, contraceptive use, PrEP knowledge/use, gravidity, gestational age and

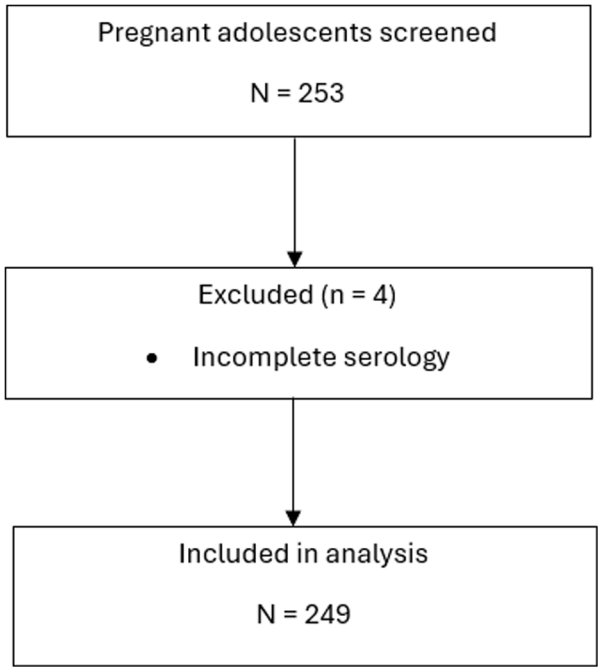


Figure 1. Study flow diagram.

transactional sex, three variables retained independent associations with STI. Being married or co-habiting was protective (adjusted OR: 0.37, 95 % CI: 0.14–0.96; $p = 0.040$), whereas ever use of modern contraception, excluding condoms (aOR: 3.04, 95 % CI: 1.10–8.45; $p = 0.033$) and multigravidity (aOR: 2.81, 95 % CI: 1.01–7.84; $p = 0.048$) were associated with increased odds of STI (Table 5).

Model performance

The final model showed good discrimination with an apparent area under the receiver-operating-characteristic (AUC) of 0.79 (95 % CI 0.70–0.88) (Figure S1, Supplemental Material). Calibration was acceptable: the calibration-in-the-large was 0, the calibration slope of 0.90 and observed proportions in each decile of the predicted probability closely followed the 45-degree reference line (Figure S2, Supplemental Material).

Sensitivity analysis

Re-fitting the final model with ordinary maximum-likelihood logistic regression produced odds ratios that differed by <10% from the Firth estimates (Table S2, Supplemental Material). Confidence intervals were slightly wider, and only the association with knowledge or prior use of PrEP crossed the 0.05 significance threshold. Because penalised likelihood yields bias-reduced coefficients and more stable standard errors in low events-per-parameter settings, the Firth model was retained as our primary analysis.

Discussion

Key results

In this hospital-based study of 249 pregnant adolescents, nearly one in eight was seropositive for any of the STIs, with HIV (8.8%), syphilis (4.0%) and hepatitis B (0.4%). Factors independently associated with STI seropositivity were ever use of modern contraception (excluding condoms) and multigravidity, while marriage/cohabitation reduced the odds of STI seropositivity by nearly two-thirds.

Comparison with other studies

Our composite prevalence of STIs is similar to those of prior studies in northwestern Ethiopia (15.2%)[33] and southern Ethiopia (14.6%)[24] but lower in a South African study (32%), reflecting the geographical burden in the different individual STIs included in each study. The individual STI prevalence exceed the pooled global estimates for pregnant women (HIV ≈ 3%, syphilis ≈ 5%, HBV ≈ 1%) reported in a 2023 meta-analysis,[5] underscoring the disproportionate burden borne by adolescents in low-income settings. The prevalence of syphilis (4%) is almost identical to the 5.9% observed among adult antenatal attendees in Kampala,[9] but the adolescent HIV prevalence (8.8%) is five-fold higher than the 1.7% recorded in the 2020–2021 UPHIA statistics for girls aged 15–19 years.[8] The hepatitis B prevalence in our study is markedly lower than the 3.1% HBsAg prevalence previously documented at the same hospital,[10] perhaps reflecting successful infant vaccination since 2002.

The factors associated with STI seropositivity are consistent with those described previously. Being unmarried/not cohabiting has been associated with STI diagnosis.[23,24] Positive association between ever use of non-condom modern contraceptive and STI agrees with findings from a meta-analysis that long-acting reversible contraception

Table 1. Socio-demographic and sexual-behavioural characteristics of pregnant adolescents, overall and by sexually transmitted infection status, $N = 249$.

STI					
Characteristics		***N* = 249** ***N* (%)**	**Negative** ***n* = 219** ***n* (%)**	**Positive** ***n* = 30** ***n* (%)**	***p*-value**
Age (years)	Median (IQR)	18 (18–19)	18 (18–19)	19 (17–19)	0.885[a]
	⩽17	44 (17.7)	36 (81.8)	8 (18.2)	0.168
	18–19	205 (82.3%)	183 (89.3)	22 (10.7)	
Residence	Rural	114 (45.8)	97 (90.4)	17 (14.9)	0.202
	Urban	135 (54.2)	122 (90.4)	13 (9.6)	
Marital status	Single/divorced	46 (18.5)	35 (76.1)	11 (23.9)	0.006
	Married/cohabiting	203 (81.5)	184 (90.6)	19 (9.4)	
Religion	Christian	220 (88.4)	193 (87.7)	27 (12.3)	0.764
	Moslem	29 (11.6)	26 (89.7)	3 (10.3)	
Education level	Primary or less	205 (82.3)	177 (86.3)	28 (13.7)	0.092
	Secondary/tertiary	44 (17.7)	42 (95.5)	2 (4.6)	
Occupation	Unemployed/dependent	104 (41.8)	88 (84.6)	16 (15.4)	0.171
	Working	145 (58.2)	131 (90.3)	14 (9.7)	
Monthly income tertile (UGX)[b]	<20,000	107 (43.0)	91 (85.1)	16 (15.0)	0.407
	20,000–<50,000	69 (27.7)	63 (91.3)	6 (8.7)	
	⩾50,000	68 (27.3)	61 (89.7)	7 (10.3)	
Age at sexual debut, coitarche (years)	Median (IQR)	17 (16–17)	17 (16–18)	16 (15–17)	0.001[a]
	⩽17	187 (75.1)	160 (85.6)	27 (14.4)	0.044
	18–19	62 (24.9)	59 (95.2)	3 (4.8)	
Number of sexual partners	Median (IQR)	1 (1–2)	1 (1–2)	1 (1–2)	0.485[a]
	1	149 (59.8)	129 (86.6)	20 (13.4)	0.416
	⩾2	100 (40.2)	90 (90.0)	10 (10.0)	
Partner concurrency	Median (IQR)	1 (1–2)	1 (1–2)	1 (1–2)	0.875[a]
	None	151 (60.6)	132 (87.4)	19 (12.6)	0.748
	⩾1	98 (39.4)	87 (88.8)	11 (11.2)	
Ever use of modern contraception[c]	No	210 (84.3)	192 (91.4)	18 (8.6)	<0.001
	Yes	39 (15.7)	27 (69.2)	12 (30.8)	
Knowledge and prior use of PrEP	No	237 (95.2)	213 (89.9)	24 (10.1)	<0.001
	Yes	12 (4.8)	6 (50.0)	6 (50.0)	

(Continued)

Table 1. (Continued)

STI					
Characteristics		***N*** **= 249** ***N*** **(%)**	**Negative** ***n*** **= 219** ***n*** **(%)**	**Positive** ***n*** **= 30** ***n*** **(%)**	***p*-value**
Type of marriage arrangement[b]	By parents	26 (10.4)	24 (92.3)	2 (7.7)	0.467
	By self	222 (89.2)	194 (87.4)	28 (12.6)	
Pregnancy partner identity[b]	Unknown partner	90 (36.3)	78 (86.7)	12 (13.3)	0.662
	Known partner	158 (63.7)	140 (88.6)	18 (11.4)	
History of transactional sex	Ever	10 (4.0)	6 (60.0)	4 (40.0)	0.006
	Never	239 (96.0)	213 (89.1)	26 (10.9)	

p-Values from tests: [a]Wilcoxon rank-sum test and the rest (unmarked) from the chi-squared test.
[b]Missing data: Monthly income tertile (5/249, 2.0%), type of marriage arrangement (1/249, 0.4%) and pregnancy partner identity (1/249, 0.4%).
[c]Ever use of modern contraception excludes the use of condoms (information on duration of use and adherence patterns was not collected in this study).
IQR, interquartile range; PrEP, pre-exposure prophylaxis; STI, sexually transmitted infection; UGX, Uganda shillings (1 United States $ = 3585 UGX as on 22 July 2025).

markedly reduces condom uptake and is linked to STI.[34] Literature rarely examines multigravidity as a determinant of STI in pregnant women. Most antenatal studies pool adolescents with older women, analyse single infections or treat gravidity merely as a demographic descriptor without entering it into multivariable models. Consequently, our finding that multigravidity independently increased the odds of STI is among the first to fill this evidence gap. It is important to note that comparator findings come from mixed-age studies, so our study is among the first to study STIs among pregnant adolescents.

Interpretation and public-health implications

The high HIV and syphilis prevalence in these pregnant adolescents suggests that pregnancy alone does not confer protection from sexual exposure and that current goal oriented antenatal packages, which may screen once for syphilis and HIV, may miss incident infections acquired later in gestation.[19] Ever use of hormonal contraception likely reflects earlier attempts at fertility control; once pregnant, condom negotiation power may further diminish, perpetuating exposure. Multigravidity signals repeated unprotected intercourse and possibly previous gaps in postpartum STI prevention.

Collectively, these findings support three programmatic priorities: Integrated re-testing, repeat HIV–syphilis dual testing every 3 months for all adolescents, with point-of-care treatment or antiretroviral optimisation[31]; enhanced counselling, emphasising dual-method contraception and partner testing for multigravidae and contraceptive users; and youth-friendly antenatal platforms, combining biomedical services with empowerment interventions that address relationship power dynamics and school re-enrolment.

Strengths and limitations

Strengths include age-specific focus, simultaneous assessment of three high-impact pathogens, quality-assured laboratory algorithms and use of Firth-penalised logistic regression to minimise small-sample bias. Limitations are inherent to the cross-sectional design (temporal ambiguity), single-centre sampling, which may under-represent peri-urban or non-attending adolescents, and limited power for rare outcomes such as hepatitis B. Behavioural variables were self-reported and subject to social-desirability bias, although confidential interviews and adolescent counsellors mitigated this risk. Additionally, there is a potential seasonal variation in the STI prevalence given the 3-month recruitment period. The definition of

Table 2. Obstetric characteristics of pregnant adolescents, overall and by STI status, *N* = 249.

STI					
Characteristics		***N* = 249 *N* (%)**	**Negative *n* = 219 *n* (%)**	**Positive *n* = 30 *n* (%)**	***p*-value**
Gravidity	Median (IQR)	1 (1–1)	1 (1–1)	1 (1–2)	0.009[a]
	Primigravida	205 (82.3)	185 (90.2)	20 (9.8)	0.016
	Multigravida	44 (17.7)	34 (77.3)	10 (22.7)	
Gestational age at interview (weeks)[b]	Median (IQR)	38 (29–39)	38 (30–40)	34 (28–39)	0.042[a]
	<37	101 (40.6)	84 (83.2)	17 (16.8)	0.037
	⩾37	147 (59.0)	135 (91.8)	12 (8.2)	
Number of ANC visits	Median (IQR)	4 (3–5)	4 (3–5)	3 (2–4)	0.095[a]
	<4	92 (36.9)	76 (82.6)	16 (17.4)	0.047
	⩾4	157 (63.1)	143 (91.1)	14 (8.9)	
Gestational age at ANC booking (weeks)	Median (IQR)	5 (4–14)	5 (4–14)	5 (4–17)	0.714[a]
	First trimester	178 (71.5)	156 (87.6)	22 (12.4)	0.811
	After the first trimester	71 (28.5)	63 (88.7)	8 (11.3)	
Pregnancy intendedness	Planned	172 (69.1)	153 (89.0)	19 (11.1)	0.468
	Unplanned	77 (30.9)	66 (85.7)	11 (14.3)	

p-Values from tests: [a]Wilcoxon rank-sum test and the rest (unmarked) from the chi-squared test.
[b]Missing data: Gestational age at interview (1/249, 0.4%).
ANC, antenatal care; IQR, interquartile range; SD, standard deviation; STI, sexually transmitted infection.

'ever' use of contraception did not capture duration or adherence, which may influence associations with STI risk. Also, we did not capture data on prior STI diagnosis or treatment history beyond HIV, which limited our ability to distinguish between new and recurrent infections. Finally, reliance on a prevalence estimate from Ethiopia for sample size determination may limit regional generalisability, although it balanced statistical power with feasibility in the given study context.

Table 3. Seroprevalence of individual STI and composite STI outcome, *N* = 249.

STI seropositivity	Positive (*n*)	Prevalence (%)	95 % CI
HIV	22	8.8	5.6–13.1
Hepatitis B	1	0.4	0.01–2.2
Syphilis	10	4.0	1.9–7.3
Any STI	30	12.1	8.3–16.8

CI, confidence interval; HIV, human immunodeficiency virus; STI, sexually transmitted infection.

Generalisability

Our study comprised consecutive pregnant adolescents attending antenatal or delivery care at Mbarara Regional Referral Hospital, a public tertiary unit serving 10 districts where >80% of births occur in facilities.[12] Consequently, estimates should apply to pregnant adolescents who reach public maternity services in rural and peri-urban south-western Uganda. Similar HIV/syphilis prevalence reported in Kampala and other East-African antenatal studies suggest broader relevance to high-burden settings.[9,24] Nonetheless,

Table 4. Univariable logistic regression for factors associated with STI.

Characteristics		Crude OR (95% CI)	*p*-value[a]
Age (years)	⩽17	1	0.173
	18–18	0.54 (0.22–1.31)	
Residence	Rural	1	0.205
	Urban	0.61 (0.28–1.31)	
Marital status	Single/divorced	1	0.008
	Married/cohabiting	0.33 (0.14–0.75)	
Religion	Christian	1	0.765
	Moslem	0.82 (0.23–2.91)	
Education level	Primary or less	1	0.110
	Secondary/tertiary	0.30 (0.07–1.31)	
Occupation	Unemployed/dependent	1	0.174
	Working	0.59 (0.27–1.26)	
Monthly income tertile (UGX)	<20,000	1	
	20,000–<50,000	0.54 (0.20–1.46)	0.226
	⩾50,000	0.65 (0.25–1.68)	0.376
Age at sexual debut (years)	⩽17	1	0.056
	18–19	0.30 (0.09–1.03)	
Number of sexual partners	1	1	0.418
	⩾2	0.72 (0.32–1.60)	
Partner concurrency	None	1	0.748
	⩾1	0.88 (0.40–1.94)	
Ever use of modern contraception[b]	No	1	<0.001
	Yes	4.74 (2.06–10.92)	
Knowledge and prior use of PrEP	No	1	<0.001
	Yes	8.88 (2.65–29.69)	
Type of marriage arrangement	By parents	1	0.472
	By self	1.73 (0.39–7.73)	
Pregnancy partner identity	Known partner	1	0.662
	Unknown partner	1.20 (0.53–2.68)	

(Continued)

Table 4. (Continued)

Characteristics		Crude OR (95% CI)	*p*-value[a]
History of transactional sex	Never	1	0.012
	Ever	5.46 (1.45–20.63)	
Gravidity	Primigravida	1	0.020
	Multigravida	2.72 (1.17–6.31)	
Number of ANC visits	<4	1	0.051
	⩾4	0.47 (0.22–1.00)	
Gestational age at ANC booking (weeks)	First trimester	1	0.811
	After the first trimester	0.90 (0.38–2.13)	
Pregnancy intendedness	Unplanned	1	0.469
	Planned	0.75 (0.34–1.65)	

[a]Wald test *p*-Values.
[b]Ever use of modern contraception excludes the use of condoms.
ANC, antenatal care; CI, confidence interval; OR, odds ratio; PrEP, pre-exposure prophylaxis; UGX, Uganda shillings (1 United States $ = 3585 UGX as on 22 July 2025).

Table 5. Adjusted odds ratios from Firth-penalised logistic regression models.

Characteristics		cOR (95% CI)	*p*-value[a]	aOR (95% CI)	*p*-value[a]
Age (years)	⩽17	1	0.173	1	0.361
	18–18	0.54 (0.22–1.31)		0.61 (0.21–1.75)	
Marital status	Single/divorced	1	0.008	1	0.040
	Married/cohabiting	0.33 (0.14–0.75)		0.37 (0.14–0.96)	
Education level	Primary or less	1	0.110	1	0.149
	Secondary/tertiary	0.30 (0.07–1.31)		0.35 (0.08–1.46)	
Occupation	Unemployed/dependent	1	0.174	1	0.190
	Working	0.59 (0.27–1.26)		0.53 (0.20–1.38)	
Age at sexual debut (years)	⩽17	1	0.056	1	0.391
	18–19	0.30 (0.09–1.03)		0.58 (0.17–2.01)	
Ever use of modern contraception[b]	No	1	<0.001	1	0.033
	Yes	4.74 (2.06–10.92)		3.04 (1.10–8.45)	

(Continued)

Table 5. (Continued)

Characteristics		cOR (95% CI)	*p*-value[a]	aOR (95% CI)	*p*-value[a]
Knowledge and prior use of PrEP	No	1	<0.001	1	0.051
	Yes	8.88 (2.65–29.69)		4.53 (0.99–20.63)	
History of transactional sex	Never	1	0.012	1	0.932
	Ever	5.46 (1.45–20.63)		1.09 (0.15–7.85)	
Gravidity	Primigravida	1	0.020	1	0.048
	Multigravida	2.72 (1.17–6.31)		2.81 (1.01–7.84)	
Number of ANC visits	<4	1	0.051	1	0.241
	⩾4	0.47 (0.22–1.00)		0.59 (0.25–1.42)	

[a]Wald test *p*-values.
[b]Ever use of modern contraception excludes the use of condoms.
ANC, antenatal care; CI, confidence interval; PrEP, pre-exposure prophylaxis; OR, odds ratio.

out-of-facility adolescents, primary-care sites without referral bias, and regions with markedly different pathogen epidemiology or screening policies were not sampled. In addition, reliance on a prevalence estimate from Ethiopia for sample size determination may constrain broader extrapolation. Finally, the 3-month recruitment window may have missed seasonal variation, further limiting generalisability. Results should therefore be generalised confidently to facility-attending pregnant adolescents in comparable East-African contexts but extrapolated with caution elsewhere.

Conclusion

Pregnancy does not insulate Ugandan adolescents from a syndemic of HIV and syphilis; nearly one in eight enter pregnant adolescent maternity wards infected, and modifiable behavioural and reproductive factors compound risk. Scaling up repeat integrated screening, reinforcing dual-method counselling, and targeting multigravidae could accelerate progress towards the World Health Organization 2030 elimination goals. Future studies should extend recruitment periods to capture seasonal variation, incorporate additional STIs such as gonorrhoea and chlamydia into testing panels, and better characterise contraceptive use patterns and prior STI treatment histories. Although vertical transmission was not assessed in the present study, it remains an important gap; such prospective approaches would allow evaluation of incident infections, vertical transmission and the effectiveness of adolescent-tailored interventions on maternal–neonatal outcomes.

Declarations

Ethics approval and consent to participate

The study protocol received ethical clearance from the Faculty of Medicine Research Committee and the Mbarara University of Science and Technology Research Ethics Committee (MUST-REC) (Ref No. MUST 09/05-17) and was subsequently registered with the Uganda National Council for Science and Technology (Ref. No. HS967ES). Administrative permission to conduct the work was granted by the Director of Mbarara Regional Referral Hospital. All procedures complied with the 2013 Declaration of Helsinki and relevant national guidelines. Written informed consent was obtained from every participant prior to enrolment. Participation was voluntary, and

participants could withdraw at any time without affecting the care they received. Confidentiality was safeguarded by replacing personal identifiers with unique study codes, storing the linkage file separately on password-protected computers with restricted access and keeping paper records in locked cabinets. Test results were delivered privately to the participant by a trained counsellor. Results were not shared with guardians or partners without the participant's permission, unless required for duty-of-care or safeguarding. Participants with reactive HIV or syphilis results (not yet on treatment) were linked to clinical care and assisted partner notification per national guidance. Partner referral slips were issued for testing and treatment. Participants HBsAg-positive were linked to clinical care, and partners were referred for HBsAg testing and vaccination as indicated. Expedited partner therapy was not available in this setting. Participants experiencing perinatal loss were referred for psychosocial counselling. All participants received health education and were offered a postpartum family-planning method of their choice.

Consent for publication

Not applicable: the manuscript does not include any individual-level images, videos or other personally identifying data.

Author contributions

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Competing interests

The authors declare that there is no conflict of interest.

Availability of data and materials

The de-identified datasets generated and analysed during the current study can be obtained from the corresponding author on reasonable request, in accordance with institutional and national data-sharing policies.

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Supplemental material
Supplemental material for this article is available online.

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