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Prevalence and Determinants of Composite Sexual and Reproductive Health Risk Behaviour Among Adolescents and Youth in Post-Conflict Tigray, Ethiopia: A Cross- Sectional Study

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Abstract

Background

Adolescents and youth in conflict-affected settings face elevated sexual and reproductive health (SRH) risks due to disrupted services, limited access to information, and increased vulnerability. Evidence from post-conflict northern Ethiopia remains scarce. This study assessed the prevalence of SRH risk behaviors and identified associated factors among adolescents and youth in Tigray following prolonged conflict-related health system disruption.

Methods

A cross-sectional analysis was conducted using data collected in 2025 from 5,004 in-school and out-of-school adolescents and youth aged 10–24 years across the 31 selected districts of Tigray. The primary analytical focus was a binary composite measure of sexual and reproductive health (SRH) risk behaviour. The prevalence of key SRH risk and protective behaviours was estimated. Multivariable logistic regression analyses were performed to identify factors associated with unprotected sex at last intercourse, early sexual debut, and multiple sexual partnerships. Results are presented as adjusted odds ratios (AORs) with corresponding 95% confidence intervals (CIs).

Results

Overall, 11.6% of participants reported ever having had sexual intercourse and 3.8% initiated sex before age 15. Among sexually active respondents, 11.6% reported unprotected sex at last intercourse and 2.9% reported multiple sexual partners. Condom use at last sex (2.9%), consistent condom use (3.7%), HIV testing uptake (10.6%), and SRH service utilization (< 1%) were low. Adolescents who had never been tested for HIV had higher odds of unprotected sex (AOR = 4.67; 95% CI: 2.07–10.53). Female sex (AOR = 0.37; 95% CI: 0.25–0.55) and rural residence (AOR = 0.54; 95% CI: 0.36–0.81) were associated with lower odds of multiple partnerships. Early sexual debut was associated with younger age (AOR = 1.99; 95% CI: 1.64–2.42) and lower education (AOR = 1.46; 95% CI: 1.03–2.08).

Conclusions

Despite relatively low sexual activity, adolescents and youth in Tigray face substantial SRH vulnerabilities characterized by unprotected sex, limited HIV testing, and extremely low service utilization. Strengthening HIV testing, expanding adolescent-friendly SRH services, improving access to condoms and contraception, and implementing conflict-sensitive interventions are critical to reducing SRH risks in post-conflict settings.

Introduction

Adolescence (10–19 years) and youth (15–24 years) are critical developmental stages characterized by rapid physical, psychological, and social transitions. During these stages, individuals form sexual identity, initiate intimate relationships, and begin independent health decision-making (1). Without adequate information, protection, and services, these transitions can increase vulnerability to sexual and reproductive health (SRH) risks (2). Globally, adolescents and young people continue to face substantial SRH challenges, including unintended pregnancy, unsafe abortion, HIV/STIs, and limited access to youth-friendly services, particularly in low- and middle-income and fragile settings. Consistent age definitions recommended by international agencies support comparability and program monitoring (1, 3). In Ethiopia, adolescents and youth constitute nearly one-third of the population, making their health central to national development (2, 4).

Ethiopia has introduced national strategies to improve adolescent and youth health (AYH), emphasizing equitable access to comprehensive, confidential, and adolescent-responsive SRH services (5, 6). These frameworks promote integrated delivery across health facilities, schools, communities, and humanitarian contexts, targeting barriers such as stigma, stock-outs, and limited confidentiality. However, implementation gaps persist, particularly in rural and conflict-affected regions such as Tigray.

Risk behaviours—including early sexual debut, unprotected intercourse, inconsistent condom use, multiple partnerships, and low contraceptive uptake—remain key contributors to adverse SRH outcomes (7, 8). Evidence from Ethiopia shows considerable levels of risky sexual behaviour among young people, with associations linked to gender, substance use, limited parental support, and inadequate SRH knowledge (9, 10).

Local evidence further supports these trends. In Mekelle, northern Ethiopia, 41% of preparatory school students reported ever having had sexual intercourse with more than half engaging in unprotected intercourse (11, 12). Similarly, a study conducted in Aksum among high school adolescents aged 15–19 years reported a risky sexual behaviour prevalence of 17.2%, with significant associations observed for limited family support, parental neglect, and alcohol use (13). Research from other Ethiopian universities and colleges also documents high levels of premarital sexual activity, inconsistent condom use, and low utilization of emergency contraception (14). Together, these findings indicate that although awareness of SRH may be improving, sustained behaviour change and consistent adoption of protective practices remain insufficient.

The context of Tigray presents additional challenges. Since 2020, armed conflict has disrupted health systems, supply chains, outreach programs, and schooling. Reports indicate reduced access to essential health and SRH services, increased displacement, and heightened vulnerability to sexual violence and socioeconomic stress (15–18). These disruptions likely increased unmet needs for contraception, HIV testing, and psychosocial support among adolescents and youth compared with more stable regions.

Despite these concerns, systematically analyzed, post-conflict data on adolescent and youth SRH behaviours in Tigray remain scarce. Previous studies have largely focused on urban or school-based populations and predate the recent conflict, limiting their relevance for current program planning (19, 20). The absence of updated, representative evidence constrains targeted interventions and alignment with national AYH priorities.

Against this backdrop, this study analyzed a large, integrated dataset of adolescents and youth (N = 5,004) in Tigray. The objective of the study was to assess the prevalence of SRH risk behaviours and identify associated factors among adolescents and youth in Tigray following prolonged conflict-related health system disruption. We hypothesized that SRH risk behaviours would remain prevalent and would be significantly associated with socio-demographic characteristics, SRH knowledge, and access to youth-friendly services. By generating updated, population-level evidence, the study aims to inform targeted adolescent and youth health interventions in post-conflict Tigray.

Methods

Study design

A quantitative survey with cross-sectional design was used to answer the objectives of the survey of sexual and reproductive health risk behaviors among adolescents and youths in Tigray. In school and out school adolescents and youths were included in the survey to assess the risky sexual behavior. Health facility data was also gathered from May 24 to June 24, 2025 from health facility viewpoints that ranges from health post to a specialized comprehensive specialized hospital.

Study Setting

The study was conducted in the Tigray Region of northern Ethiopia. Tigray is bordered by Eritrea to the north, Sudan to the west, the Amhara Region to the south, and the Afar Region to the east. Administratively, the region comprises 93 districts (woredas), including 36 urban and 57 rural districts, organized into seven zones: Mekelle, Eastern, Southern, South Eastern, North Western, Western, and Central zones.

The study was implemented in 31 selected districts (Weredas) across the region. The entire Western Zone, which consists of nine districts, as well as selected districts from the North Western, Central, and Eastern Zones, were excluded due to security concerns at the time of data collection. The geographic distribution of the study areas is illustrated in Fig. 1. Data were collected from 82 health facilities (health centers, primary hospitals, and general hospitals) to assess service readiness and availability.

The study setting is characterized by prolonged conflict and population displacement, conditions known to significantly influence adolescents' and youths' sexual and reproductive health risk behaviors. The target population comprised all adolescents and youth aged 10–24 years residing in the Tigray Region,

while the study population included in-school and out school adolescents and youth within the selected districts (21, 22). This age range aligns with the definitions of adolescence and youth adopted by the World Health Organization (WHO) and the Ethiopian Ministry of Health (5, 23).

Study variables

The main variable of interest for this cross-sectional study was sexual and reproductive health (SRH) risk behavior, conceptualized as a binary composite measure. An adolescent or youth was classified as having an SRH risk behavior if they reported at least one of the following: having multiple sexual partners in the past 12 months, early sexual debut (before age 15), ever having had sexual intercourse, inconsistent or non-use of condoms, never having tested for HIV, experiencing STI symptoms in the past 12 months, or lacking access to youth-friendly SRH services.

A range of explanatory variables, drawn from the survey instrument, were examined across five broad domains. Socio-demographic characteristics included age, sex, marital status, education, occupation, residence, ethnicity, and family size. Individual and behavioral factors encompassed substance use, detailed sexual history, HIV/STI testing, and contraceptive or abortion experience. Knowledge and attitudinal factors covered awareness of services, knowledge of various SRH topics, and attitudes toward services, marriage, and menstruation. Family and social factors assessed parent-adolescent communication and sources of SRH information. Finally, health service–related factors measured perceived access, utilization patterns, service readiness and availability, community mobilization, and menstrual hygiene management practices.

Sample size

This study was designed as a complete census of the target population. All eligible adolescents and youths residing in the 31 selected districts (Weredas) across the region during the study period were identified and invited to participate. A total of 5,004 individuals were enrolled, representing a full enumeration of the available study population. Consequently, no a priori sample size calculation was performed, as the study aims to describe the characteristics of this specific population rather than to infer to a larger one. Reported prevalence estimates are accompanied by 95% confidence intervals to quantify the precision of these point estimates based on the enumerated population (24).

Statistical analysis

Data were cleaned, coded, and analyzed using the Statistical Package for the Social Sciences (SPSS) version 25. Descriptive statistics were used to summarize socio-demographic characteristics and the distribution of all study variables, presented as frequencies and percentages (24). The primary analytical focus was on sexual and reproductive health (SRH) risk behavior, operationalized as a binary composite outcome. A participant was classified as having SRH risk behavior if they reported at least one of the

following: multiple sexual partners in the past 12 months, early sexual debut (< 15 years), ever having had sexual intercourse, inconsistent or non-use of condoms, never having tested for HIV, experiencing STI symptoms in the past 12 months, or lacking access to youth-friendly SRH services. The use of a composite indicator allows multidimensional risk constructs to be captured within a single binary outcome and is widely recommended in epidemiological and public health research when behaviors co-occur and jointly increase adverse health outcomes (25). The prevalence of this composite measure, along with its individual components, was estimated with 95% confidence intervals (CIs) for the total sample and key subgroups (24).

To identify factors associated with SRH risk behaviors, a two-step analytical approach was employed. First, bivariable analyses between each explanatory variable and the outcome were conducted using Chi-square tests (or Fisher's Exact test where appropriate). All variables from the five conceptual domains (socio-demographic, individual/behavioral, knowledge/attitudinal, family/social, and health service-related) with a bivariable association of $p < 0.25$ were selected as candidates for multivariable modeling, consistent with recommended purposeful variable selection strategies in regression modeling (26). Subsequently, binary logistic regression was used to determine independent predictors. Separate multivariable models were constructed for the composite SRH risk outcome and for key secondary outcomes, including unprotected sex at last intercourse and early sexual debut. A backward stepwise elimination procedure (likelihood ratio) was applied to retain only variables significant at $p < 0.05$ in the final models. Results are presented as adjusted odds ratios (AORs) with 95% CIs. Model fit was assessed using the Hosmer–Lemeshow goodness-of-fit test, and model-building procedures followed established principles for applied logistic regression (27). A sensitivity analysis was performed to assess the robustness of the composite outcome by testing an alternative definition that excluded "ever having had sexual intercourse" to avoid over-classification of all sexually active youth as at-risk (27).

Results

Sample characteristics

A total of 5,004 adolescents and youth (AY) participated in the survey, representing a 100% response rate, and all were included in the analysis. The median age was 17 years (IQR: 15–19), and just over half (51%) were female. By age group, 31% were 10–14 years, 51% were 15–19 years, and 18% were 20–24 years. Most participants (75%) were in school at the time of survey, while 9% reported displacement due to conflict or other reasons. The majority (60%) resided in rural areas, and nearly all (96%) had never been married, with only small proportions reporting current or past marriage (Table 1).

Table 1
Distribution of the study population by sex, age group, and key sociodemographic characteristics.

Age group (years)	Characteristics	Male (n)	Female (n)	Total (N)	Total (%)
	10–14	**772**	**783**	**1555**	**31**
	15–19	1193	1338	2531	51
	20–24	497	421	918	18
Marital status	Never married	2422	2376	4798	95.9
	Currently married	22	90	112	2.2
	Formerly married	18	76	94	1.9
Education status	Not attended school	135	141	276	5.5
	Read and write	71	86	157	3.1
	Primary	1300	1352	2652	53.0
	Secondary	956	963	1919	38.3
Residence	Urban	969	1052	2021	40.4
	Rural	1493	1490	2983	59.6
Main occupation	Student	1861	1875	3736	74.7
	Housewife	0	57	57	1.1
	Self-employed	46	72	118	2.4
	Merchant	33	55	88	1.8
	Government-employed	6	4	10	0.2
	Farmer	193	75	268	5.4
	Daily laborer	158	156	314	6.3
	Others	165	248	413	8.3
Ethnicity	Tigraway	2395	2473	4868	97.3
	Erob	57	61	118	2.4
	Afar	3	5	8	0.4

Prevalence of SRH risk behaviors

The prevalence of sexual and reproductive health (SRH) risk and protective behaviors is presented in Table 2. Overall, 11.6% of adolescents and youth reported ever having had sexual intercourse, with

sexual activity increasing markedly with age and remaining very low among those aged 10–14 years. Early sexual debut (before age 15) was uncommon but present. Multiple sexual partnerships in the past 12 months were reported by 2.9% of participants, slightly higher among males than females and concentrated in older age groups. Condom use was generally low: only 2.9% reported condom use at last sexual intercourse, and consistent condom use was reported by 3.7%, with higher proportions among males and older participants. HIV testing uptake was limited, with only 10.6% ever tested, while the majority had never been tested. Self-reported STI symptoms in the previous 12 months were rare (0.8%), and utilization of SRH services was extremely low, with less than 1% reporting access to services from any health facility type in the preceding year.

Table 2
Prevalence of key SRH risk and protective behaviors by sex and age, Tigray 2025

Behavior / Outcome		Overall (%)	Female (%)	Male (%)	10–14 yrs (%)	15–19 yrs (%)	20–24 yrs (%)
Ever had sexual intercourse		11.6	6.6	4.9	0.44	9.11	2.05
Multiple sexual partners (past 12 months)	Yes	2.9	1.1	1.8	0.02	0.90	1.98
	No	8.7	5.5	3.2	0.10	3.59	5.00
Condom use at last sex	Yes	2.9	0.9	1.9	0.00	0.95	1.95
	No	0.8	0.3	0.5	0.00	0.30	0.50
Consistent condom use	Yes	3.7	1.3	2.4	0.00	1.25	2.45
	No	7.9	5.4	2.5	0.12	3.25	4.53
Ever tested for HIV	Yes	10.6	6	4.6	0.88	4.17	5.55
	No	89.4	44.8	44.6	30.22	46.40	12.78
STI symptoms (past 12 months)	Yes	0.8	0.5	0.2	0.02	0.29	0.48
	No	99.2	50.3	49	31.05	50.29	17.86
Accessed SRH services	Healthcare	0.2	0.1	0.1	0.00	0.09	0.11
	Hospital	0.1	0.1	0	0.02	0.03	0.05
	Private clinic	0.2	0.1	0.1	0.00	0.07	0.13

The bar chart shows the proportion (%) of participants reporting selected SRH indicators in a cross-sectional survey of 5,004 adolescents and youth. Overall, 11.6% reported ever having had sexual intercourse, 3.8% initiated sexual activity before age 15, and 2.9% reported multiple sexual partners in the past 12 months. Protective behaviors were limited: condom use at last sex (2.9%), consistent condom use (3.7%), and ever testing for HIV (10.6%). Self-reported STI symptoms in the previous 12

months were rare (0.8%), and access to SRH services was extremely low (< 1%). Percentages are calculated from the total sample (Fig. 2).

SRH knowledge and access

Indicators of SRH knowledge and access further revealed substantial gaps. Only a small proportion of adolescents and youth had ever undergone HIV testing, and fewer than one in five knew where to obtain condoms or reported being able to access them when needed. Receipt of SRH counseling or information within the last 12 months was also limited. Overall, these findings indicate low engagement in protective SRH behaviors alongside significant barriers to SRH knowledge and service utilization, particularly among younger age groups.

Determinants of unprotected sex at last intercourse

Results from the bivariable and multivariable logistic regression analyses are presented in Table 3. In the crude analysis, adolescents and youth who had never been tested for HIV had significantly higher odds of reporting unprotected sex at last intercourse compared with those who had ever been tested (Crude OR = 3.71; 95% CI: 1.78–7.76; p < 0.001). This association remained strong and statistically significant after adjustment for age group, sex, educational level, place of residence, and multiple sexual partnerships (Adjusted OR = 4.67; 95% CI: 2.07–10.53; p < 0.001).

None of the other covariates demonstrated statistically significant associations with unprotected sex in either the crude or adjusted models. Age group, sex, educational attainment, residence, and reporting multiple sexual partners all showed adjusted odds ratios close to unity, with confidence intervals crossing one, indicating no independent association after controlling for potential confounders.

Table 3
Factors associated with unprotected sex at last sexual intercourse among adolescents and youth

Variable	Crude OR (95% CI)	p-value	Adjusted OR (95% CI)	p-value
Age group (15–19 vs 20–24)	1.002 (0.859, 1.168)	0.984	1.114 (0.937, 1.324)	0.220
Sex (Female vs Male)	0.727 (0.353, 1.496)	0.386	0.530 (0. 238, 1.181)	0.120
Education level (≤ Primary)	1.385 (0.887, 2.164)	0.152	1.397 (0.885, 2.203)	0.151
Residence (Rural vs Urban)	0.994 (0.492, 2.011)	0.988	0.813 (0.368,1.796)	0.608
Multiple partners (Yes/No)	0.665 (0.329, 1.343)	0.255	0.714 (0.334, 1.525)	0.384
HIV testing (Never vs Ever)	3.714 (1.779, 7.756)	0.000	4.673 (2.073, 10.532)	0.000

Determinants of multiple partnerships and early sexual debut

Results from the secondary multivariable logistic regression models are presented in Table 4. Distinct patterns of association were observed for multiple sexual partnerships and early sexual debut.

For multiple sexual partnerships, sex and place of residence emerged as significant predictors. Female participants were significantly less likely than males to report having multiple sexual partners (AOR = 0.37; 95% CI: 0.25–0.55; p < 0.001). Adolescents residing in rural areas also had lower odds of reporting multiple partnerships compared with their urban counterparts (AOR = 0.54; 95% CI: 0.36–0.81; p = 0.003). Age group, educational level, current living arrangement, and HIV testing status were not significantly associated with multiple partnerships in the adjusted model.

With respect to early sexual debut, age and educational attainment were the primary determinants. Adolescents aged 15–19 years had nearly twice the odds of initiating sexual activity before the age of 15 compared to those aged 20–24 years (AOR = 1.99; 95% CI: 1.64–2.42; p < 0.001). Participants with lower educational attainment were also more likely to report early sexual debut (AOR = 1.46; 95% CI: 1.03–2.08; p = 0.036). Sex, residence, current living arrangement, and HIV testing status did not show statistically significant associations with early sexual debut.

Table 4
Determinants of Multiple Partnerships and Early Sexual Debut (Secondary Models)

Variable	Outcome 1: Multiple Partnerships		Outcome 2: Early Sexual Debut	
	AOR (95% CI)	p-value	AOR (95% CI)	p-value
Age group (15–19 vs 20–24)	0.943, (0.862, 1.032)	0.202	1.994 (1.643, 2.420)	0.000
Sex (Female vs Male)	0.367 (0.246, 0.549)	0.000	1.511 (0.761, 3.000)	0.238
Education level (≤ 15)	1.013 (0.793, 1.295)	0.915	1.461 (1.025, 2.082)	0.036
Residence (Rural vs Urban)	0.541 (0.361, 0.811)	0.003	0.831 (0.424, 1.627)	0.588
Current living arrangement	0.981 (0.956, 1.006)	0.127	0.994 (0.950, 1.040)	0.798
HIV testing (Never vs Ever)	0.853 (0.567, 1.283)	0.445	0.605 (0.305, 1.197)	0.149

Sensitivity analysis

Sensitivity analyses were conducted to assess the robustness of the primary regression findings given the low prevalence of sexual activity and protective behaviors observed in the study population. First, the multivariable logistic regression model for unprotected sex at last intercourse was re-estimated using alternative outcome definitions. Specifically, unprotected sex was redefined as (i) non-use of a condom at last sexual intercourse only, and (ii) non-use of any modern contraceptive method among sexually active participants. Across these alternative specifications, the direction and magnitude of the association between HIV testing status and unprotected sex remained consistent, with adolescents and youth who had never been tested for HIV continuing to demonstrate substantially higher odds of

unprotected sexual intercourse. No additional covariates emerged as statistically significant predictors in these models.

In addition, given the very low levels of sexual activity among younger adolescents, sensitivity analyses restricting the sample to sexually active participants aged 15–24 years were performed. The results were comparable to those of the main analysis, with HIV testing status remaining the sole robust determinant of unprotected sex. Similarly, sensitivity analyses for the secondary outcomes—multiple sexual partnerships and early sexual debut—did not materially alter the pattern of associations observed in the primary models.

Overall, these findings indicate that the main results are not driven by outcome definition, sample composition, or sparse event counts, and support the robustness of the reported associations.

Discussion

This study provides one of the first large-scale, population-based insights into the sexual and reproductive health (SRH) behaviors of adolescents and youth in the severe post-conflict context of Tigray, Ethiopia. Our analysis of 5,004 participants reveals a critical paradox: while reported ever having had sexual intercourse was relatively low (11.6%), those who were sexually active faced profound vulnerabilities. Unprotected sex at last intercourse was common, and the prevalence of protective behaviors—including consistent condom use (3.7%), HIV testing (10.6%), and SRH service utilization (< 1%)—was alarmingly deficient. Similar patterns of low condom use and limited uptake of HIV testing among adolescents in sub-Saharan Africa have been documented in recent multi-country analyses, particularly in fragile and humanitarian settings, where service disruption and structural barriers compound risk (28).

The strongest and most consistent finding was that never having been tested for HIV was associated with a more than four-fold increase in the odds of unprotected sex. These results underscore the urgent need for targeted, conflict-sensitive interventions to bridge the gap between sexual activity and the uptake of essential SRH

The strongest and most consistent finding was that never having been tested for HIV was associated with a more than four-fold increase in the odds of unprotected sex. This aligns with recent evidence demonstrating that engagement in HIV testing is strongly correlated with safer sexual practices, including condom use and linkage to preventive services, underscoring testing as both a diagnostic and behavioral gateway intervention[2]. In post-conflict settings, disruption of health systems, displacement, and reduced access to youth-friendly services further exacerbate these vulnerabilities, widening the gap between sexual activity and the uptake of essential SRH services (29, 30). These results underscore the urgent need for targeted, conflict-sensitive interventions to strengthen HIV testing outreach, condom accessibility, and adolescent-responsive SRH services in Tigray.

Our findings resonate with, yet also diverge from, the broader body of evidence on adolescent SRH in Ethiopia and sub-Saharan Africa. The low level of ever having had sex (11.6%) is comparable to national estimates from the Ethiopia Demographic and Health Survey (EDHS) for never-married youth (10, 31), suggesting that social norms around sexual debut may be relatively stable even in crisis. However, the levels of risky behavior among sexually active youth in our study are stark.

The high prevalence of unprotected sex and low condom use align with a meta-analysis of Ethiopian higher education students, which found that inconsistent condom use was the most common risky behavior, with over 40% of sexually active students engaging in it (34). Similarly, our finding linking lower education to early sexual debut corroborates a systematic review identifying poor parental monitoring and low SRH knowledge—often correlated with limited education—as key drivers of early sexual initiation in Ethiopia (10).

In the immediate post-conflict setting of Tigray, the vulnerabilities are more pronounced. Prior local studies in Mekelle and Aksum reported higher rates of sexual activity but identified similar determinants of risk, such as limited knowledge and weak social support (13). The much lower service utilization in our study (< 1% accessed SRH services) compared to pre-conflict levels likely reflects the devastating impact of the war on the health system, including the destruction of health facilities, stock-outs of commodities, and displacement of health workers (19, 20). This disruption appears to have created a "perfect storm," where the legacy of pre-existing risks is compounded by the collapse of the very systems designed to mitigate them.

The strong, independent association between never having tested for HIV and unprotected sex (AOR = 4.67) is a pivotal finding. Recent global evidence indicates that adolescents and young people who utilize HIV testing services are significantly more likely to adopt protective sexual behaviors, including condom use and linkage to prevention programs, particularly when testing is integrated with counseling and youth-friendly services (32). This supports the interpretation that HIV testing functions not merely as a diagnostic activity but as a behavioral intervention platform that facilitates risk perception, knowledge acquisition, and preventive action. In humanitarian and fragile settings, where service disruption limits routine access to care, strengthening HIV testing delivery has been identified as a high-impact entry point for broader SRH engagement (32).

In contrast to national survey findings from Ethiopia, where urban residence is frequently associated with higher odds of multiple partnerships and greater exposure to sexual risk environments, our study found that rural youth were less likely to report multiple partners (33). Recent analyses of adolescent sexual risk patterns in sub-Saharan Africa demonstrate that contextual instability—including conflict, displacement, and social network disruption—can significantly reshape traditional urban–rural differentials in sexual behavior (33, 34). In post-conflict settings, mobility restrictions, economic hardship, altered peer networks, and reinforced conservative norms may modify risk structures in ways not observed under stable conditions (35). These dynamics may partially explain the divergence from

pre-conflict national patterns and underscore the importance of context-sensitive interpretation of behavioral data.

Implications for policy and practice

These findings underscore several priorities. First, ensuring reliable access to condoms and modern contraceptives through fixed, mobile, and outreach services is critical in conflict-affected and displaced communities, consistent with recent global guidance emphasizing continuity of adolescent contraceptive services in fragile and humanitarian settings (32). Second, gaps in knowledge and early sexual initiation highlight the need for age-appropriate, culturally sensitive comprehensive sexuality education that emphasizes negotiation skills and correct condom use, as reinforced by updated international technical guidance on comprehensive sexuality education and adolescent well-being (36). Third, structural barriers—including stigma, confidentiality concerns, and inconvenient service hours—must be addressed through adolescent-friendly service models, in line with current WHO recommendations on quality standards for adolescent-responsive health services (32). Fourth, HIV testing and counseling should be integrated across all AY SRH entry points, given its strong association with protective behaviours. Finally, humanitarian-adapted SRH service packages remain essential to mitigate unintended pregnancies, HIV/STI transmission, and gender-based violence in post-conflict settings, particularly under the 2022–2030 global strategies framework that prioritizes integrated HIV and SRH service delivery for adolescents and young people (32).

Strengths and limitations

This study has several strengths, including its large sample size, its focus on a hard-to-reach post-conflict population, and its use of a composite SRH risk measure aligned with national indicators. The sensitivity analyses reinforce the robustness of our primary findings (33). However, the findings must be interpreted in light of important limitations. First, the cross-sectional design precludes any causal inference. The association between HIV testing and unprotected sex, for example, cannot establish temporality. Second, data on sexual behavior are self-reported and subject to social desirability and recall bias, which may have led to underreporting of sensitive behaviors like early debut or multiple partners, particularly among females and younger adolescents. Third, the study was conducted in a post-conflict setting with ongoing insecurity, and while we sampled widely, some of the most severely affected and hard-to-reach districts were excluded, meaning our findings may not be fully representative of the entire region's most vulnerable youth. Finally, despite sensitivity analyses, unmeasured confounding (e.g., detailed measures of household wealth, exposure to sexual violence, or mental health status) could influence the observed associations.

This study has several strengths, including its large sample size, its focus on a hard-to-reach post-conflict population, and its use of a composite SRH risk measure aligned with national indicators. The sensitivity analyses reinforce the robustness of our primary findings. However, the findings must be interpreted in light of important limitations.

First, the cross-sectional design precludes any causal inference. The association between HIV testing and unprotected sex, for example, cannot establish temporality, a well-recognized limitation of cross-sectional epidemiological studies in sexual and reproductive health research (37). Second, data on sexual behavior are self-reported and subject to social desirability and recall bias, which may have led to underreporting of sensitive behaviors like early debut or multiple partners, particularly among females and younger adolescents. Such reporting biases in adolescent SRH surveys are extensively documented, especially in contexts characterized by stigma and restrictive social norms (38).

Third, the study was conducted in a post-conflict setting with ongoing insecurity, and while we sampled widely, some of the most severely affected and hard-to-reach districts were excluded, meaning our findings may not be fully representative of the entire region's most vulnerable youth. Finally, despite sensitivity analyses, unmeasured confounding (e.g., detailed measures of household wealth, exposure to sexual violence, or mental health status) could influence the observed associations, as residual confounding remains a persistent challenge in observational SRH research in humanitarian settings (37).

Conclusions

In conclusion, this study provides robust evidence that adolescents and youth in post-conflict Tigray face an "implementation gap" between their SRH needs and their access to life-saving services. Despite relatively low levels of sexual activity, those who are sexually active are doing so with minimal protection and virtually no engagement with the health system. HIV testing emerges as a critical, modifiable factor associated with safer behavior. For policymakers and humanitarian actors, the path forward is clear: reconstructing adolescent-friendly SRH services, ensuring a reliable supply of commodities, and using HIV testing as a gateway for broader engagement are not just health priorities but essential interventions for safeguarding the future of a generation devastated by conflict.

Declarations

Ethics approval and consent to participate

Ethical clearance was obtained from the Institutional Review Board (IRB) of the Tigray Health Research Institute (THRI), Mekelle, Ethiopia (Reference No.: 001/77/2025). The study was conducted in accordance with the Declaration of Helsinki and relevant national and international ethical guidelines for research involving human participants (39).

For in-school adolescents, the informed consent and assent procedures were implemented in coordination with school administrations and local education authorities. Information sheets and parental consent forms were distributed through the schools prior to data collection. Community sensitization was conducted where appropriate.

Written informed consent was obtained from parents or legal guardians for participants under 18 years of age, and written assent was obtained from the adolescents. Participants aged 18 years and above

provided their own written informed consent.

Participants were informed about the study objectives, procedures, potential risks, and anticipated benefits. Participation was voluntary, confidentiality was strictly maintained, and participants were informed of their right to withdraw at any time without academic or other consequences (39, 40).

Consent for publication

Not applicable. The manuscript does not contain any individual-level identifying information, images, or personal data requiring separate consent for publication.

Availability of data and materials

The datasets generated and/or analyzed during the current study are available from the corresponding author on reasonable request, subject to ethical approval and data-sharing regulations of the Tigray Health Research Institute.

Competing interests

The authors declare that they have no competing interests.

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Authors' contributions

Degnesh Negash Zigta contributed to the conceptualization and design of the study, data interpretation, and the drafting of the initial manuscript. Data collection was performed collaboratively by all authors. Brhane Ayele conducted data acquisition and analysis. Afewerki Tesfahunegn critically revised and edited the manuscript for important intellectual content. All authors reviewed and approved the final version of the manuscript and agree to be accountable for all aspects of the work.

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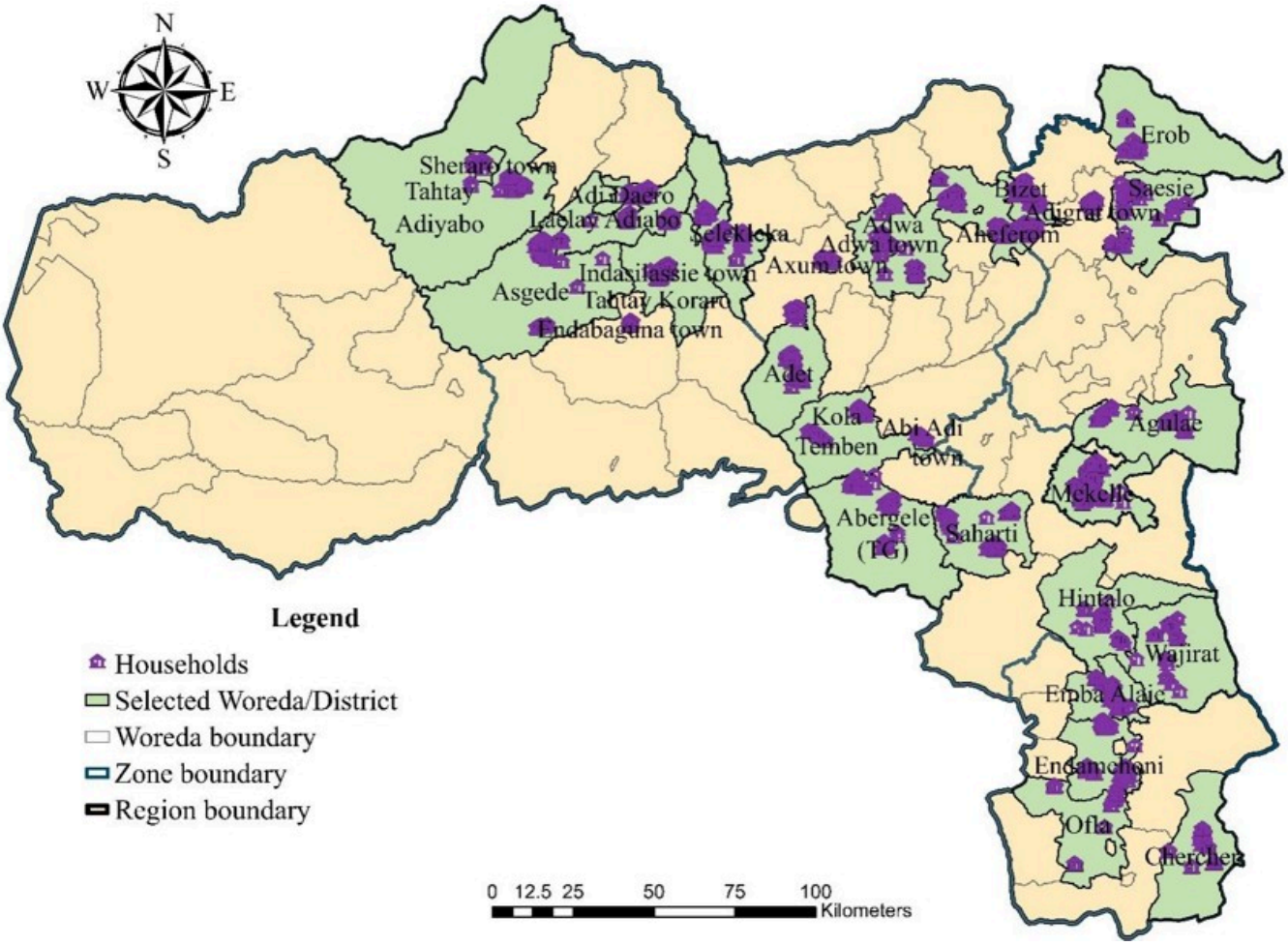
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Figures



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Figure 1

Map of study areas assessing SRH risk behaviors among adolescents and youth in Tigray

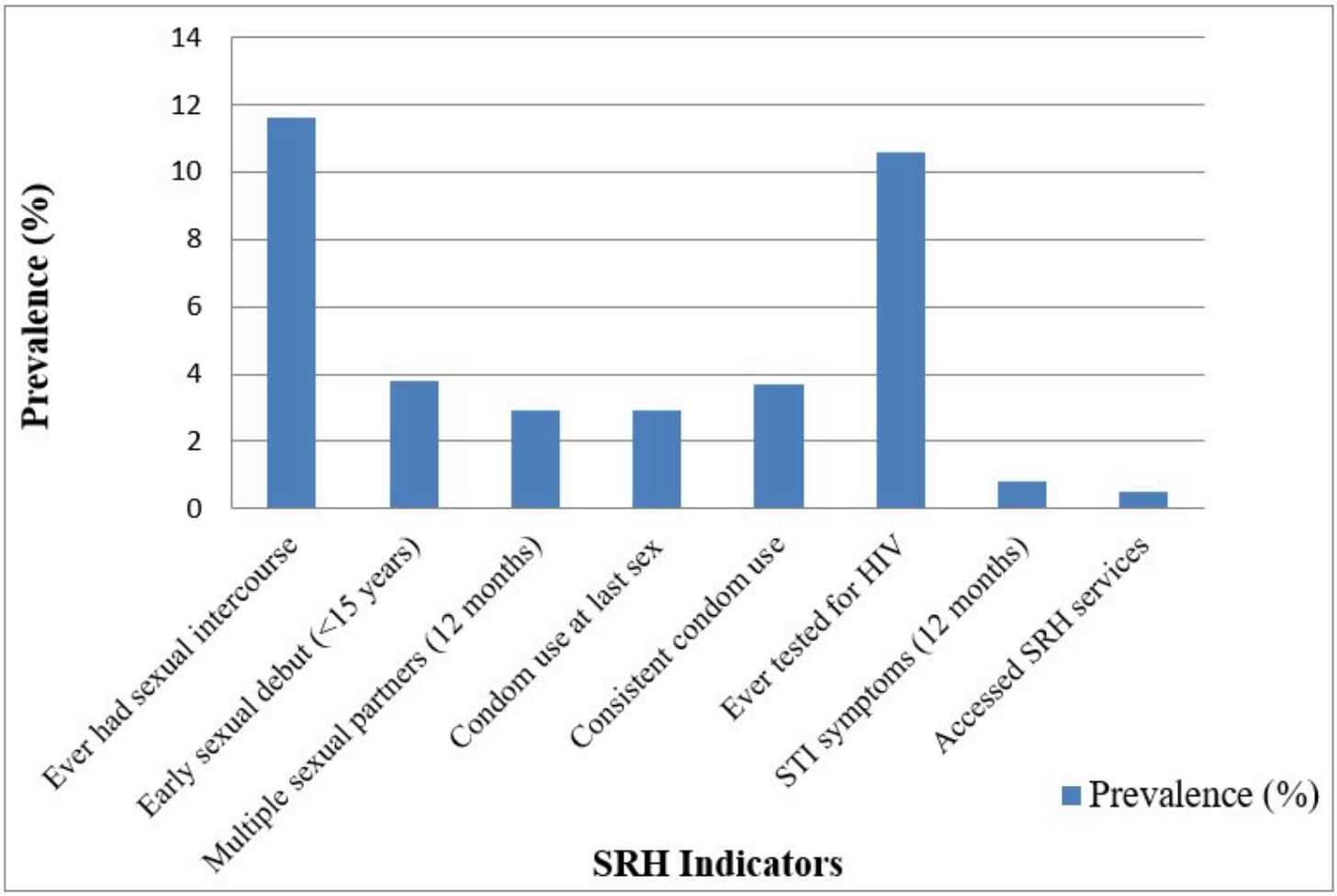


Figure 2

Prevalence of key SRH risk and protective behaviors among youth, Tigray 2025

Supplementary Files

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- Appendix.docx