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Sexual Partnership Heterogeneity and HIV Seropositivity Among Adolescent Girls and Young Women in Cameroon and Côte d'Ivoire: A Partner-Level Latent Class Analysis

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Abstract

Background: Adolescent girls' and young women's (AGYW) heightened HIV vulnerability has been understudied in West and Central Africa, where AGYW account for 1 in 5 new HIV diagnoses. Identifying contextually specific drivers of AGYW's HIV risk can help tailor HIV prevention programming to AGYW in the region.

Methods: We pooled data from nationally representative HIV-seroprevalence surveys for sexually active AGYW in Cameroon and Côte d'Ivoire. We used latent class analysis to partition past-year sexual partnerships into discrete typologies based on 6 relationship characteristics: cohabitation, known partner HIV status, condom use at last sex, age mixing (≥5-year age disparity), transactional sex, and likelihood of having sex again. Mixture modeling with cluster-robust standard errors then assessed differences in AGYW's HIV seropositivity by partnership type.

Results: Overall, 5482 AGYW reported 6389 past-year sexual partners. Four distinct partnership types emerged from LCA: Type 1 (Cohabiting, Age-Disparate Partners: ~46%); Type 2 (Non-Cohabiting, Similar-Aged Partners: ~15%); Type 3 (One-Off, Age-Disparate Partners: ~30%); and Type 4 (Non-Cohabiting, Permanent, Age-Disparate Partners: ~9%). AGYW reporting One-Off, Age-Disparate Partners and Non-Cohabiting, Permanent, Age-Disparate Partners exhibited

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significantly ($P < 0.05$) elevated adjusted odds of HIV seropositivity relative to AGYW reporting Cohabiting, Age-Disparate Partners and Non-Cohabiting, Similar-Aged Partners, respectively.

Conclusions: AGYW reported heterogeneous partnerships that were differentially associated with HIV seropositivity, suggesting discrete relationship characteristics may confer differential HIV acquisition risks among AGYW. Delivery of HIV prevention (ie, long-acting injectable pre-exposure prophylaxis) and diagnostic (ie, HIV self-testing) technologies should be prioritized among AGYW with older, nonpermanent partners, where HIV burdens appear most pronounced.

Keywords

adolescents; youth; HIV prevention; population-based study; West and Central Africa

INTRODUCTION

Adolescent girls and young women [adolescent girls' and young women's (AGYW)] aged 15–24 years are disproportionately impacted by HIV, accounting for almost 60% of new cases in their age group worldwide and a staggering 90% of new HIV diagnoses among 15- to 19-year-olds in East and Southern Africa (ESA).[1] While the scale-up of combination HIV prevention has mitigated HIV transmission at the population level, HIV incidence declines have been geographically imbalanced; in countries with generalized HIV epidemics in ESA, new HIV diagnoses have declined by over 30% in the last decade, but in West and Central Africa (WCA), HIV incidence plateaued in 2010 and has since stagnated.[1,2] Compared with ESA, WCA's HIV epidemic is distinguished by lower (but moderate) HIV prevalence (1.3%); higher HIV-associated mortality (20 deaths per 100,000 population), attributed primarily to sub-optimal coverage of HIV care and treatment services—with nearly a quarter of persons living with HIV not receiving antiretroviral therapy; and performance gaps in HIV epidemic control efforts, especially for girls and women.[1,3] Despite a more concentrated HIV epidemic in WCA, 1 in 5 new HIV diagnoses in the region are observed in AGYW (aged 15–24 years)—comparable with the incidence disparities documented in ESA.[1,2]

Numerous studies have identified sociostructural vulnerabilities (eg, gender-inequitable norms and relationships, food insecurity, school attrition) as factors associated with behaviors (eg, transactional sex, diminished capacity to safely negotiate condom use, coercive sex) that heighten AGYW's susceptibility to HIV acquisition.[4–8] Most evidence related to heightened HIV vulnerability among AGYW has emanated from generalized HIV epidemic contexts in ESA, where HIV burdens among women are substantially larger than in WCA.[2] Moreover, existing scholarship has emphasized the contribution of AGYW's embodied vulnerability (ie, risk experienced at the individual level) to HIV acquisition but has been less attentive to partner-level (eg, male partner occupation and knowledge of HIV status, shared decision-making, and autonomy in sexual relationships) and sexual network (eg, number of extramarital sexual contacts among AGYW's male partners) characteristics that critically potentiate the HIV risk environment for AGYW.[9,10] There is a critical dearth of this scholarship specifically in WCA, where—despite unmet HIV prevention needs among AGYW—virtually no studies have described relationship

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characteristics potentially contributing to HIV transmission dynamics among AGYW and their male partners, especially at the population level.

Given the distinct profile and trajectory of WCA's HIV epidemic, understanding contextually specific partner-level factors associated with HIV seropositivity among AGYW is vital to identifying prevention needs and informing tailored programming to AGYW and their male partners in the region. Accordingly, we pooled population-based HIV-seroprevalence surveys from Cameroon and Côte d'Ivoire to identify sexual relationship typologies and quantify their disparate effects on HIV burdens among sexually active AGYW in WCA.

METHODS

Design and Population

Data were derived from the Population-based HIV Impact Assessment (PHIA) surveys implemented in Cameroon and Côte d'Ivoire in 2017 and 2018, respectively. Briefly, the PHIA surveys are nationally representative, cross-sectional, household-based studies of the HIV epidemic in high-burden settings.[11,12] Through multistage cluster sampling, systematically selected households within randomly selected geographic enumeration areas were approached for participation, and household heads completed a census-like questionnaire characterizing the composition and material/financial assets within the home. After enumeration of survey-eligible individuals within the household, adults (Cameroon: aged 21–64 years; Côte d'Ivoire: aged 18–64 years), minors (Cameroon: aged 10–20 years; Côte d'Ivoire: aged 10–17 years), and children (aged younger than 10 years) were enrolled in the study following written informed consent/assent (and written parental consent where applicable). Individuals who did not sleep in the household the night prior to survey administration were ineligible to participate.

Procedures

Selected individuals (aged 15–64 years) completed a structured, interviewer-administered questionnaire eliciting demographics, sexual and health-seeking behaviors, and HIV-related outcomes. To assess HIV status, sequential rapid point-of-care tests were implemented using the Determine HIV-1/2 test (Abbott Molecular, Inc., Des Plaines, IL) for screening and the OraQuick test (OraSure Technologies, Inc., Bethlehem, PA) for confirmation. Venous or capillary blood was collected from individuals aged 15–64 years for laboratory confirmation of HIV-positive or HIV-indeterminant results from in-home rapid testing protocols using the Geenius HIV-1/2 Supplemental Assay (Bio-Rad Laboratories, Inc., Philadelphia, PA). For the present study, only complete data from AGYW reporting any past-year sexual partnerships were retained.

Measures

Sexual relationships were enumerated using repetitive question blocks eliciting attributes of up to 3 past-year partnerships. Measured partnership characteristics included cohabitation status (living with partner versus not); transactional sex (having sex with partner expecting money or gifts in exchange: yes versus no); likelihood of having sex with partner again (yes

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versus no/unsure); known partner HIV status (yes versus no/unsure); condom use at last sex (yes versus no/unsure); and age-disparate relationship (AGYW ≥5 years younger than male partner versus <5 years younger or older than male partner).

Analysis

After aggregating survey responses from Cameroon and Côte d'Ivoire into a pooled multicountry sample, individual-level descriptive statistics were calculated and compared by country using design-based F-tests of association. Data were then reshaped at the partner level (with each observation corresponding to an elicited AGYW male partner), and sexual relationship types were taxonomized using latent class analysis (LCA)—a Bayesian statistical approach for identifying hidden ("latent") population subgroups, or classes, that are distinguished by specific combinations of features/characteristics.[13] LCA iterations specifying 2–5 classes were estimated, and selection of an optimal LCA solution was guided by model fit indices [ie, smallest class size, Akaike Information Criterion, Bayesian Information Criterion, entropy, χ^2 and Vuong-Lo-Mendell-Rubin (VLMR) likelihood ratio tests] and interpretability of the emergent solution.[13,14] Next, a 3-step Bayesian mixture modeling approach[15] was implemented to quantify differences in HIV seropositivity by latent sexual partnership type—adjusting a priori for age, household wealth (derived from an index of household possessions that was collapsed into socioeconomic quintiles using principal components analysis),[16] residence type (rural versus urban), and country.

Survey-weighted, jackknife variance-corrected descriptive sample characteristics and HIV prevalence estimates, respectively, were obtained to account for the probability of survey selection/nonresponse and the multistage cluster sampling design. Cluster-robust standard errors were implemented in LCA and mixture modeling as variance correction for non-independent observations (ie, past-year partnerships emanating from the same AGYW). Weighted descriptive statistics were computed using Stata/IC 15.1 (StataCorp LLC, College Station, TX). Unweighted LCA and mixture modeling were implemented using M*plus* version 8 (Muthén & Muthén, Los Angeles, CA).

Ethics

The PHIA protocols were reviewed and approved by the Columbia University Medical Center Institutional Review Board (IRB), the Westat IRB, the US Centers for Disease Control and Prevention IRB, the Cameroon National Ethics Committee for Research on Human Subjects, and the National Ethics Committee for Research in Côte d'Ivoire. The Johns Hopkins University Bloomberg School of Public Health IRB reviewed the protocol for secondary data analyses and deemed the present study exempt from further human subjects research oversight.

RESULTS

Overall, 45,412 individuals across countries (Cameroon: N = 27,085; Côte d'Ivoire: N = 18,327) completed a PHIA survey, of whom 12% were sexually active AGYW eligible for inclusion in the present analysis. The final analytic sample included 5523 AGYW (Cameroon: n = 3,200, 47.3%; Côte d'Ivoire: n = 2,323, 52.7%) reporting 6839 unique past-

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year sexual partners (Table 1). Most AGYW were aged 20–24 years (62%), were unmarried (53%), had secondary-level education or higher (52%), reported no past-year income-based employment (70%), and lived in urban areas (58%). More than half (52%) had had a live birth, and 14% reported being pregnant at the time of survey. Fewer AGYW reported first sex before age 15 (15%), having ≥2 past-year sexual partners (15%), and condom use at last sex (28%). AGYW reported an average of 1.22 past-year sexual partners (95% CI: 1.19 to 1.24), which was significantly ($P < 0.001$) higher in Côte d'Ivoire (mean: 1.30, 95% CI: 1.25 to 1.35) than in Cameroon (mean: 1.13, 95% CI: 1.11 to 1.15). Fewer than two-thirds of sexually active AGYW reported ever testing for HIV (60%). The pooled HIV prevalence was 1.9% (95% CI: 1.4% to 2.4%)—significantly ($P = 0.010$) higher in Cameroon (2.7%, 95% CI: 1.9% to 3.4%) than in Côte d'Ivoire (1.2%, 95% CI: 0.5% to 1.8%).

Four distinct sexual partnership types emerged from LCA (AIC: 39,868.558; BIC: 40,051.141; entropy: 0.612; χ^2 LRT: 49.580, $P = 0.0522$; VLMR LRT: 52.116, $P = 0.0745$) and were characterized as follows (Fig. 1): *Type 1* (~46% class prevalence), characterized by primarily cohabiting (~75%), age-disparate (~80%) partnerships; *Type 2* (~15% class prevalence), distinguished by relationships that were non-cohabiting (~96%) with similarly aged (~95%) male partners; *Type 3* (~30% class prevalence), characterized by primarily one-off (~52%), age-disparate (~74%) partner-ships; and *Type 4* (~9% class prevalence), distinguished by partnerships that were non-cohabiting (~77%), steady/permanent (~98%), age-disparate (~71%), and unknown HIV serostatus of partners (~0%).

In multivariable mixture modeling, AGYW reporting one-off, age-disparate partners [*Type 3*] exhibited significantly elevated odds of HIV seropositivity related to AGYW reporting cohabiting, age-disparate partners [*Type 1*] [adjusted odds ratio (adjOR) = 2.28, 95% CI: 1.96 to 2.61, $P = 0.001$] and non-cohabiting, similar-aged partners [*Type 2*] (adjOR = 7.46, 95% CI: 6.86 to 8.06, $P = 0.005$), respectively. Similarly, AGYW with non-cohabiting, permanent, age-disparate partners [*Type 4*] exhibited significantly higher elevated odds of HIV seropositivity relative to AGYW with cohabiting, age-disparate partners [*Type 1*] (adjOR = 2.05, 95% CI: 1.64 to 2.46, $P = 0.014$) and non-cohabiting, similar-aged partners [*Type 2*] (adjOR = 6.71, 95% CI: 6.09 to 7.33, $P = 0.007$), respectively.

DISCUSSION

LCA uncovered 4 sexual relationship types among AGYW in Cameroon and Côte d'Ivoire, revealing heterogeneities in partnership characteristics that may confer differential HIV acquisition risks, with implications for programming. AGYW with one-off, age-disparate [*Type 3*] and non-cohabiting, permanent, age-disparate [*Type 4*] partnerships were more likely to be living with HIV. We found that relationship permanence or fluidity, partner residence (cohabiting or non-cohabiting), and male partner age were associated with AGYW's HIV status synergistically, rather than independently, as emphasized in the extant scholarship from ESA.[10,17,18] Upstream socio-structural (eg, economically motivated sexual activity, condom use coercion, non-disclosure of HIV status between partners) and epidemiologic forces (eg, high-density sexual networks among male partners) likely contribute to disparities in HIV burdens among latent partnership profiles emerging from LCA.[2,7,10] Moreover, unlike prior studies from ESA,[17–19] AGYW in Cameroon and

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Côte d'Ivoire reported age-disparate, cohabiting partners with greater frequency—likely a reflection of marriage or cohabiting-union formation at younger ages among AGYW in WCA.[20] Consistent with extant scholarship,[4,19] transactional sex also appeared to cluster in latent partnership profiles exhibiting the highest HIV burdens—reaffirming the potential contribution of exchange sex to elevated HIV acquisition risks in AGYW. HIV risk assessments and risk counseling should, therefore, consider the contributions of non-cohabiting, older male partners (both permanent and non-permanent), as well as transactional sex relationships, to AGYW's HIV acquisition risks in Cameroon and Côte d'Ivoire.

Limitations

Our findings are subject to several limitations. First, apart from HIV seropositivity, all survey measures were assessed via self-report and are limited by recall and response inaccuracies. Second, while standard errors were appropriately corrected in LCA and mixture modeling to account for nonindependent observations, analyses at the partnership level inhibited capacity to assess how different combinations of sexual relationship types (eg, AGYW reporting both Type 1 and Type 3 relationships) were associated with HIV seropositivity. Third, PHIA's repetitive sexual partner modules did not include an exhaustive list of partner-level covariates (eg, number of sexual partners, viral load, circumcision status) associated with HIV acquisition among AGYW; the addition of these covariates to LCA and mixture modeling could yield alternative latent partnership compositions and associations with HIV seropositivity, respectively. Fourth, only 7 AGYW in the present study exhibited evidence of recent HIV acquisition (per quantitative limiting antigen avidity enzyme immunoassay results), which inhibited model convergence in mixture modeling. The pooling of recent and longer-term HIV infections for the primary outcome measure, thus, obfuscates the effect of partnership types on AGYW's HIV acquisition risks. Fifth, given the study's cross-sectional design, temporality cannot be inferred from the observed relationships between HIV seropositivity and sexual partnership types; while sexual partner characteristics are plausible antecedents of HIV seropositivity, HIV stigma, and discrimination may constrain partner availability/selection for AGYW living with HIV. Finally, since data were derived from nationally representative surveys that did not explicitly privilege participation of sexually active AGYW, study findings are likely to mask heterogeneities within AGYW's male partners due to undersampling of AGYW with potentially elevated HIV acquisition risks (eg, sex workers), whose partnerships will likely vary from those of AGYW identified through random household-based sampling.

CONCLUSION

This is among the first population-based studies to characterize sexual relationship typologies among AGYW in WCA and quantify their discrete associations with HIV seropositivity. LCA uncovered heterogeneous sexual partner-ship types—and the clustering of HIV seropositivity among them—reported by AGYW in Cameroon and Côte d'Ivoire. An expanding menu of HIV prevention tools, namely long-acting injectable pre-exposure prophylaxis, and diagnostic technologies like HIV self-testing should be availed to AGYW

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in transactional sex relationships with older, nonpermanent partners in high-transmission localities across WCA.

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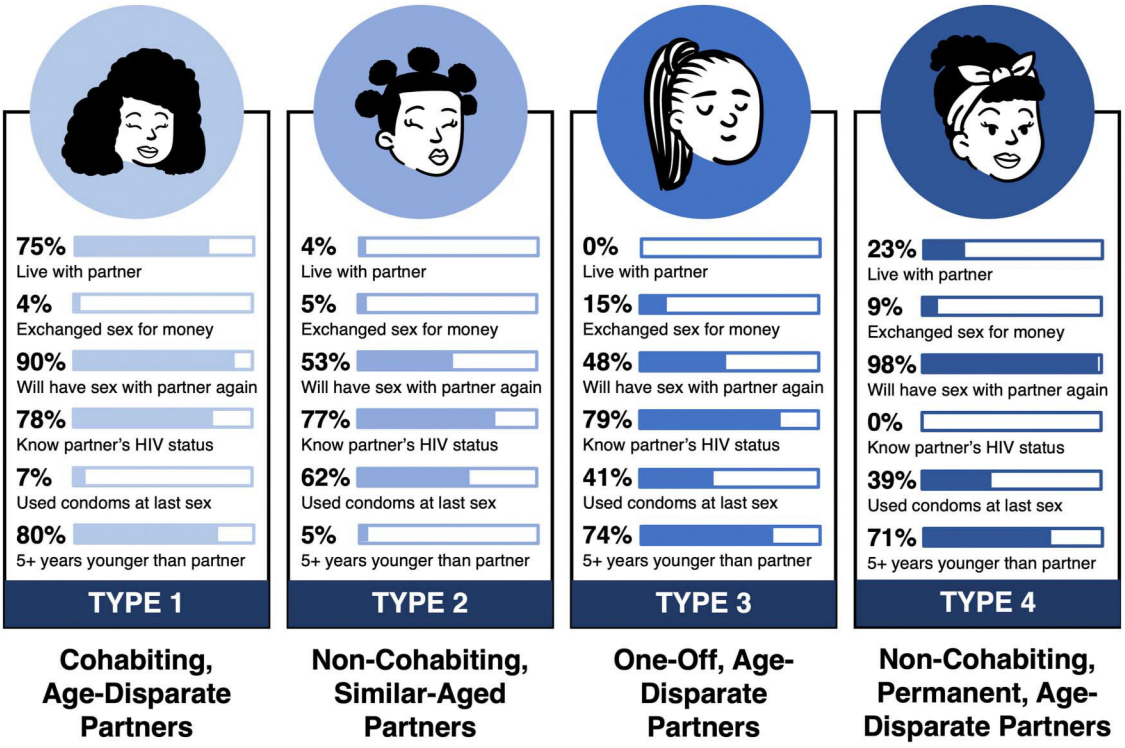


FIGURE 1.

Sexual partnership types identified from latent class analysis among adolescent girls and young women in Cameroon and Côte d'Ivoire ($N = 6,839$).

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TABLE 1.

Weighted Descriptive Characteristics Among Sexually Active Adolescent Girls and Young Women Participating in the Cameroon and Côte d'Ivoire Population-Based HIV Impact Assessments (PHIA)

Characteristics (number, weighted %)	Total N = 5523	Cameroon n = 3200	Côte d'Ivoire n = 2323	*P*
Sociodemographics				
Age group				0.206
15–19 yrs	2143 (37.6)	1152 (36.7)	971 (38.3)	
20–24 yrs	3400 (62.4)	2048 (63.3)	1352 (61.7)	
Marital status				**<0.001**
Never married	2380 (49.1)	1205 (44.8)	1175 (53.0)	
Married or in union	2838 (46.5)	1763 (48.8)	1075 (44.4)	
Separated, widowed, or divorced	283 (4.4)	223 (6.4)	60 (2.6)	
Union type				0.133
In a polygynous union	517 (7.6)	354 (9.0)	163 (6.4)	
In a monogamous union	2120 (37.0)	1242 (37.0)	878 (36.9)	
Not currently in union	2663 (55.4)	1428 (54.0)	1235 (56.7)	
Educational attainment				**<0.001**
No formal education	1452 (26.1)	540 (12.2)	912 (38.5)	
Primary	1374 (22.3)	762 (20.1)	612 (24.4)	
Secondary	1826 (34.3)	1118 (37.4)	708 (31.5)	
Tertiary or higher	863 (17.3)	775 (30.3)	88 (5.6)	
Relation to household head				**<0.001**
Wife or cohabiting partner	1881 (31.7)	1110 (30.3)	771 (32.9)	
Daughter	1385 (25.2)	843 (28.2)	542 (22.6)	
Daughter-in-law	342 (5.7)	206 (6.4)	136 (5.1)	
Granddaughter	229 (4.0)	126 (3.9)	103 (4.1)	
Head of household	422 (7.9)	254 (8.7)	168 (7.2)	
Sibling	344 (7.3)	198 (7.5)	146 (7.1)	
Other relative	749 (14.3)	404 (12.8)	345 (15.6)	
Not related	168 (3.9)	49 (2.2)	109 (5.4)	
Income-based employment, past 12 mo	1691 (30.4)	1024 (32.5)	667 (28.5)	0.055

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Characteristics (number, weighted %)	Total N = 5523	Cameroon n = 3200	Côte d'Ivoire n = 2323	*P*
Household wealth				0.104
Poorest	1255 (22.5)	886 (19.4)	389 (25.2)	
Poorer	1238 (20.1)	766 (20.6)	472 (19.7)	
Average	1136 (20.4)	607 (21.3)	529 (19.6)	
Wealthier	1038 (19.6)	512 (19.5)	526 (19.7)	
Wealthiest	852 (17.4)	445 (19.2)	407 (15.8)	
Residence type				**<0.001**
Urban	2632 (57.5)	1313 (49.4)	1319 (64.7)	
Rural	2819 (42.5)	1887 (50.6)	1004 (35.3)	
Sexual and reproductive health				
Ever had a live birth	3132 (52.3)	1951 (55.6)	1181 (49.4)	**0.010**
Currently pregnant	813 (13.8)	499 (14.7)	314 (12.9)	0.181
First sex before age 15	938 (14.6)	577 (15.4)	361 (13.8)	0.184
Number of past-year sexual partners				**<0.001**
One	4804 (85.4)	2901 (90.0)	1903 (81.3)	
Two or 3	615 (13.2)	264 (9.5)	351 (16.5)	
Four or more	63 (1.4)	15 (0.5)	48 (2.2)	
Condom use at last sex, past 12 mo	1256 (28.1)	715 (28.3)	541 (27.8)	0.778
Ever tested for HIV	2164 (59.9)	1056 (68.7)	1108 (52.1)	**<0.001**
HIV prevalence (95% CI)	1.9% (1.4% to 2.4%)	2.7% (1.9% to 3.4%)	1.2% (0.5% to 1.8%)	**0.010**

Notes: Bolded values represent statistically significant (<0.05) *P*-values, estimated from design-based F tests of association. Percentages and HIV prevalence estimates were obtained using selection weights with jackknife standard errors, accounting for the surveys' multistage cluster sampling design.