

Multilevel Analysis of HIV Knowledge Among Reproductive-Age Women in Somaliland: Evidence from the Somaliland Demographic and Health Survey (SLDHS) 2020

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Multilevel Analysis of HIV Knowledge Among Reproductive-Age Women in Somaliland: Evidence from the Somaliland Demographic and Health Survey (SLDHS) 2020

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Scope Statement

This manuscript fits within the scope of the journal and selected specialty because it examines HIV knowledge among reproductive-age women in Somaliland using nationally representative data from the 2020 Somaliland Demographic and Health Survey. The study applies multilevel statistical analysis to identify individual- and community-level factors associated with HIV knowledge, providing evidence relevant to HIV prevention, health education, sexual and reproductive health, and public health interventions in underserved settings.

Conflict of interest statement

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest

Credit Author Statement

Abdifatah Mohamed Abdi: Conceptualization, Data curation, Formal Analysis, Investigation, Methodology, Project administration, Resources, Software, Supervision, Validation, Visualization, Writing – original draft, Writing – review & editing. **Abdifatah Ibrahim Mouse:** Conceptualization, Data curation, Formal Analysis, Investigation, Methodology, Project administration, Software, Supervision, Validation, Visualization, Writing – original draft, Writing – review & editing. **Mohamed Ali Muhumed:** Conceptualization, Data curation, Formal Analysis, Investigation, Methodology, Project administration, Resources, Software, Supervision, Validation, Visualization, Writing – original draft, Writing – review & editing. **Mustafe M. Ahmed:** Conceptualization, Data curation, Formal Analysis, Investigation, Methodology, Project administration, Resources, Software, Supervision, Validation, Visualization, Writing – original draft, Writing – review & editing. **Nimcan Adam Filfil:** Conceptualization, Data curation, Formal Analysis, Investigation, Methodology, Project administration, Resources, Software, Supervision, Validation, Visualization, Writing – original draft, Writing – review & editing.

Keywords

HIV knowledge, Multilevel analyses, Nomadic populations, SLDHS 2020, Somaliland

Abstract

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Introduction: Human Immunodeficiency Virus (HIV) awareness is critical to reducing transmission and achieving global health targets, yet significant socio-demographic disparities persist in developing settings. This study aimed to investigate the individual- and community-level determinants of HIV awareness among reproductive-age women in Somaliland.

Methods: A secondary analysis was performed using data from 6,259 women aged 15–49 years who participated in the 2020 Somaliland Demographic and Health Survey (SLDHS). Multilevel multivariable logistic regression modeling was utilized to account for hierarchical community-level clustering and to identify predictors associated with having ever heard of HIV/AIDS.

Results: The overall prevalence of basic HIV awareness was 73.7%. The null model revealed that community-level clustering accounted for 24.38% of the variance in awareness ($ICC = 0.24$). In the final multivariable model, older age (e.g., 35–39 years: Adjusted Odds Ratio [AOR] = 3.03, 95% CI [2.43, 3.79]) and higher educational levels (e.g., higher education: AOR = 24.04, 95% CI [5.89, 98.16]) were strongly associated with higher odds of awareness. Conversely, lack of radio exposure was associated with significantly lower odds of awareness (AOR = 0.49, 95% CI [0.30, 0.82]). At the community level, rural (AOR = 0.65, 95% CI [0.51, 0.83]) and nomadic residence (AOR = 0.33, 95% CI [0.24, 0.44]) were significantly associated with decreased odds of awareness compared to urban residence. Significant regional disparities in awareness were also observed.

Conclusion and recommendations: HIV awareness in Somaliland is moderate but highly unequal. Public health interventions should prioritize marginalized rural and nomadic communities, promote female literacy, and implement tailored adolescent-focused programs using radio and local community channels to ensure equitable access to health information.

Keywords: HIV knowledge, Multilevel analysis, Somaliland, Nomadic populations, SLDHS 2020.

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No Generative AI was used in the preparation of this manuscript.

In review

Multilevel Analysis of HIV Knowledge Among Reproductive-Age Women in Somaliland: Evidence from the Somaliland Demographic and Health Survey (SLDHS) 2020

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Abstract

Introduction: Human Immunodeficiency Virus (HIV) awareness is critical to reducing transmission and achieving global health targets, yet significant socio-demographic disparities persist in developing settings. This study aimed to investigate the individual- and community-level determinants of HIV awareness among reproductive-age women in Somaliland.

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Conclusion and recommendations: HIV awareness in Somaliland is moderate but highly unequal. Public health interventions should prioritize marginalized rural and nomadic

communities, promote female literacy, and implement tailored adolescent-focused programs using radio and local community channels to ensure equitable access to health information.

Keywords: HIV knowledge, Multilevel analysis, Somaliland, Nomadic populations, SLDHS 2020.

Introduction

Human Immunodeficiency Virus (HIV) knowledge—comprising transmission pathways, prevention strategies, and risk comprehension—is key to reducing stigma and encouraging protective behaviors [1,2]. Under Sustainable Development Goal (SDG) 3, enhancing this knowledge is vital to ending the AIDS epidemic by 2030 [3,4], especially among reproductive-age women who bear a disproportionate burden of the disease [5]. Globally, sub-Saharan Africa faces the highest burden of HIV/AIDS [1]. Historically, early generalized awareness campaigns in East Africa struggled against deeply entrenched socio-economic inequalities, cultural stigmas, and restricted information access [6–8]. In the Horn of Africa, these challenges have been further compounded by conflict, displacement, and fragile health systems, which continue to limit awareness and elevate infection risks [9,10].

Factors influencing women's HIV knowledge are multi-layered. At the individual level, higher education and exposure to television and radio significantly improve awareness [11–14]. At the household level, wealthier status facilitates better access to resources [15], while community-level factors such as urban-rural divides determine localized access to health information [16]. Superimposed on these are structural inequalities, including restrictive gender norms, limited female autonomy, and HIV-associated stigma, which collectively constrain health-seeking behaviors [17,18]. Furthermore, regional conflict and unstable health infrastructures exacerbate these barriers, preventing effective public health interventions [9,19]. Dissecting these intersecting contexts requires a robust multilevel analytical framework.

Despite these insights, critical contextual and methodological gaps persist. While a prior study identified demographic predictors of HIV knowledge among women in Somalia [14], its findings may not reflect the distinct socio-demographic realities of Somaliland, which features unique population dynamics, including a substantial nomadic sector. Methodologically, existing regional analyses predominantly rely on standard, single-level regression models. Because demographic survey data are collected using multi-stage cluster sampling, individual respondents are hierarchically nested within specific communities. Standard regression models ignore this clustering, which violates the assumption of independent observations, biases standard errors, and masks the distinct influence of community-level contexts. To date, no study in Somaliland has utilized a multilevel framework to concurrently disentangle the individual- and community-level determinants of HIV knowledge.

This study addresses these gaps by conducting a multilevel analysis of HIV knowledge predictors among women aged 15–49 in Somaliland, utilizing data from the 2020 Somaliland Demographic and Health Survey (SLDHS). By adjusting for hierarchical clustering, this research aims to provide methodologically robust evidence to guide targeted, context-specific public health interventions.

Material and Methods

Study Design and Data Source

This study was based on a secondary analysis of data obtained from the 2020 Somaliland Demographic and Health Survey (SLDHS), a nationally representative cross-sectional household survey. The SLDHS was designed to provide comprehensive information on demographic, socioeconomic, and health indicators across Somaliland. In the present study, the survey data

were analyzed to investigate the multilevel determinants of HIV knowledge among women of reproductive age.

Sampling Procedure and Study Population

The SLDHS employed a stratified multistage cluster sampling design. The six administrative regions of Somaliland constituted the primary strata and were further stratified by place of residence (urban, rural, and nomadic).

In urban and rural areas, enumeration areas (EAs) were selected using probability proportional to size (PPS) based on a sampling frame developed through Geographic Information System (GIS) mapping. Household listings were subsequently conducted within the selected EAs, and households were chosen through systematic random sampling. For nomadic populations, temporary nomadic settlements (TNS) were used to establish the sampling frame, and clusters and households were selected using the same probability-based procedures.

All women aged 15–49 years who were usual residents or who had stayed in the selected households the night before the survey were eligible for interview. Overall, 6,259 women were successfully interviewed. After data cleaning and assessment of missing values, all 6,259 respondents were included in the final analysis.

Study Variables

The outcome variable was HIV knowledge, measured using respondents' answers to the survey question on whether they had ever heard of HIV/AIDS. The variable was coded as a binary outcome (Yes = 1; No = 0).

Individual-level explanatory variables included respondents' age, educational attainment, household wealth quintile, exposure to radio, and exposure to television. Community-level variables comprised place of residence (urban, rural, or nomadic) and administrative region.

Data Management and Statistical Analysis

Data management and multilevel statistical analyses were performed using Stata version 14.0.

Descriptive statistics were summarized using frequencies, and percentages. To identify factors associated with HIV knowledge while accounting for the hierarchical structure of the survey data, multilevel multivariable logistic regression models were fitted. Four sequential models were estimated: Model I (empty model without explanatory variables), Model II (individual-level variables only), Model III (community-level variables only), and Model IV (combined individual- and community-level variables).

Random-effect parameters, including the intra-cluster correlation coefficient (ICC), were estimated to quantify between-cluster variation. Sampling weights were applied throughout the analyses to account for the complex survey design and to obtain nationally representative estimates. Results were reported as adjusted odds ratios (AORs) with 95% confidence intervals (CIs), and statistical significance was determined using a two-sided p-value < 0.05.

Results

Sociodemographic Characteristics of Respondents

A total of 6,259 women of reproductive age were included in this study (**Table 1**). The highest proportion of participants belonged to the youngest age group of 15–19 years (26.76%), followed by 20–24 years (18.38%) and 25–29 years (16.99%). Nearly two-thirds of the respondents (65.67%) had no formal education, whereas 17.49%, 12.14%, and 4.71% had attained primary, secondary, and higher education levels, respectively. Regarding economic distribution, 42.47% of the households fell within the highest wealth quintile, while 17.06% belonged to the lowest

quintile. Exposure to mass media was notably low among the respondents; the vast majority reported not listening to the radio (89.92%) and not watching television (67.50%) at all. Only 8.08% listened to the radio and 27.13% watched television at least once a week.

Geographically, more than a third of the study population resided in the Marodijeh region (34.39%), followed by Togdheer (28.32%) and Sanaag (13.61%). Most participants were urban residents (62.06%), while rural and nomadic residents accounted for 20.64% and 17.29% of the sample, respectively.

Table 1. Characteristics of Study Participants (N = 6,259)

Variables	Categories	Frequency	Percentage (%)
Age Group (years)	15–19	1,675	26.76
	20–24	1,150	18.38
	25–29	1,063	16.99
	30–34	869	13.88
	35–39	724	11.57
	40–44	459	7.33
	45–49	318	5.08
Educational Level	No education	4,110	65.67
	Primary	1,095	17.49
	Secondary	760	12.14
	Higher	295	4.71
Wealth Status	Lowest	1,068	17.06
	Second	636	10.16
	Middle	663	10.59
	Fourth	1,234	19.72
	Highest	2,658	42.47
Exposure to Radio	At least once a week	506	8.08
	Less than once a week	125	2.00
	Not at all	5,628	89.92
Exposure to Television	At least once a week	1,698	27.13
	Less than once a week	336	5.37
	Not at all	4,224	67.50
Region	Awdal	544	8.69
	Marodijeh	2,152	34.39
	Sahil	304	4.86
	Togdheer	1,773	28.32
	Sool	634	10.13
	Sanaag	852	13.61
Place of Residence	Urban	3,884	62.06
	Rural	1,292	20.64
	Nomadic	1,082	17.29

Prevalence of HIV Awareness among Women in Somaliland

The overall prevalence of basic HIV awareness (defined as having ever heard of HIV/AIDS) among reproductive-age women in Somaliland was 73.7%. Conversely, more than a quarter of the study participants (26.3%) reported that they had never heard of HIV/AIDS (**Figure 1**).

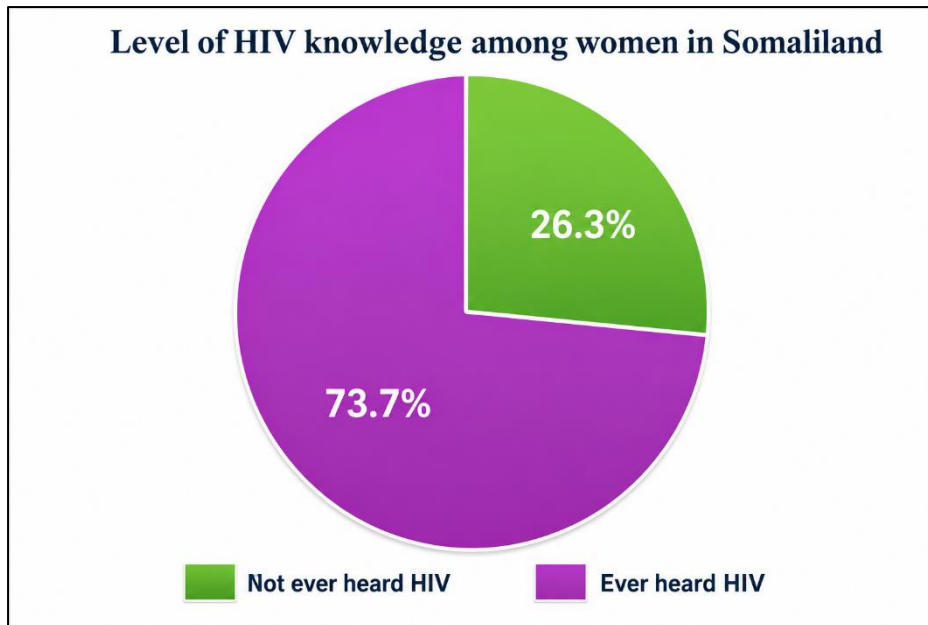


Figure 1. Level of HIV Knowledge Among Reproductive-Age Women in Somaliland, SLDHS 2020.

Random Effects and Model Fitness Analysis

The random effects and model fitness indicators are summarized in **Table 2**. In the null model (Model 0), the intra-cluster correlation coefficient (ICC) was 0.2438, indicating that approximately 24.38% of the total variation in HIV/AIDS awareness among women was attributable to differences between communities (clusters). This significant clustering effect justified the utilization of a multilevel analysis.

Upon adjusting for individual-level factors in Model 1, the ICC fell to 7.02%. When community-level factors were added in Model 2, the ICC was 2.57%. In the final combined model (Model 3), which adjusted for both individual- and community-level characteristics, the ICC fell further to 2.33%, indicating that the included covariates accounted for a substantial portion of the cluster-level variance. Based on model fit diagnostics, Model 3 was selected as the optimal model as it demonstrated the lowest Akaike's Information Criterion (AIC = 6,196.58) and Bayesian Information Criterion (BIC = 6,371.82) values.

Table 2. Random Effects and Model Fitness Analysis

	Model 0	Model 1	Model 2	Model 3
AIC	6741.15	6330.23	6496.02	6196.58
BIC	6754.63	6458.28	6556.68	6371.82
LLR	-3368.58	-3146.1	-3239	-3072.3
Deviance				
ICC	0.243832	0.0702	0.02571	0.02331

AIC = Akaike's information criterion; BIC = Bayesian information criterion ICC = intra-class correlation coefficient LLR = Log Likelihood Ratio

Fixed Effects Analysis

The fixed effects of the individual- and community-level variables on HIV/AIDS awareness are presented in **Table 3**. In the final model (Model 3), age, education, radio exposure, region, and place of residence remained significantly associated with having ever heard of HIV/AIDS.

Among individual-level characteristics, older age groups demonstrated progressively higher odds of HIV/AIDS awareness compared to adolescents aged 15–19 years. The odds of having ever heard of HIV/AIDS were highest among women aged 35–39 years (Adjusted Odds Ratio [AOR] = 3.03; 95% Confidence Interval [CI]: 2.43, 3.79, $p < .001$) and those aged 45–49 years (AOR = 3.01; 95% CI: 2.18, 4.16, $p < .001$).

Educational attainment showed a strong, graded positive relationship with awareness. Relative to women with no formal education, those with primary education had twice the odds of awareness (AOR = 2.14; 95% CI: 1.75, 2.63, $p < .001$), those with secondary education had more than five times the odds (AOR = 5.32; 95% CI: 3.60, 7.88, $p < .001$), and those with higher education had twenty-four times higher odds of having ever heard of HIV/AIDS (AOR = 24.04; 95% CI: 5.89, 98.16, $p < .001$).

In terms of mass media, women who had no radio exposure at all had 51% lower odds of having ever heard of HIV/AIDS compared to those who listened to the radio at least once a week (AOR = 0.49; 95% CI: 0.30, 0.82, $p < .05$). Wealth status was significantly associated with higher awareness in the individual-only model (Model 1), but its significance did not persist in the final model (Model 3) after controlling for community-level factors.

Among community-level factors, both region and place of residence were strong predictors of HIV/AIDS awareness. Compared to women in the Awdal region, women in Marodijeh (AOR = 2.35; 95% CI: 1.74, 3.17, $p < .001$), Sahil (AOR = 2.39; 95% CI: 1.78, 3.21, $p < .001$), and Sanaag (AOR = 1.33; 95% CI: 1.03, 1.70, $p < .05$) had significantly higher odds of awareness. Furthermore, place of residence was a strong predictor; compared to urban residents, women living in rural areas (AOR = 0.65; 95% CI: 0.51, 0.83, $p < .05$) and nomadic communities (AOR = 0.33; 95% CI: 0.24, 0.44, $p < .001$) had significantly lower odds of having ever heard of HIV/AIDS.

Table 3. Multilevel Logistic Regression Analysis of Factors Associated with Ever Having Heard of HIV Among Reproductive-Age Women in Somaliland, SLDHS 2020.

Variables	Categories	Model 1	Model 2	Model 3
Individual-level Factors				
Age Group	15–19	1		1
	20–24	1.80 (1.48, 2.18)**		1.80 (1.49, 2.19)**
	25–29	2.49 (2.05, 3.02)**		2.50 (2.06, 3.04)**
	30–34	2.72 (2.21, 3.35)**		2.69 (2.18, 3.32)**
	35–39	3.10 (2.49, 3.86)**		3.03 (2.43, 3.79)**
	40–44	3.06 (2.47, 3.95)**		2.91 (2.25, 3.77)**
	45–49	3.17 (2.30, 4.37)**		3.01 (2.18, 4.16)**
Education	No education	1		1
	Primary	2.11 (1.73, 2.58)**		2.14 (1.75, 2.63)**
	Secondary	5.56 (3.76, 8.22)**		5.32 (3.60, 7.88)**
	Higher	24.44 (5.98, 99.85)**		24.04 (5.89, 98.16)**
Wealth Status	Lowest	1		1
	Second	1.16 (0.96, 1.41)		1.05 (0.86, 1.27)

	Middle	1.37 (1.08, 1.74)*		0.92 (0.70, 1.20)
	Fourth	2.14 (1.69, 2.73)**		1.19 (0.90, 1.58)
	Highest	2.35 (1.80, 3.06)**		1.20 (0.89, 1.64)
Radio	At least once a week	1		1
	Less than once a week	0.57 (0.26, 1.24)		0.68 (0.31, 1.49)
	Not at all	0.43 (0.27, 0.71)*		0.49 (0.30, 0.82)*
TV	At least once a week	1		1
	Less than once a week	0.96 (0.57, 1.60)		1.01 (0.60, 1.70)
	Not at all	0.64 (0.48, 0.85)*		0.78 (0.58, 1.04)
Community-level Factors				
Region	Awdal		1	1
	Marodijeh		2.22 (1.65, 2.97)**	2.35 (1.74, 3.17)**
	Sahil		2.12 (1.58, 2.82)**	2.39 (1.78, 3.21)**
	Togdheer		0.96 (0.75, 1.22)	1.17 (0.92, 1.50)
	Sool		0.71 (0.56, 0.89)*	0.83 (0.66, 1.05)
	Sanaag		1.15 (0.90, 1.47)	1.33 (1.03, 1.70)*
Residence	Urban		1	1
	Rural		0.57 (0.45, 0.71)**	0.65 (0.51, 0.83)*
	Nomadic		0.19 (0.16, 0.23)**	0.33 (0.24, 0.44)**

Discussion

This study investigated the multilevel determinants of HIV knowledge (measured as basic awareness) among reproductive-age women in Somaliland using nationally representative data from the 2020 Somaliland Demographic and Health Survey (SLDHS). The overall prevalence of basic HIV awareness among women in Somaliland was 73.7%, meaning that over a quarter (26.3%) of reproductive-age women had never heard of HIV/AIDS. This prevalence is lower than the near-universal basic awareness reported in other sub-Saharan African contexts [11,15], yet it is higher than the comprehensive HIV knowledge levels documented across the region [12,15].

Our findings are consistent with prior research in the Horn of Africa, which highlights that while basic awareness of the epidemic exists, systemic barriers continue to hinder universal access to information [9,10,14]. Crucially, the random effects analysis indicated that community-level factors accounted for approximately 24.38% of the total variation in HIV awareness (Model 0), highlighting that individual knowledge is heavily shaped by broader environmental and structural contexts.

Consistent with previous literature, older age was significantly associated with higher odds of HIV awareness [12,15,17]. Compared to young adolescents aged 15–19 years, women in all older age brackets exhibited higher odds of awareness, peaking among those aged 35–39 and 45–49. This pattern is consistent with study in Ethiopia [12]. Adolescents often face substantial cultural and social barriers to accessing reproductive health information, as discussion of sexually transmitted infections is highly stigmatized in traditional societies [7,10,17]. Furthermore, older women have

accumulated more life experience, had more frequent interactions with maternal healthcare services, and experienced prolonged exposure to public health messages, thereby increasing their likelihood of hearing about the virus.

Educational attainment emerged as the strongest individual-level predictor of HIV awareness, showing a powerful and graded positive relationship. Women with higher education had twenty-four times higher odds of having heard of HIV compared to those with no formal education. This finding is highly consistent with studies conducted in East Africa and sub-Saharan Africa at large [6,12,15]. Education enhances cognitive development, reading literacy, and information-seeking behaviors, enabling women to comprehend and retain complex health messages [11]. In Somaliland, where nearly two-thirds (65.67%) of reproductive-age women have no formal education, this structural deficit represents a key barrier to public health communication, underscoring the vital role of education as a social determinant of health.

Regarding media exposure, women with no radio exposure at all had significantly lower odds of HIV awareness compared to those who listened to the radio at least once a week. This aligns with extensive evidence across sub-Saharan Africa demonstrating that mass media remains a primary tool for disseminating health information [12,13,15]. In resource-limited and low-literacy settings, radio campaigns serve as an accessible and cost-effective channel for reaching marginalized populations [10]. Interestingly, while wealth status was significantly associated with higher awareness in the individual-level model (Model 1), this significance disappeared in the final combined model (Model 3) once community-level factors were controlled. This suggests that in Somaliland, the geographic distribution of health resources, infrastructure, and information campaigns overrides individual economic status; a wealthy woman living in an isolated nomadic cluster may still lack basic access to health communication due to structural community-level disadvantages [9,15,16].

At the community level, geographic region and place of residence were prominent predictors of HIV awareness. Women residing in the Marodijeh, Sahil, and Sanaag regions had significantly higher odds of awareness compared to those in the Awdal region. This regional variation is consistent with research in Somalia [14] and reflects uneven regional development, differing health facility densities, and localized variations in non-governmental organization outreach programs [9,19].

Furthermore, place of residence was a critical predictor. Rural and nomadic women had 35% and 67% lower odds of HIV awareness, respectively, compared to their urban counterparts. This finding is highly consistent with studies across sub-Saharan Africa [12,15] and localized research among semi-nomadic populations in Somaliland [10]. Urban areas benefit from concentrated health infrastructure, better telecom network coverage, higher literacy rates, and frequent public health campaigns [16]. Conversely, rural and nomadic women experience extreme geographic isolation, limited exposure to health-promoting media, and severe barriers to accessing health facilities, leaving them largely excluded from traditional public health interventions [9,10].

Strengths and Limitations

A major strength of this study is its use of a large, nationally representative sample from the 2020 SLDHS, which provides highly generalizable findings for Somaliland. Additionally, this study utilized multilevel modeling to account for the hierarchical structure of the survey data, thereby correcting for cluster-level correlation and avoiding the biased standard errors associated with traditional single-level regression analyses [20]. This study also uniquely highlights the

vulnerabilities of nomadic populations, a demographically significant group that is frequently underrepresented in standard public health research.

Despite these strengths, several limitations must be acknowledged. First, the cross-sectional nature of the survey prevents any assertions of temporal order or causal relationships between the studied predictors and HIV awareness. Second, the outcome variable—whether a participant had "ever heard of HIV/AIDS"—only captures basic awareness. It does not measure comprehensive HIV knowledge, such as an understanding of transmission routes, prevention methods, or the rejection of common misconceptions, which are crucial for behavioral change [15]. Finally, because the survey relies on self-reported data, there is a potential for social desirability and recall biases, particularly given the highly sensitive and stigmatized nature of discussing HIV/AIDS in Somaliland.

Conclusion and Recommendations

In conclusion, basic HIV awareness among reproductive-age women in Somaliland is moderate (73.7%) but remains significantly constrained by individual and community-level inequalities. The study demonstrates that older age, higher educational attainment, regular radio exposure, urban residence, and residing in specific administrative regions are strong predictors of HIV awareness. Methodologically, the high community-level clustering (ICC of 24.38% in the null model) confirms that intervention strategies must look beyond individual-level factors and directly address geographic and structural disparities.

Based on these findings, the following policy, practice, and research recommendations are proposed:

1. Public health policymakers should design culturally sensitive, adolescent-friendly reproductive health education programs tailored for young women aged 15–19 years, incorporating these modules into school curricula and community-youth networks.
2. Given the massive impact of education, integrating basic health and HIV/AIDS education into adult literacy and informal educational initiatives is highly recommended to reach uneducated women.
3. Public health authorities and non-governmental organizations should deploy mobile outreach strategies and targeted health communication campaigns for rural and nomadic communities. These campaigns should leverage radio broadcasting and collaborate with respected community leaders and traditional elders to address the low awareness in these hard-to-reach populations.
4. Future studies should focus on conducting longitudinal analyses to monitor trends in comprehensive HIV knowledge over time. Qualitative research is also strongly recommended to explore the socio-cultural, religious, and systemic barriers that hinder information uptake, particularly among nomadic pastoralists.

Abbreviations

AIC: Akaike's Information Criterion; AIDS: Acquired Immunodeficiency Syndrome; AOR: Adjusted Odds Ratio; BIC: Bayesian Information Criterion; CI: Confidence Interval; EA: Enumeration Area; GIS: Geographic Information System; HIV: Human Immunodeficiency Virus; ICC: Intraclass Correlation Coefficient; LLR: Log-Likelihood Ratio; PPS: Probability Proportional to Size; SDG: Sustainable Development Goal; SLDHS: Somaliland Demographic and Health Survey; TNS: Temporary Nomadic Settlement.

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Author Contributions (CRediT)

NAF, AIM, AMA, MAM, MMA: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Software, Validation, Visualization, Writing – original draft, Writing – review & editing, Project administration.

All authors read and approved the final version of the manuscript.

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Availability of Data and Materials

The data supporting the findings of this study are presented within the manuscript. The dataset analyzed during the current study is publicly available from the DHS Program upon reasonable request and registration through the DHS website: <https://dhsprogram.com>.

Declarations

Ethics Approval

The study was exempt from institutional ethical review board approval given the nature of the study. The study used publicly available data that was de-identified and analyzed for review.

Consent to Participate

Informed consent was not required for this study.

Consent to Publish

Not applicable.

Competing Interests

The authors declare that they have no competing interests.

Reference

1. (UNAIDS) JUNP on H. Global HIV & AIDS statistics—2020 fact sheet. Geneva: UNAIDS. 2020;
2. UNAIDS D, Update AE. Geneva: joint united nations programme on HIV. Aids. 2021;1.
3. Nations U. The Sustainable Development Goals Report: Special Edition Towards a Rescue Plan for People and Planet. United Nations, Department of Economic and Social Affairs Statistics Division; 2023.
4. Affairs UND of E and S. The sustainable development goals report 2023: Special edition. UN; 2023.
5. Organization WH. Women and health: today's evidence tomorrow's agenda. World Health Organization; 2009.
6. Teshome R, Wang YouJie WY, Habte E, Kasm NM. Comparison and association of comprehensive HIV/AIDS knowledge and attitude towards people living with HIV/AIDS among women aged 15-49 in three east African countries: Burundi, Ethiopia and Kenya. 2016;
7. Okoye HU. Intersecting social statuses, health inequities, and macro-social influences on HIV risk behaviour among adolescents in sub-Saharan Africa: A structural determinants exploration. University of British Columbia; 2024.
8. Criel B, Waelkens MP. Declining subscriptions to the Maliando mutual health organisation in Guinea-Conakry (West Africa): what is going wrong? Soc Sci Med. 2003;57(7):1205–19.
9. Bile K, Warsame M, Ahmed AD. Fragile states need essential national health research: the

- case of Somalia. *Lancet Glob Heal*. 2022;10(5):e617–8.
10. Abdi IA, Ereg D, Ali M, Rahlenbeck SI. Knowledge and attitudes about AIDS/HIV in a semi-nomadic population in Somaliland. *J Community Health*. 2013;38:246–9.
 11. Haile ZT, Teweldeberhan AK, Chertok IRA. Correlates of women's knowledge of mother-to-child transmission of HIV and its prevention in Tanzania: a population-based study. *AIDS Care*. 2016;28(1):70–8.
 12. Agegnehu CD, Geremew BM, Sisay MM, Muchie KF, Engida ZT, Gudayu TW, et al. Determinants of comprehensive knowledge of HIV/AIDS among reproductive age (15–49 years) women in Ethiopia: further analysis of 2016 Ethiopian demographic and health survey. *AIDS Res Ther*. 2020;17:1–9.
 13. Jung M, Arya M, Viswanath K. Effect of media use on HIV/AIDS-related knowledge and condom use in sub-Saharan Africa: a cross-sectional study. *PLoS One*. 2013;8(7):e68359.
 14. Mohamud LA, Hassan AM, Nasir JA. Determinants of HIV/Aids knowledge among females in Somalia: findings from 2018 to 2019 SDHS data. *HIV/AIDS-Research Palliat Care*. 2023;435–44.
 15. Teshale AB, Yeshaw Y, Alem AZ, Ayalew HG, Liyew AM, Tessema ZT, et al. Comprehensive knowledge about HIV/AIDS and associated factors among women of reproductive age in sub-Saharan Africa: a multilevel analysis using the most recent demographic and health survey of each country. *BMC Infect Dis*. 2022;22(1):130.
 16. Yaya S, Bishwajit G, Danhouno G, Shah V, Ekholuenetale M. Trends and determinants of HIV/AIDS knowledge among women in Bangladesh. *BMC Public Health*. 2016;16(1):812.
 17. Stephenson R. A community perspective on young people's knowledge of HIV/AIDS in three African countries. *AIDS Care*. 2009;21(3):378–83.
 18. Shannon K, Leiter K, Phaladze N, Hlanze Z, Tsai AC, Heisler M, et al. Gender inequity norms are associated with increased male-perpetrated rape and sexual risks for HIV infection in Botswana and Swaziland. *PLoS One*. 2012;7(1):e28739.
 19. Morrison J, Malik SMMR. Population health trends and disease profile in Somalia 1990–2019, and projection to 2030: will the country achieve sustainable development goals 2 and 3? *BMC Public Health*. 2023;23(1):66.
 20. SLHDS. Central Statistics Department, Ministry of Planning and National Development, Somaliland Government. The Somaliland Health and Demographic Survey 2020. 2020;