p-ISSN 2086-6380, e-ISSN 2548-7949

Jurnal Ilmu Kesehatan Masyarakat (JIKM)

HIV TESTING AND ACCESS IN PALEMBANG, SOUTH SUMATRA, INDONESIA DURING THE 2021 COVID-19 PANDEMIC

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ARTICLE INFO

Article History:

Received : March 12, 2025

Accepted : June 16, 2025

Published: August 4, 2025

DOI:

https://doi.org/10.26553/jikm.2025.16.2.249-268

Available online at

http://ejournal.fkm.unsri.ac.id/index.php/jikm

ABSTRACT

HIV testing is one of the most effective strategies for accelerating access to prevention and treatment services, supporting efforts to end the AIDS epidemic by 2030 through the 95-95-95 targets. This study describes the socio-demographic characteristics and spatial distribution of HIV cases and screening among key and general populations in Palembang City in 2021. Data were extracted from the HIV/AIDS Information System and analyzed using descriptive and ecological spatial analysis within the key and general populations. Findings indicate the rates of HIV are 4.2 per 100 among Men having Sex with Men (MSM) and 7.8 per 100 transgender individuals accessing HIV testing. Among women and pregnant women, rates were zero and 1.04 %, respectively, while among children (0-19 years old), the rate was nearly 2 per 100 children. A higher level of HIV testing in health facilities was correlated with increased detection of HIV cases. Among low-risk groups of women and children, one subdistrict, Kemuning, reported 30 HIV- positive cases in women and children – markedly higher than the 0 to 6 HIV-positive cases reported in other subdistricts. The observed disparity underscores a critical public health challenge: the potential for a hidden HIV epidemic among pregnant women in Palembang, a situation likely exacerbated by service disruptions during the COVID-19 pandemic.

Keywords: HIV testing, spatial analysis, COVID-19 Pandemic, Palembang.

Introduction

The National HIV/AIDS strategic plan aims to end the AIDS epidemic by 2030 through the 95-95-95 targets. In line with the direction of the national action plan, the Indonesian government and stakeholders are working together to implement various HIV prevention and control measures**,** including accelerating access to HIV testing.[1] Early detection through HIV screening contributes to more cases being found and treated. The Ministry of Health Regulation Number 4 of 2019 mandates education and HIV screening as a minimum standard of service (*Standar Pelayanan Minimal or SPM*) in community health services (*Pusat Kesehatan Masyarakat* or *puskesmas*) across Indonesia. This regulation stipulates that "health services for people at risk of being infected with viruses that weaken the human immune system (Human Immunodeficiency Virus)" must meet 100% of the quality of service of each type of basic service under the health SPM which is an indicator of the 12th Minimum Service Standard, namely health services for people at risk of HIV infection. HIV screening in Indonesia largely targets both the key and general population, including pregnant women, tuberculosis patients, individuals with Sexually Transmitted Infections (STIs), female or male sex workers, Men having Sex with Men (MSM), Persons Who Inject Drugs (PWID) and prisoners.[2]

There have been impressive gains in the uptake of HIV testing around the world. The COVID-19 pandemic, however, has disrupted access to HIV testing and screenings in Indonesia. Since the beginning of the HIV epidemic, Indonesia has made ongoing efforts to prevent and control HIV, as evidenced in multiple strategic and national action plans across the health sector and other sectors. Such collaboration involves various stakeholders and funding sources from the national and regional governments, communities, and international development cooperation.[3] For instance, In 2022, USAID (U.S. Agency for International Development) provided HIV testing to 22.4 million people, helped over 800000 people learn of their HIV-positive serostatus and linked 92 per cent (approximately 750000) to treatment. Additionally, USAID distributed over 2.6 million HIV self-test kits.[4]

During the COVID-19 pandemic, there was a global decline in newly reported HIV cases from 1.7 million in 2019 to 1.5 million in 2020 and further down to 1.3 million in 2022.[5,6] In the US, new HIV cases reported to the CDC (Centers for Disease Control and Prevention) decreased by 17% between 2019 and 2020, a substantial decline coincided with a significant reduction in HIV testing, including among priority populations in CDC-funded jurisdictions.[7]

Globally, in 2022, 46% of all new HIV infections were among women and girls. Every day in 2022, approximately 740 children were newly infected with HIV, and approximately 274 children died from AIDS-related illnesses, largely due to a lack of access to HIV prevention, care and treatment services.[8] In Indonesia, the availability of HIV testing services during the pandemic, was severely limited during the COVID-19 Pandemic. Of the 10,203 health facilities in 2020,[9] By

the end of December 2020, only 7,391 or 74% were able to provide HIV counselling and testing services.[10]

Research by Magnani et al (2022) conducted in 23 priority districts in Indonesia between January and July 2020 reported a 50% decline in the availability of testing services in health facilities, which then gradually began to recover. Mobile clinic services were mostly stopped during April-June. In addition, the number of Female Sex Workers (FSWs) tested for HIV and HIV cases detected all declined drastically in April and May but had largely returned to pre-pandemic levels by July.[11] Overall, the COVID-19 pandemic resulted in a 47.6% reduction in HIV testing services due to fears of COVID-19 transmission.[12]

Indonesia has reported approximately 526,841 HIV cases by 2022. In 2021, new HIV infections were at 27,000 (25,000-28,000), a significant decline from 46,000 (42,000-50,000) in 2018. Before the COVID-19 pandemic[13,14] Children aged 0-14 years accounted for 10 per cent of reported cases,[5] with an estimated 2800 new HIV infections among children in 2022.[15] New HIV cases in Palembang during the early stage of the pandemic were 268 cases in 2019, dropped to 219 cases in 2020, and further dropped to 93 cases in 2021.[16] While the decline in HIV services in Palembang in 2021 is not specifically mentioned in the available data, the reduction likely reflects service disruptions during the pandemic.

In 2022, there was a reported increase to 261 HIV cases from 93 cases in Palembang, partly due to the resumption of data collection after temporarily halted during the pandemic, as reported by the Palembang City Health Department.[17] A systematic literature review conducted in South Africa highlights the decline in new HIV diagnoses during the peak of the COVID-19 pandemic, primarily due to reduced HIV testing.[18] Spatial analysis has been used in China to identify trends and spatial clustering within the key and the general populations.[19] This study shows that spatial analysis can provide an in-depth understanding of the socio-demographic and behavior determinants of HIV, reinforcing the importance of tailored HIV education for different socio-demographic groups.

Although global awareness of the importance of HIV testing continues to increase, and Palembang has shown strong commitment to HIV prevention and control efforts, specific knowledge gaps in the literature continue to limit the effectiveness of HIV testing at the local level.[20] Previous research in Palembang and other regions in Indonesia has often focused on key populations due to the high prevalence of HIV in these groups.[21,22] These studies have successfully identified major barriers faced, such as stigma, discrimination, and the lack of friendly services in conventional healthcare facilities. On the other hand, HIV testing among the general population is conventional healthcare settings. On the contrary, HIV testing in general populations is often integrated into routine services, yet data on testing behavior, coverage rates, and challenges faced by the general population in Palembang remain understudied.

This study focuses on HIV testing and access in Palembang, the capital city of South Sumatra Province. Research that identifies access gaps between key populations and general populations can directly inform health policy development. Understanding the specific barriers of key populations (such as fear of confidentiality breaches or discrimination) can guide the development of supportive policies. Similarly, understanding barriers experienced by the general population (such as lack of awareness or low risk perception) can inform policies that integrate HIV testing more effectively into routine health systems. By mapping these access differences, decision-makers can move away from 'one-size-fits-all' strategies toward tailored interventions, enabling more resource allocations and accelerating progress to end the HIV epidemic. This study aims to analyse the socio-demographic characteristics of key and general populations in accessing HIV testing in Palembang in 2021, and to examine the spatial accessibility of HIV testing using the Geographic Information System.

Methods

This study uses descriptive (also epidemiological) analysis, followed by spatial analysis to examine HIV testing access among key and the general populations. The study was conducted in Palembang City, South Sumatra, Indonesia. The research relies on secondary data collected from hospitals and health centres in Palembang City, initially collected by health workers or Non-Governmental Organisations (NGOs). The sample was analysed to capture the characteristics of key populations (high risk) and general populations (low risk) who were vulnerable to HIV and accessed HIV testing. Spatial area mapping data was also carried out. Secondary data was obtained from the SIHA website of the Palembang City Health Office. Access to secondary data was obtained through official requests or data requests submitted to the Palembang City Health Office (HIV-AIDS Program). Researchers requested access or asked staff managing HIV or SIHA accounts to export data as needed.

The demographic profiles and HIV/AIDs were obtained from the HIV/AIDS Information System (*Sistem Informasi* HIV/AIDS or SIHA) in 2021. SIHA provides access to HIV-related data across various health services (*Puskesmas* and hospitals). The variables used in this study included the number of HIV cases in the key and the general populations, as well as their characteristics - age, employment, education, marital status, and HIV test result.

The 2021 SIHA data provided to the researchers had undergone several stages of data processing by the Palembang City Health Office Team. These processes included extraction, editing, coding and formatting to ensure confidentiality and to limit the risk of disclosing personal patient data. In preparing for the analyses, the research team removed entities with missing data due to incomplete filling in the original 2021 SIHA data form. The remaining characteristic variables were transformed into new variables. SIHA data were collected using the Voluntary

Counselling and Testing (VCT) and Provider Initiated Testing and Counselling (PITC) forms, which were completed by health providers at health facilities. As the primary data custodians, these healthcare providers and the Palembang City Health Office had ensured validity; thus, no further validation was required by the research team.

The study population included residents of Palembang City categorised into the 'bridging population'. According to UNAIDS, a bridging population is "a population at higher risk of HIV exposure whose members may have unprotected sexual relations with individuals who are otherwise at low risk of HIV exposure".[23] In this study, individuals were classified into high and low risk groups. MSM (Men having Sex with Men), FSW (Female Sex Workers), transgender and PWIDs (Persons Who Inject Drugs) were categorised as high-risk groups. Women, including pregnant women and children, were categorised as low-risk groups.

The data analysed consisted of aggregated data representing the total number of HIV cases and individuals accessing HIV testing, categorised by sub-district and health facility. In total, 2,301 samples from key population groups and 11,202 from the general population were included. These samples comprised key population groups (MSM, FSW, transgender, and PWIDs) and the general population (women and children) who accessed HIV testing services in Palembang City in 2021.

For statistical analysis, univariate analysis was used to present categorical data, with each variable described as a percentage (%). These results support epidemiological calculations. Including positive rates and age-specific rates. The Age-Specific Rate is calculated similarly but focuses on HIV positive individuals within specific age categories. It is derived by dividing the number of HIV positive individuals in each group within the high-risk and low-risk groups by the total number tested in the corresponding groups, multiplied by the 1,000 population.[24]

The Positive Rate was calculated by dividing the number of HIV positive individuals in high-risk and low-risk populations in 2021 by the total number of individuals in each group who underwent HIV testing, then multiplying by 1,000 population. The positive rate estimates the proportion of individuals in different risk groups with HIV positive test results during a certain period. The age-specific rate provides the proportion of HIV positive individuals within a specific risk group by age category.

In this research, the ecological study helped show how different groups in Palembang city were affected by HIV in 2021, by mapping where people who got HIV tested lived. This ecological study helped to explain how various population groups are vulnerable to HIV in the city of Palembang in 2021. Spatial analysis was conducted using QGIS Desktop (Version 3.16.10) to map coverage areas of HIV testing for the key and general populations. QGIS (Quantum Geographic Information System) is a geographic information system software that visualises spatial data and area codes.[24,27] Buffer analysis was conducted to identify HIV treatment facilities within a 5 km radius. The results are presented as a map within the buffer zones, including map details, data

sources, and descriptive interpretation. Ethics approval was received from the Health Research Ethics Committee (No. 015/UN9.FKM/TU.KKE/2022).

Results

Table 1 shows that most key populations accessing HIV services had non-reactive HIV test results, including MSM (95.8%), FSW (100%), and transgender persons (92.2%). Of these key populations, transgender individuals had the highest proportion of those employed (92.5%) and completed senior high school (98.4%). Most of the key populations were aged ≥ 25 years, with the largest proportion in the transgender group (90.6%), most of whom had never been married.

Table 1. Demographic Characteristics of Key Populations Accessing HIV Services

Variables	MSM (n= 1708)		FSW (n= 527)		PWID (n= 2)		Transgender (n= 64)	
	n	%	n	%	n	%	n	%
Employment								
Unemployed	335	19.6	66	12.5	1	50	5	7.9
Employed	1,373	80.4	461	87.5	1	50	59	92.3
Education level								
Senior High School or lower	1,587	92.9	517	98.1	1	50	63	98.4
University graduate/Diploma	121	71	10	1.9	1	50	1	1.6
Marital status								
Never been married	1,434	84	198	37.6	2	100	52	81.3
Married	274	16	329	62.4	0	0	12	18.8
Age (year)								
<25	681	39.9	121	23	1	50	6	9.4
≥25	1,027	60.1	406	77	1	50	58	90.6
HIV test result								
Non-reactive	1,636	95.8	527	100	0	0	59	92.2
Reactive	72	4.2	0	0	2	100	5	7.8

In this study, Children and women are categorised as general population that is considered as low-risk populations. MSM, FSW, PWID, and transgender individuals are categorised as key population that is considered as the high-risk populations. Table 2 shows that among 829 children tested, 16 were HIV-positive. The positivity rate was 2.6 per 100 children tested for HIV. Nearly two (or 1.9) per 100 for those aged 5–14 years, and 1.8 per 100 for those aged 15–19. Among pregnant women, 9034 were HIV tested, all with negative results. Among women, 1339 tested, 14 were positive; a positive rate of 1.04 per 100 women.

Among the key population, Table 2 shows that 72 MSM tested positive, meaning 42 per 1000 MSM had positive results. For MSM aged 15-25, the HIV positivity rate was the highest, with 28 out of 770 MSM testing positive. No female sex workers tested positive. Both injecting drug users (IDUs) tested positive; they were aged 21-25, resulting in a positivity rate of 10 per 100 IDUs. Among transgender individuals, the positivity rate was 7.8 per 100.

Table 2. HIV Testing Positive Rates Across the Population Groups

Groups		Age (year)	People who access HIV tests	HIV Positive Result	Positive Rate
General Population	**Children**	Under 4	155	4	2.6
		5-14 years old	103	2	1.9
		15-19 years	571	10	1.8
		COUNT (Positive Rate)	**829**	**16**	**1.9**
	Pregnant Women	12-25	2,345	0	0
		26-39	6,045	0	0
		40-53	543	0	0
		54-67	64	0	0
		68-82	14	0	0
		COUNT (Positive Rate)	**9,034**	**0**	**0**
	Women	≤19	6	1	16.7
		20-24	219	1	0.5
		25-49	990	9	0.9
		≥50	112	3	2.7
		COUNT (Positive Rate)	**1,339**	**14**	**1.04**
Key Population	**Men Having Sex with Men (MSM)**	15-25	770	28	3.66
		26-36	574	32	5.6
		37-47	255	11	4.3
		48-58	80	1	1.3
		59-70	29	0	0
		COUNT (Positive Rate)	**1,708**	**72**	**4.2**
	Female Sex Worker (FSW)	17-27	189	0	0
		28-38	200	0	0
		39-49	106	0	0
		50-60	27	0	0
		61-72	4	0	0
		COUNT (Positive Rate)	**527**	**0**	**0**
	Injecting Drug Users (PWID)	**21-25 (Positive Rate)**	**2**	**2**	**100**
	Transgender	16-25	10	2	200
		26-36	19	2	10.5
		37-47	19	0	0
		48-58	13	1	7.7
		59-66	3	0	0
		COUNT (Positive Rate)	**64**	**5**	**7.8**

***Note:** Positive rate is the proportion of positive people out of the total number of people tested for HIV. If the positive rate is low, it means that only a few people are HIV positive out of the total number of people tested for HIV, and vice versa.

Figure 1 shows that the highest HIV-test access among MSM, transgender persons, and FSWs was recorded at Sukarami Community Health Centres (*Puskesmas*), with a total of 388 people (273 MSM, 32 transgender, 83 FSW). Puskesmas Merdeka followed this with 377 people

(230 MSM, 60 transgender, 87 FSWs) and *Puskesmas* Nagaswidak with 337 people (285 MSM, 5 transgender, 47 FSWs).

Category 2 considered a high-access group, includes *Puskesmas* Dempo with 281 people (207 MSM, 5 transgender, 69 FSWs), and 5 other *Puskesmas* - Makrayu, Kampus, 1 Ulu, Boom Baru, and Basuki Rahmat had medium HIV-testing levels. Puskesmas with low and the lowest levels of HIV-testing, ranging from 0-78 and 78-155 cases, are distributed across several locations.

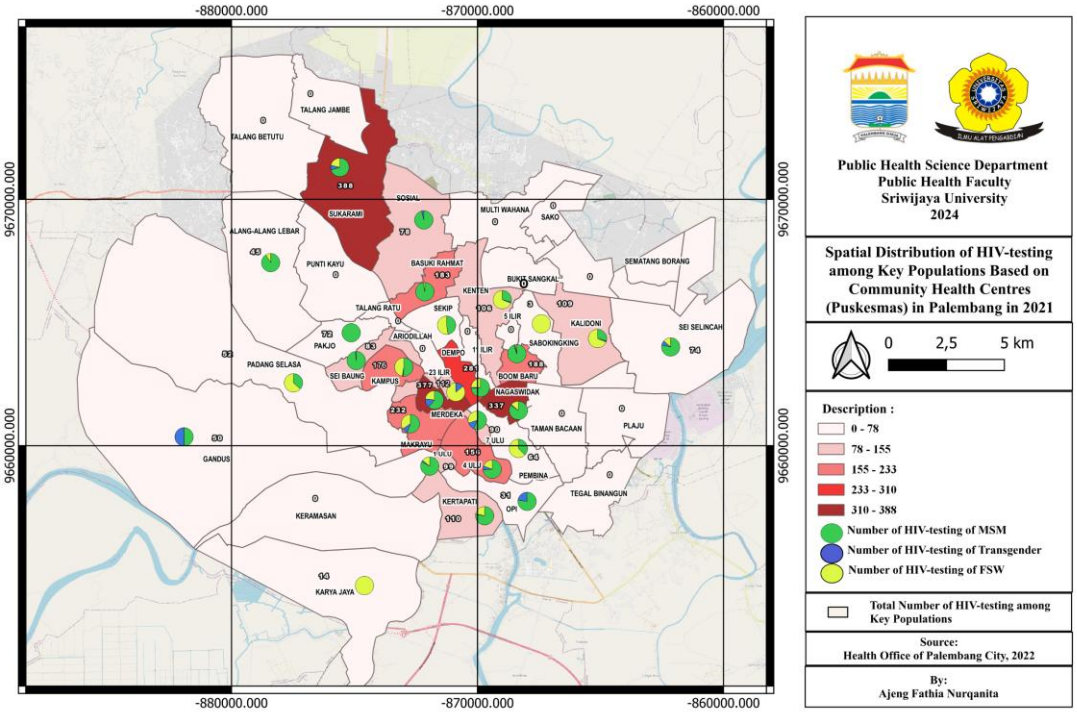

Figure 1. Spatial Distribution of HIV Testing Among key populations by *Puskesmas* in Palembang, 2021

Figure 2 shows that the highest number of HIV positive cases was found in Kemuning, with 30 HIV+ (25 women out of 1222 and 5 children out of 122 tested). This is followed by Bukit Kecil with 6 HIV positive cases (3 women out of 500 and 3 children out of 48). Eight other sub-districts had a medium HIV+ distribution. Several subdistricts, including Gandus, Kertapati, and Ilir Barat II. Seberang Ulu I, Jakabaring, Ilir Timur, Kalidoni, Sako, and Sematang Borang reported low or zero HIV positive cases.

Figure 3 illustrates the accessibility of HIV testing and treatment within a 5 km radius of known positive cases. The highest concentration of People Living with HIV (PLHIV was found in the Kemuning sub-district, with a total of 73 HIV positive cases. This was followed by 11 sub-districts with lower distributions: Ilir Barat I (30 PLHIV), Ilir Timur I (26), Sukarami (25), Seberang Ulu II (20), Bukit Kecil (19), Seberang Ulu I (6), Kalidoni (3) PLHIV), Plaju and Ilir East III (2 each), and Jakabaring (1). Seven sub-districts reported no PLWH cases: Kertapati,

Gandus, Alang-Alang Lebar, Ilir Barat II, Ilir Timur II, Sako and Sematang Borang. A buffer analysis was conducted to map areas within 5 km of HIV treatment facilities relative to the distribution of PLHIV. However, the data might have underestimated actual cases due to limited accessibility of HIV testing during COVID-19.

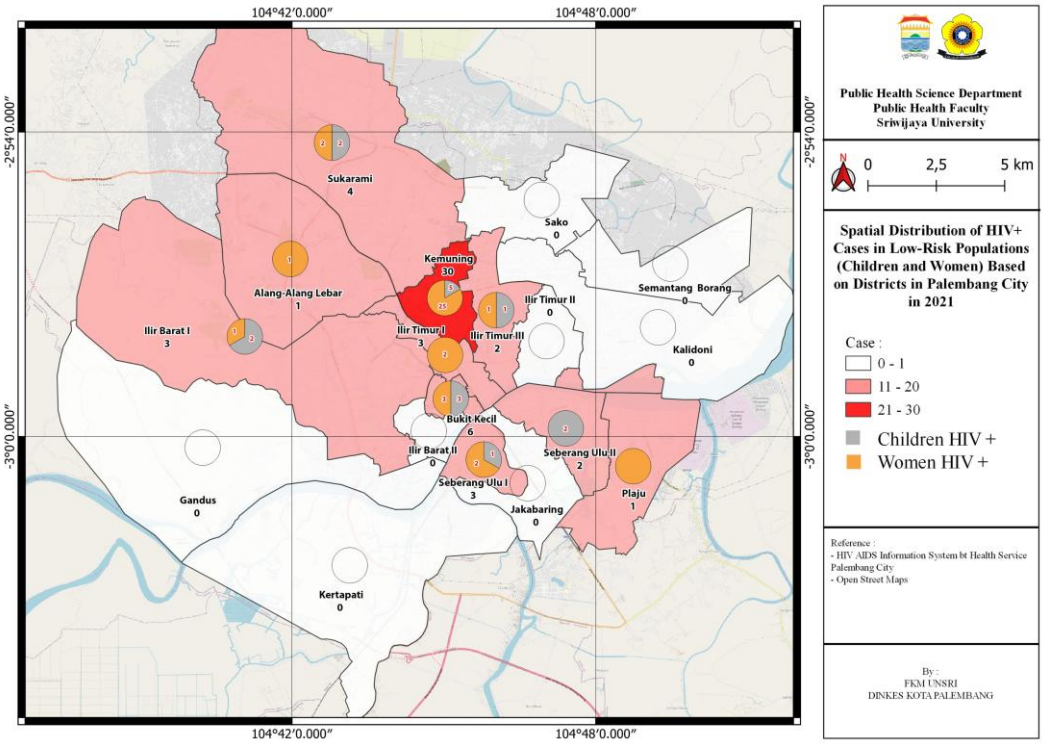

Figure 2. Spatial Distribution of HIV-Cases among general population Based on Sub-District (*Kecamatan*) in Palembang in 2021

In Figure 3, *Puskesmas* providing HIV treatment are marked with a red plus sign, while hospitals are marked by a red circle with a red plus sign in the centre. Buffer zones are represented in green for Puskesmas and green for hospitals, representing their 5 km coverage areas. In the sub-districts of Bukit Kecil, Seberang Ulu I, Kemuning, and Seberang Ulu II, HIV treatment facilities cover the entire area. However, coverage is incomplete in Sukarami, Plaju and Ilir Barat I subdistricts.

The spatial analysis shows that HIV testing among MSM, transgender individuals, and FSWs was highest at Sukarami, Merdeka, and Nagaswidak *Puskesmas*, each testing over 300 people. Dempo also records high testing numbers, while Makrayu, Kampus, 1 Ulu, Boom Baru, and Basuki Rahmat fall into the medium level category. Other Puskesmas had low to very low HIV testing coverage. Kemuning sub-district has the highest HIV burden within Palembang City, with the largest number of HIV-positive women, children, and a total of 73 PLHIV. However, the buffer analysis shows that HIV treatment facilities mostly cover high-burden areas like Kemuning and Bukit Kecil. Yet gaps remain in parts of Sukarami, Plaju, and Ilir Barat I, leaving some PLHIV

with limited access within a 5 km range. This highlights the need to expand HIV service coverage to underserved areas.

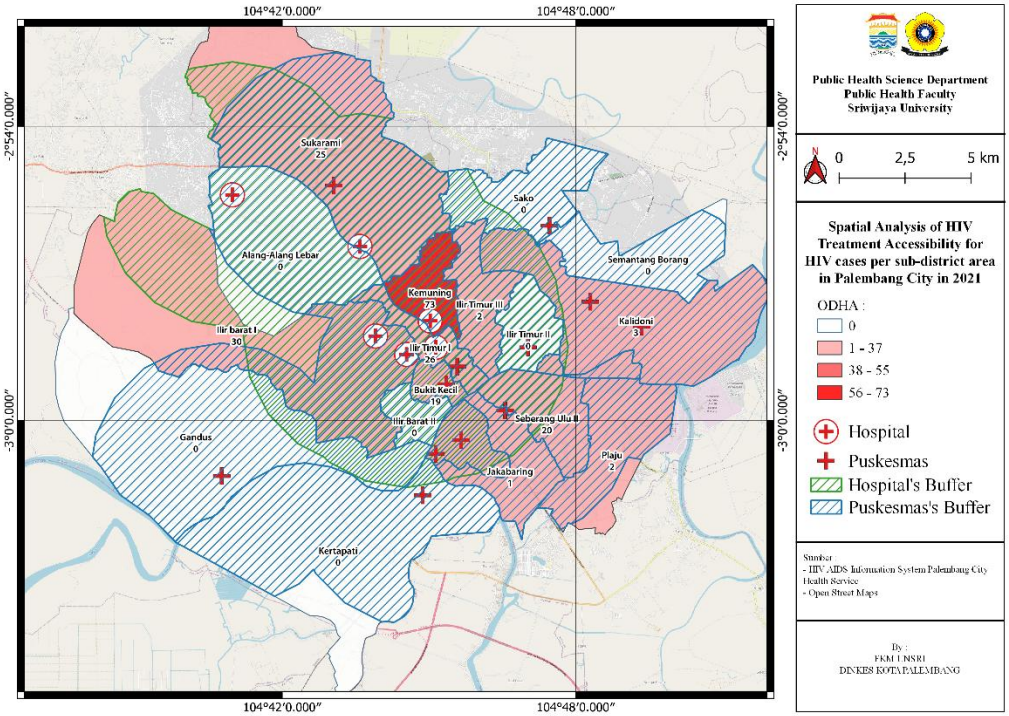

Figure 3. Accessibility of HIV-Testing Accessibility and Treatment within a 5 km Radius from HIV-Positive Cases, 2021

Discussion

This study supports the Indonesian Ministry of Health and UNAIDS 95-95-95 targets, focusing especially on the first goal, ensuring 95% of PLHIV know their HIV status. This research was conducted among key populations and the general population in the city of Palembang, with notable HIV prevalence in South Sumatra Province. Achieving the national goal of ending HIV/AIDS requires equitable access to HIV testing and counselling, as well as effective HIV prevention, treatment and care services.

While anyone at risk of HIV infection should be able to access testing at a health facility, the reality, particularly during the COVID-19 pandemic, was challenging. Both population groups face significant challenges in accessing testing and treatment services. Previous studies have shown that HIV testing declined significantly following the onset of the pandemic, with low-and lower-middle-income countries, like Indonesia, experiencing greater reductions compared to high-income countries.[28]

The pandemic has affected healthcare workers and resources to respond to COVID-19.[29] Many facilities that had previously offered HIV services reduced capacity or suspended services altogether, either due to the demand for COVID-19 care or to prevent the risk of transmission.

Furthermore, restrictions on movements and social interactions, and fear of exposure to COVID-19, further exacerbate individuals' fears of visiting healthcare facilities for HIV testing or treatment. COVID-19 disruptions have had a significant impact on the use and provision of HIV services, with implications for policy and practice at the global, national and organisational levels.[30]

Our findings show that the majority of key population groups were aged 25 years and older (25-49 years). This is consistent with the 2021 Ministry of Health report, which notes that 70.7% of HIV cases in Indonesia were found in the 25-49 age group (70.7%), followed by 15.7% in the 20-24 age group.[31] Regarding employment status, most individuals in the key groups were employed, mainly as private employees. This concurs with previous research, where the majority of respondents were unmarried and working.[32] The nature of employment amongst the key populations, such as labourers, nightclub workers, and Indonesian migrant workers, may contribute to higher vulnerability to HIV/AIDs.

This study reveals that individuals aged 15 and older face a higher burden of disease and mortality from HIV, particularly in the key population groups.[33] This means that the disease affects individuals during their most productive years, which can lead to reduced economic productivity. Risky sexual behaviours, such as unsafe sex, injecting drug use, are often more established after age 25, making prevention efforts more complex and challenging.[34] Key populations aged 25-49 typically have more sexual experience and are more likely to have multiple sexual partners or engage in high-risk sexual behaviors (e.g., unprotected sex, anal sex) increasing the risk of transmission. Furthermore, this age group is also involved in high levels of social and sexual activity, further increasing exposure to HIV.

Our findings show that most key populations have completed high school, consistent with other studies where more than half of MSM, transgender, and PWID have attained a senior high school.[35] Another study reported that 84.3% of respondents had at least a senior secondary education.[36] Among MSM in Oebobo District, Kupang City, 67.9% had completed high school.[37] These findings suggest a relatively high level of literacy within these key populations.

High school education provides an opportunity for the health education and promotion of reproductive health and HIV awareness for students. Education will shape knowledge, attitudes, influencing future sexual behaviour and decision making, helping to reduce risky practices.[38–40] However, despite having high literacy, key population groups remain vulnerable, showing that other factors beyond formal education, such as economic pressure, peer and social environment, and limited specific knowledge about HIV, contributed to continued risky sexual behaviours.[33,34]

This research also found that the majority of individuals in the key population groups (MSM, FSW, transgender persons) had non-reactive HIV test results. In contrast, people with inject drugs, PWIDs, showed reactive results. These are consistent with findings from the Campurejo *Puskesmas*, Kediri, where more respondents had non-reactive responses. In the homosexual group,

only 1 out of 25 samples (4%) was reactive. In the FSW group, 5 out of 25 (20%) were reactive.[41] A positive or reactive result means the body's HIV antibodies are present, confirming that the individual is infected with HIV.

During the pandemic, this study found that among the general population -children and women - accessing HIV testing, 1.9% of children were tested positive. Most of those children were under 4 years, yielding a positivity rate of 2.6%. However, the new cases of HIV were predominantly found in women in the non-key population group (37.0%), followed by men in the non-key population group (11.2%), MSM (25.1%) and FSW (15.6%).[42]

The pandemic significantly weakened HIV services, with many facilities reducing or temporarily closing operations as resources were diverted to COVID-19 response and care. Key populations such as MSM and FSW, who are typically reached through outreach field workers/NGOs, have become more difficult to engage due to mobility restrictions and public health measures. As a result, fewer cases were identified in these groups during the pandemic. Meanwhile, when an HIV positive individual was identified, like a pregnant woman, contact tracing of family members continued. This may have contributed to an increase in the proportion of men and children being identified, even though they were not part of the key population.

Low- and lower-middle-income countries often have weaker health systems and limited resources even before the pandemic. Inadequate infrastructure, such as limited internet access for telemedicine and inadequate public transportation systems, further hinders service deliveries. Populations in these countries are often more vulnerable to the economic and social impacts of the pandemic, which can indirectly reduce their access to healthcare. In Myanmar, for example, the COVID-19 pandemic caused significant disruption in HIV services, resulting in sharp declines in both HIV testing and viral load monitoring. Such disruptions were to be mostly due to lockdowns to prevent the spread of COVID-19, along with widespread fear of infections in already fragile health systems.[43]

Studies in Indonesia and neighbouring countries have shown that clinic closures, reduced outreach activities, and disruptions to community-based testing programs during the pandemic have led to a significant decline in HIV testing uptake among key populations.[44] Financial hardships experienced by these groups also contributed, at times, forcing individuals into riskier situations while making access to health services, including HIV testing, a lower priority or even inaccessible.[45,46] Geographical circumstances and social context also influence a person's vulnerability to HIV. For key populations, social, legal, structural and other contextual factors not only increase HIV risks but also hinder access to essential HIV service.[47] The buffer analysis shows that HIV treatment facilities for PLHIV in Palembang City generally serve areas within 2-5 km. This coverage indicates that PLHIV living beyond a 5 km radius may face reduced access to services. When HIV services, such as puskesmas or referral hospitals, are located too far away,

case detection declines significantly. Key populations are less likely to seek testing if services are too far and not easily accessible. As a result, many cases remain undetected, increasing the risk of ongoing transmission in the community.

Most HIV positive cases were found in Kemuning District, where major facilities are located, including Mohammad Hoesin Central General Hospital, Bhayangkara Hospital, *Puskesmas* Basuki Rahmat, and *Puskesmas* Sekip. The M. Hosein Regional Hospital (*Rumah Sakit Mohamad Hoesin* or RSMH) is a government-owned public hospital and serves as a referral hospital for several districts/cities in South Sumatra Province. This could explain the highly reported HIV cases from this hospital. A doctor from the Department of Internal Medicine at RSMH Palembang, sustainable and comprehensive HIV services and access to care are essential to ensure PLHIV and their families receive proper testing and treatment.[48]

Many primary health facilities (*Puskesmas*) still lack HIV testing equipment or do not have facilities for confirmatory testing services. In such cases, the referral system allows patients with suspected HIV or reactive rapid test results to be referred to provincial hospitals to access more complete diagnostics and treatments. A robust referral system can support outreach efforts to key populations who may be harder to reach at the primary health care level. When cases are identified in the community or lower-level health facilities, timely referrals help ensure access to appropriate services.

Bukit Kecil sub-district has the second highest number of positive HIV cases. Bukit Kecil sub-district is served by two Puskesmas, 23 Ilir and Merdeka, the latter acting as a referral service for other Puskesmas. This also includes a women's prison, which is considered a high-risk environment for HIV transmission. Other study also found that women or girls in prison are particularly vulnerable due to mental stress and overall prison conditions, which increases the significant risk of HIV.[49]

Ilir Barat I District reported the highest HIV testing access for children and women but only found three positive HIV cases. Limited accessibility to treatment facilities in some areas within Ilir Barat I District may explain the low number of detected cases. Although HIV treatment was initially provided at the FKRTL (Fasilitas Kesehatan Rujukan Tingkat Lanjutan) (hospital) level, it has been expanded to the primary care level/ *puskesmas*, but not all puskesmas have the capacity to detect and treat HIV cases. The Ministry of Health 2022 report states that increased outreach activity remains below the national target.[3]

The Prevention of Mother-to-Child Transmission (PMTCT) services were amongst the most disrupted during the pandemic, in Indonesia and neighbouring nations. Fear of contracting COVID-19 at healthcare facilities, movement restrictions and an overburdened healthcare system have led to reduced Antenatal Care (ANC) attendance. As a result, fewer pregnant women were tested for HIV. In Indonesia, studies reported a sharp decline in HIV testing among pregnant women, due to

fear of visiting health facilities and limited awareness of vertical transmission. This leads to serious concerns about delayed infant diagnosis and increased MTCT.[50–52]

Based on the HIV testing results for MSM, transgender, and FSWs, the majority who accessed testing came from the MSM group, with the highest number recorded at *Puskesmas* Sukarami, Merdeka, and Nagaswidak. These puskesmas serve areas where the MSM population is most concentrated. Geographically, Merdeka Health Centre is located in Bukit Kecil sub-district, an area with many public and entertainment places like parks, cafes, and gyms that attract large gatherings. Merdeka Health Centre was also a pioneer in implementing and leading the HIV programme in Palembang City, which likely contributes to a higher number of people accessing testing here. According to WHO (2019), HIV testing is a critical entry point to HIV care and treatment. People who know their HIV positive status are more likely to reduce risky behaviour. However, barriers to HIV testing persist, including limited knowledge and awareness about HIV testing, lack of self-testing options, and fear and anxiety around test results. Key populations remain the target for VCT services due to their vulnerability to contracting HIV.[53]

This study has some limitations. This study cannot compare data with previous years, as the 2021 data was obtained. Additionally, because secondary data was used, missing data led to sample reduction. The ecological study design also limits individual-level interpretation, as it is intended to explain group-level patterns, particularly in the spatial analysis.[26]

The results of the HIV testing in this study focused on vulnerable populations in mapped high-risk areas, highlighting the importance of considering geographical conditions and social context. For example, the high number of cases reported in Kemuning District is likely influenced by the availability of adequate health facilities. However, the ecological study design cannot explain that all areas in the city of Palembang have equal access to HIV testing, as in Kemuning. To address this limitation, additional epidemiological analyses were conducted to assess the positive rate and age-specific rate in HIV-vulnerable populations. Therefore, the finding can only be generalised to the key populations vulnerable to HIV in Palembang in 2021.

Conclusion

This 2021 study of Palembang City describes HIV cases across both key and general populations, identifying men who have sex with men (MSM) as the most affected key group (72 cases) and the Kemuning sub-district as a significant spatial hotspot for the general population, with 30 cases among women and children. These findings likely underrepresent the true prevalence, as the COVID-19 pandemic created barriers to screening that left many unaware of their status and increased transmission risk. Therefore, the study highlights an urgent need for more accessible and prioritized HIV testing

services, particularly in high-prevalence areas, to overcome these setbacks and effectively work towards ending the epidemic.

Acknowledgement

We would like to thank the Dean Public Health Faculty of Sriwijaya University and the staff, and the Head of Palembang City Health Office (*Dinas Kesehatan Kota Palembang*) for their valuable support in this research.

Funding

There are no funds in this study.

Conflict of Interest

The authors declare that they have no conflict of interest.

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