REVIEW PAPER

A systematic review and meta-analysis of worldwide prevalence of HIV in men who have sex with men

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Abstract

Introduction: This systematic review and meta-analysis aimed to estimate the worldwide prevalence of human immunodeficiency virus (HIV) in men who have sex with men (MSM).

Material and methods: Search was conducted in international databases (PubMed, Scopus, Web of Science, Embase, Ovid, Cochrane, and PsycINFO) to find cross-sectional studies published up to April 2023. Following pre-determined inclusion and exclusion criteria, relevant studies were selected and evaluated using Newcastle Ottawa scale checklist for quality assessment. Random-effects model was utilized to perform meta-analysis using Stata 17.

Results: This meta-analysis included 21 cross-sectional investigations, which collectively tested 75,473 MSM for HIV, of whom 9,212 were found to be HIV-infected. The overall HIV prevalence among MSM globally, based on the combined results of these studies, was estimated at 20%, with a 95% confidence interval (CI) of 12-28%. In the subgroup analysis of two studies from Europe, the pooled HIV prevalence was 49% (95% CI: 23-86%).

Conclusions: The findings indicate a substantial prevalence of HIV among MSM across the included studies. Continued efforts to improve access to HIV prevention, regular testing, and appropriate treatment services, including pre-exposure prophylaxis and antiretroviral therapy, may help address the burden of HIV in this population.

HIV AIDS Rev 2026; 25, 3: 193-203
DOI: https://doi.org/10.5114/hivar/187907

Key words: human immunodeficiency virus, HIV, men who have sex with men, MSM, systematic review, meta-analysis.

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Article history:
Received: 23.12.2023
Revised: 16.04.2024
Accepted: 16.04.2024
Available online: 25.09.2026

International Journal of HIV-Related Problems
HIV & AIDS Review

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Introduction

Human immunodeficiency virus (HIV) is one of the most common chronic viral infections worldwide and is still one of the world's most critical public health issues, especially in low- and middle-income countries [1-3], with more than 35 million people living with the virus worldwide. According to the World Health Organization (WHO), in 2017, 940,000 people died of HIV-related causes globally. At the end of 2017, about 9.36 million individuals were living with HIV, of whom 1.8 million were infected in the same year. The African Region, with 25.7 million people, have the highest number of cases [4, 5]. In 2015, the HIV rate in the Eastern Mediterranean Region was 1.8 per 100,000 people, a notable increase of 43% since 1990. Also, years of life lost due to this disease and years lived with disability increased from 15.3 and 1.3 per 100,000 people in 1990 to 81.9 and 4.4 in 2015, respectively [6]. The most common HIV cases are injecting drug users, non-injecting cocaine users, transgender people (TGs), and MSM [7]. The prevalence of this infection is increasing in MSM, one of the high-risk groups. MSM is one of the key populations, where the concern of epidemic concentration is a significant threat to the HIV epidemic in high-, middle-, and low-income countries. If there were accurate statistics on the incidence of HIV and its prevalence in MSM, health policy-makers could implement various programs to control the HIV epidemic and its effects on this group of men. Therefore, access to accurate and reliable information, especially the status of HIV epidemic and other sexually transmitted diseases among men at high-risk of HIV, especially MSM, is one of the primary needs and integral part of HIV care system [8, 9].

Various studies have been conducted in the past to determine the prevalence of HIV in MSM but with conflicting results. For example, according to the WHO, 1% of HIV cases in Eastern European countries are MSM (with men at the highest risk of HIV), while in Western European countries, up to 50% of HIV cases are MSM [10-12]. In addition, previous studies showed that the prevalence of HIV among men at the highest risk was 25% in Ghana, 30% in Jamaica, 45% in Kenya, and 27% in Thailand [13-15].

The difference in prevalence and statistics in various countries makes health planning, HIV prevention and control difficult, especially in developing countries. Thus, precise epidemiological studies, such as a systematic review and meta-analysis, can help assess the accurate prevalence rate of HIV infection in this population.

Both homosexual and heterosexual MSM are usually engaging in unprotected anal sex, which transmit HIV more than unprotected vaginal sex. On the other hand, MSM are reluctant to protect themselves against diseases, such as HIV, due to psychological issues and crises, including self-harm, suicide, stigma, and social discrimination. Therefore, determining the prevalence of HIV in this population is required [16-18]. Given the specific circumstances of these individuals, inconsistencies in previous studies as well as development of HIV, its complications, and burden, is it significant to conduct a systematic review and meta-analysis to determine the prevalence of HIV in MSM.

Most HIV cases are observed in high-risk groups, such as MSM. Assessing their HIV prevalence rate and informing the authorities of the statistics can help allocate human and financial resources for intervention, screening, and timely diagnosis of HIV in this high-risk group. Therefore, the current study aimed to accurately establish the worldwide prevalence of HIV in MSM through a systematic review and meta-analysis. The study's originality stems from its thorough and methodical approach to estimate HIV worldwide prevalence rate among MSM, which overcomes the limitations of prior research while giving current and reliable data. The findings of this study have the potential to inform public health efforts, intervention programs, and policy-makers, to reduce HIV burden among MSM and improve their overall well-being.

Material and methods

This study was a systematic review and meta-analysis, which aimed to accurately estimate the worldwide prevalence of HIV in MSM population using 5 steps: search strategy, screening and selection, data extraction, risk of bias, and meta-analysis. The preferred reporting items for systematic reviews and meta-analyzes (PRISMA) and meta-analysis of observational studies in the epidemiology (MOOSE) were used in the study [19-21] (Table 1).

Search strategy

Articles published from January 1990 to April 2023 in 5 electronic databases, including PubMed (MEDLINE), Scopus, Web of Science, Embase, Ovid, and PsycINFO, were retrieved and reviewed using the following key words: "Men Who Have Sex with Men," "Gender Minorities," "Gays," "Non-Heterosexual Persons," "Gender Incongruence," "Ego-Dystonic Homosexuality," "HIV," "AIDS," "Human Immunodeficiency Virus," "Acquired Immunodeficiency Syndrome."

In each electronic database, English-written papers only were selected using medical subject heading (MeSH) and Excerpta Medica Tree (Emtree). Search strategy was based on PRISMA reporting checklist. Cross-sectional research targeting MSM, which primary outcomes were to evaluate the prevalence of HIV/AIDS, were included in the study. Also, laboratory tests, such as enzyme-linked immunosorbent assay (ELISA), Western blotting, etc., for detecting and evaluating HIV antibodies were considered in establishing the prevalence of HIV. Studies written in languages other than English, cohorts, case series, reports, clinical trials, letters to editors, and systematic reviews, were excluded from analysis. Similarly, studies with populations other than MSM, such as lesbians or transgender people, were not considered. This meta-analysis defined MSM as those who have sex with other men, independent of sexual orientation or self-identification, and included both homosexual and bisexual males

Table 1. Characteristics and demographic variables of men who have sex with men (MSM) populations in the included studies

Authors (year) [Ref]	Type of study (country)	Study population	Age in years (mean)	Sample size (*n*)	HIV prevalence, *n* (%)	Laboratory test type
Bayer AM *et al.* (2013) [46]	Cross-sectional (Peru)	MSM	24	84	15 (17.8)	HIV rapid test
Belza MJJSTI (2002) [47]	Cross-sectional (Spain)	MSM	29.2	418	51 (12.2)	ELISA, Western blot or immunofluorescence
Bockting W *et al.* (2005) [48]	Cross-sectional (England)	MSM	≥ 18	480	408 (86.0)	Not reported
Brahmam GN *et al.* (2008) [49]	Cross-sectional (India)	MSM	≥ 18	2,023	293 (14.5)	Serologic tests
Figueroa JP *et al.* (2011) [50]	Cross-sectional (Jamaica)	MSM	≥ 16	449	141 (31.4)	HIV rapid test, Western blot, ELISA
Hakim AJ *et al.* (2017) [51]	Cross-sectional (Papua New Guinea)	MSM	≥ 12	848	54 (6.3)	HIV rapid test
Hawkes S *et al.* (2007) [52]	Cross-sectional (Pakistan)	MSM	≥ 18	1,448	7 (0.4)	Vironostika HIV Uni-Form II plus, EIA
Keshinro B *et al.* (2016) [53]	Cross-sectional (Nigeria)	MSM	24	862	473 (54.9)	HIV rapid test
Perez-Brumer AG *et al.* (2007) [54]	Cross-sectional (Peru)	MSM	28	560	125 (22.3)	EIA, Western blot
Poteat T *et al.* (2017) [55]	Cross-sectional (Africa)	MSM	39	3,649	505 (14.1)	HIV rapid test
Somia IKA *et al.* (2018) [56]	Cross-sectional (South East Asia)	MSM	≥ 18	392	245 (62.5)	Blood tests for CD4+ count, plasma HIV-RNA
Supindham T *et al.* (2015) [57]	Cross-sectional (Thailand)	MSM	≥ 18	200	10 (5.0)	HIV rapid test, ELISA
Beyrer C *et al.* (2005) [58]	Cross-sectional (Thailand)	MSM	≥ 13	1,752	303 (17.2)	Western blot
Brito MO *et al.* (2015) [59]	Cross-sectional (Dominican Republic)	MSM	≥ 18	100	5 (5.0)	HIV rapid test, ELISA
Phillips AE *et al.* (2010) [60]	Cross-sectional (India)	MSM	≥ 18	357	26 (7.4)	Not reported
Lahuerta M *et al.* (2015) [61]	Cross-sectional (Mali)	MSM	≥ 18	552	76 (13.7)	HIV rapid test, Western blot
Cao W *et al.* (2022) [62]	Cross-sectional (China)	MSM	All age	711	22 (3.09)	Not reported
Prabhu S *et al.* (2022) [63]	Cross-sectional (India)	MSM (condomless anal intercourse)	28	4,290	474 (11.0)	ELISA
		MSM (anal intercourse without condoms)	29	3,796	814 (21.4)	
		MSM (all population)	28	8,086	1,288 (15.9)	
Zhang F *et al.* (2022) [64]	Cross-sectional (China)	MSM (Taiyuan City)	15-50	755	184 (24.4)	ELISA
		MSM (Linfen City)	15-50	1,098	268 (24.4)	
		MSM (Changzhi City)	15-50	855	92 (10.8)	
Lin GE *et al.* (2017) [65]	Cross-sectional (China)	MSM	Not reported	41,503	3,312 (7.9)	ELISA
Chen J *et al.* (2021) [66]	Cross-sectional (Vietnam)	MSM	Not reported	205	21 (10.0)	HIV rapid test, ELISA

who have intercourses with other men. For gray literature, HIV/AIDS-related databases, such as UNAIDS and WHO reports were explored. Search strategy was independently developed by two authors (YM and MS), with existing differences resolved with the opinion of a third, more experienced researcher (GM). A manual search was also performed by reviewing sources and references of related articles.

Screening and selection of articles

EndNote X8 library was used to collect articles, remove duplicates, and review titles and abstracts. Initially, titles and abstracts were independently reviewed by two researchers (MS and YM), and differences were discussed and referred to a third person (GM) to be solved, if necessary. Screened references were selected for full-text review if they contained the desired data in their titles or abstracts. Full texts were separately reviewed by two authors (YM and MS). Data were extracted from eligible studies and entered into Microsoft Excel 2016.

Data extraction

Initially, a checklist was prepared with an opinion of experts in data extraction. Data collected included authors' names, year of article's publication, HIV prevalence rate among MSM, type of study, sample size, participants age, country or region, statistics of studied population, and method of measuring HIV prevalence.

Risk of bias

Studies were evaluated qualitatively with the Newcastle-Ottawa quality assessment scale (NOS) checklist [22]. This checklist assessed the quality of observational studies, mainly cross-sectional ones, and examined each study using six items in three groups, including selecting study samples, comparing and analyzing study groups, and measuring and analyzing the desired outcome. Each of these items was given a score of 1 if that was observed in the studies, and the maximum score for each survey was 9 points. In case of discrepancies in the score assigned to published articles and reaching an agreement, discussion and a third researcher's opinion were applied. The STROBE checklist [23] was also employed for all articles, which consisted of six general sections as follows: titles and abstracts, introductions, methods, results, discussions, and other information.

Meta-analysis

For meta-analysis, prevalence values were first extracted from selected studies, and typical error prevalence values were calculated for each analysis. In addition to HIV prevalence, total sample size of each study was extracted to perform the metaprop command, while the DerSimonian-Laird random effects model was employed to estimate the pooled prevalence of HIV (95% CI) in MSM population, with the metaprop and metan commands in Stata 17. Also, Cochrane Q and I2 tests were used to examine the

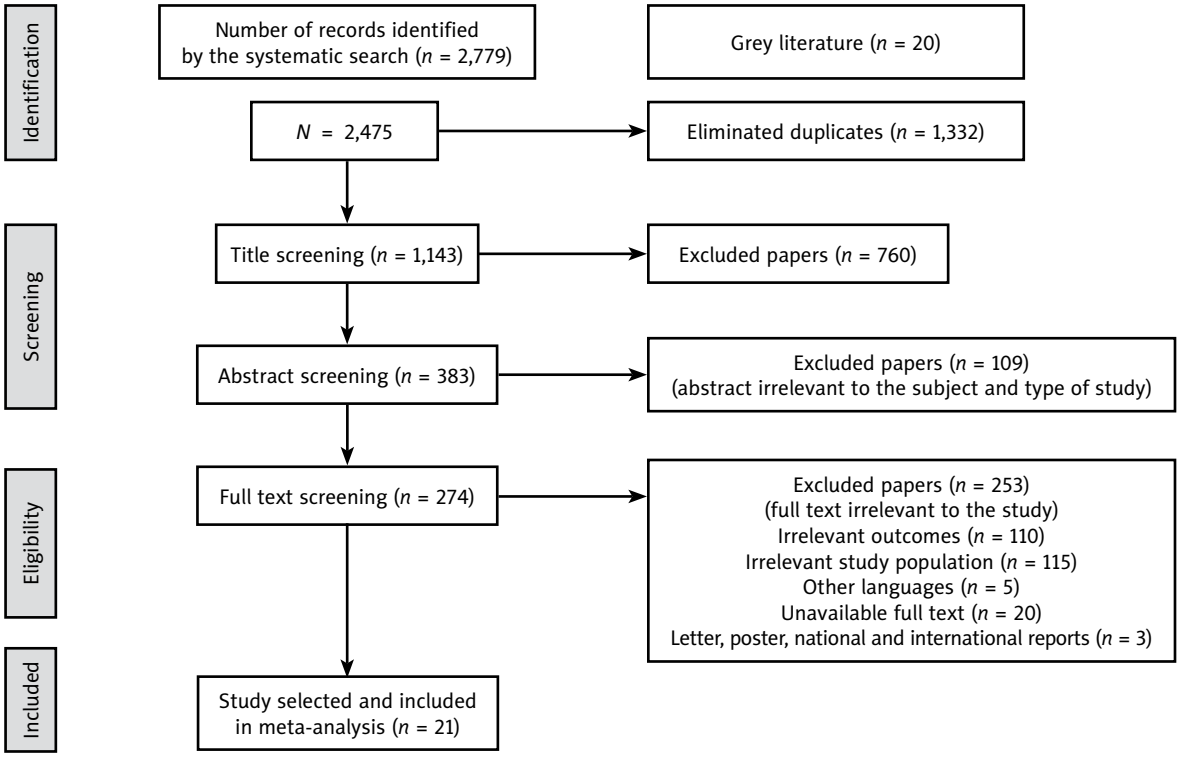

Figure 1. Search outputs and study selection

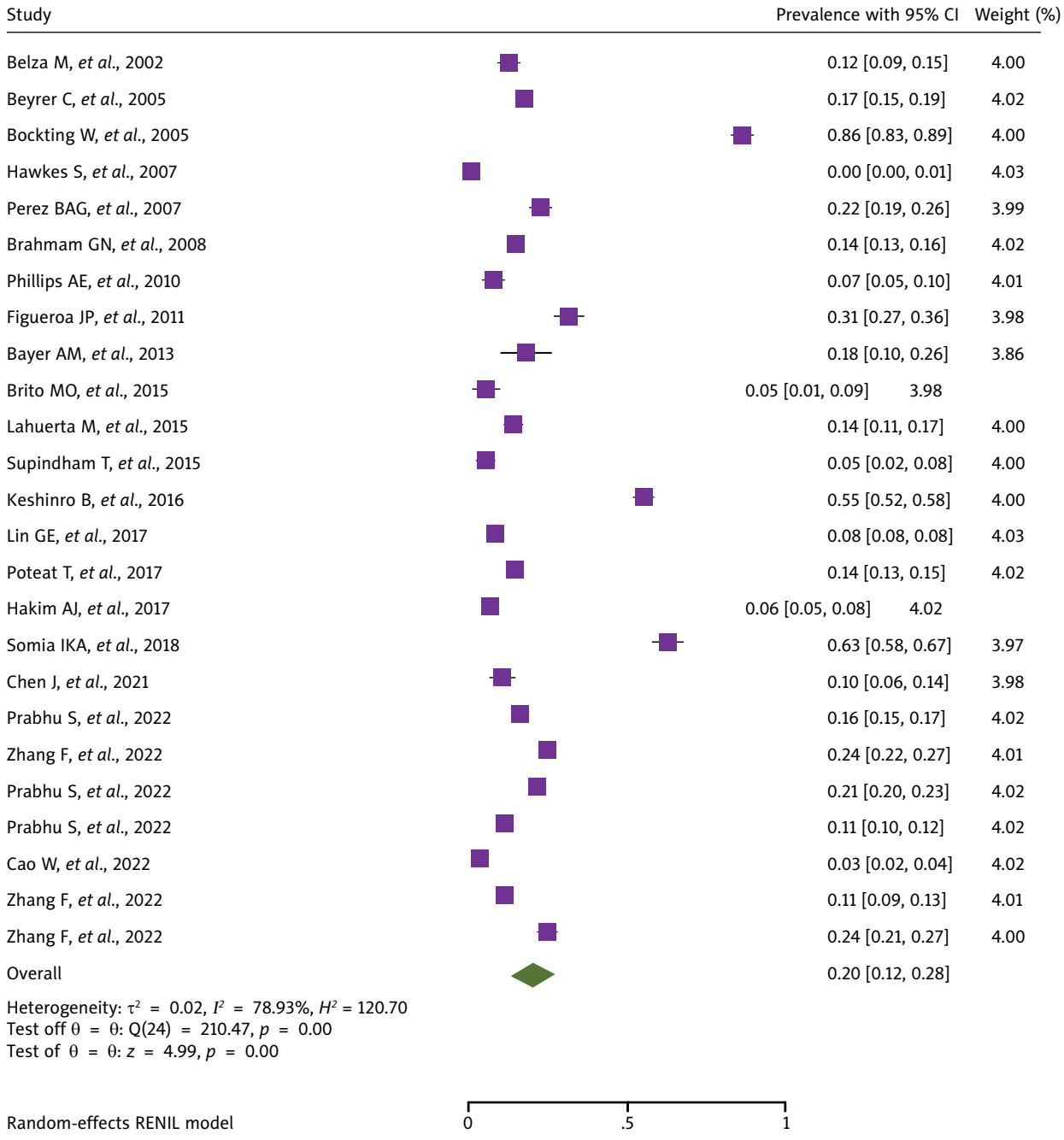

Figure 2. Pooled worldwide prevalence of HIV in MSM populations

heterogeneity and variance between the studies selected for meta-analysis, and funnel plot and Egger test were utilized to evaluate the publication bias. Meta-regression analysis and chart were used to investigate the relationship between age of MSM and sample size of selected studies with the estimated cumulative prevalence. Sensitivity analyses were also performed for each of the outcomes in forest plot [24-26] to assess the robustness and reliability of the results by examining the effect of different factors or assumptions on the results of meta-analysis. In this study, statistical significance threshold was set at $p < 0.05$.

Results

After performing the search with its strategy in international databases, 2,779 articles were found in the databases and 20 papers in the gray literature. After eliminating duplicates and screening according to titles, there were 383 articles from the screening phase based on their abstracts. In the next stage, after screening based on abstracts, 109 articles were excluded due to irrelevance of their abstracts and study type with the research objectives, and 274 papers were reviewed based on full text.

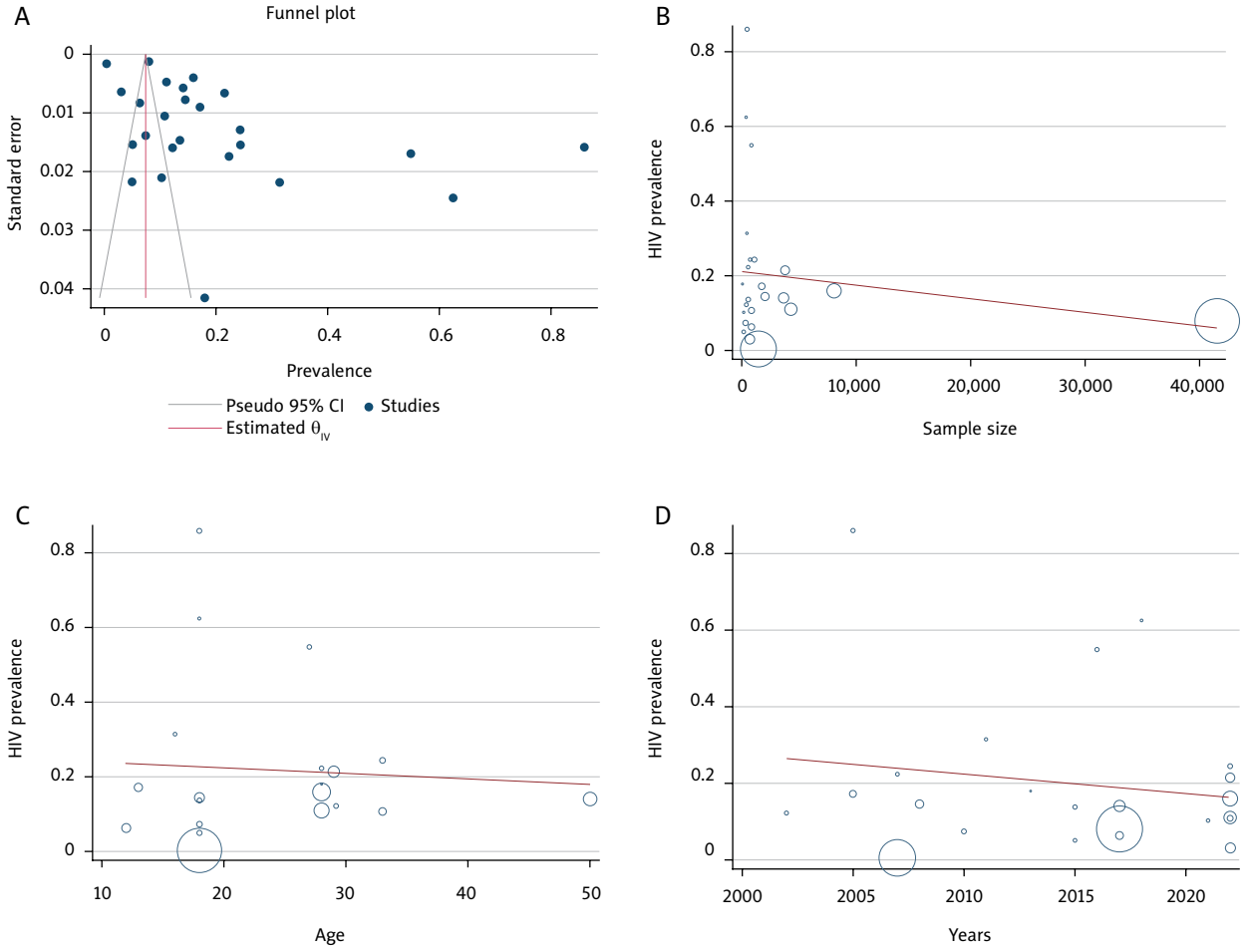

Figure 3. Funnel plot and meta-regression analysis of the effect of age, sample size, and year of publication on pooled prevalence of HIV in MSM population

After a complete review and evaluation of their full texts, 21 cross-sectional articles assessing MSM populations were considered for a meta-analysis (Figure 1). Generally, in these studies, 75,473 MSM were tested for HIV, of whom 9,212 were HIV-positive. The pooled worldwide prevalence of HIV in MSM after combining these studies was 20% (95% CI: 12-28%) (Figure 2). The majority of HIV ranged from 0 to 86%, with the lowest and highest rates related to Hawkes et al. and Bockting et al. papers, respectively. The results of Egger test showed that publication bias did not occur in calculating the pooled prevalence of HIV in MSM (B = 6.86, SE = 6.71, $p = 0.306$). The funnel plot is demonstrated in Figure 3.

Meta-regression analysis was also used to investigate the relationship between age of MSM, year of publication, and sample size of studies included in meta-analysis, the results of which are presented in Figure 3. According to this analysis, age was not significantly associated with the pooled prevalence of HIV in MSM (coefficient = –0.057, SE = 0.006, $t = -0.08$, $p = 0.935$). Also, the sample size (coefficient = –0.041, SE = 0.006, $t = -0.60$, $p = 0.555$) and year of publication (coefficient = –0.544, SE = 0.021, $t = -0.22$, $p = 0.332$) were not significantly related to the pooled prevalence calculated in the meta-analysis, respectively (coefficient = –0.041, SE = 0.006, $t = -0.60$, $p = 0.555$) (Figure 3).

Sub-group analysis

In this study, sub-group analysis was performed based on the place of study, method of diagnosing HIV in MSM, and year of article's publication. The results are presented in Table 2.

There were 16 studies, which included a total sample size of 68,319 MSM in Asia, with 7,413 of HIV-infected cases. The pooled prevalence of HIV in Asian MSM was 16% (95% CI: 12-23%). In addition, two studies were conducted with a sample size of 898 people in continental Europe, of whom 459 were HIV-positive MSM. The pooled prevalence of HIV in European MSM was 49% (95% CI: 23-86%), which was higher than that in other parts of the world. In Africa, there were three studies with a sample size of 5,063 individuals, of which 1,054 people were infected with HIV.

Table 2. Summary of prevalence estimates (95% CI) for included studies conducted on the prevalence of HIV in MSM populations based on the continent and methods of detecting HIV

Sub-group	No. of studies (sample size)	No. of cases (MSM with HIV)	Pooled prevalence (95% CI)	Between studies			Between sub-groups	
				I^2 (%)	$P_{heterogeneity}$	Q	Q	$P_{heterogeneity}$
Continent								
Asia	16 (68,319)	7,413	16% (8-23%)	65.20	0.13	10.84	4.88	0.00
USA	4 (1,193)	283	19% (8-30%)	79.07	0.00	50.41		
Europe	2 (898)	459	49% (23-86%)	69.10	0.04	21.40		
Africa	3 (5,063)	1,054	28% (5-50%)	88.62	0.00	82.89		
Diagnostic method								
ELISA	16 (66,178)	7,330	17% (10-25%)	90.14	0.00	97.33	1.98	0.00
Rapid test	4 (5,443)	1,047	23% (7-39%)	90.40	0.00	99.76		
Western blot	2 (2,304)	379	16% (12-19%)	65.88	0.19	8.15		
Not reported	3 (1,548)	456	32% (21-54%)	75.93	0.00	113.50		
Years								
2000-2005	3 (2,650)	762	38% (10-72%)	69.22	0.03	79.64	3.02	0.55
2006-2010	4 (4,388)	451	11% (2-20%)	77.27	0.02	88.43		
2011-2015	5 (1,385)	247	14% (5-24%)	66.78	0.02	77.63		
2016-2020	5 (47,254)	4,589	29% (5-53%)	89.99	0.00	99.42		
2021-2022	8 (19,796)	3,163	15% (10-20%)	89.03	0.01	98.77		

The meta-analysis results indicated that the pooled prevalence of HIV in African MSM was 28% (95% CI: 5-50%). Finally, four studies were conducted in the United States, showing that out of 1,193 MSM surveyed, 283 were infected with HIV. The pooled prevalence in this meta-analysis was 19% (95% CI: 8-31%) (Table 2).

In terms of HIV diagnostic method in MSM, the results demonstrated that in 16 studies, ELISA serum method was utilized (a sample size of 66,178 people), four other studies used a rapid test (a sample size of 5,443 people), and two studies used a Western blot for definitive results (a sample size of 2,304 people), whereas two studies with a sample size of 837 patients did not report method of HIV diagnosing. The pooled prevalence of HIV in MSM in studies employing the rapid test method was higher than that using other diagnostic tests, while the lowest pooled prevalence was in studies evaluating HIV with the Western blot test (Table 2).

Three studies were performed to determine the worldwide prevalence of HIV in MSM between 2000 and 2005. The total sample size in these studies was 2,650 individuals, and the pooled prevalence of HIV in MSM after combining the studies was 38% (95% CI: 10-72%). However, four studies were done between 2005 and 2010, with a sample size of 4,388 and a pooled prevalence of 11% in meta-analysis (95% CI: 2-20%). The pooled prevalence of HIV in MSM between 2016 and 2020 was higher than in other years (Table 2 and Figure 4).

Sensitivity analysis

In the sensitivity analysis, the lowest prevalence was assessed excluding Bockting *et al.*, while the highest prevalence was calculated without considering Hawkes *et al.* study. Thus, the results of sensitivity analysis almost presented the stability of calculated pooled prevalence with 20% (95 CI%: 12-28%) (Figure 5).

Discussion

MSM are at high-risk for being infected with HIV worldwide due to their high numbers of partners without using any definite protection. Also, high migration rate is important reason [17, 27]. In 2005, out of 30,956 HIV-infected patients in the USA, 53% were MSM. This amount was

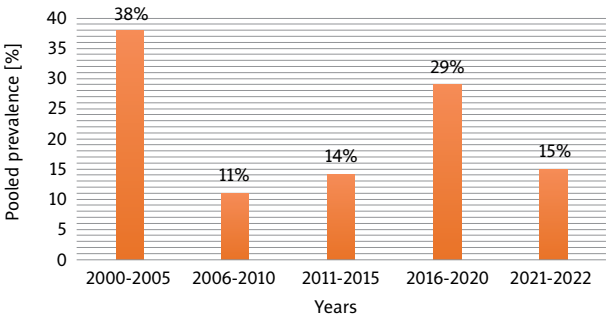

Figure 4. Pooled prevalence of HIV in MSM population based on various years

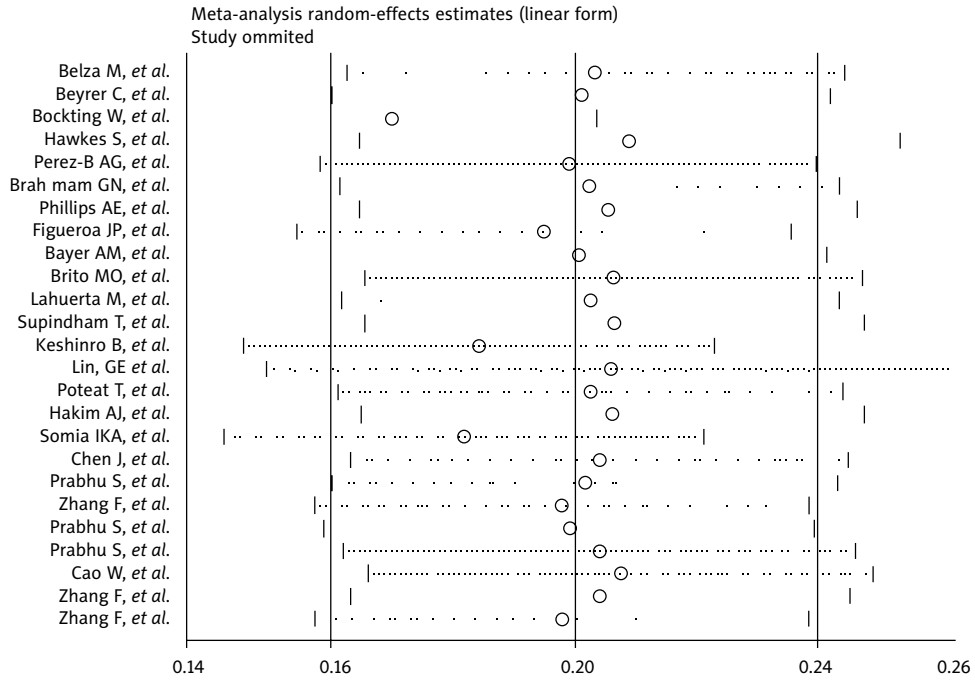

Figure 5. One-way sensitivity analysis of HIV pooled prevalence in MSM population

more than twice in Black MSM than in White MSM [28]. A huge concern for HIV prevention in the world is whether MSM living with HIV may potentially transmit HIV to their female spouses, since it is estimated that 90% of MSM would eventually marry a woman in their lifetime due to the traditional cultures and illegality of homosexual marriage in some countries [29-31]. In this study, we found substantial underreporting of male-to-male sex. MSM remain disproportionally affected by HIV compared with men who have sex with women only. To the best of our knowledge, this study is one of the newest updates of meta-analysis evaluating data of recent years. The results of the present meta-analysis demonstrate that the cumulative worldwide prevalence of HIV in MSM was 23%, with a confidence interval of 15 to 31%. The cumulative prevalence of HIV in European MSM was 49%, with a confidence interval of 23 to 86%, higher than in other parts of the world. According to the Global HIV Report of 2023, by the end of 2022, an estimated 39 million people worldwide were living with HIV (PLHIV), ranging from 33.1 million to 45.7 million. Additionally, over 1.3 million of HIV new cases were reported in 2022, ranging from 1 million to 1.7 million. Of the 39 million people living with HIV, approximately 53% were women and girls. Regarding key and high-risk populations, statistics in 2022 showed that the median HIV prevalence among key populations aged 15 to 49 years was 0.7%, with the highest prevalence among transgender individuals and MSM at 10.3% and 7.5%, respectively [32]. The prevalence of HIV among MSM varied in terms of geographic location, and was highest in the European Region but did not differ by age and time interval of the evaluations. The sampling methods used were scientific and standard; these were needed to calculate the exact estimation of HIV among MSM. The prevalence in some studies might be overestimated or underestimated, especially in studies with smaller sample sizes. The results of the present meta-analysis demonstrated that the prevalence of HIV in European MSM community is higher than in other geographical locations, which is in line with the Global HIV Report of 2023 also emphasizing this finding. The published report mentions that due to the increasing trend of MSM engaging in chemsex, which is more common in developed countries, the incidence of HIV is on the rise [32]. Additionally, results of a recent review study indicated that this growing phenomenon is also seen in Asian countries, which might contribute to the higher prevalence of HIV in the Asian Region [33, 34]. In terms of chemsex, especially in key populations and their sexual partners, it requires a comprehensive, non-judgmental, and person-centered approach. This include integrated sexual and reproductive health services, mental health services, needle-syringe programs, opioid agonist maintenance treatment services as well as linkage to other evidence-based prevention, diagnosis, and treatment interventions [33, 35-37].

MSM population carry the most significant burden of HIV infections in the United States, and account for most HIV infections (68%) diagnosed among adults and adolescents [38]. There was a high prevalence of HIV in countries with mixed and generalized epidemics, while it was close to one in some of the gross hyper-endemic countries. Because the total prevalence in these countries was already very high, the prevalence of HIV among men in the general population was very close to that of MSM. The national response to HIV

infection in this context at the country level may also directly influence the MSM sub-population [39].

Regarding the type of laboratory tests, the highest prevalence was achieved by using the rapid test, while the lowest prevalence was earned through the Western blot. These findings might have important policy implications regarding the area of residency and selection of tests for diagnosing HIV-positive patients. Because the Western blotting diagnostic test was used as a definitive test, ELISA was applied initially for diagnosing HIV; if it was positive, Western blotting would be performed. This was the reason why the prevalence of HIV analyzed by Western blotting was lower than the rapid test. However, in epidemiological studies, ELISA is usually performed without Western blotting. Data from this study indicated that there is a high burden of HIV infection among MSM in European countries. Therefore, there should be significant considerations for MSM in these regions.

For routine, universal HIV testing, finger-stick whole-blood rapid testing was observed more acceptable and feasible than ELISA. A larger use of rapid tests by general practitioners, especially free of cost, reduced the number of patients unaware of their HIV-positive status [40].

HIV prevalence rate among MSM students in China revealed their high-risk of HIV infection within their age range. The prevalence of HIV in this group was 6.8% from 2000-2010, representing the need for comprehensive intervention strategies to prevent this infection [41]. In a meta-analysis from China, the pooled prevalence of HIV infection was 7.7%, with every year increasing rate among MSM. This prevalence differed in various regions of China [42]; in an older Chinese study, the occurrence of HIV among MSM was reported 2.5% [42]. This difference in prevalence rate showed an increasing risk of HIV infection among MSM in recent years. However, according to the analysis of our study, there was not any meaningful data presenting the increasing rate of HIV prevalence during these years, thus, our results were not in line with these two studies.

In Latin America, the prevalence of HIV was evaluated, and it was highly concentrated on the MSM population. This meta-analysis reported that the Latin America Region was one of the highest HIV prevalence regions in the world for MSM. Nonetheless, there was no evaluation in terms of the time passage or age range [43].

In our study, we did not find any meta-analysis evaluating the prevalence of HIV in European countries, therefore, our study can be considered the first in the field. Our analysis showed a high prevalence of HIV in Europe. Therefore, it can be concluded that regardless of the region and its majority of HIV, there should be a considerable program for HIV prevention, surveillance, intervention strategies, and treatment among at-risk populations. This high incidence of HIV among MSM demonstrated a high prevalence of unprotected sex behaviors, suggesting a potential risk of accelerated AIDS contamination among MSM, hence prevention programs should include evidence-based policy decisions for plans' improvement. Although differences between sampling methods, sample sizes, and study locations are required to be considered, European countries should be more aware of planning an exact preventive program due to their high migration rate.

HIV-positive patients must be integrated into epidemiological monitoring systems at the country level. The programs for this group of patients can involve sexually transmitted infections (STIs) screening and treatment among men, facilitating access to vaccines to prevent infections, such as HBV and HPV, which can help reduce their HIV risk as well as educational programs, such as condom using, etc. [44, 45].

One of the strengths of this study is that it is the first and up-to-date meta-analysis to determine the prevalence of HIV in MSM populations in the world. The results of this study can also be significant for health professionals and policy-makers. Limitations of this study include the lack of reporting other influential variables on the prevalence of HIV in MSM, such as the number of sexual partners, sexual relationships, existence or absence of unprotected intercourses, and other essential variables in preliminary studies entered into the meta-analysis. This prevented the identification of crucial factors and sources affecting the existence of heterogeneity in the final results of the meta-analysis.

Conclusions

The findings indicate a substantial prevalence of HIV among MSM across the included studies, highlighting the importance of targeted HIV prevention, testing, and treatment services for this population. Continued efforts at the international, national, and regional levels may help improve access to appropriate HIV prevention and care, including regular testing, pre-exposure prophylaxis, and antiretroviral therapy. Further well-designed studies with larger and more representative samples are needed to better characterize the epidemiological and behavioral patterns of HIV among MSM.

Disclosures

1. Institutional review board statement: Not applicable. This study was recorded in the Research of Kurdistan University of Medical Sciences under the number of IR.MUK.REC.1398.154.
2. Assistance with the article: All the authors of the primary studies included in this review are sincerely appreciated.
3. Financial support and sponsorship: None.
4. Conflicts of interest: None.

References

1. Supram HS, Gokhale S, Sathian B, Bhatta DR. Hepatitis B Virus (HBV) and Hepatitis C Virus (HCV) Co-infection among HIV infected individuals at tertiary care hospital in western Nepal. Nepal J Epidemiol 2015; 5: 488-493.
2. Kumari S, Kiran A, Kujur M, Kumar R. Trend of viral (HBV, HCV & HIV) co-infections among apparently healthy blood donors in Ranchi, Jharkhand. Int J Sci Res 2020; 9.
3. Shrestha SM, Shrestha S. Chronic hepatitis B in Nepal: an Asian country with low prevalence of HBV infection. Trop Gastroenterol 2012; 33: 95-101.

4. Tyson GL, Kramer JR, Duan Z, Davila JA, Richardson PA, El-Serag HB. Prevalence and predictors of hepatitis B virus coinfection in a United States cohort of hepatitis C virus-infected patients. Hepatology 2013; 58: 538-545.
5. Qadar LT, Shabbir O, Asghar SA. An uprising threat in the Pakistani society – the HIV outbreak. J Pak Med Assoc 2019; 69: 606.
6. Trends in HIV/AIDS morbidity and mortality in Eastern Mediterranean countries, 1990-2015: findings from the Global Burden of Disease 2015 study. Int J Public Health 2018; 63: 123-136.
7. dos Ramos Farías MS, Garcia MN, Reynaga E, Romero M, Vaulet MLG, Fermepín MR, et al. First report on sexually transmitted infections among trans (male to female transvestites, transsexuals, or transgender) and male sex workers in Argentina: high HIV, HPV, HBV, and syphilis prevalence. Int J Infect Dis 2011; 15: e635-e640. DOI: 10.1016/j.ijid.2011.05.007.
8. Wade AS, Kane CT, Diallo PAN, Diop AK, Gueye K, Mboup S, et al. HIV infection and sexually transmitted infections among men who have sex with men in Senegal. AIDS 2005; 19: 2133-2140.
9. Smith AD, Tapsoba P, Peshu N, Sanders EJ, Jaffe HW. Men who have sex with men and HIV/AIDS in sub-Saharan Africa. Lancet 2009; 374: 416-422.
10. Price MA, Rida W, Mwangome M, Mutua G, Middelkoop K, Roux S, et al. Identifying at-risk populations in Kenya and South Africa: HIV incidence in cohorts of men who report sex with men, sex workers, and youth. J Acquir Immune Def Syndr 2012; 59: 185-193.
11. Geibel S, Van Der Elst EM, King'ola N, Luchters S, Davies A, Getambu EM, et al. 'Are you on the market?': a capture–recapture enumeration of men who sell sex to men in and around Mombasa, Kenya. AIDS 2007; 21: 1349-1354.
12. Sanders EJ, Graham SM, Okuku HS, van der Elst EM, Muhaari A, Davies A, et al. HIV-1 infection in high risk men who have sex with men in Mombasa, Kenya. AIDS 2007; 21: 2513-2520.
13. Risher K, Mayer KH, Beyrer C. HIV treatment cascade in MSM, people who inject drugs, and sex workers. Curr Opin HIV AIDS 2015; 10: 420-429.
14. Heyns A. Policy and decision making by blood transfusion services in South Africa. South Afr Med J 2006; 96: 420-422.
15. Cloete A, Rispel L, Metcalf C (eds.). Behind the mask: the need for research on HIV among men who have sex with men in South Africa. Cape Town Pride seminar series; 2007.
16. Veronese V, Ryan KE, Hughes C, Lim MS, Pedrana A, Stoové M. Using digital communication technology to increase HIV testing among men who have sex with men and transgender women: systematic review and meta-analysis. J Med Internet Res 2020; 22: e14230. DOI: 10.2196/14230.
17. Baral S, Sifakis F, Cleghorn F, Beyrer C. Elevated risk for HIV infection among men who have sex with men in low-and middle-income countries 2000-2006: a systematic review. PLoS Med 2007; 4: e339. DOI: 10.1371/journal.pmed.0040339.
18. Hessou SP, Glele-Ahanhanzo Y, Adekpedjou R, Ahoussinou C, Djade CD, Biaou A, et al. HIV incidence and risk contributing factors among men who have sex with men in Benin: a prospective cohort study. PLoS One 2020; 15: e0233624. DOI: 10.1371/journal.pone.0233624.
19. Hutton B, Catala-Lopez F, Moher D. The PRISMA statement extension for systematic reviews incorporating network meta-analysis: PRISMA-NMA. Med Clin (Barc) 2016; 147: 262-266.
20. Moher D, Shamseer L, Clarke M, Ghersi D, Liberati A, Petticrew M, et al. Preferred reporting items for systematic review and meta-analysis protocols (PRISMA-P) 2015 statement. Syst Rev 2015; 4: 1. DOI: https://doi.org/10.1186/2046-4053-4-1.
21. Stroup DF, Berlin JA, Morton SC, Olkin I, Williamson GD, Rennie D, et al. Meta-analysis of observational studies in epidemiology: a proposal for reporting. JAMA 2000; 283: 2008-2012.
22. Wells G, Shea B, O'Connell D, Peterson J, Welch V, Losos M, et al. The Newcastle-Ottawa Quality Assessment Scale (NOS) for assessing the quality of nonrandomized studies in meta-analyses. Clin Epidemiol [Internet] 2017: 1-2.
23. Von Elm E, Altman DG, Egger M, Pocock SJ, Gøtzsche PC, Vandenbroucke JP. The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement: guidelines for reporting observational studies. Ann Intern Med 2007; 147: 573-577.
24. Lipsey MW, Wilson DB. Practical meta-analysis. SAGE publications, Inc; 2001.
25. Jackson G, Xu T, Jia X. Meta-analysis. Sage: Beverly Hills, CA, USA; 1982.
26. Borenstein M, Hedges LV, Higgins JP, Rothstein HR. Introduction to meta-analysis: John Wiley & Sons; 2011.
27. Dougan S, Evans B, Macdonald N, Goldberg D, Gill O, Fenton K, et al. HIV in gay and bisexual men in the United Kingdom: 25 years of public health surveillance. Epidemiol Infect 2008; 136: 145-156.
28. Johnson WD, Diaz RM, Flanders WD, Goodman M, Hill AN, Holtgrave D, et al. Behavioral interventions to reduce risk for sexual transmission of HIV among men who have sex with men. Cochrane Database Syst Rev 2008; (3): CD001230. DOI: 10.1002/14651858.CD001230.pub2.
29. van de Laar TJ, Bezemer D, Van Laethem K, Vandewalle G, de Smet A, Van Wijngaerden E, et al. Phylogenetic evidence for underreporting of male-to-male sex among human immunodeficiency virus-infected donors in the Netherlands and Flanders. Transfusion 2017; 57: 1235-1247.
30. Wu W, Yan X, Zhang X, Goldsamt L, Chi Y, Huang D, et al. Potential HIV transmission risk among spouses: marriage intention and expected extramarital male-to-male sex among single men who have sex with men in Hunan, China. Sex Transm Infect 2020; 96: 151-156.
31. Wei L, Chen L, Zhang H, Yang Z, Liu S, Tan W, et al. Relationship between gay app use and HIV testing among men who have sex with men in Shenzhen, China: a serial cross-sectional study. BMJ Open 2019; 9: e028933. DOI: 10.1136/bmjopen-2019-028933.
32. Global AIDS Monitoring 2023: indicators and questions for monitoring progress on the 2021 Political Declaration on Ending AIDS. [Internet]. Available from: https://www.unaids.org/sites/default/files/media_asset/global-aids-monitoring_en.pdf (Accessed: 10 July 2023).
33. Maviglia F, Wickersham JA, Azwa I, Copenhaver N, Kennedy O, Kern M, et al. Engagement in chemsex among men who have sex with men (MSM) in Malaysia: prevalence and associated factors from an online national survey. Int J Environ Res Public Health 2022; 20: 294. DOI: 10.3390/ijerph20010294.
34. Wang H, Jonas KJ, Guadamuz TE. Chemsex and chemsex associated substance use among men who have sex with men in Asia: a systematic review and meta-analysis. Drug Alcohol Depend 2023; 243: 109741. DOI: 10.1016/j.drugalcdep.2022.109741.
35. Guerras JM, Hoyos Miller J, Agustí C, Chanos S, Pichon F, Kuske M, et al. Association of sexualized drug use patterns with HIV/STI transmission risk in an internet sample of men who have sex with men from seven European countries. Arch Sex Behav 2021; 50: 461-477.
36. Sewell J, Cambiano V, Miltz A, Speakman A, Lampe FC, Phillips A, et al. Changes in recreational drug use, drug use associated with chemsex, and HIV-related behaviours, among HIV-negative men who have sex with men in London and Brighton, 2013-2016. Sex Transm Infect 2018; 94: 494-501.
37. Curtis TJ, Rodger AJ, Burns F, Nardone A, Copas A, Wayal S. Patterns of sexualised recreational drug use and its association with risk behaviours and sexual health outcomes in men who have sex with men in London, UK: a comparison of cross-sectional studies conducted in 2013 and 2016. Sex Transm Infect 2020; 96: 197-203.
38. Centers for Disease Control and Prevention. Diagnoses of HIV infection in the United States and dependent areas, 2011. HIV Surveill Rep 2013; 500: 23.
39. Hessou PS, Glele-Ahanhanzo Y, Adekpedjou R, Ahouada C, Johnson RC, Boko M, et al. Comparison of the prevalence rates of HIV

infection between men who have sex with men (MSM) and men in the general population in sub-Saharan Africa: a systematic review and meta-analysis. BMC Public Health 2019; 19: 1634. DOI: 10.1186/s12889-019-8000-x.
40. Demorat H, Lopes A, Chopin D, Delcey V, Clevenbergh P, Simoneau G, et al. Acceptability and feasibility of HIV testing in general medicine by ELISA or rapid test from finger-stick whole blood. Presse Med 2018; 47: e15-e23. DOI: 10.1016/j.lpm.2017.11.022.
41. Li Y, Xu J, Reilly KH, Zhang J, Wei H, Jiang Y, et al. Prevalence of HIV and syphilis infection among high school and college student MSM in China: a systematic review and meta-analysis. PLoS One 2013; 8: e69137. DOI: 10.1371/journal.pone.0069137.
42. Huang Q, Li Q, Li Y, Zeng G, Cui X, Yan P, et al. Prevalence of HIV infection and syphilis, sexual behaviors and awareness of HIV/AIDS related knowledge among men who have sex with men in China: a meta-analysis of data collected from 2010 to 2013. Zhonghua Liu Xing Bing Xue Za Zhi 2015; 36: 1297-1304.
43. Oldenburg CE, Perez-Brumer AG, Reisner SL, Mimiaga MJ. Transactional sex and the HIV epidemic among men who have sex with men (MSM): results from a systematic review and meta-analysis. AIDS Behav 2015; 19: 2177-2183.
44. Nelson LE, Tharao W, Husbands W, Sa T, Zhang N, Kushwaha S, et al. The epidemiology of HIV and other sexually transmitted infections in African, Caribbean and Black men in Toronto, Canada. BMC Infect Dis 2019; 19: 294. DOI: 10.1186/s12879-019-3925-3.
45. Dong MJ, Peng B, Liu ZF, Ye QN, Liu H, Lu XL, et al. The prevalence of HIV among MSM in China: a large-scale systematic analysis. BMC Infect Dis 2019; 19: 1000. DOI: 10.1186/s12879-019-4559-1.
46. Bayer AM, Garvich M, Díaz DA, Sánchez H, García PJ, Coates TJJ-STI. 'Just getting by': a cross-sectional study of male sex workers as a key population for HIV/STIs among men who have sex with men in Peru. Sex Transm Infect 2014; 90: 223-229.
47. Belza M. Risk of HIV infection among male sex workers in Spain. Sex Transm Infect 2005; 81: 85-88.
48. Bockting W, Huang CY, Ding H, Robinson BB, Rosser BS. Are transgender persons at higher risk for HIV than other sexual minorities? A comparison of HIV prevalence and risks. Int J Transgenderism 2005; 8: 123-131.
49. Brahmam GN, Kodavalla V, Rajkumar H, Rachakulla HK, Kallam S, Myakala SP, et al. Sexual practices, HIV and sexually transmitted infections among self-identified men who have sex with men in four high HIV prevalence states of India. AIDS 2008; 22 Suppl 5: S45-S57. DOI: 10.1097/01.aids.0000343763.54831.15.
50. Figueroa JP, Cooper CJ, Edwards JK, Byfield L, Eastman S, Hobbs MM, et al. Understanding the high prevalence of HIV and other sexually transmitted infections among socio-economically vulnerable men who have sex with men in Jamaica. PLoS One 2015; 10: e0117686. DOI: 10.1371/journal.pone.0117686.
51. Hakim AJ, Coy K, Badman SG, Willie B, Narokobi R, Gabuzzi J, et al. One size does not fit all: HIV prevalence and correlates of risk for men who have sex with men, transgender women in multiple cities in Papua New Guinea. BMC Public Health 2019; 19: 623. DOI: https://doi.org/10.1186/s12889-019-6942-72019.
52. Hawkes S, Collumbien M, Platt L, Lalji N, Rizvi N, Andreasen A, et al. HIV and other sexually transmitted infections among men, transgenders and women selling sex in two cities in Pakistan: a cross-sectional prevalence survey. Sex Transm Infect 2009; 85 (Suppl 2): ii8-ii16.
53. Keshinro B, Crowell TA, Nowak RG, Adebajo S, Peel S, Gaydos CA, et al. High prevalence of HIV, chlamydia and gonorrhoea among men who have sex with men and transgender women attending trusted community centres in Abuja and Lagos, Nigeria. J Int AIDS Soc 2016; 19: 21270. DOI: 10.7448/IAS.19.1.21270.
54. Perez-Brumer AG, Konda KA, Salvatierra HJ, Segura ER, Hall ER, Montano SM, et al. Prevalence of HIV, STIs, and risk behaviors in a cross-sectional community-and clinic-based sample of men who have sex with men (MSM) in Lima, Peru. PLoS One 2013; 8: e59072. DOI: 10.1371/journal.pone.0059072.
55. Poteat T, Ackerman B, Diouf D, Ceesay N, Mothopeng T, Odette KZ, et al. HIV prevalence and behavioral and psychosocial factors among transgender women and cisgender men who have sex with men in 8 African countries: a cross-sectional analysis. PLoS Med 2017; 14: e1002422. DOI: 10.1371/journal.pmed.1002422.
56. Somia IKA, Teeratakulpisarn N, Jeo WS, Yee IA, Pankam T, Nonenoy S, et al. Prevalence of and risk factors for anal high-risk HPV among HIV-negative and HIV-positive MSM and transgender women in three countries at South-East Asia. Medicine (Baltimore) 2018; 97: e9898. DOI: 10.1097/MD.0000000000009898.
57. Supindham T, Chariyalertsak S, Utaipat U, Miura T, Ruanpeng D, Chotirosniramit N, et al. High prevalence and genotype diversity of anal HPV infection among MSM in Northern Thailand. PLoS One 2015; 10: e0124499. DOI: 10.1371/journal.pone.0124499.
58. Beyrer C, Sripaipan T, Tovanabutra S, Jittiwutikarn J, Suriyanon V, Vongchak T, et al. High HIV, hepatitis C and sexual risks among drug-using men who have sex with men in northern Thailand. AIDS 2005; 19: 1535-1540.
59. Brito MO, Hodge D, Donastorg Y, Khosla S, Lerebours L, Pope Z. Risk behaviours and prevalence of sexually transmitted infections and HIV in a group of Dominican gay men, other men who have sex with men and transgender women. BMJ Open 2015; 5: e007747. DOI: 10.1136/bmjopen-2015-007747.
60. Phillips AE, Lowndes CM, Boily MC, Garnett GP, Gurav K, Ramesh BM, et al. Men who have sex with men and women in Bangalore, South India, and potential impact on the HIV epidemic. Sex Transm Infect 2010; 86: 187-192.
61. Lahuerta M, Patnaik P, Ballo T, Telly N, Knox J, Traore B, et al. HIV prevalence and related risk factors in men who have sex with men in Bamako, Mali: findings from a bio-behavioral survey using respondent-driven sampling. AIDS Behav 2018; 22: 2079-2088.
62. Cao W, Li J, Sun S, Sturm C, Peng L, Gu J, et al. HIV Serostatus Disclosure Among Men Who Have Sex with Men in China in the Era of U= U and PrEP. AIDS Behav 2022; 26: 1477-1488.
63. Prabhu S, Mehta SH, McFall AM, Srikrishnan AK, Vasudevan CK, Lucas GM, et al. Substance use is associated with condomless anal intercourse among men who have sex with men in India: a partner-level analysis. BMC Public Health 2022; 22: 722. DOI: 10.1186/s12889-022-13192-y.
64. Zhang F, Nie C, Yuan F, Liu Y, Xie N, Li J, et al. HIV infection status and related factors in men who have sex with men in sentinel surveillance in Shanxi province, 2010, 2015 and 2020. Zhonghua Liu Xing Bing Xue Za Zhi 2022; 43: 554-559 [Article in Chinese].
65. Yang S, Yang C, Liao Q, Zhai W, Yu G, Xiao L, et al. Analysis of HIV prevalence among pregnant women in Liangshan Prefecture, China, from 2009 to 2015. PLoS One 2017; 12: e0183418. DOI: 10.1371/journal.pone.0183418.
66. Chen JS, Levintow SN, Tran HV, Sripaipan T, Nguyen MX, Nguyen SM, et al. HIV and STI prevalence and testing history among men who have sex with men in Hanoi, Vietnam. Int J STD AIDS 2021; 33: 193-201.