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Correlates of HIV infection in adolescent girls and young women in Lesotho: results from a population-based survey

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AL, KT, SMcC, HP, BP, AS, and KF designed the study. AL, KT, SD, JM, MK, PR, NA, AS, and KF designed the data collection tools. AL, JM, and KF did the statistical analysis. AL took primary responsibility for writing the manuscript. All authors contributed to data analysis and interpretation and to the writing and review of the manuscript.

Declaration of interests

We declare no competing interests.

Data sharing

Deidentified participant data and study documents will be made publicly available with publication of the LePHIA final report.

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Summary

Background—HIV acquisition remains high among adolescent girls and young women (AGYW, aged 15–24 years) in sub-Saharan Africa. We aimed to estimate prevalence and incidence of HIV in AGYW and to identify correlates of HIV infection by using data from the Lesotho Population-based HIV Impact Assessment (LePHIA).

Methods—LePHIA was a nationally representative survey of adults and children based on a multistage cluster sampling method with random selection of enumeration areas and households. All adults aged 15 years and older who had slept in the household the night before were eligible for participation; participants completed an interview and HIV testing. We estimated incidence with the HIV-1 limiting antigen avidity enzyme immunoassay combined with viral load and examined the association between demographic and behavioural variables (including characteristics of cohabitating mothers and sexual partners, when available) and prevalence and incidence among AGYW using logistic regression, incorporating survey weights.

Findings—We interviewed 8824 households, including 2358 AGYW who were tested for HIV infection. Weighted HIV prevalence was 11·1% (95% CI 9·7–12·5) in the overall population (273 of 2358 AGYW), 5–7% (4·1–7·2) in adolescent girls aged 15–19 years (64 of 1156), and 16·7% (14·4—19·0) in women aged 20–24 years (209 of 1212). Annualised HIV incidence was 1–8% (0·8–2·8). Correlates of prevalent infection include reporting a history of anal sex (adjusted odds ratio [aOR] 3·08, 1·11–8·57), having lived outside Lesotho in the past year (1·86, 1·01–3·42), having a partner suspected or known to be HIV positive (11·7, 6·0–22·5), and having two or more lifetime sexual partners (1·84, 1·21–2·78, for 2–3 lifetime sexual partners; 2·44, 1·45–4·08, for ≥4 lifetime sexual partners). For the 570 AGYW living with their mothers, maternal education was negatively associated with HIV prevalence in their daughters (aOR 0·36, 0·15–0·82, per increase in level attended). For AGYW with a cohabitating partner, the factors associated with AGYW infection were partner age (OR 4·54, 1·30–15·80, for partners aged 35–49 years, although the OR was no longer significant when adjusted for HIV status of partner), HIV status (aOR 11·22, 4·05–31·05), lack of viral load suppression (OR 0·16, 0·04–0·66), and partner employment in the past year (aOR 3·41, 1·12–10·42).

Interpretation—The findings confirm the importance of improving the treatment cascade in male partners and targeting preventive interventions to AGYW who are at increased risk. A

regional approach to prevention could mitigate the effect of migration on transnational spread of HIV.

Introduction

Despite substantial progress in epidemic control of HIV in sub-Saharan Africa, HIV acquisition remains high among adolescent girls and young women (AGYW) aged 15–24 years.[1] This early acquisition of HIV is a result of both biological susceptibility, based on increased risk of perturbations of the vaginal microbiome and an inflammatory milieu,[1–3] and social vulnerability as AGYW transition to adulthood,[4] with the attendant disruption as they leave home and enter employment, marriage, and sexual debut.[5,6] The high rates of infection in young women have serious implications in terms of individual health as well as lifetime risk of vertical and sexual transmission, particularly in a region where much of the population is younger than 18 years.[7] To achieve the UNAIDS goal of reducing global infections among AGYW to less than 100 000 per year, the President's Emergency Program for AIDS Relief has designed a core package, the DREAMS intervention (Determined, Resilient, Empowered, AIDS-free, Mentored, and Safe Women), to address multiple levels of risk, including gender inequality, lack of access to education, and poverty.[1,8] The aim, as articulated in 2015, was to reduce incidence by 40% in AGYW by 2017, by use of a focused approach in targeted districts in sub-Saharan African countries with high rates of infection.[8]

Effective response to the HIV epidemic requires comprehensive information regarding factors that put young people at risk for HIV infection. Previous population-based surveys have identified various risk factors in AGYW, such as early sexual debut, but have not included measures of infection in the previous 12 months.[9] Other data on risk factors in this population are derived from observational studies based on convenience samples. These studies often recruit populations at high risk for HIV and thus might not offer an accurate snapshot of risk among the overall population of AGYW.[5] Thus, although studies to date have identified multiple factors that contribute to HIV acquisition in AGYW, some are based on select populations that differ substantially between studies,[10] requiring different programmatic strategies for prevention.[11]

Lesotho, a small country in southern Africa, has a severe HIV epidemic with the second highest HIV prevalence globally.[12] The Lesotho Population-based HIV Impact Assessment (LePHIA) was a national survey designed to measure HIV-related parameters including prevalence, incidence, and viral load suppression. LePHIA provides a unique opportunity to estimate risk factors among a population-based sample of AGYW in Lesotho, a subset of the overall population recruited for the survey. This analysis was therefore done to estimate See Online for appendix prevalence and incidence of HIV in AGYW and identify correlates of HIV infection.

Methods

Study design and participants

Investigators did the LePHIA survey between November, 2016, and May, 2017, using a two-stage sampling design to select a nationally representative sample of adults and children

aged 0–59 years in 418 enumeration areas. Consenting heads of households completed a household questionnaire and provided details of all household members, who then separately consented to participate in an interview on sociodemographic and behavioural factors and to home-based HIV testing. A guardian or parent provided permission for interviewers to approach children aged 10–17 years, who were then asked for assent for all procedures. Written informed consent or assent was documented via electronic signature, with witnesses verifying consent for illiterate individuals. The LePHIA protocol and data collection tools were approved by the Lesotho Research and Ethics Committee, and the institutional review boards at Columbia University Medical Center and the US Centers for Disease Control and Prevention (CDC).

Procedures

Survey staff administered the questionnaire to participants aged 15–59 years during face-to-face interviews in a private area using Google Nexus 9 tablets. The questionnaire included questions on lifetime and recent sexual behaviours and on characteristics of the three most recent sexual partners from the past year (appendix pp 1–2). HIV knowledge indicators were drawn from the Demographic and Health Surveys (appendix p 2).[13] Recent migration was defined as having lived outside Lesotho for more than 1 month in the past year. Any AGYW younger than 18 years who reported being sexually exploited was referred to support services for counselling and further management.

Survey nurses tested participants for HIV using Determine HIV-1/2 Rapid Tests (Alere Inc, Chiba-ken, Japan), confirmed with Uni-Gold HIV Tests (Trinity Biotech, Wicklow, Ireland). They provided counselling, with referral to a preferred facility for those who tested seropositive. Laboratory staff verified all HIV-positive results using the Geenius HIV-1/2 supplemental assay (Bio-Rad, Hercules, CA, USA), and measured HIV-1 RNA in plasma and dried blood spots using real-time PCR (Cobas Taqman, Roche, Indianopolis, IN, USA). Staff used the HIV-1 limited antigen (LAg) avidity enzyme immunoassay (Sedia Biosciences, Portland, OR, USA) to classify HIV-positive samples. Samples that had a normalised optical density less than 1–5 and that were not virally suppressed (ie, with HIV RNA concentration >1000 copies per mL) were classified as recent infection (infected within the past 130 days [95% CI 118–142]).[14] We calculated annualised incidence estimates using the CDC incidence calculator.[15]

Statistical analysis

The survey was powered to achieve precision with a relative SE of 30% around a national annualised estimate of HIV incidence in AGYW predicted at 1·85% based on UNAIDS estimates in 2014 (appendix p 1).

We calculated design weights on the basis of sampling design, including probabilities of household and individual selection adjusted for non-response at the house-hold, individual, and biomarker levels using SI-CHAID 4.0 program (appendix p 3). We compared female adolescents aged 15–19 years and young women aged 20–24 years and used LePHIA survey data from young men aged 15–24 years for comparison for key sexual behaviours. We made comparisons using χ^2 analysis for proportions and *t* tests for continuous outcomes, and did

all analyses in Stata version 15.1 using weighted data, with jackknife replicate weights for variance estimation. All presented percentages are weighted.

We analysed factors associated with HIV prevalence or incidence in AGYW using logistic regression, and built a multivariable model including all variables with a p value less than 0·10 in univariable analysis, with urban or rural residence included a priori. In a separate analysis of parental characteristics associated with HIV infection in a cohabitating daughter, we identified parents using the household roster (appendix p 2). We created regression models using the same methodology as for all AGYW, with household wealth quintile and maternal marital status included a priori and, similarly, when data were captured on a cohabitating sexual partner (appendix pp 2–3), with the partner's education and migration status included a priori, to determine the association of parental and partner factors to AGYW's HIV status.

We generated an HIV prevalence map with the package prevR in R version 3.4.2 using georeferenced HIV testing data from enrolled AGYW, with all cases linked to the centroid of the selected enumeration area, using kernel density smoothing and interpolation over 200 participants for each smoothing circle.[16,17] We constructed the density of infection map using gridded population density data for 2015 from the AfriPop project for women of reproductive age, adjusted for the estimated proportion of women aged 15–24 years on the basis of 2016 Lesotho census data. We combined the prevalence map and AGYW density map using raster multiplication in ArcGIS 10.2 to generate the number of HIV-positive AGYW per km^2.

Role of the funding source

The funder of the study participated in study design, data collection, data analysis, data interpretation, and writing of the report. All authors except NF had full access to all the data in the study and the corresponding author had final responsibility for the decision to submit for publication.

Results

Of 10 887 target households we enrolled 9403 (86%) and of 2708 eligible AGYW we interviewed and tested 2358 (87%; figure 1). There were no differences between interview respondents and non-respondents in terms of geographical location or age. The mean age among AGYW was 19·4 years (SD 2·9) and 1434 (58%) of the respondents resided in rural areas, 294 (12%) had lived outside Lesotho for longer than a month at any time of their lives, 1765 (76%) had attended secondary or higher education, and 998 (40%) were unemployed and not attending school. There was no difference in the proportion of young women aged 15–19 years and aged 20–24 years who had sexual debut before 15 years of age. Women aged 20–24 years were significantly more likely to have lived outside Lesotho for more than a month in the past year ($p<0·0001$), be sexually active ($p<0·0001$), be married ($p<0·0001$), and be parous ($p<0·0001$) than those aged 15–19 years. Among all AGYW who reported sexual activity in the past year, 41% reported being in an age-disparate relationship (partner >5 years older), and 11% reported having an intergenerational partner (≥10 years older); the mean reported age of partners was 25·1 years (SD 5·1). Condom use was

significantly lower in women with intergenerational partners, particularly for those aged 15–19 years (p<0·001). 82% of participants reported previous HIV testing, but only 31% had comprehensive HIV knowledge (table 1).

HIV prevalence among AGYW was 11·1% (95% CI 9·7–12·5) overall (273 of 2358 AGYW), 5·7% (4·1–7·2) in those aged 15–19 years (64 of 1156), and 16·7% (14·4–19·0) in those aged 20–24 years (209 of 1202). Prevalence was 6 2% (3 9–8·4) in adolescents aged 15–17 years (40 of 694), and there was a sharp rise in prevalence occurring between 18–19 years (4·9%, 2 9–7-0; 24 of 462) and 23–24 years (19·9%, 16· 0–23·8; 98 of 470; figure 2). 172 (61 4%, 55 2–67·7) of 271 HIV-positive AGYW for whom we had both viral load and awareness data reported having been previously diagnosed, but only 141 (50·9%, 44 8–57 1) of all 272 HIV-positive AGYW were virally suppressed. Prevalence was lowest at 7 2% (2 5–11 9; 12 of 143) in the northern district of Butha-Buthe, and was lower than in the capital district, Maseru (13 2%, 10·3–16·1; 78 of 569), with prevalence highest in the lowlands of the country (figure 3A, appendix p 4). This translated into 5862 HIV-positive female adolescents aged 15–19 years and 16 707 HIV-positive women aged 20–24 years in the country, mostly concentrated in urban areas (figure 3B). Visually, high prevalence appears to map onto some transport routes and areas near border crossings (we did no formal statistical testing). Annualised estimated incidence was 1·8% (0· 8–2·8). Estimated incidence in rural areas was lower (1 3%, 0·2–2·4) than in urban areas (2 3%, 0·7–3·9), although the difference was not significant. Most new infections were observed in older AGYW (appendix p 5).

Of 2159 eligible young men aged 15–24 years, 1690 (78%) were interviewed and tested for HIV. Their mean age was 19 3 years (SD 3 4) and 65% resided in rural areas (1140 of 1690; appendix p 6). HIV prevalence was 3 4% (95% CI 2·6–4·2; 58 of 1690) and incidence was 0·1% (0–0·4), and there was not a significant difference in prevalence between young men aged 15–17 years (3· 4%, 1·7–4·4; 18 of 593) and 23–24 years (5· 1%, 2·2–8·0; 14 of 291; figure 2). The mean age of sexual debut for young men was significantly lower than in AGYW (15·6 years [15 ·4—15 7] for men *vs* 17·2 years [17·0–17·3] for women; p<0·0001), their mean number of lifetime sexual partners was significantly higher (5·2 [4·7–5·8] *vs* 25 [2· 3–2· 7]; p<0·0001), more of them reported having sex without a condom with someone with unknown HIV status (744% [71·4–77· 4] *vs* 46·9% [43 ·9–49·8]; p<0·0001), and the average age of their partners was significantly lower (18·9 years [SD 7·2; 18·8–19 1] *vs* 25 1 years [5 4; 24·9–25 4]; p<0·0001).

In the univariable model for AGYW, having an intergenerational partner (odds ratio [OR]) 1·85, 95% CI 1·19–2·87), being married (2 35, 1·79–3·09) or divorced or widowed 43, 3·07–9·61), reporting an early sexual debut (2·28, 1·31–3·98), or reporting a history of commercial sex (2 15, 1·04–4·44), were associated with prevalent HIV infection. In the multivariable model, these effects were no longer significant, but HIV infection continued to be associated with reporting having a suspected or known HIV-positive partner in the past year (adjusted OR [aOR] 11 ·72, 6 ·07–22·62) compared with only HIV-negative partners, ever having anal sex (3·08, 1 11–8·57), having two or more lifetime sexual partners (1·84, 1·21–2·78, for 2–3 lifetime sexual partners; 2·44, 1·45–4·08, for ≥4 lifetime sexual partners), or living outside Lesotho in the past year (1·86, 1·01–3·42; table 2). Higher educational attainment (aOR 0·29, 0·06–1·36, for primary education; 0·22, 0·05–1·01, for secondary education; and 0· 09,

0· 02–0·42, for above secondary education) and rural residence (0·60, 0· 40–0 • 90) were protective. The associations noted with incident HIV infection showed a similar pattern, with anal sex (aOR 14·57, 4·61–46·04), early sexual debut (7·27, 1·81–29·23), having been married (4·49, 1·02–17·29), and having a suspected or known HIV- positive partner (6·25, 1·27–30·72) significantly associated with recent infection (appendix p 5). There was weak evidence for an association between incident infection and recent frequent food shortages (aOR 3·88, 0·83–18·12).

There were 570 AGYW who had a cohabitating mother who participated in the survey (table 2). There was evidence of a pronounced protective effect of maternal education, as for each increase in level of schooling attended by the mother, there was a 64% decrease in the odds of HIV infection in the daughter (aOR 0·36, 95% CI 0·15–0·82), even after adjusting for AGYW age, education, sexual risk behaviour, maternal marital status, and household wealth.

Data were available from 272 live-in partners or spouses of AGYW (table 3). The partners' mean age was 25·2 (SD 0·7) for AGYW aged 15–19 years and 28·4 (0·3) for AGYW aged 20–24 years, with a mean age difference of 6·3 years (0·3; 95% CI 5·7–7-0); 47 (17–0%, 12·3–21·7) of 272 partners were HIV seropositive, with partner prevalence increasing with age, whereby five (6·2%, 0·6–11·7) of 72 partners aged 15–24 years were HIV seropositive compared with 10 (49·4%, 22·9–75·8) of 20 partners aged 35–49 years (p=0·0031). Of those testing HIV seropositive, 29 (64·8%) of 47 were aware of their status and 23 (52·9%) of 47 of all HIV-seropositive partners reported taking antiretroviral therapy (ART). There was no difference in partners' viral suppression by age band, although numbers were small. The subset of AGYW with observed cohabitating partners was more likely to be HIV seropositive if their partners were employed, or significantly older, particularly if older than 35 years. A partner being virally suppressed was associated with an 84% reduction in odds of AGYW infection (OR 0·16, 0·04–0·66). In the multivariable model, the strongest predictor of the AGYW's HIV status was whether their partners tested HIV seropositive (aOR 11·22, 4·05–31·05), and the partners' age was no longer a significant factor. Partner employment in the past year, but not current employment, was also associated with increased odds of prevalent HIV infection in AGYW (aOR 3·41, 1·12–10·42).

Discussion

The LePHIA survey indicates that prevalence and incidence of HIV in AGYW in Lesotho are high, particularly in urban areas. However, when comparing HIV prevalence in LePHIA with prevalence in the Lesotho Demographic and Health Surveys of 2009 and 2014,[13,18] there has been a decrease in overall prevalence, from 13·6% in 2009 to 11·1% in 2017, and a substantial drop in prevalence in women aged 23–24 years, from 31·6% in 2009 to 19·9% in 2017, suggesting a decrease in HIV acquisition in AGYW. This drop might be a result of improvements in protective structural factors such as educational attainment and delayed marriage, as well as expansion of HIV treatment coverage and reduction in population viraemia.[12,19,20] However, AGYW are still becoming infected at high rates. The apparent decrease in comprehensive HIV knowledge from 38% (according to the 2014 Demographic and Health Survey)[13] to 31% is remarkable in a high-prevalence region, particularly in terms of lack of knowledge about HIV transmission in this key transitional period, where acquired

behaviours can have long-term consequences in adulthood.[5] Further analysis should be done to determine which populations are not being reached with current educational programming and resources directed to addressing this ongoing gap in prevention.

AGYW continue to be at substantially higher risk than young men, despite having fewer partners and higher reported condom use with high-risk partners. Aside from biological vulnerability in AGYW and the possible inflation of reports of sexual experience in young men,[21,22] one of the primary differences between AGYW and young men was the higher average age of partners of AGYW. The importance of intergenerational sex as a risk factor for HIV among AGYW has been controversial.[10,23] In our analysis of cohabitating partners, older partners were more likely to be HIV seropositive, a fact that has been hitherto assumed in previous studies. In both the models we used, adjusting for suspected, known, or documented HIV status eliminated the association with partner's age, confirming that the direct effect of older sexual partners is through their increased likelihood of HIV infection, and that AGYW usually suspect or know that their older partners are HIV positive. The directionality of transmission can be inferred on the basis of the six-fold increase in odds of recent infection in AGYW with partners suspected or known to be HIV positive, and from prevalence gradients,[12] in which it is more likely for transmission to occur from high-prevalence to low-prevalence populations.[10] As viral load suppression among HIV-positive partners was highly protective, the low prevalence of viral suppression in key male-partner age bands (eg, 25–34 years)[12] is also likely to be an important driver of the epidemic in AGYW in Lesotho, although we did not observe any difference in viral suppression by age in the male partners.

The role of mobility in HIV acquisition in AGYW in Lesotho has not been previously described. AGYW who had lived outside Lesotho in the past year were noted to have higher odds of infection. In addition, we observed higher HIV prevalence close to some border crossings with South Africa and near major transport routes. Most AGYW who reported recent migration indicated that such travel was for work, with most working in private households. Although a previous study[24] in Lesotho found migration as an HIV risk predominantly for men, our data are consistent with a recent study in South Africa,[25] where migration also conferred a risk to women who travelled greater distances from home, and with a recent study from Uganda,[26] where an increase in HIV acquisition in women occurred soon after moving. However, because of small numbers of AGYW who reported such travel in this survey, it was not feasible to assess if mobility was associated with risky behavioural changes[26,27] or whether their partners' mobility also contributed to their risk. We did observe that partners' recent but not current employment was associated with AGYW's HIV status, which might reflect the complexity of mobility and its intersection with employment in this region.[28]

Our findings show the benefit of maternal education in relation to risk of HIV acquisition in AGYW, whereby a protective association was observed not only for education among AGYW but also for daughters living with mothers with higher educational attainment, independent of household wealth. This association was noted regardless of age of the AGYW, making it less likely to be a consequence of better maternal access to prevention of mother-to-child transmission. Several studies[29,30] have shown the benefits of maternal

education in terms of their children's health, where maternal schooling is thought to engender better use of health services, as well as increased educational attainment for their children. However, as we adjusted for the AGYW's education, the observed protective association suggests additional benefits, such as more egalitarian norms within the household.[31]

Our study has several strengths. These include the nationally representative sampling, the high response rates, and the collection of behavioural risk factors among AGYW as well as parental and partner characteristics. The study is also the first to examine risk factors for incident HIV infections among a nationally representative sample of AGYW. Study limitations include the risk of social desirability bias, leading to underestimates of key behaviours such as anal or transactional sex. As mobility was associated with HIV infection in AGYW, it is possible that the participants at highest risk were not in Lesotho during the survey, affecting our estimates of incidence. However, survey weighting should reduce some of that bias. Additionally, the roster was not entirely reliable for identification of parents or partners because of some miscoding and did not allow differentiation between mothers and co-wives or stepmothers in terms of their relationship to the AGYW. The LAg avidity enzyme immunoassay is also still experimental for classification of recent infection, particularly in the era of test-and-treat, which means that some uncertainty exists in estimates of recent infection. However, our findings are supported by other studies on this topic.[9,32] Finally, the age distribution of viral suppression in the male partners differed from that seen in the total survey population, in which males aged 25–34 years had the lowest levels.[12] Further research on maternal and partner characteristics should be done in other settings and with larger samples to explore these results.

In conclusion, the findings from the LePHIA survey suggest progress toward epidemic control in AGYW, but also highlight ongoing high incidence. This study identified key drivers of vulnerability for AGYW, particularly having high-risk, older partners and labour migration. These findings have clear policy implications, including the importance of improving the HIV treatment cascade in male partners (ie, increasing awareness of HIV-positive status and promoting ART initiation and viral load suppression) and the rapid expansion of high-impact preventive measures such as offering testing and counselling to couples or pre-exposure prophylaxis to AGYW at increased risk. Finally, the findings identify geographical priority areas for expansion of HIV programmes that are specifically focused on prevention of HIV acquisition and identification and engagement of HIV-positive AGYW, such as the southern districts or the eastern area near KwaZulu Natal Province, the province with the highest burden of HIV in South Africa.[10] This potential corridor of transmission, and the correlation of migration and HIV infection in this population, indicate that a more regional approach to testing and prevention could help mitigate the effects of mobility on facilitating the transnational spread of HIV.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

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Research in context

Evidence before this study

To explore the recent state of evidence on HIV infection in adolescent girls and young women (AGYW), we searched PubMed using the terms “adolescent girls”, “young women”, “HIV”, and “Africa”, from Jan 1, 2000, to May 1, 2018. Despite substantial advances in prevention methods, HIV incidence remains high in this population in southern Africa. Adolescent girls and young women in southern Africa are a priority population because of a heightened risk of HIV acquisition and their demographic importance. Risk factors for HIV transmission are temporally and geographically heterogeneous; however, most of the data available are derived from observational studies based on convenience samples, or from clinical trials that recruited AGYW at high risk for HIV. Data from population surveys have focused solely on factors associated with HIV prevalence and did not include analysis of household and partner characteristics that affected risk among AGYW.

Added value of this study

The study provides unique information on risk factors associated with HIV prevalence and HIV incidence among AGYW in a representative sample of this population in Lesotho. In this national survey of 2358 AGYW, the data enabled a comprehensive analysis of factors associated with HIV infection, including previously poorly described characteristics of partners and parents, whose influence on HIV risk has usually been drawn from reports by participants, rather than directly observed from inclusion of family members. This study also includes the first directly measured estimate of incidence among AGYW in a nationally representative sample in Lesotho, and identified key risk factors for acquisition, including high-risk sexual practices and migration.

Implications of all the available evidence

Our results provide clear policy targets for HIV programmes in Lesotho as it aims to achieve epidemic control. The findings shed light on which AGYW to target with HIV prevention interventions as well as where to target these interventions, including collaboration with South African programmes. The findings also highlight the effect of migration for work on risk of HIV acquisition by AGYW and the effects of maternal characteristics on risk among their daughters. The findings confirm the importance of reaching men—the sexual partners of these AGYW—to ensure that they get tested and, if they are found to be HIV positive, to promptly initiate antiretroviral therapy to achieve and maintain viral load suppression.

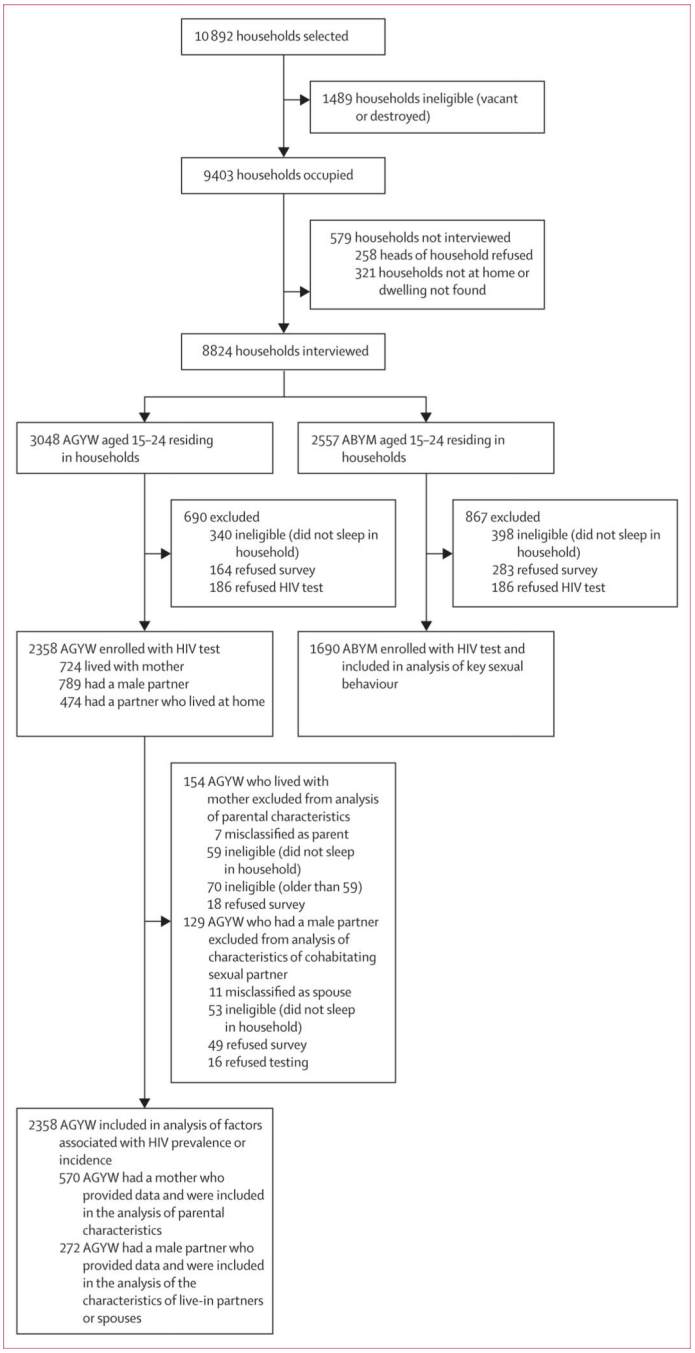

Figure 1: Study profile

ABYM=adolescent boys and young men. AGYW=adolescent girls and young women.

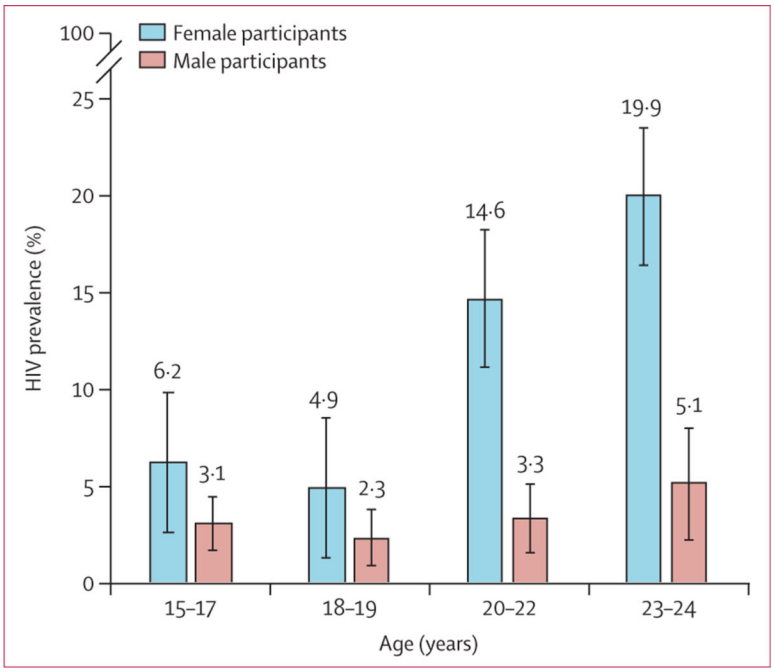

Figure 2:
National weighted HIV prevalence (%) in young people aged 15–24 years in Lesotho (2016–17)

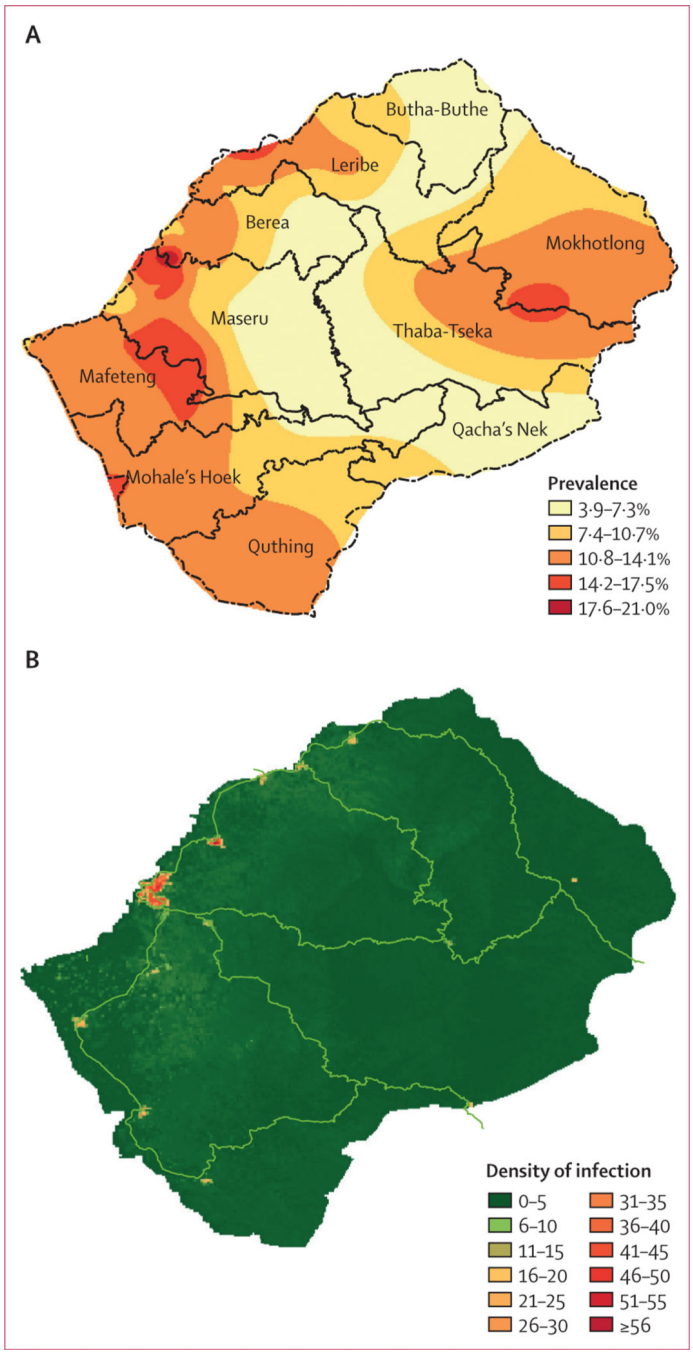

Figure 3: HIV prevalence in AGYW in Lesotho (2016–17)

(A) Map of weighted HIV prevalence (%) in women aged 15–24 years with spatial interpolation used to calculate prevalence, based on 200 AGYW participants per isocline. Black lines indicate the 10 national administrative districts. (B) Density of infection (ie, estimated number of AGYW living with HIV per km^2) derived from 2015 AfriPop projected population of women aged 15–49 years restricted to the population aged 15–24 years. The

green lines represent major roads, leading to border crossings with South Africa. AGYW=adolescent girls and young women.

Table 1:

Characteristics of AGYW in Lesotho (2016–17)

	Total AGYW population (n=2358)	AGYW aged 15–19 (n=1156)	AGYW aged 20–24 (n=1202)	p value*
Residence				
Urban	924 (42%)	423 (39%)	501 (45%)	0·0028
Rural	1434 (58%)	733 (62%)	701 (55%)	··
District				
Berea	316 (15%)	163 (16%)	153 (15%)	0·080
Butha-Buthe	143 (5%)	74 (6%)	69 (5%)	··
Leribe	392 (17%)	192 (17%)	200 (17%)	··
Mafeteng	237 (8%)	130 (9%)	107 (7%)	··
Maseru	569 (31%)	254 (28%)	315 (34%)	··
Mohale's Hoek	172 (6%)	84 (6%)	88 (6%)	··
Mokhotlong	161 (6%)	81 (6%)	80 (5%)	··
Qacha's Nek	104 (3%)	46 (3%)	58 (3%)	··
Quthing	127 (4%)	71 (5%)	56 (3%)	··
Thaba-Tseka	137 (5%)	61 (5%)	76 (6%)	··
Migration				
Never left Lesotho	2063 (88%)	1053 (91%)	1010 (85%)	<0·0001
Away for >1 month in lifetime, but not in past year	191 (8%)	86 (8%)	105 (9%)	··
Away for >1 month in past year	103 (4%)	17 (1%)	86 (7%)	··
Education†				
None	21 (1%)	13 (1%)	8 (1%)	<0·0001
Primary	571 (23%)	282 (23%)	289 (22%)	··
Secondary	1619 (69%)	848 (74%)	771 (64%)	··
Tertiary or above secondary	146 (7%)	13 (1%)	133 (13%)	··
Employment‡				
In school	976 (44%)	753 (67%)	223 (20%)	<0·0001
Working	294 (13%)	57 (5%)	237 (21%)	··
Both	68 (3%)	27 (3%)	41 (4%)	··
Neither	998 (40%)	306 (25%)	692 (55%)	··
Marital status				
Never married	1495 (66%)	1003 (88%)	492 (43%)	<0·0001
Married or living with partner	789 (31%)	143 (12%)	646 (52%)	··
Separated, divorced, or widowed	71 (3%)	9 (1%)	62 (5%)	··
Lifetime sexual partners				
None	754 (35%)	683 (60%)	71 (7%)	<0·0001
1	637 (26%)	253 (21%)	384 (32%)	··
2–3	678 (29%)	186 (16%)	492 (43%)	··
≥4	234 (10%)	28 (2%)	206 (18%)	··

	Total AGYW population (n=2358)	AGYW aged 15–19 (n=1156)	AGYW aged 20–24 (n=1202)	p value*
Sexual activity before 15 years of age	113 (5%)	56 (5%)	57 (5%)	0·70
Ever had anal sex	26 (1%)	4 (0%)	22 (2%)	0·0001
Multiple partners in the past 12 months	216 (9%)	68 (6%)	148 (13%)	<0·0001
Condom used with last non-marital partner§¶	506 (72%)	207 (76%)	299 (69%)	0·020
Intergenerational sex (partner >10 years volder) in past 12 months§	163 (11%)	31 (7%)	132 (13%)	0·0016
Age-disparate sex (partner >5 years older) in past 12 months§	581 (41%)	131 (32%)	450 (45%)	<0·0001
Condomless sex in past 12 months with partner who was§//				
1 to 4 years older	502 (58%)	132 (46%)	370 (65%)	<0·001
5 to 9 years older	334 (72%)	76 (70%)	258 (73%)	··
≥10 years older	125 (73%)	26 (80%)	99 (72%)	··
HIV status of sexual partners in the past 12 months§**				
Any suspected or known HIV-positive partner	84 (6%)	17 (4%)	67 (6%)	<0·0001
Any partner with unknown status	630 (45%)	234 (60%)	396 (39%)	··
Ever sold sex	48 (2%)	12 (1%)	36 (3%)	0·0010
Ever pregnant	978 (39%)	166 (13%)	812 (66%)	<0·0001
Comprehensive HIV knowledge	365 (31%)	162 (28%)	203 (34%)	0·020
Ever tested for HIV	1966 (82%)	843 (73%)	1123 (92%)	<0·0001

Percentages are survey-weighted using jackknife replicate weights. Note that totals might not add to 100% because of rounding or missing responses. AGYW=adolescent girls and young women.

*p values for comparisons across age bands were calculated using χ-squared analysis of weighted data.

†Education refers to highest level attended.

‡Employment refers to status of formal employment or being enrolled in school in the past year.

§Among AGYW with any sexual partners in the past 12 months; data were collected on the three most recent partners.

¶Among AGYW who reported sexual activity with an extramarital partner in the past 12 months.

//Among AGYW who reported a male partner of that age differential in the past twelve months.

**AGYW were classified by their most high-risk partner.

Table 2:

Predictors of prevalent HIV infection in AGYW in Lesotho (2016–17)

	OR (95% CI)	aOR (95% CI)	p value
Whole AGYW population (n=2358)			
Age (years)			
15–19	1 (ref)	1 (ref)	..
20–24	3·33 (2·36–4·70)	2·46 (1·20–5·06)	0·016
Residence			
Urban	1 (ref)	1 (ref)	..
Rural	0·61 (0·46–0·80)	0·60 (0·40–0·90)	0·014
Migration			
Never center Lesotho	1 (ref)	1 (ref)	..
Away for >1 month in lifetime, but not in past year	1·23 (0·74–2·04)	1·36 (0·68–2·72)	0·37
Away for >1 month in past year	2·54 (1·56–4·14)	1·86 (1·01–3·42)	0·047
Education *			
None	1 (ref)	1 (ref)	..
Primary	0·41 (0·13–1·32)	0·29 (0·06–1·36)	0·11
Secondary	0·28 (0·09–0·88)	0·22 (0·05–1·01)	0·051
Tertiary or above secondary	0·20 (0·06–0·67)	0·09 (0·02–0·42)	0·0040
Food shortage in the past 4 weeks			
None	1 (ref)	1 (ref)	..
Rarely	1·27 (0·89–1·80)	1·26 (0·75–2·13)	0·37
Sometimes	1·06 (0·69–1·12)	0·96 (0·52–1·78)	0·90
Often	1·59 (0·94–2·69)	1·79 (0·82–3·89)	0·14
Marital status			
Single	1 (ref)	1 (ref)	..
Married or living with partner	2·35 (1·79–3·09)	1·09 (0·62–1·93)	0·75
Divorced, separated or widowed	5·43 (3·07–9·61)	1·56 (0·68–3·56)	0·28
Number of lifetime sexual partners			
1	1 (ref)	1 (ref)	..
2–3	2·16 (1·51–3·10)	1·84 (1·21–2·78)	0·0060
≥4	3·93 (2·43–6·36)	2·44 (1·45–4·08)	0·0020
Sexual activity before 15	2·28 (1·31–3·98)	1·90 (0·91–3·96)	0·085
Ever had anal sex	3·12 (1·27–7·66)	3·08 (1·11–8·57)	0·033
Intergenerational sex (partner >10 years older) in past 12 months	1·85 (1·19–2·87)	0·99 (0·57–1·74)	0·99
Ever sold sex	2·15 (1·04–4·44)	0·78 (0·35–1·74)	0·53
Ever pregnant	2·99 (2·26–3·96)	1·28 (0·72–2·26)	0·39
HIV status of sexual partners in the past 12 months †‡			
All HIV-negative partners	1 (ref)	1 (ref)	..
Any suspected or known HIV-positive partner	13·30 (7·89–22·43)	11·72 (6·07–22·62)	<0·0001
Any partner with unknown status	1·11 (0·77–1·61)	1·29 (0·86–1·93)	0·21

	OR (95% CI)	aOR (95% CI)	p value
Condom used with last sexual partner in past 12 months	0·99 (0·98–0·99)	0·73 (0·47–1·14)	0·16
Ever tested for HIV	5·34 (2·68–10·64)	1·44(0·53–3·97)	0·46
AGYW living in households in which there are data from a parent (n=570)[§]			
Mean age	18·5 (18·3–18·8)	··	··
Maternal education			
Per additional level attended	0·54 (0·32–0·90)	0·36 (0·15–0·82)	0·015
Mother away >1 month in past year	0·45 (0·08–2·61)	··	··
Mother currently married	1·28 (1·00–1·63)	1·05 (0·73–1·50)	0·80
Household wealth quintile Highest quintile	1·32 (0·67–2·63)	1·34 (0·39–4·6)	0·63

Data were survey-weighted using jackknife replicate weights. Univariable and multivariable models were constructed using logistic regression of weighted data. Characteristics that were significant at p<0·10 were included in the multivariable model. A separate model was constructed for participants with data on parental characteristics, using the same threshold for inclusion in the final model. Not shown in the table are those variables with a p value greater than 0·10 in the univariable models, including residence in a DREAMS *vs* non-DREAMS district, condom used with the last casual partner, household wealth quintile, gender of the head of household, or current employment status. OR=odds ratio. aOR=adjusted OR. AGYW=adolescent girls and young women. ref=reference. DREAMS=Determined, Resilient, Empowered, AIDS-free, Mentored, and Safe Women.

[*] Education refers to highest level attended.

[†] Amongst AGYW with any sexual partners in the past 12 months; data were collected on the three most recent partners.

[‡] AGYW were classified by their most high-risk partner.

[§] The model of maternal characteristics included AGYW age band, education, history of anal sex, condom use at latest intercourse, having a suspected HIV-positive partner, maternal marital status, household wealth quintile, and urban or rural status; there was no effect of maternal or paternal employment status or recent parental migration status.

Table 3:

Partner characteristics and prevalent HIV infection in AGYW in Lesotho (2016–17)

	OR (95% CI)	aOR (95% CI)	p value
All participating partners (n=272)			
Age (years)			
15–24	1 (ref)	1 (ref)	..
25–34	1·36 (0·55–3·38)	0·70 (0·23–2·07)	0·50
35–49	4·54 (1·30–15·80)	1·23 (0·32–4·72)	0·76
Migration			
Never center Lesotho	1 (ref)	1 (ref)	..
Away for >1 month in lifetime, not in past year	1·07 (0·51–2·23)	1·02 (0·38–2·75)	0·97
Away for >1 month in past year	2·62 (0·29–23·53)	1·39 (0·29–6·74)	0·67
Education *			
Secondary or greater	0·57 (0·27–1·20)	0·78 (0·28–2·21)	0·64
Formal employment			
Not working	1 (ref)	1 (ref)	..
Currently working	1·32 (0·55–3·14)	2·20 (0·69–7·23)	0·17
Worked in the past 12 months, but not currently working	3·12 (1·35–7·18)	3·41 (1·12–10·42)	0·032
Condom used with last non-marital partner in past 12 months	0·36 (0·09–1·44)	..	..
Medically circumcised	0·72 (0·31–1·66)	..	..
HIV status			
Tested positive in LePHIA	10·64 (4·20–26·91)	11·22 (4·05–31·05)	<0·0001
HIV-positive participants (n=47)			
Aware of being HIV positive	0·65 (0·16–2·60)	NA	..
On antiretroviral therapy	0·32 (0·08–1·31)	NA	..
Viral load suppressed	0·16 (0·04–0·66)	NA	..

Data are survey-weighted using jackknife replicate weights. Univariable and multivariable models were constructed using logistic regression of weighted data. Characteristics that were significant at p<0·10 or decided a priori to include (ie, male education and migration) were included in the multivariable model. AGYW=adolescent girls and young women. OR=odds ratio. aOR=adjusted OR. LePHIA=Lesotho Population-based HIV Impact Assessment. NA=not available due to small numbers of HIV-positive male partners.

* Education refers to highest level attended.