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Prevalence and associated factors of condomless sex among adolescents and young adults in Liberia: a multilevel analysis using data from the 2019-2020 Demographic and Health Survey

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Abstract

Background Condom use is an essential component of strategies to improve the sexual and reproductive health of adolescents and young adults (AYA). However, it remains a challenge for many Sub-Saharan African countries, including Liberia. This study aimed to examine the effects of individual and contextual factors on condomless sex within the past 12 months among AYA in Liberia.

Methods A secondary analysis was conducted using data from the 2019-2020 Liberia Demographic and Health Survey (2019-20 LDHS). Sexually active AYA were included in the study. A simultaneous assessment of the effects of individual and community characteristics on unprotected sex was conducted using a multilevel mixed-effects logistic regression model. The adjusted odds ratios (aORs) and their 95% confidence intervals (CIs) for condomless sex were estimated.

Results Of the 2,260 AYA included in the analysis, 68.3% were female, and 40.0% were living in poor households. Their mean age (± SD) was 19.3 (±2.6) years. Only 31.6% reported a history of HIV testing. The prevalence of condomless sex was 83.1%. Individual and contextual factors explained 71.4% of the variation in condomless sex among AYA. In the multivariable analysis, condomless sex was less likely among males (aOR = 0.36 [0.27–0.47]), those with moderate (aOR = 0.67 [0.48–0.94]) or high (aOR = 0.46 [0.31–0.67]) media exposure, and those with occasional partners (aOR = 0.61 [0.39–0.96]). Having a professional activity was associated with higher odds (aOR = 1.52 [1.17–1.97]). Contextual factors associated with lower odds included high community-level education (aOR = 0.65 [0.43–0.98]), urban residence (aOR = 0.54 [0.37–0.78]), and living in South-Eastern B region (aOR = 0.52 [0.3–0.93]; reference = North-Western).

Conclusion The study shows a high prevalence of condomless sex in Liberia. Condom promotion strategies must take into account individual and contextual factors such as gender and regional inequalities.

Keywords Condomless sex, Adolescents and young adults, Cross-sectional study, Liberia

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Background

Sexually transmitted infections (STIs), including HIV infection, remain a major reproductive health problem in sub-Saharan Africa (SSA). The World Health Organization (WHO) estimates that in 2017, Africa had the highest regional prevalence of each of the major curable STIs, including syphilis, gonorrhea, chlamydia and trichomoniasis [1]. The human papilloma virus (HPV) and the herpes simplex virus (HSV-2), two incurable STI, are also widespread in that region [2]. Adolescents and young adults (AYA), particularly those living in SSA, have a higher risk of STIs [3]. This is due to their risky sexual behaviors, including early sexual activity, multiple sexual partnerships and condomless sex, as shown in studies conducted in several countries in this region of Africa [4–6]. In 2021, 1.7 million adolescents (10–19 years) were living with HIV/AIDS worldwide; among them, 90% were from the WHO African Region [7]. A study of demographic data from 27 countries in this part of Africa between 2010 and 2018 found that the prevalence of SR-STI among adolescent girls and young women was 6.62% [8]. In West Africa, several studies have reported the prevalence of STIs in AYA [8–10], including 14,1% for SR-STI among the adolescent girls and young women in Mali, 14,1% for SR-STIs among the adolescent girls and young women in Mali [9], 3.6% for human papillomavirus (HPV) in Côte d'Ivoire [11] and 21.96% for herpes simplex virus (HSV) in Nigeria [12].

But beyond the numbers, it is important to understand the factors that prevent young people from using condoms. These factors include the stigma associated with condom use, myths and misconceptions (such as the idea that condoms reduce pleasure or are only for casual sex), lack of knowledge, cultural norms, cost or limited access, and power dynamics within relationship [13].

The prevalence of risky sexual behaviors among AYA reported in the scientific literature in sub-Saharan Africa highlights the magnitude of this problem [14–16]. Indeed, a study conducted in Ghana in 2022 found that 79% of young women and 68% of young men did not use a condom during last sexual intercourse [14]. Several other studies on risky sexual behavior among young people have examined how factors at the individual level (such as gender, age, educational level, etc.) [17–19], as well as those at the contextual level (such as region, place of residence, etc.) [20–22], affect young people's sexual behavior.

In 2022, 31,000 adults over the age of 15 years were living with HIV in Liberia, with a prevalence of 1.1% [23]. For the 15–24 age group, data on HIV and STI prevalence are limited in Liberia. In addition, this age group has increased biological vulnerability, making the study of these sexual behaviors even more important. Therefore, there is a need for the development of tailored strategies to change risky sexual behavior among AYA to curb the spread of HIV and other STIs. However, studies on sexual risk behavior, including condom use during sex in this group are rare..

This study aimed to assess the prevalence of condomless sex among AYA living in Liberia and to identify the individual and contextual factors associated with high-risk sex.

Methods

Data source and study design

This was a secondary analysis of data from the 2019-2020 Liberia Demographic and Health Survey (2019-20 LDHS). The 2019-20 LDHS is the fifth DHS conducted in Liberia and provides up-to-date estimates of key demographic and health indicators needed by program managers, policymakers and implementers to monitor and evaluate the impact of existing policies and programs and to design new health policy initiatives in Liberia. Data collection took place from 16 October 2019 to 12 February 2020. The sampling for the 2019-20 LDHS is based on a stratified, two-stage area survey. The first step was to select clusters constituting the enumeration areas (EAs), with a probability proportional to their size in each EA. A total of 325 clusters were selected. The second step consisted of systematic sampling of households. A household census was undertaken in all selected clusters. In each cluster, 30 households were selected by systematic equal probability sampling. The total sample size was 9745 households. The results from this sample are representative at the national, urban (Greater Monrovia and all other urban areas) and rural levels, including each of the five regions. In each household, all females aged 15–49 and males aged 15–59 who were either permanent residents of the selected households or visitors who stayed in the households the night before the survey were interviewed. Structured questionnaires were used to collect data from respondents through face-to-face interviews. A total of 29,014 individuals aged 15–59 years, of whom 24,765 were women, participated in the survey. Details on the methodology have been described in the final report of the LDHS 2019-2020 [24].

The entire survey dataset was downloaded from https://dhsprogram.com/data/dataset/. A reconstruction process was carried out to obtain the final database used for this study. This was the standard individual dataset containing sociodemographic and behavioral characteristics of household members, as well as characteristics of the households that participated in the survey. In total, two datasets, including Individual Recode (IR) and Men's Recode (MR), were used to construct the database for our analysis. For this analysis, males and females respondents

aged 15–24 years and sexually active at the time of the LDHS survey, with valid data on the variable of interest, were included. Sexual behavior was assessed based on reports of male or female condom use at last sexual intercourse within the past 12 months. The total sample size for the age group was 3,949 (Fig. 1).

Definition of variables

Dependent variable

The outcome of interest was condomless sex, a dichotomous variable defined as non-systematic use of a condom during the last sexual intercourse of the past twelve (12) months preceding the survey [18].

Explanatory variables

The following explanatory variables were selected from the DHS data:

Individual variables

- *Sociodemographic characteristics of participants*: Age (15–19 years and 20–24 years), sex (female and male), marital status (in union and not union), education level (no formal education, primary, secondary and above), read perfectly (No, Yes), employment status (does not work, works), religion (Christian, Muslim, other), wealth level (poor, medium, rich), level of exposure to mass media (low, medium, high), gender of head of household (female and male).
- *Sexual behaviors*: age of first sexual intercourse (before 16 years and 16 to 24 years), multiple sexual partners (defined as at least 2 sexual partners), last sexual partner (occasional sexual partner, boyfriend/girlfriend, spouse).
- *HIV knowledge (low, medium, high)*: This is a composite variable constructed from six questions on STI/HIV/AIDS. The HIV knowledge score (minimum = 0; maximum = 6) was constructed by assigning a value of 1 to true answers and 0 for false answers. Three questions addressed false modes of transmission (each coded 1 for No and 0 for Yes): 1) "Can you get AIDS through witchcraft or supernatural means?" 2) "AIDS transmission can occur by being bitten by a mosquito", and 3) "AIDS transmission can occur by sharing food with a person who has AIDS". The other three questions asked about knowledge to reduce the risk of contracting HIV (each coded 1 for Yes and 0 for No): 1) "using condoms would reduce the risk of contracting AIDS", 2) "having only one sexual partner would reduce their risk of contracting AIDS", and 3) "it is possible for a person who appears healthy to have the AIDS virus". Thus, the level of knowledge was established as follows: low (score =< 2), medium (score between 3 and 4) and high ((score >= 5).
- *Sexually transmitted infection history variables*: STIs in the last 12 months (No, Yes), ever tested for AIDS (No, Yes)

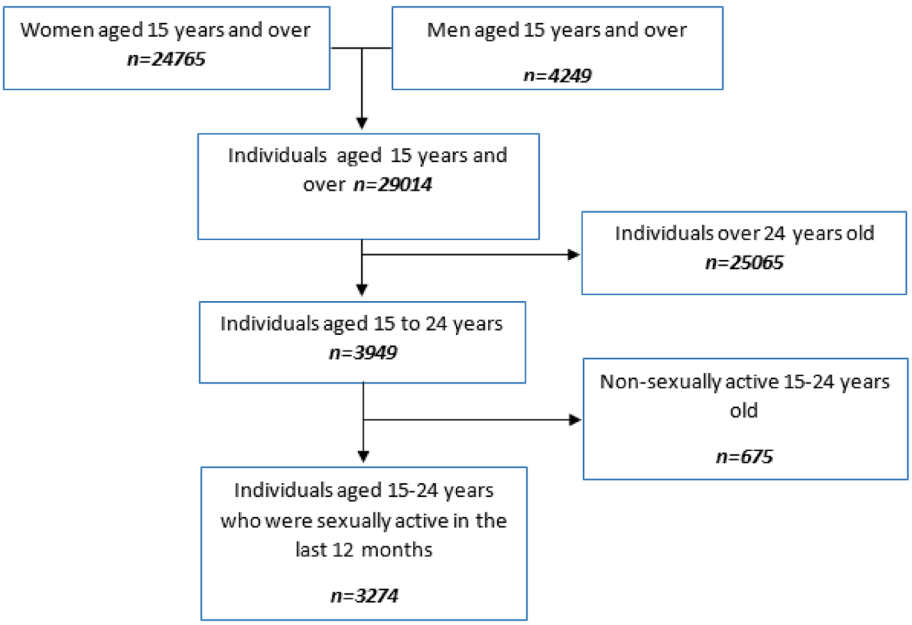

Fig. 1 Flow chart of the study population

Contextual variables Contextual variables are community-based variables. The LDHS-2019-2020 data include identifiers for the primary survey units (PSUs) where each respondent resided. Each PSU (cluster) had between 20 and 30 households. For the purposes of this study, clusters were considered representative of the community from which the individuals came. Thus, place of residence (rural, urban), region, and aggregate variables (education, poverty, and community-level media exposure) were included in this analysis:

- *Community-level education*: Clusters whose median number of years of education is less than the median number of years of education of the study population are classified as having a low level of education. Otherwise, they are classified as having a high level of education.
- *Poverty at the community level*: Clusters whose proportion of the poor is lower than the proportion of the poor in the study population are classified as having a low level of poverty. Otherwise, they are classified as having a high level of poverty.
- *Media exposure at the community level*: Clusters whose proportion of mass media exposure is less than the proportion of mass media exposure of the study population are classified as having a low level of mass media exposure. Otherwise, they are classified as having a high level of mass media exposure.

Statistical analyses

A descriptive analysis was performed. The frequencies and weighted percentages were generated. The comparison according to the variable of interest was performed, and the association was tested using Chi-square or Fischer's exact tests, if appropriate. The explanatory variables associated with the variable of interest with a p value of less than 0.25 were introduced into the regression model, thus constituting the main multivariable model. Additionally, variables such as age, which have a high risk of confounding, were kept in the model regardless of the degree of statistical significance.

At the multivariate analysis level, a two-level multivariable logistic regression was used. The first level examined the relationship between individual variables and condomless sex. The second level examined the effects of aggregate community-level factors on condomless sex. To assess the effects of individual and community characteristics on condomless sex, a two-stage mixed-effects logistic regression model is appropriate and was therefore fitted.

Multivariate analysis strategy

Four models were fitted as follows: *Model 0* or the empty model. In this model, no effect of the explanatory variable on the dependent variable was applied, condomless sex. It is used to determine the initial within-cluster and between-cluster variance of condomless sex or the unconditional variance. If the variance is statistically nonzero, then a multilevel model can be conducted. *Model I* allows the block addition of individual variables to determine the effect of individual characteristics on condomless sex. *Model II* allows the block addition of contextual variables only. It assesses the effect of contextual characteristics on condomless sex. In *Model III*, individual and contextual variables were introduced simultaneously to determine their combined fixed and random effects on condomless sex. Variance inflation factors were estimated to assess the risk of multicollinearity between the variables [25].

The final model results were presented as adjusted odds ratios (aORs) with their corresponding 95% confidence intervals (CIs). Parameters such as the intraclass correlation (ICC) [25, 26], the median odds ratio (MOR) [26] and the proportional variation of variance (PCV) [26, 27] were estimated to assess the contribution of the random part of the model.

Results

Characteristics of the participants

Out of a total of 3,949 AYA, 2,260 individuals residing in 324 clusters were included in the analysis (Fig. 1). Table 1 presents the characteristics of the participants. The mean age (± SD) of the participants was 19.3 (± 2.6) years, and 68.3% were female. More than half of the participants (57.2%) had a secondary education or higher, 51.8% had a low literacy level and 49.8% were living in rural areas. In addition, 49.1% of these AYA were employed, and 40.0% were living in poor households. Most of these households were headed by men (56.7%). More than a fifth.of the AYA (20.7%) had a low level of exposure to the mass media.

Regarding sexual behavior, 83.1% of AYA reported condomless sex during their last sexual intercourse, and 18.2% reported multiple sexual partners (2 sexual partners or more). The median age at first sexual intercourse was 16 years. Approximately 56.2% of the respondents had good knowledge about HIV. However, only 31.6% had been tested for HIV, and approximately 26.7% of the participants reported a history of STIs.

In the bivariate analysis, almost all the sociodemographic characteristics were associated with condomless sex, with the exception of sex of the head of household, SR-STIs and history of HIV testing (Table 1). Being

Table 1 Characteristics of adolescents and young adults (*N*= 3274)

Characteristics of the participants (*N*= 3274)	Frequency	%	% (weighted)**	Unprotected sex. *n* = 2842	*p*-value*
Individual characteristics					
Age (years)					0.900
15–19	1490	45.5	42.0	1295 (87.0%)	
20–24	1784	54.5	58.0	1547 (87.0%)	
Sex					**< 0.001**
Female	2385	72.8	71.0	2167 (91.0%)	
Male	889	27.2	29.0	675 (76.0%)	
Living in a couple					**< 0.001**
No	2260	69.0	73.0	1879 (83.0%)	
Yes	1014	31.0	27.0	963 (95.0%)	
Education level					**< 0.001**
No education	413	12.6	11.0	395 (96.0%)	
Primary	1160	35.4	25.0	1058 (91.0%)	
Secondary or higher	1701	52.0	64.0	1389 (82.0%)	
Sufficient literacy level					**< 0.001**
No	1814	55.4	50.0	1664 (92.0%)	
Yes	1460	44.6	50.0	1178 (81.0%)	
Religion					0.110
Christianity	2816	86.0	84.2	2434 (86.0%)	
Islam	376	11.5	13.5	331 (88.0%)	
Other	82	2.5	2.3	77 (94.0%)	
Professional activity					**0.013**
No	1545	47.2	49.0	1317 (85.0%)	
Yes	1729	52.8	51.0	1525 (88.0%)	
Level of wealth					**< 0.001**
Poor	1381	42.2	36.6	1241 (90.0%)	
Middle	701	21.4	21.6	613 (87.0%)	
Rich	1192	36.4	41.8	988 (83.0%)	
Gender of the head of household					0.300
Female	1235	37.7	41.0	1062 (86.0%)	
Male	2039	62.3	59.0	1780 (87.0%)	
Level of media exposure					**< 0.001**
Low	2469	75.4	69.5	2207 (89.0%)	
Medium	698	21.3	25.8	559 (80.0%)	
High	107	3.3	4.7	76 (71.0%)	
Age at first sexual intercourse					**< 0.001**
< 16	976	29.8	34.0	2.042 (89.0%)	
16–24 years	2298	70.2	66.0	800 (82.0%)	
Multiple sexual partnerships					**< 0.001**
No	2745	83.8	83.0	2415 (88.0%)	
Yes	529	16.2	17.0	427 (81.0%)	
Last sex partner					**< 0.001**
Occasional partner	139	4.2	4.8	102 (73.0%)	
Boyfriend or girlfriend	2207	67.4	69.7	1849 (84.0%)	
Spouse	928	28.4	25.5	891 (96.0%)	
Self-reported STIs					0.999
No	2352	71.8	69.0	2041 (87.0%)	
Yes	922	28.2	31.0	801 (87.0%)	

Table 1 (continued)

Characteristics of the participants (*N*= 3274)	Frequency	%	% (weighted)**	Unprotected sex. *n* = 2842	*p*-value*
History of HIV testing					**0.012**
No	2004	61.2	62.0	1716 (86.0%)	
Yes	1270	38.8	38.0	1126 (89.0%)	
Level of knowledge of HIV					**0.001**
Low	417	12.7	12.5	381 (91.0%)	
Medium	1049	32.1	29.7	923 (88.0%)	
High	1808	55.2	57.8	1538 (85%)	
Contextual characteristics					
Community poverty levels					**< 0.001**
Low	1790	54.7	63.0	1517 (85.0%)	
High	1484	45.3	37.0	1325 (89.0%)	
Community education level					**< 0.001**
Low	1321	40.3	27.0	1239 (94.0%)	
High	1953	59.7	73.0	1603 (82.0%)	
Level of media exposure					**< 0.001**
Low	1803	55.1	57.0	1531 (85.0%)	
High	1471	44.9	43.0	1311 (89.0%)	
Place of residence					**< 0.001**
Rural	1781	54.4	34.0	1631 (92.0%)	
Urban	1493	45.6	66.0	1211 (81.0%)	
Region					**< 0.001**
North Central	730	22.3	29.7	640 (88.0%)	
North Western	389	11.9	6.1	362 (93.0%)	
South Central	933	28.5	51.6	759 (81.0%)	
South Eastern A	535	16.3	6.3	487 (91.0%)	
South Eastern B	687	21.0	6.3	594 (86.0%)	

* Pearson's Chi-squared test

** Weighting is used to adjust the number of individuals in each county so that the contribution of each county to the total is proportional to the actual population of the county

female and having a professional activity were associated with a high prevalence of condomless sex (p<0.001). The prevalence of condomless sex was lower among those with secondary education or higher (p<0.001) or those with high literacy (p<0.001). Low levels of mass media exposure were associated with a high prevalence of condomless sex (p<0.001). Regarding sexual behavior, AYA who had sex before the age of 15 and those with only one sexual partner were more likely to report condomless sex (p<0.001). Those for whom the last sexual intercourse was with a boyfriend or girlfriend and those who had been tested for HIV were more likely to report condomless sex (p<0.001). Good knowledge of HIV was significantly associated with a low prevalence of condomless sex (p<0.001).

At the contextual level, all characteristics tested were associated with condomless sex. High levels of poverty, high levels of exposure to mass media, and low levels of education were associated with a high prevalence of condomless sex (p<0.001). With regard to residence, those living in rural areas were more likely to report condomless sex at last intercourse (p<0.001).

Factors associated with condomless sex among AYA in Liberia (Table 2)

Model III was considered for determining factors associated with condomless sex among AYA, as it had the lowest AIC.

For individual factors, being male (aOR = 0.36 [0.27–0.47]), having moderate (aOR = 0.67 [0.48–0.94]) or high (aOR = 0.46 [0.31–0.67]) exposure to mass media (reference = low), and having an occasional partner (aOR = 0.61 [0.39–0.96]) were associated with lower odds of condomless. In contrast, having a professional activity was associated with higher odds of condomless sex (aOR = 1.52 [1.17–1.97]).

Among contextual factors, living in a community with a high level of education (aOR = 0.65 [0.43–0.98]), living in urban area (aOR = 0.54 [0.37–0.78]), and living in

Table 2 Individual and contextual factors associated with unprotected sex among adolescents and young adults in Liberia (multilevel logistic regression)

Characteristics of the participants (N= 3274)	Model 0 aOR[95%CI]	Model I aOR[95%CI]	Model II aOR[95%CI]	Model III aOR[95%CI]
Individual characteristics				
Age (years)				
15–19		Ref		Ref
20–24		1.02 [0.80–1.31]		1.01 [0.79–1.29]
Sex, male		0.36***[0.29–0.48]		0.35** * [0.27–0.46]
Living in a couple		0.80 [0.41–1.57]		0.98 [0.54–1.78]
Education level				
No education		Ref		Ref
Primary		0.74 [0.43–1.27]		0.77 [0.44–1.31]
Secondary or higher		0.54*[0.31–0.94]		0.71 [0.41–1.25]
Sufficient literacy level		0.80 [0.60–1.05]		0.86 [0.65–1.14]
Religion				
Christian		Ref		Ref
Islam		0.89 [0.61–1.29]		0.93 [0.63–1.37]
Other		1.65 [0.59–4.60]		1.51 [0.5–4.21]
Professional activity		0.66*** [0.52–0.84]		0.72** [0.57–0.92]
Level of wealth				
Poor		Ref		Ref
Middle		0.88 [0.65–1.21]		0.91 [0.65–1.27]
Rich		0.70** [0.54–0.91]		0.67** [0.49–0.90]
Level of media exposure				
Low		Ref		Ref
Medium		0.71** [0.55–0.92]		0.76*[0.56–0.99]
High		0.54*[0.32–0.88]		0.63[0.38–1.03]
Age at first sexual intercourse				
< 16		Ref		Ref
16–24 years		0.82[0.65–1.05]		0.86[0.68–1.09]
Multiple sexual partnerships		0.92 [0.70–1.23]		0.89 [0.67–1.17]
Last sex partner				
Occasional partner		Ref		Ref
Boyfriend or girlfriend		0.39** [0.20–0.77]		0.35** [0.18–0.69]
Spouse		0.23** * [0.11–0.51]		0.22** * [0.10–0.47]
History of HIV testing		0.85 [0.66–1.09]		0.80 [0.62–1.03]
Level of knowledge of HIV				
Low		Ref		Ref
Medium		0.95 [0.63–1.45]		0.98 [0.64–1.50]
High		0.99 [0.65–1.49]		1.03 [0.68–1.55]
Contextual characteristics				
Community poverty levels				
Low			Ref	Ref
High			1.60** [1.21–2.12]	1.24 [0.91–1.69]
Community education level				
Low			Ref	Ref
High			0.41*[0.30–0.58]	0.54*** [0.38–0.77]
Level of media exposure				
Low			Ref	Ref
High			1.03 [0.81–1.32]	0.88 [0.68–1.14]

Table 2 (continued)

Characteristics of the participants (N= 3274)	Model 0 aOR[95%CI]	Model I aOR[95%CI]	Model II aOR[95%CI]	Model III aOR[95%CI]
Place of residence				
Rural			Ref	Ref
Urban			0.58** * [0.42–0.79]	0.61** [0.44–0.85]
Region				
North Western			Ref	Ref
North Central			0.49** [0.30–0.79]	0.49** [0.29–0.81]
South Central			0.49** [0.30–0.79]	0.59*[0.37–0.99]
South Eastern A			0.64 [0.38–1.09]	0.87 [0.49–1.51]
South Eastern B			0.40** * [0.24–0.65]	0.48** [0.29–0.80]
PSU Variance(S.E)	0.4997(0.71)	0.2103(0.46)	0.1197(0.35)	0.07029(0.27)
ICC	13.19%	6.00%	3.51%	3.56%
PCV	Ref	57.91%	76.05%	85.93%
MOR	1.96	1.56	1.39	1.29
Wald X^2	Ref	267.87***	119.9***	325.37***
Model fitness				
AIC	2516.0	2291.874	2412.068	2246.595

PSU Primary Sample Unit, *ICC* Intraclass correlation, *PCV* Proportional Variance Variation, *MOR* Median odds ratio, *AIC* Akaike Information Criterion

* $p < 0.05$

** $p < 0.01$

*** $p < 0.001$

South-Eastern B region (aOR = 0.52 [0.3–0.93]; reference = North-Western) were associated with lower odds of condomless sex.

Random effect analysis and model fitness comparison

The random effect model's assessment was conducted using ICC, PCV, and MOR. The prevalence of condomless sex varied significantly across clusters. In the null model, there was statistically significant variability in the odds of reporting condomless sex among AYA. In that, 13% of the variance in reporting condomless sex was explained by the variation in characteristics between clusters (ICC = 0.130). The within-cluster variation was reduced to 4.09% in model III, which included both individual and community factors. The variance in reporting condomless sex could therefore be explained by cluster differences.

Furthermore, the proportional change in variance (PCV) was found to be highest in the final model, indicating that both individual- and community-level variables accounted for 71.4% of the variation in condomless sex. The median odds ratio (MOR) in model III showed that if an AYA moved from a cluster with a low risk of condomless sex to a cluster with a high risk of condomless sex, the median increase in the odds of condomless sex would increase by 42% (MOR = 1.42) (Table 3).

Table 3 Assessment of multilevel models

	Model 0	Model I	Model II	Model III
PSU Variance(S.E)	0.4917(0.70)	0 (0)	0.1901(0.43)	0.1405(0.37)
ICC	13.0%	6.99%	5.46%	4.09%
PCV	Ref	49.66%	61.33%	71.42%
MOR	1.95	1.60	1.51	1.42
Wald X2	Ref	159.45*	78.35*	200.54*
Model fitness				
AIC	2022.089	1896.641	1959.734	1871.548

PSU Primary Sample Unit, *ICC* Intraclass correlation, *PCV* Proportional Variance Variation, *MOR* Median odds ratio, *AIC* Akaike Information Criterion

* $p < 0.001$

Discussion

This study, based on a nationwide survey in Liberia conducted in 2019-2020, reported condomless sex and identified its associated factors (individual and contextual) among AYA.

Indeed, the prevalence of condomless sex among AYA in this study was found to be higher (86.8%) than those reported in several studies in sub-Saharan Africa [4–6], where the prevalence ranged between 30% and 77%. This high prevalence could be explained by the fact that in African societies, sexuality remains taboo at this age and is generally not discussed much within the family

[28]. Additionally, in some relationships, people may begin to neglect condom use after a few dates [29]. Factors contributing to this laxity include high mutual trust, lack of awareness of risks, increased comfort, and insufficient communication regarding condom use. Therefore, it is important to promote communication for change in young people, including with peers or parents, to improve awareness of safe or protective behaviors regarding sexual reproductive health.

The prevalence of condomless sex in this study varied between regions, with the exception of South East Region. AYA in the North Central South and South East B regions were less likely to report unprotected sex than those in the North West region. The North-West region is the region that houses the capital of Liberia. This seems paradoxical since in Africa, capital cities and their surroundings areas often have the greatest number of socio-educational and health infrastructures and better access to preventive sexual health care [30].

Other contextual factors, including place of residence, administrative region and community education level, were associated with condomless sex.

Rural residents were more likely to report condomless sex. This appears to reflect the disparity in condom availability between rural and urban areas [30, 31]. This is partly due to the low coverage of rural areas with sexual health prevention services. To reach the rural community, it is necessary to involve leaders in behavior change actions. In addition, there is a need to improve, including reproductive health services in primary health care facilities.

The level of community education influences condom nonuse. Indeed, the high level of education in the community is a factor in the low prevalence of condomless sex. Previous studies have shown that residential area is another key factor in condom use [30]. This fact seems obvious, as a community with a high level of education certainly has a sufficient level of knowledge to take control of its sexual health.

At the level of individual factors, the results showed that male gender, having a professional activity, wealth level of household, media exposure and type of sexual partner were associated with a decreased likelihood of condomless sex.

Male participants were less likely to have condomless sex compared to female participants. This result is in line with those reported in the studies conducted by Sunday et al. in Nigeria and Evans et al in South Africa [5, 6]. This gender difference in the prevalence of condomless sex could be explained by the existence of negative stereotypical representations of condom use that are still widespread in Africa, particularly among girls, who were considered promiscuous when they used condoms [32]. These representations may constitute real obstacles to condom use in this region. In addition, most of the time, girls are financially dependent on their male partner and therefore have little decision-making power, including whether to use condoms [30]. This finding could also support the fact that in the present study, respondents from wealthy households were less likely to have condomless sex than their peers from poor households.

The impact of professional situation on condom use is confirmed by this study. Indeed, AYA with professional activity were less likely to report condomless sex. This result is similar to the result of the Rwenge JM study, in which occupation in general did not play a negative role in condomless sex [4].

The influence of exposure of AYA to mass media in the household varies according to the level of exposure. Indeed, respondents from households with medium exposure were less likely to report condomless sex. This fact is certainly due to the information on sexual practices and sexual health disseminated by the mass media [30].

The main limitations of this study are the existence of social desirability bias and recall bias resulting from self-reporting of risk behavior. This inevitably leads to an under- or overestimation of behaviors. Furthermore, the study used cross-sectional surveys, so it is not possible to infer causality of the effect of individual and contextual factors on condomless sex [33]. Finally, with regard to contextual factors, as the duration of exposure to the community was not taken into account, it was impossible to assess a possible cumulative effect [25].

Nevertheless, the abovementioned limitations do not call into question the results of this work, as the data are from a nationally representative survey with high response rates. In addition, it has the merit of having highlighted individual and contextual factors to be considered in the design and implementation of interventions tailored to AYA to improve their condom use.

Conclusion

The prevalence of condomless sex in Liberia was high in this study. The inclusion of contextual factors in the analysis helped to highlight factors associated with condomless sex and to reduce the disproportionate importance of individual factors. These results provide a compass for developing strategies to reduce condomless sex by considering individual factors such as gender, occupation and household wealth. However, contextual factors such as place of residence, region and community education level should be considered. Measures such as sex education programs and behavior change communication are needed to reduce the prevalence of condomless sex. Further analysis of these data could provide insight into condomless sex among men compared to women. In addition, to better understand condomless sex, qualitative studies would be useful.

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Authors' contributions
KMN: Conceptualization, data curation, formal analysis, writing of original draft, review and editing, ETTD: reviewing and editing, AN: reviewing and editing, DFRM: reviewing and editing, BS: reviewing and editing, IY: Conceptualization, supervision, reviewing and editing. All the authors have read and approved the final manuscript.

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Data availability
Datasets are available from https://dhsprogram.com/data/available-datasets.cfm Liberia 2020 Standard DHS.

Declarations

Ethics approval and consent to participate
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Competing interests
The authors declare no competing interests.

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