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Research Article

Spatial Variations and Factors Influencing HIV Testing Access in Guinea: A Secondary Analysis of the 2018 Demographic and Health Survey Data

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Abstract

Background: HIV is a chronic infection that weakens the immune system. In sub-Saharan Africa, and more specifically in Guinea, access to HIV testing remains a significant issue in certain areas, with geographic disparities. This study aimed to analyze spatial variations and factors influencing access to HIV testing among men and women aged 15 to 49 years in Guinea in 2018. *Methods*: This was a secondary analysis of existing data. This study utilized data from the 2018 Demographic and Health Survey (DHS) in Guinea. It was an ecological, cross-sectional study where the statistical unit was the health area. Spatial analysis was conducted through Moran's I coefficient, local autocorrelation, hot and cold spot analysis, and ordinal logistic regression. *Results*: Data from a total of 14,451 individuals distributed across 340 health areas and 38 health districts were analyzed. Most individuals had at least partial access to testing across all health areas. The percentages of moderate and optimal access decreased progressively among those with partial access. A significant global spatial autocorrelation was observed ($I = 0.170$; $p < 0.001$) for moderate access percentages and optimal access percentages ($I = 0.232$; $p < 0.001$). Age (OR = 1.005; 95% CI: 1.001-1.009; $p = 0.009$), gender (OR = 0.517; 95% CI: 0.481-0.555; $p < 0.001$), socioeconomic status (OR = 1.119; 95% CI: 1.031-1.215; $p < 0.001$), and residential setting (OR = 1.384; 95% CI: 1.239-1.491; $p < 0.001$) were significantly associated with testing access. *Conclusion*: This study reveals substantial geographic disparities in HIV testing access in Guinea, influenced by age, gender, socioeconomic status, and residence. Despite widespread awareness, moderate and optimal access remains limited, especially in rural areas. Targeted public health strategies such as community-based interventions, service decentralization, and integration into primary care are essential to improving coverage and ensuring equitable HIV service access nationwide.

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Keywords

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1. Introduction

Human Immunodeficiency Virus (HIV) is the causative agent of Acquired Immunodeficiency Syndrome (AIDS), a chronic infection that progressively weakens the immune system, thereby rendering the body vulnerable to various opportunistic infections and cancers [1]. Since its discovery in 1983, HIV/AIDS has posed a significant global health challenge. As of 2023, UNAIDS estimates that 39.9 million people are living with HIV [1]. While prevention and treatment efforts have reduced new global infections by 39% since 2010 from 2.1 million to 1.3 million in 2023this figure remains far from the target of 370,000 new cases set for 2025 [2]. HIV primarily affects low- and middle-income countries as well as adults aged 15 to 49 years, with a global prevalence of 0.8% within this age group [2]. Africa continues to be the most affected continent, accounting for two-thirds of global cases, with prevalence rates reaching up to 3% in certain West African countries [3-5].

Global strategies, including expanded testing programs and increased access to antiretroviral treatments, have significantly reduced HIV-related mortality rates [1, 6]. According to the World Health Organization (WHO), testing is a cornerstone of HIV prevention, care access, and support services [7]. It plays a pivotal role in the continuum of care, particularly for at-risk populations, enabling individuals to learn their serostatus and access prevention and treatment services [8-11].

However, despite the progressive availability of counseling and testing services, a substantial proportion of people living with HIV remain unaware of their serostatus. This lack of awareness delays diagnosis and the initiation of antiretroviral therapy, contributing to high mortality rates during the first year of treatment [12, 13]. Despite noteworthy efforts to improve testing access, it often remains insufficient and delayed [14]. According to UNAIDS' 2017 report, sub-Saharan Africa accounts for a significant share of the 9.4 million people living with HIV (PLHIV) who are unaware of their serostatus, thereby jeopardizing global efforts to curb the epidemic [15, 16].

In sub-Saharan Africa, limited access to HIV testing leaves most individuals unaware of their serological status, thereby perpetuating the spread of the virus. In Guinea, only 18% of women and 9% of men had undergone testing and received their results in 2018 [17-19]. A study indicates that 35.1% of men aged 15 to 49 in ten countries within the region utilized testing services, with rates ranging from 65.5% in Rwanda to 10.2% in Guinea [19]. This low testing uptake challenges the universal and timely access to antiretroviral therapy (ART) as recommended by the World Health Organization (WHO) [7, 20]. Numerous barriers hinder individuals from accessing HIV testing services [3, 17, 21]. These obstacles primarily include insufficient testing infrastructure, limited availability of tests, geographic distance to testing sites, and sociodemographic factors such as age, residence, gender, marital status, income level, and education. Additionally, contextual and political factors further complicate access, such as the scarce availability of testing centers in rural areas and the persistent stigma associated with HIV [4, 7, 22].

In Guinea, although nearly half of women and more than half of men report being aware of HIV testing services [18], actual utilization of these services remains low. This issue is further aggravated by limited service coverage, especially in rural areas, and socio-economic disparities. Expanding access to testing is a critical step in reducing HIV transmission and improving the care provided to affected individuals.

To date, research has primarily focused on HIV prevalence and the factors influencing testing uptake in sub-Saharan Africa [23], with limited analyses specifically addressing Guinea. Spatial disparities in access to testing and local factors affecting such access across Guinea's various regions have not been adequately explored. This study aims to analyze, using data from the 2018 Demographic and Health Survey, spatial variations and determinants of HIV testing access amongst men and women aged 15 to 49 years in Guinea.

2. Methods

2.1. Type of Study

We conducted an ecological and cross-sectional study as part of the Expanded Vaccination Program. This study utilized data from the 2018 Guinea Demographic and Health Survey (DHS).

2.2. Study Setting

Guinea, a West African country, had a population of 12,554,864 and covered an area of 245,857 km² as of 2018 [24]. The country is divided into 38 health districts and eight (08) regions: Boké, Conakry, Faranah, Kankan, Kindia, Labé, Mamou, and Nzérékoré. The study period extended from January to December 2018.

Guinea’s health system operates on three tiers: the central level, the intermediate (regional) level, and the peripheral level (prefectoral and community-based). Its organization aligns with the administrative divisions of the country, encompassing eight health regions and 38 health districts, including Koundara, Boké, Boffa, Fria, Gaoual, Ratoma, Kaloum, Dixinn, Matoto, Matam, Kindia, Télimélé, Coyah, Forécariah, Dubréka, Mamou, Dalaba, Pita, Labé, Tougué, Lélouma, Mali, Koubia, Faranah, Dabola, Kissidougou, Dinguiraye, Kankan, Mandiana, Siguiri, Kérouané, Kouroussa, Nzérékoré, Beyla, Lola, Yomou, Macenta, Guéckédou. Each district comprises health areas and community health centers that focus on screening activities and primary care services [25]. For this ecological study, the statistical unit of analysis was the health area. However, descriptive data were analyzed at the district level for a broader overall assessment.

2.3. Study Population, Data Source, and Sampling

The study focused on individuals aged 15 to 49 years, both men and women, in Guinea. It utilized data from the 2018 Demographic and Health Survey conducted by the National Institute of Statistics (INS) in collaboration with the National Program for the Fight Against AIDS and Hepatitis (PNLSH) and the Demographic and Health Surveys (DHS) program. Data were collected from randomly selected households, encompassing both urban and rural settings. The dataset included 14,451 individuals, comprising 3,577 men and 10,874 women distributed among 7,912 households. The datasets are publicly accessible on the DHS website: www.dhsprogram.com [26].

2.4. Study Variables

2.4.1. Dependent Variable

The primary variable of interest was "HIV testing access," defined as an individual’s ability to obtain HIV testing services. This composite variable was constructed using two components: knowledge of a testing facility (Yes/No) and distance to a testing facility (less than 5 km, between 5 and 20 km, greater than 20 km). It represents potential access to testing based on awareness of services and their geographic proximity. The coding for this variable was established as follows: 0: No access to testing (Knowledge = No), 1: Limited access (Knowledge = Yes and Distance = Greater than 20 km), 2: Moderate access (Knowledge = Yes and Distance = Between 5 and 20 km), 3: Optimal access (Knowledge = Yes and Distance = Less than 5 km).

Since this dependent variable was categorical and ordinal, we created three dichotomous variables for HIV testing access to facilitate mapping and spatial analyses: Known access: Includes categories {1, 2, 3}, At least moderate access: Includes categories {2, 3}, Optimal access: Exclusively corresponds to category 3.

2.4.2. Independent Variables

The independent variables included age, gender, marital status, educational level, employment status, socio-economic status, risk behaviors, and level of knowledge about HIV. Additionally, community factors such as residential environment and region of origin were considered.

2.5. Analysis Strategy

All analyses and mapping were performed using R software (version 4.4.2).

2.5.1. Univariate Descriptive Analyses

For qualitative variables, frequencies and percentages were calculated to provide an overview of data distribution. For quantitative variables, measures of central tendency such as mean, median, and quartiles were determined to enrich the analysis. The results were visually represented in impactful ways: box plots highlighted distributions by district, while stacked bar charts detailed proportions across different categories. Finally, access percentages were meticulously mapped, offering insights into geographical disparities and facilitating a clear and intuitive understanding of the data.

2.5.2. Spatial Analysis

In this study, spatial analysis was used to identify geographic disparities in access to HIV testing within Guinea's health areas in 2018. The analysis began with a descriptive mapping of HIV testing access percentages by district and health area, offering a visualization of their distribution across the entire territory. Two complementary approaches to spatial detection were applied: global and local analyses of spatial clusters. The global analysis relied on Moran's I index, a spatial autocorrelation measure that evaluates the similarity of values between health areas based on their geographic proximity. A positive and significant Moran's coefficient (close to +1) indicates that neighboring health areas exhibit similar testing rates, thereby forming clusters. Conversely, a coefficient close to -1 suggests random dispersion of values [23, 27]. This test provided insight into general trends in the distribution without pinpointing the exact locations of the clusters. To refine this analysis, local cluster detection was conducted using the Local Indicator of Spatial Association (LISA). This metric, derived from global Moran’s I, highlights significant clusters or outlier values by considering the immediate neighbors of each health area [28]. The interpretation of LISA values was adjusted using Bonferroni correction to limit false positives. Significant clusters were represented visually on a map.

Additionally, hot spot and cold spot analyses using Getis-Ord Gi* statistics were employed to identify areas where testing rates were significantly higher (hot spots) or lower (cold spots) than expected by chance. The Z-scores associated with each health area were used to visualize these concentrations: positive and significant Z-scores indicated hot spots, while negative Z-scores signaled cold spots [29, 30]. These results were also presented in map format.

2.5.3. Modeling: Ordinal Logistic Regression with Cumulative Logits

Given the ordinal nature of the dependent variable (levels of HIV testing access), an ordinal logistic regression model with cumulative logits was used [31]. This method estimates the effect of explanatory variables on an ordinal categorical outcome under the assumption that the effect of each variable is constant across the different thresholds of the dependent variable. This is referred to as the proportional odds assumption [32]. Before implementing the model, this assumption was tested using a likelihood ratio test comparing a restricted model (including only intercepts) with the full model (incorporating all variables). The significance of the test, interpreted at the 1% threshold, validated the model's appropriateness. A stepwise backward selection procedure was then conducted, starting from the full model and progressively removing non-significant variables until the optimal model was obtained, as determined by the lowest Akaike Information Criterion (AIC). In the final model, odds ratios (ORs) with 95% confidence intervals were calculated, and variables with p-values below 0.05 were considered significantly associated with the different levels of HIV testing access.

3. Results

3.1. Participant Characteristics

The study, ecological and cross-sectional in design, examined geographic disparities and determinants of access to HIV testing in Guinea in 2018 among individuals aged 15 to 49 years. Descriptive analyses were conducted across 38 health districts, while spatial analyses focused on health areas, incorporating distance to testing centers as well as various contextual variables. A total of 14,451 participants were included, of whom 75.3% were women and 61.6% lived in rural areas. The mean age was 28.6 years, and 66.4% of individuals were married. The Nzérékoré and Conakry regions were most strongly represented in the sample (Table 1).

Table 1. *Description of Sociodemographic Characteristics of Survey Participants According to the 2018 Guinea Demographic and Health Survey Data.*

Variables	Categories	Number	Percentage (%)
Sex	Women	10,874	75.25
	Men	3,577	24.75
Marital status	Never married	4,4	30.44
	Married	9,593	66.38
	Widowed	198	1.37
	Divorced	260	1.79
Education level	No education	9,187	63.57
	Primary	1,797	12.43
	Secondary and higher	3,467	23.99
Employment status	Unemployed	4,08	28.23
	Employed	731	5.05
	Self-employed	9,64	66.70
Socioeconomic status	Poor	9,492	65.68
	Middle	3,633	25.14
	Rich	1,326	9.17
Residence setting	Urban	5,554	38.43
	Rural	8,897	61.56
Region	Boké	2,004	13.86
	Conakry	2,066	14.29

Variables	Categories	Number	Percentage (%)
	Faranah	1,73	11.97
	Kankan	1,768	12.23
	Kindia	1,863	12.89
	Labé	1,382	9.56
	Mamou	1,545	10.69
	Nzérékoré	2,093	14.48
	5-20 km	2,858	19.78
Distance to testing site	< 5 km	2,241	15.51
	> 20 km	9,352	64.72
HIV knowledge	Poor knowledge	9,026	62.45
	Good knowledge	5,425	37.55
Risk behavior	High risk	10,04	69.47
	Low risk	4,411	30.53

The median age ranges between 25 and 28 years, with notably higher interquartile ranges observed in certain districts. This reflects considerable diversity and highlights age as an inclusive criterion, smoothing out extremes.

3.2. Knowledge and Access to HIV Screening Services

Regarding the distance to the screening site, the median varies significantly from one district to another. Some districts stand out for their high interquartile range, indicating a wide dispersion in the distances traveled to access screening services (Figure 1).

The distribution of sex was consistent across all districts, with women representing most of the population compared to men.

Marital status was predominantly characterized by married individuals in most districts, followed by single individuals, whose proportions were notably higher in Ratoma, Matoto, Matam, Dixinn, and Kaloum compared to other districts. The proportions of divorced and widowed individuals remained relatively low across all areas.

Educational attainment analysis revealed that individuals with no formal education represented the largest group in every district. However, certain districts namely Ratoma, Matoto, Matam, Kaloum, and Dixinn—stood out for having higher rates of secondary and tertiary education (Figure 2).

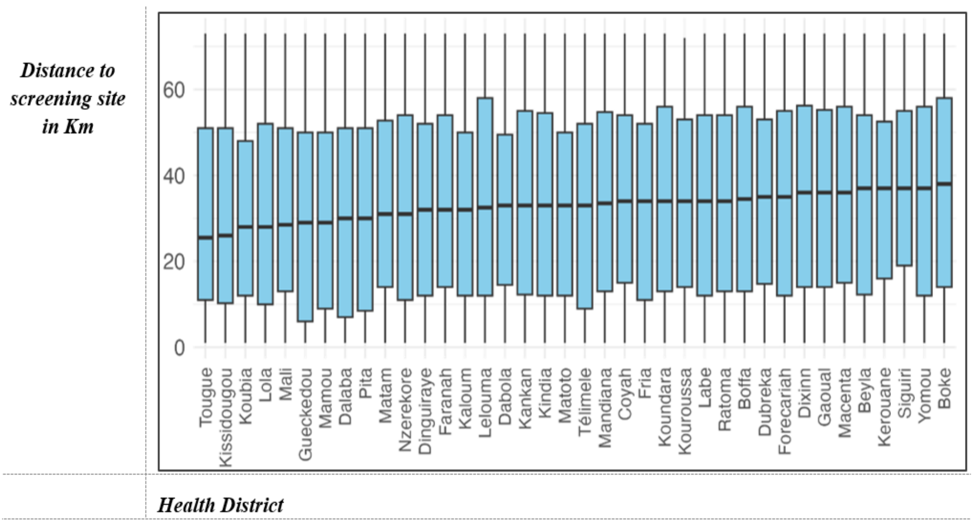


Figure 1. *Distribution of the distance to the screening site by Health District.*

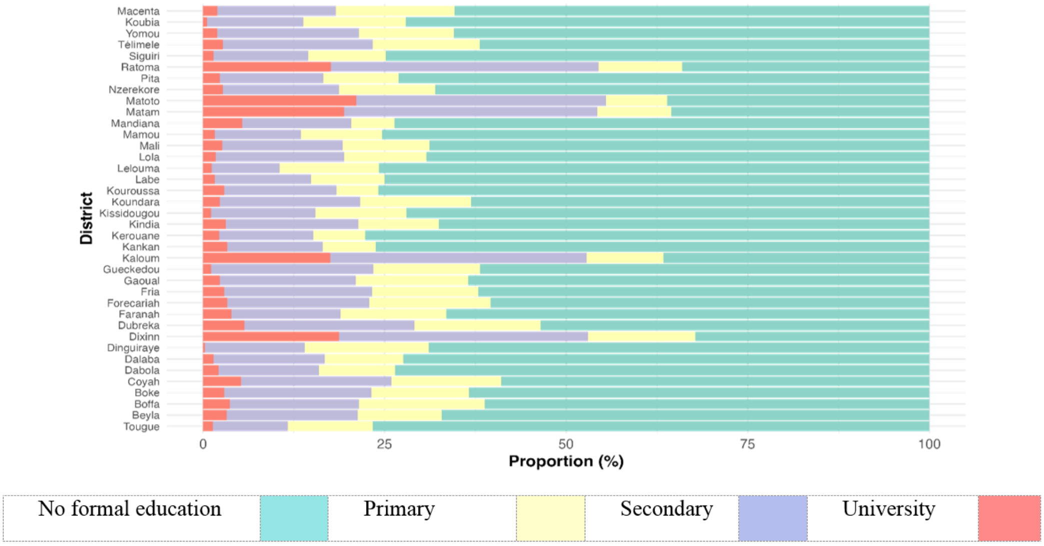


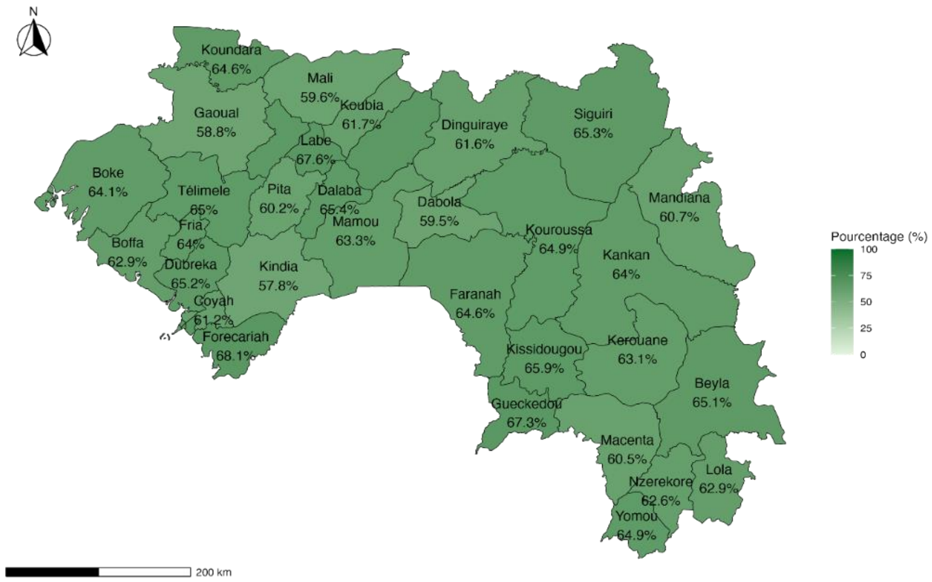
Figure 2. *Distribution of education level by district.*

A notable disparity in residential distribution was observed across health districts. Districts located in Conakry (Ratoma, Matoto, Matam, Kaloum, and Dixinn) are exclusively urban, whereas other districts such as Yomou, Tougué, Télimélé, Lélouma, and Kissidougou are predominantly rural, with only a small proportion of the population residing in urban areas.

Knowledge of screening sites was relatively uniform throughout all districts, with many individuals in each area aware of at least one screening facility.

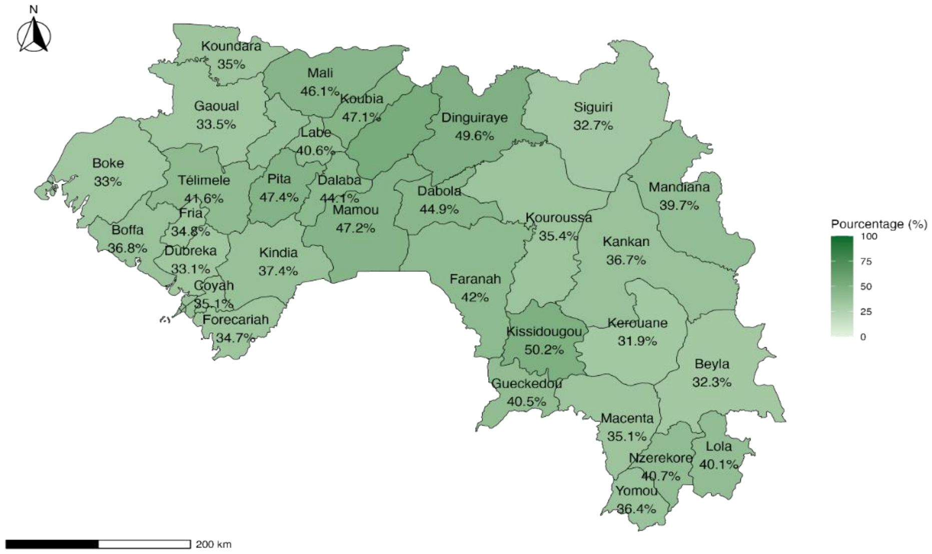
The cumulative percentages of the population with at least one known point of access were generally high across all health districts, indicating widespread awareness of screening sites (Figure 3). However, the proportions of individuals with at least moderate and optimal access decreased among those who were aware of a screening facility. Progressively fading from a light to a pale green on the maps (Figure 4 and Figure 5), these results illustrate that districts had more individuals with at least moderate access than those with optimal access.

These findings highlight a significant geographic disparity in screening access in Guinea, likely associated with the distance to screening sites and the urban-rural divide.



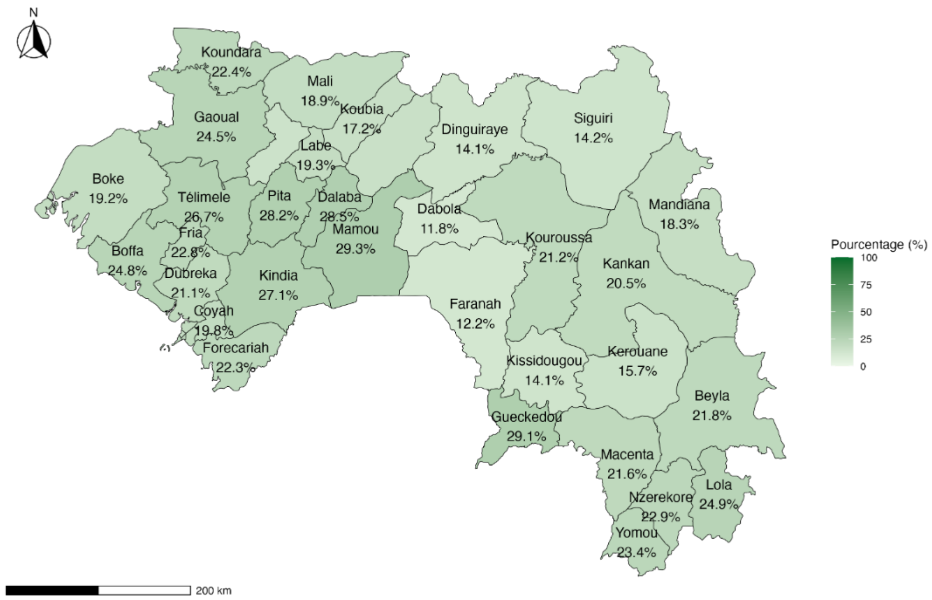
Source: DHS & PNLSH survey data, 2018

Figure 3. *Distribution of the percentages of at least one known access point by district.*



Source: DHS & PNLSH survey data, 2018

Figure 4. *Distribution of the percentages of at least moderate access by district.*



Source: DHS & PNLSH survey data, 2018

Figure 5. *Distribution of optimal access percentages by district.*

3.3. Spatial Analysis

3.3.1. Spatial Autocorrelation

The analysis of spatial autocorrelation using Moran's I coefficient reveals contrasting dynamics depending on the level of access to screening. For the population with at least one known access point, no significant spatial clustering is observed ($I = 0.013$; $p = 0.317$), indicating a rather random distribution across health areas. Conversely, the results for moderate access ($I = 0.170$; $p < 0.001$) and optimal access ($I = 0.232$; $p < 0.001$) highlight more marked tendencies toward geographic concentration: neighboring districts exhibit similar access levels, illustrating genuine zones of advantage or deficit. This approach thus underscores focal points of spatial inequalities, which are crucial for targeting efforts to improve screening equity at the national level.

3.3.2. Cluster and Outlier Analysis

The spatial analysis of HIV screening access reveals notable disparities between districts. Significant clusters of populations with at least moderate access are identified in the districts of Boké, Pita, Kankan, Kérouané, Macenta, and Lola, while Beyla reports substantially lower rates (Figure 6). For optimal access, high-percentage clusters are found in Pita, Dalaba, Kankan, Kérouané, Macenta, and Lola, whereas Koubia, Dabola, and Faranah stand out for their lower access levels. This mapping of strong and weak points sheds light on the regional dynamics unique to each area, providing targeted avenues for improving equity in screening and healthcare access (Figure 7).

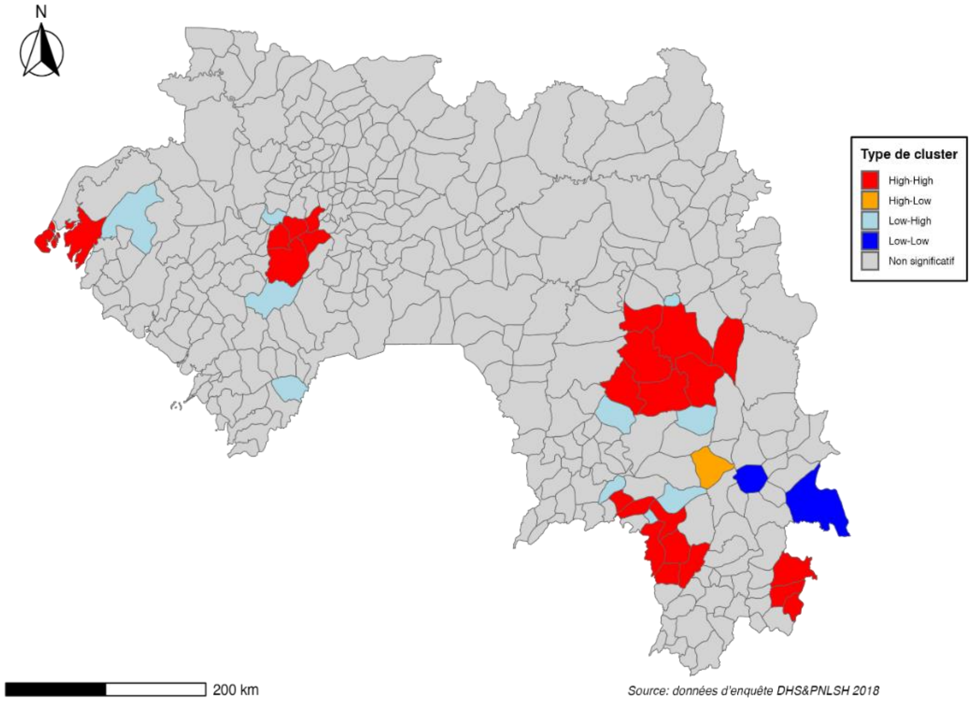


Figure 6. *Spatial clusters of the percentages of at least moderate access.*

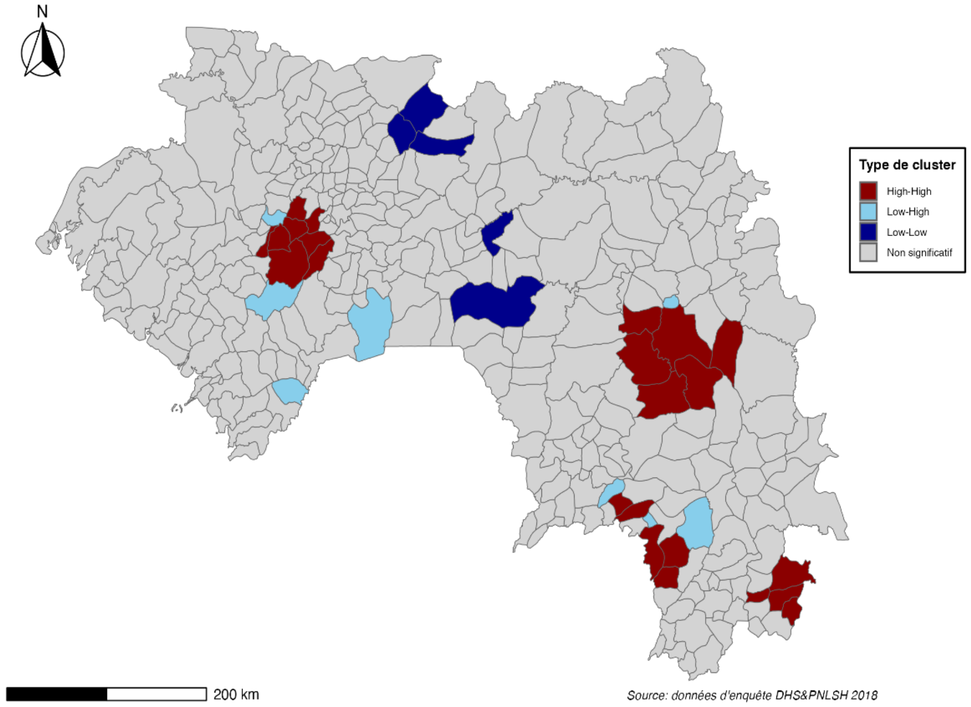


Figure 7. *Spatial clusters of optimal access percentages.*

3.3.3. Hot and Cold Spot Analysis

The analysis of hot and cold spots for moderate access rates highlights a contrasting distribution across health areas. Red zones, identified as hot spots, are characterized by a significant concentration of populations with at least moderate access to screening, while blue zones, or cold spots, point to areas where this proportion is particularly low (Figure 8). In contrast, for optimal access, hot spots appear in orange, revealing notably higher percentages, whereas purple zones indicate low rates of optimal access (Figure 9). Gray areas, meanwhile, show no statistically significant concentration.

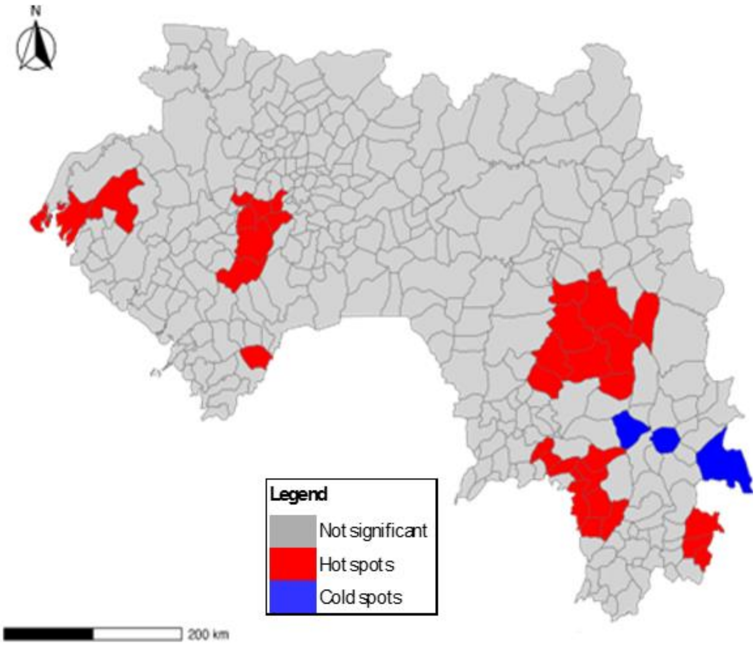


Figure 8. Analysis of hot and cold spots for percentages of at least moderate access.

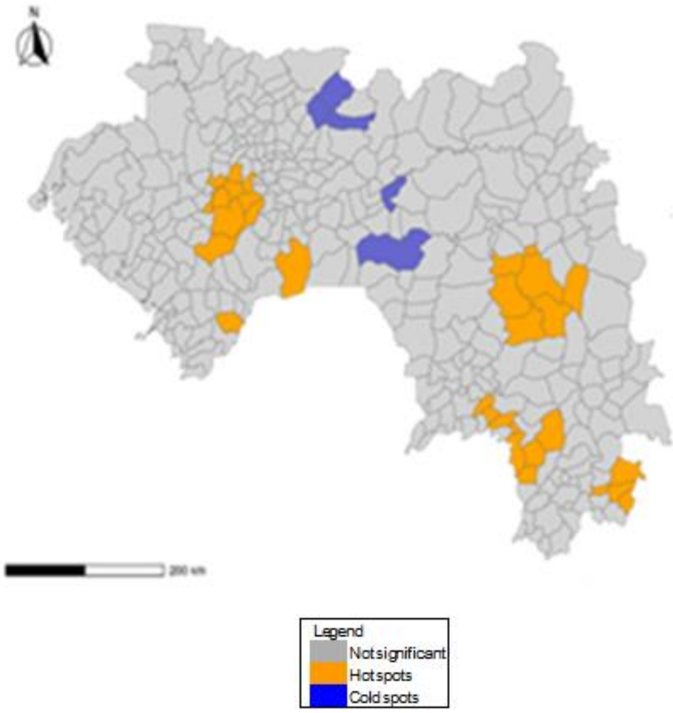


Figure 9. Analyse des points chauds et froids des pourcentages d'accès optimal.

3.4. Ordinal Logistic Regression

The full model incorporated various explanatory variables, including age, marital status, educational level, employment status, socioeconomic level, place of residence, region, HIV knowledge, and risk behaviors. A likelihood ratio test was conducted to compare this comprehensive model to a restricted model that included only the constants. The results were highly significant ($p < 0.01$), indicating that the full model provides a much better explanation of access to HIV testing. This statistical superiority highlights the critical contribution of explanatory variables in analyzing the determinants of HIV testing. Following a stepwise backward selection process, five key factors age, sex, marital status, socioeconomic status, and place of residence emerged as the main determinants influencing individuals' likelihood of undergoing HIV testing.

Table 2. Comparison of Models With and Without Intercepts.

Parameters	Initial Model (with intercepts)	Full Model
Number of parameters	11	27
Log-likelihood	-17,907	-16,634
AIC	35,837	33,322
LR test statistic	—	2,546.9
Degrees of freedom	—	16
p-value		< 0.01

After adjusting the model, age was found to be significantly associated with access to HIV testing, with an odds ratio (OR) of 1.005 (CI = [1.001 - 1.009], $p = 0.009$). All else being equal, each additional year of age was associated with a 0.5% increase in the odds of belonging to a higher category of testing access (limited, moderate, or optimal) compared to no access.

Sex ($p < 0.001$), socioeconomic status ($p < 0.001$), and place of residence ($p < 0.001$) also showed significant overall associations with access to testing. Men were 48.3% less likely than women to reach a higher category of HIV testing access (OR = 0.517; CI = [0.481 - 0.555]).

Similarly, individuals with high socioeconomic status had an 11.9% higher chance of being in a higher access category compared to those with low status (OR = 1.119; CI = [1.031 - 1.215]). Those living in urban areas were 38.4% more likely than those in rural areas to have access to a higher category of HIV testing (OR = 1.384; CI = [1.239 - 1.491]). These findings highlight the significant influence of various sociodemographic factors on access to HIV testing in Guinea.

Table 3. Adjusted model estimating the effect of variables on access to HIV testing among men and women aged 15 to 49 in Guinea in 2018.

Characteristics	OR	95% CI	p-value
Age (years)	1.005	1.001 - 1.009	0.009
Sex			<0.001
Female	—	—	—
Male	0.517	0.481 - 0.555	—
Socioeconomic status			<0.001
Low	—	—	—
High	1.119	1.031 - 1.215	—
Middle	0.932	0.855 - 1.016	—
Marital status			0.082

Characteristics	OR	95% CI	p-value
Single	—	—	—
Divorced	0.808	0.634 - 1.028	—
Married	0.916	0.840 - 0.998	—
Widowed	0.787	0.595 - 1.041	—
Place of residence			<0.001
Rural	—	—	—
Urban	1.384	1.239 - 1.491	—

Comparison levels: (P[Y ≤ 1]), (P[Y ≤ 2]), (P[Y ≤ 3])

4. Discussion

We conducted a cross-sectional ecological study using data from the 2018 Demographic and Health Survey to analyze spatial variation and factors influencing HIV testing access among men and women across health districts in Guinea. Descriptive analysis showed high percentages of individuals with at least some known access to testing in all health districts. However, these percentages gradually declined for moderate and optimal access levels, with significant spatial variation. The Moran's I statistic revealed a significant positive global spatial autocorrelation for moderate and optimal access rates. Spatial cluster analysis confirmed significant groupings of high and low values, reflecting marked geographic disparities. Additionally, ordinal logistic regression identified age, sex, socioeconomic status, and place of residence as significant determinants of testing access.

It is important to note that the cross-sectional design limits causal inferences, and the use of secondary data restricted access to additional variables that could have enriched the analysis.

Overall, findings highlight widespread awareness of testing facilities but reduced access at higher levels, indicating distance as a major barrier to testing. This aligns with broader Sub-Saharan African trends, where urban residents, particularly in large cities, have better access due to closer proximity to healthcare infrastructure [23]. Similarly, a study conducted in Paris revealed that disparities between neighborhoods were associated with contextual factors, such as local accessibility to testing services, which notably influenced the behaviors of vulnerable populations [33].

In our study, no significant global spatial autocorrelation was observed for the percentages of individuals with at least one known access, as indicated by Moran's I (I = 0.013; p = 0.317), suggesting a random distribution of awareness of testing sites across health areas. However, significant global spatial autocorrelation was detected for moderate access percentages (I = 0.170; p < 0.001) and optimal access percentages (I = 0.232; p < 0.001), highlighting a similar distribution of values in geographically proximate health areas. Cluster analysis revealed significant groupings of both high and low values in certain health areas. Similarly, Emebet Birhanu Lealem et al. reported a global Moran's I value of 0.444 (p = 0.00616), indicating a non-random spatial distribution [23]. Similarly, the authors identified clusters of both high and low values in geographically proximate regions, highlighting significant spatial disparities in HIV testing access. Getis-Ord statistical analysis revealed hotspots and cold spots, indicating significant concentrations of high and low percentages of individuals with at least moderate or optimal access in certain health areas. The presence of low values in some regions can be attributed to the lack of testing facilities in remote areas, forcing populations to travel long distances to urban centers. Furthermore, since most HIV intervention programs are donor-funded, the successful implementation and expansion of testing sites heavily rely on local stakeholders' capacity to efficiently manage resources and tailor interventions to community contexts [23, 34, 35]. Furthermore, these disparities may be explained by substantial geographic variations in education levels, media exposure, and living conditions [23, 36].

This study found that age (OR = 1.005; 95% CI: 1.001-1.009) was significantly associated with access to HIV testing, controlling for other factors. This finding is consistent with results reported in previous studies [37-39].

The study revealed that sex was significantly associated with HIV testing uptake. Men were 48.3% less likely than women to achieve a higher category of testing access (OR = 0.517; 95% CI: 0.481-0.555). Similar disparities between sexes in HIV testing utilization have been reported in other studies. This difference may be explained by women's more frequent use of maternal, child health, family planning, and other related health services, which facilitates their access to HIV testing compared to men [23].

Socioeconomic status was significantly associated with access to HIV testing. Individuals with higher socioeconomic status had a 11.9% greater likelihood of belonging to a higher category of testing access compared to those with lower socioeconomic status (OR = 1.119; 95% CI: 1.031-1.215). This finding is consistent with results reported in other studies [40-42].

This study found that place of residence was significantly associated with access to HIV testing. Individuals living in urban areas were 38.4% more likely than those in rural areas to belong to a higher category of testing access (OR = 1.384; 95% CI: 1.239-1.491). This finding aligns with previous studies reporting that people residing in rural areas have lower likelihoods of accessing testing compared to their urban counterparts [23, 43]. The availability and accessibility of healthcare services, infrastructure deficiencies, and low levels of awareness may explain this disparity [40]. Furthermore, in large cities and urban areas, the high population density supports the availability of infrastructure such as healthcare facilities and testing sites, in contrast to rural areas. In rural settings, populations tend to be smaller and more dispersed, resulting in greater distances from health and testing services, which are predominantly located in urban centers.

Strengths and Limitations

Strengths

This study presents several noteworthy strengths. First, it leverages nationally representative data from the 2018 Demographic and Health Survey (DHS), ensuring strong external validity and allowing for generalization of findings to the broader Guinean population aged 15-49 years. Second, the ecological and cross-sectional design enables an in-depth exploration of geographic disparities in access to HIV testing across 340 health areas and 38 districts, making it one of the few studies to conduct such granular spatial analysis in the country. Third, the use of advanced spatial statistical methods such as Moran's I, local indicators of spatial association (LISA), and Getis-Ord hot spot analysis adds significant methodological rigor and highlights patterns of spatial clustering that are critical for targeted intervention planning. Finally, the integration of multivariable ordinal logistic regression identifies individual-level determinants, strengthening the analytical depth and policy relevance of the findings.

Limitations

Despite its strengths, this study has certain limitations. First, the cross-sectional nature of the data precludes any inference of causality between the predictors and access to HIV testing. Second, the analysis relies on secondary data, which limits control over the variables included and prevents the exploration of other potentially influential contextual factors, such as stigma, health-seeking behavior, or facility-level service availability. Third, the ecological design may introduce an ecological fallacy, as associations observed at the aggregate level may not hold at the individual level. Finally, spatial misclassification or inaccuracies in the geographical positioning of clusters may affect the precision of the spatial analysis, especially in rural or remote areas.

Despite these limitations, this study offers important insights into the spatial dynamics and sociodemographic factors influencing access to HIV testing in Guinea. It provides valuable evidence to guide geographically targeted and equity-focused public health interventions aimed at achieving universal access to HIV diagnostic services.

5. Conclusion

This study highlights significant geographic disparities in access to HIV testing across Guinea, underscoring the influence of sociodemographic factors such as age, gender, socioeconomic status, and residential setting. The findings suggest that while awareness of HIV testing is widespread, moderate and optimal access remains limited in many areas, particularly rural and underserved regions. These inequities emphasize the urgent need for context-specific and spatially targeted public health strategies to improve testing coverage. Strengthening community-based interventions, expanding testing services to hard-to-reach populations, and integrating HIV testing into broader primary healthcare services are critical to closing the gap. Addressing these disparities is vital to achieving equitable access to HIV services and advancing the country's progress toward epidemic control. We additionally propose conducting a mixed cross-sectional prospective study, combining both quantitative and qualitative components, in order to better understand the factors limiting access to HIV testing services in Guinea.

6. Ethical Considerations

Data access was authorized by the DHS data center, with approval from the international review committee. The data, retrieved via an online request on the DHS website, were processed anonymously, adhering to the ethical principles of the Declaration of Helsinki to ensure participant confidentiality. Additionally, HIV testing data were provided by the National Program for the Fight Against AIDS and Hepatitis (PNLSH) following a formal request addressed to its National Coordinator.

Abbreviations

AIC	Akaike Information Criterion
AIDS	Acquired Immunodeficiency Syndrome
ART	Antiretroviral Therapy
DHS	Demographic and Health Survey
HIV	Human Immunodeficiency Virus
INS	National Institute of Statistics
LISA	Local Indicator of Spatial Association
LVHIV	People living with HIV
OR	Odds Ratios
PNLSH	Fight Against AIDS and Hepatitis (PNLSH)
UNAIDS	United Nations Programme on HIV/AIDS
WHO	World Health Organization

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Author Contributions

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Conflicts of Interest

The authors declare no conflicts of interest.

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