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HIV testing and engagement with the HIV treatment cascade among men who have sex with men in Africa: a systematic review and meta-analysis

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Contributors

MCB, JE, KM, ED, and JS conceptualised this review and planned the analysis. JS, ED, and RS did the search and independently did all stages of screening. JS and ED independently extracted data, and JS did all analyses. KM double-checked data extraction and checked the data analysis, with input from MCB. JS, ED, KM, and MCB interpreted the results and conceptualised the first draft of the review. JE and CB made substantial intellectual contributions to the interpretation of the results and edited the manuscript. All authors read and approved the final version of the manuscript.

Declaration of interests

We declare no competing interests.

Summary

Background—HIV disproportionately affects gay, bisexual, and other men who have sex with men (MSM) in Africa, where many countries criminalise same-sex behaviour. We assessed changes in the engagement of African MSM with HIV testing and treatment cascade stages over time, and the effect of anti-LGBT legislation and stigma.

Methods—We systematically searched Embase, Global Health, MEDLINE, Scopus, and Web of Science for peer-reviewed cross-sectional or longitudinal studies recruiting at least ten MSM, published from Jan 1, 1980, to Oct 10, 2018. We extracted or derived estimates of HIV testing, engagement with the HIV treatment cascade, or both among African MSM from published reports. We derived pooled estimates using inverse-variance random-effects models. We used subgroup and meta-regression analysis to assess associations between testing and status awareness outcomes and study and participant characteristics, including the severity of country-level anti-LGBT legislation.

Findings—Our searches identified 75 independent eligible studies that provided estimates for 44 993 MSM across one or more of five testing and treatment cascade outcomes. HIV testing increased significantly over time overall, with pooled proportions of MSM ever tested for HIV of 67.3% (95% CI 62.1–72.3; 44 estimates) and tested in the past 12 months of 50.1% (42.4–57.8, 31 estimates) after 2011, which were 14.8 percentage points and 17.9 percentage points higher than before 2011, respectively. After 2011, ever testing was highest in southern Africa (80.0%), and lowest in northern Africa (34.4%), with the greatest increase in western Africa (from 42.4% to 70.9%). Levels of testing ever, in the past 12 months, and status awareness were statistically significantly lower in countries with the most severe anti-LGBT legislation compared with countries with the least severe legislation (57·4% *vs* 71·6%, p=0 0056; 35 5% *vs* 49·3%, p=0·010; 6·7% *vs* 22.0%, p=0·0050). Few estimates were available for later stages of the treatment cascade. Available data after 2011 suggest that the pooled proportion of MSM HIV-positive aware has remained low (18·5%, 12·5–25·3; 28 estimates), whereas proportions of current antiretroviral therapy (ART) use were 23·7% (15.5–33.0; 13 estimates) among all MSM living with HIV and 60·1% (48.6–71·1; five estimates) among MSM HIV-positive aware of their status. Pooled levels of viral suppression among MSM currently on ART were 75·6% (64·4–85·5; four estimates), but only 24.7% (18·8–31·2; four estimates) among all MSM living with HIV.

Interpretation—Despite improvements in HIV testing among MSM in Africa, HIV status awareness, ART coverage, and viral suppression remain much lower than required to achieve UNAIDS 90–90–90 targets. Further studies are urgently needed to provide more accurate estimates of levels of status awareness, engagement in care, ART coverage, and viral suppression among MSM to inform prevention efforts aimed at improving access to HIV services for MSM. Severe anti-LGBT legislation might be associated with lower HIV testing and status awareness; therefore, further research is needed to assess the effect of such legislation on HIV testing and engagement with the HIV treatment cascade among MSM.

Introduction

The development of highly active antiretroviral therapy (ART) in the 1990s transformed HIV from a fatal infection to a treatable chronic disease.[1] People living with HIV on

suppressive ART can live as long as people without HIV.[2] However, achieving viral suppression requires engagement in all stages of HIV care, from testing and early diagnosis, through the treatment cascade, including linkage into and retention in care, early ART initiation, and near-perfect adherence.[3] Globally, however, approximately 1 million people living with HIV still die from HIV annually because they cannot or do not complete this cascade.[4,5]

UNAIDS has formulated the 90–90-90 targets, aiming to achieve 90% of people living with HIV aware of their status, 90% of those aware of their status on ART, and 90% on ART achieving viral suppression by 2020,[6] with targets increasing to 95% by 2030.[7] Therefore, 73% of people living with HIV should be virally suppressed by 2020 and 86% by 2030.[7] Engaging people living with HIV in the cascade to meet these ambitious targets will have major implications for them and their community in terms of HIV prevention, improving mortality and morbidity outcomes,[8] and reducing transmission risk.[9,10] UNAIDS has highlighted the importance of reaching key populations, including gay, bisexual, and other men who have sex with men (MSM); however estimates of progress towards achieving 90–90-90 targets among MSM are very scarce, which compromises our ability to adequately address needs, reduce barriers to uptake of services, and improve HIV prevention services for MSM.[11,12] Globally, MSM are about 28 times more likely to be living with HIV than men in the general population, an inequality that is particularly apparent in sub-Saharan Africa, where the human rights of MSM are often violated.[5,13–19]

Almost two-thirds of African countries still criminalise same-sex relations, many with long prison sentences and some with the death penalty.[20] In this context, stigma, discrimination, and human rights violations of MSM that are linked to legislation have been widely documented.[5,13–19] These violations include blackmail, violence, reprisals from family and communities, denial of housing, health care, and access to justice, and lack of adequate and accessible services for MSM.[21–23] These attitudes also create barriers to implementing effective HIV research, policy, and health programmes for MSM, through prohibition of activism and research, arbitrary arrests of healthcare providers, and disruption of services provided by community-based and non-governmental organisations (NGOs).[24–26] This issue might also explain why research on African MSM has lagged behind compared with other parts of the world.[15,17,25–28]

After South Africa led the first UN resolution on sexual orientation and gender in 2011, some positive changes in LGBT rights protection were reported in parts of Africa, albeit inconsistently.[29] For example, although Seychelles, São Tomé and Príncipe, Mozambique, and Lesotho have decriminalised same-sex relations, Uganda and Nigeria have increased the severity of their anti-LGBT legislation.[20]

In this study, we systematically reviewed published studies providing estimates of HIV testing, diagnosis, and the treatment cascade among MSM in Africa; assessed whether these outcomes have improved over time; and explored the effect of participant and study characteristics, study quality, and two key structural factors—stigma and severity of anti-LGBT legislation—on each outcome.

Methods

Search strategy and selection criteria

For this systematic review and meta-analysis, we searched Embase, MEDLINE, Scopus, Global Health, and Web of Science for articles reporting on HIV testing, any HIV treatment cascade stages, or both, among MSM in Africa, published between Jan 1, 1980, and Oct 10, 2018, using terms for HIV, MSM, and Africa (see appendix p 1 for full search terms).

We screened initially by abstract and title, and then screened potentially relevant full texts for studies directly reporting estimates or sufficient data to self-calculate proportions of MSM engaging in HIV testing, treatment cascade stages, or both. We only included peer-reviewed cross-sectional or longitudinal studies recruiting at least ten MSM. We excluded mathematical modelling studies, qualitative studies, conference abstracts and reviews, and studies reporting cascade outcomes using self-reported HIV status (instead of confirmed biological test) to derive the number of MSM living with HIV in the denominator. We did not exclude articles based on language.

For included studies, we extracted or self-calculated proportions of MSM who self-reported having ever or recently received an HIV test; testing positive in the study (ie, MSM living with HIV) who self-reported being HIV positive before testing (ie, MSM HIV-positive aware); living with HIV who self-reported being ever or currently engaged in care or linked to care following diagnosis; living with HIV or HIV-positive aware of their status who self-reported ever or currently taking ART; and living with HIV, HIV-positive aware of their status, or currently on ART who were virally suppressed (based on viral load testing). We excluded estimates based on fewer than ten MSM. One of four study authors contacted provided estimates of MSM ever and recently tested and of MSM living with HIV virally suppressed.[32]

For each study, we extracted information on participant characteristics (eg, population, region of Africa, HIV prevalence among MSM participants tested in the study, proportion who sold sex), stigma (eg, proportion who disclosed their MSM status to health-care workers or family, or were blackmailed), and study characteristics and quality indicators (eg, study year, design, sampling, and interview methods).

We used country-specific data from International Lesbian, Gay, Bisexual, Trans and Intersex Association (ILGA) reports, country constitutions, and UN reports to construct four composite anti-LGBT legislation variables, one global anti-LGBT legislation index, and one arrests variable for each study country (appendix pp 2 , 3).[20,33–35]

The four anti-LGBT legislation variables are: repressive legislation (same-sex relations, sexual orientation-related NGOs, or LGBT promotion are illegal, age of consent differs for same-sex relationships, or legislation prohibits same-sex marriage, adoption, or both; score 0–5), absence of protective legislation (LGBT people are not protected from discrimination, or incitement to hatred based on sexual orientation is not illegal; score 0–2), absence of progressive legislation (same-sex marriage, adoption, or both are not legally recognised; score 0–2), and a penalties variable (the harshest punishment receiveable for consensual

same-sex relations varying from no punishment to death penalty; score 0–5). Our global anti-LGBT legislation index summed the scores of these four legislation variables (score 0–14) for each study country at the time the study was done. Higher scores reflected less progressive legislation. The binary arrests variable captured if arrests for consensual same-sex relations had been documented in the country between 2014 and 2017 (the only data available).[20]

JS, ED, and RS independently did all stages of screening and data extraction. Discrepancies were resolved by KM.

Data analysis

We pooled independent study estimates and calculated 95% CIs and 95% prediction intervals using random-effects models based on the DerSimonian-Laird inverse-variance method and the Freeman-Tukey transformation for proportions.[36,37] Pooled estimates were back-transformed and presented on their original scale. Heterogeneity across estimates was assessed using the I^2 statistic.[38] Where multiple articles estimated the same outcome for the same study population, we preferentially used estimates from the largest sample, or used the most recent estimates if sample sizes were equal. From these estimates, we preferentially used weighted estimates accounting for clustering (eg, from respondent-driven sampling studies) over crude estimates when available (appendix pp 3, 4). For studies done in multiple locations, we preferentially extracted estimates for separate locations if reported; otherwise we used the combined estimate. For studies reporting on both MSM and transgender women, we included estimates for MSM alone if disaggregated data were available; otherwise we used estimates from the whole sample.

We assessed whether study estimates varied by study year, region, or other study, participant, or structural variables (eg, population, MSM HIV prevalence, proportion who sold sex, stigma, anti-LGBT legislation; appendix pp 21–26), and study quality using univariate meta-regression for study outcomes with 20 estimates or more. Additionally, we assessed whether time trends differed by region (using a model with region × study year [continuous] interaction) and country if there were three estimates or more at different timepoints. If study year was significantly ($p<0.05$) associated with the outcome in univariate meta-regression, we also did bivariate (time-adjusted) meta-regression (adjusting for time as a continuous variable). We presented pooled estimates of outcomes stratified by variables statistically significantly associated in time-adjusted meta-regression in forest plots stratified by study year. We also did leave-one-out sensitivity analyses to explore how sensitive associations between ever testing and the global anti-LGBT legislation index were to the exclusion of individual countries and studies.

We further assessed study quality using subgroup analysis stratified by predefined quality indicators based on the AXIS tool for appraising cross-sectional studies,[39] including study design, reporting bias, publication bias, and a quality score summing the responses to three key quality criteria (appendix p 5). We further assessed publication bias using funnel plots and Egger's test for asymmetry.[40]

We did all analyses with R, version 3.5.1, using the metafor package.[41,42] This systematic review and meta-analysis was reported in accordance with PRISMA and MOOSE guidelines.[30,31]

Role of the funding source

The funder had no role in study design, data collection, data analysis, data interpretation, or writing of the report. The corresponding author had full access to all the data in the study and had final responsibility for the decision to submit for publication.

Results

We identified 14729 records through the database search; 7291 duplicates were removed and 7438 records screened. From these, 6882 records were excluded and 556 full-text articles were assessed for eligibility, of which 113 articles reporting on 75 independent studies providing estimates (or data to self-calculate estimates) of the testing and cascade outcomes were included in this study (figure 1). The number of relevant studies and published articles increased markedly since 2007 and 2010, respectively (appendix p 6). Table 1 summarises the outcomes, participant characteristics, structural variables, and study characteristics of included studies (see appendix pp 7–15 for additional details).

Most studies provided proportions of MSM who were ever HIV tested (number of studies [N_s] 55, number of estimates [N_e] 81,[32,43–95] studies on MSM recently HIV-tested [N_s=33, N_e=51,[32,43,46,48–51,62,73,76,78,80,82,85,96–109] and on HIV-positive MSM who were aware of their status [N_s=23, N_e=35]).[32,43,48,51,58,62,68,87,88,110–122] Very few studies provided proportions of MSM engaged in care (N_s=5),[68,116,118,123,124] on ART (ever [N_s=4],[48,116,122,124] currently [N_s=10][32,68,102,116,118,119,125–28]), or virally suppressed (N_s=5)[32,116,122,125,128–30] (table 1).

Over half the studies were done after 2011 (table 1). Studies provided estimates for 28 countries predominantly from eastern [32,43–61,77,97,108–111,121,122,124,125] western [88–92,94–97,99–106,108,115–117, 129–134,139–141] and southern[57,66–76,97,100–104,111–115,121,125,127] Africa (table 1, appendix p 19). Study participants were mainly recruited from the general population of MSM[32,43–45,47–51,53,56–59,62–70,72–84,86,88–96,98–101,103,104,106,107,109–120,122,123,127–130] (table 1). Various definitions of MSM were used for study inclusion, with the period of sexual activity with men varying between 3 months and lifetime and different types of sexual activity specified (eg, anal sex only, anal or oral sex, and anal, oral, and masturbatory sex).

HIV prevalence (1–69%) and the proportion of MSM ever or recently selling sex (11–82%) varied across studies. Face-to-face interviews were used approximately three times more frequently than confidential interview methods (eg, audio computer-assisted self-interview). Most studies used respondent-driven sampling (RDS; N_s=30; table 1). Sample sizes ranged from 26 to 2453 participants.

Only 22 studies reported on stigma, [32,46,48,56,57,59,65,66,69,79,82–84,92,98,104,111,112,114,118,120,128–130] including the proportions of MSM who disclosed their MSM status to health-care workers or family, or had been blackmailed (table 1, appendix pp 7–15). Most studies were done in countries where same-sex relations were illegal (N_s =55) [32,43–52,54–65,77–81,83,85–87,89–100,103,104,106,108–111,113,116,118–125,128–130] 43 studies were done in countries with documented arrests related to consensual same-sex relations in 2014–17 (table 1) [32,43–45,47–49,51,52,54–61,63–65–77,78,80,81,87,90–94,96–100,103,108–111,113,116,118,120–122,124,125,128–130] Global anti-LGBT legislation scores ranged from 0 to 12 and were lower in countries where same-sex relations were legal than in countries where they were illegal (table 1, appendix pp 16–18).

Overall, the pooled proportion of MSM ever tested for HIV was 61·0% (95% CI 56·2–65·7; N_e=81; I^2=98%), and was highest in southern and lowest in northern Africa (table 2, figure 2, appendix pp 21, 22). The proportion of MSM tested in the past 12 months, 46·2% (39·6–52·9, N_e=39, I^2=97%) of MSM, was similar to the proportions tested in the past 6 and 3 months, and was highest in southern and lowest in eastern Africa (figure 3, table 2, appendix pp 23, 24). The proportion of MSM HIV-positive aware was much lower (18·2% [13·0–23·9], N_e=35, I^2=91%) especially in eastern Africa (figure 4, table 2, appendix pp 25, 26).

Overall, the pooled proportions of MSM living with HIV linked to care within 30 days of diagnosis, ever engaged or currently engaged in care, were low and varied between 15·3% (95% CI 9·3–22·3) and 40·4% (0·9–91·0) (figure 5, table 2). The overall pooled proportions of MSM living with HIV ever or currently on ART were less than 24%, and between 37% and 53% among MSM HIV-positive aware of their status (figures 6, 7, table 2). Overall, an estimated 24·7% (18·8–31·2) of MSM living with HIV, 34·4% (28·3–40·7) of MSM HIV-positive aware of their status, and 75·6% (64·4–85·5) of MSM currently on ART were virally suppressed (figure 8, table 2). The 95% prediction intervals for all study outcomes are shown in the appendix (p 20).

HIV testing ever (p=0·0025) and in the past 12 months (p=0·0015) increased continuously over time (figures 2, 3, appendix pp 21–24), and by 14·8 percentage points and 17·9 percentage points, respectively, after 2011 compared with before (appendix p 27). HIV testing ever increased from 52·5% (95% CI 44·1–60·8) to 67·3% (62·1–72·3) and testing in the past 12 months increased from 32·2% (21·6–43·7) to 50·1% (42·4–57·8). Only time trends in ever tested MSM differed between regions (year × region interaction for all regions, p<0·0001), with greater increases in eastern (from 48·9% to 64·9%) and western Africa (from 42·4% to 70·9%) than in other regions, and significant within-country increases in Kenya, Uganda, and Nigeria (figure 2, appendix pp 28, 29). Testing in the past 12 months increased significantly over time in South Africa (appendix p 30). Post-2011, the proportion of participants ever tested for HIV was highest in southern Africa (80·0%) and lowest in northern Africa (34·4%), and tested in the past 12 months was highest in southern Africa (66·9%) and lowest in eastern Africa (40·4%; appendix p 27). The proportion of MSM HIV-positive aware of their status did not increase over time overall (pooled estimates before 2011 17·6% [7·1–31·3], N_e=7; after 2011 18·5% [12·5–25·3], Ne=28; slope p=0–38;

appendix p 27) or by region (year × region interaction for all regions, p=0·80; figure 4, appendix pp 25–28), but increased in South Africa (appendix p 30). Too few estimates (especially before 2011) were available for the other cascade outcomes to assess time trends, but the pooled proportion of MSM living with HIV currently on ART after 2011 (23·7% [95% CI 15·5–33·0]; N_e=13) was similar to the estimate across all study years (N_e=14) and the proportion of MSM HIV-positive aware of their status currently on ART was slightly higher after 2011 (60·1% [48·6–71·1]; N_e=5, results not shown) than across all study years (N_e=6). All viral suppression estimates are from after 2011.

In the time-adjusted meta-regression, higher proportions of MSM tested ever and in the past 12 months were associated with living in southern Africa (tested ever, p=0·0011; tested in the past 12 months, p=0·040) and less severe penalties for same-sex relations (tested ever, p=0·0010; tested in the past 12 months, p=0·00024; appendix pp 21, 23). Ever testing was also higher with more protective (p=0·0015) and progressive (p=0·016) legislation, no LGBT-related arrests from 2014 to 2017 (p=0·020), and decreased by 2% (95% CI 1–4) for each point increase on the global anti-LGBT legislation index (continuous, p=0·0026; categorical, p=0·0056; appendix pp 21, 31, 32). The magnitude of the association was sensitive (approximately halved and no longer significant) to excluding all South African studies only, but not to the exclusion of any single South African study (appendix pp 31, 32). Testing in the past 12 months was also higher with less repressive legislation (p=0·023) and with the lowest global anti-LGBT legislation index scores (categorical p=0·010; appendix p 23). In subgroup analysis, differences in getting tested ever and in the past 12 months by global anti-LGBT legislation score were reduced after 2011 (appendix pp 33–35). In univariate meta-regression, a higher proportion of MSM HIV-positive aware of their status was associated with not living in eastern Africa (p=0·046), less repressive legislation (p=0·014), less severe penalties for same-sex relations (p=0·00023), and a lower global anti-LGBT legislation index score (categorical, p=0·0050; appendix p 25). For these three outcomes (ever tested, tested in the past 12 months, and HIV-positive aware of their status), proportions were 57·4%, 35·5%, and 6·7%, respectively, for countries with the most severe legislation compared with 71·6%, 49·3%, and 22·0%, respectively, for countries with the least severe legislation (appendix pp 21–26).

Among the few studies reporting on stigma, testing ever and in the past 12 months were higher where more MSM had disclosed they were MSM to health-care workers in time-adjusted meta-regression (testing ever, p<0·0001; testing in the past 12 months, p=0·034; appendix pp 21–24). The proportion of MSM tested in the past 12 months (time-adjusted meta-regression, p=0·015) and HIV-positive aware of their status (univariate meta-regression, p=0·031) were higher where more MSM had been blackmailed for being MSM (appendix pp 23–26). Other outcomes had too few estimates to assess associations using meta-regression.

The influence of study quality was assessed for the three HIV testing and awareness outcomes with 20 study estimates or more (appendix pp 36–42). Pooled estimates of all three outcomes differed with sampling method and were significantly higher in studies that did not use a complex study design or did not use statistical adjustment for complex study design (appendix pp 21–26, 40–42). Pooled estimates were also higher for studies

specifically designed to estimate the outcome of interest (ever tested), with less adequate response rates (ever tested), that used more confidential interview methods (ever tested, tested in the past 12 months), that adequately described their methods or basic data (tested in the past 12 months), did not sufficiently describe their methods (MSM HIV-positive aware of their status) and with study populations not representative of wider MSM (MSM HIV-positive aware of their status). Although not statistically significant, higher proportions of ever testing and HIV status awareness were observed for studies with a quality score of 0 (appendix pp 40, 42).

There was no evidence of publication bias for the proportions of MSM tested ever or in the past 12 months or HIV-positive aware of their status from funnel plots and Egger's asymmetry test (appendix p 43). Pooled proportions of MSM HIV-positive aware of their status were significantly higher for the subset of directly reported study estimates than those self-calculated (p=0·0045; appendix p 42).

Discussion

Our results suggest that engagement in HIV testing and particularly treatment cascade stages for African MSM remains suboptimal, and less than that needed to achieve UNAIDS 90–90-90 targets.

From 2011 onwards, only 50% of MSM reported being tested for HIV in the past 12 months, 19% were HIV-positive aware of their status, and, of these, only 60% were on antiretroviral therapy. 76% of MSM on antiretroviral therapy were virally suppressed, suggesting that once on antiretroviral therapy, MSM can achieve fairly high viral suppression. However, since levels of diagnosis and antiretroviral therapy access remain low, ART use (24%) and viral suppression (25%) among all MSM living with HIV are critically low, meaning HIV spread within these populations will continue.

We observed significant regional differences in HIV testing and status awareness. After 2011, the proportion of MSM ever HIV tested was highest in southern Africa, tested in the past 12 months was lowest in northern and eastern Africa, and HIV-positive aware of their status was lowest in eastern Africa. The greatest improvements in testing over time occurred in eastern and western Africa. These differences might reflect different levels of expansion of community-based testing and national HIV testing campaigns across regions.[131,132] Further expansion of community-led services, access to rapid and home-based testing, along with increased treatment support or counselling from LGBT-friendly organisations, will be essential to engage more MSM with HIV testing and treatment.[132]

We found evidence of statistically significant negative associations between testing and HIV status awareness and the severity of anti-LGBT legislation, which might, but do not necessarily, reflect causal relationships. These associations appeared to be mediated by negative associations between ever testing and an absence of protective or progressive legislation, or harsher penalties for same-sex relations, and between recently testing or HIV status awareness and repressive legislation or harsher penalties for same-sex relations. However, the strength of the association between our anti-LGBT legislation index and ever

testing was affected by South African estimates, which had the lowest anti-LGBT legislation scores. Thus, other country-level factors (eg, health-care-related or epidemic-related) might partly confound this association.

Despite limited data availability, HIV testing and status awareness were lower in studies with lower disclosure of MSM status to health-care workers, consistent with studies reporting associations between stigma and limited care cascade access.[56,133] Training for health-care workers will be important to tackle the intersection of HIV-related stigma with discrimination towards MSM and improve levels of testing and status awareness.[134] Consistent with other studies, we observed a positive association between ever testing and MSM HIV prevalence.[135] Higher prevalence could encourage MSM to test for HIV (as previous studies show that low risk perception can impede testing) or reflect targeting of testing services to more HIV-prevalent areas.[136]

Our pooled estimate of testing in the past 12 months pre-2011 (overall 32%) agreed with the 2008 UN General Assembly Special Session estimate of 30% among MSM in sub-Saharan Africa (from only one country however).[97] Available UNAIDS estimates of HIV status awareness among MSM in African countries—based on unpublished data or data from 2016 onwards—tended to be higher than our estimates, but UNAIDS antiretroviral therapy coverage estimates for MSM living with HIV were mostly similar to ours.[12] Our results suggest a worse situation in terms of engagement with the HIV treatment cascade for MSM in Africa than elsewhere. Our cascade estimates of MSM living with HIV aware of their status (19%), on ART (24%), and virally suppressed (25%) for 2011 onwards are far less than those from a study[137] in six European and central Asian countries, which reported estimates for 2016 of 83%, 70%, and 63%, respectively, for these outcomes. A literature review[25] published in 2015 showed higher levels of status awareness for high-income western countries (72–100%) and India (44%; another low-income setting) than we found, but similar levels (20%) for Russia, which enforces harsh anti-LGBT legislation.

There are marked differences in HIV testing and antiretroviral therapy coverage for African MSM compared with all men (appendix pp 44–46). Although levels of testing ever and in the past 12 months are consistently higher for MSM than all men across regions, self-reported HIV status awareness and antiretroviral therapy coverage are substantially lower among MSM than corresponding estimates among men living with HIV (Maheu-Giroux M, McGill University, personal communication; appendix p 46).[138]

Our review has several strengths and limitations, partly because of data and study quality, which might reflect the challenges of doing research among key populations that face substantial stigma.[133] We reported new pooled estimates for 44993 MSM across five outcomes from studies done between 2004 and 2017 and explored changes over time, by region and country. We self-calculated additional study estimates, increasing the sample size and minimising publication bias. We explored heterogeneity due to participant and study characteristics, additionally assessing the influence of anti-LGBT legislation using a novel index. ILGA published the rainbow index for European countries,[139] but to our knowledge no similar tools exist for African countries. Despite increases over time, studies on the treatment cascade among MSM in Africa remain scarce, particularly for central and northern

Africa. Studies were missing from 26 countries, 13 where same-sex relations are illegal. Therefore, our overall pooled estimates might not be representative of MSM across Africa and might underestimate or overestimate engagement, especially for antiretroviral therapy use and viral suppression, which were based on very few estimates. Small numbers of studies in central and northern Africa limit our ability to assess regional levels and trends in HIV testing.

Heterogeneity across study estimates was substantial and could only be explored in meta-regression for the outcomes with the most study estimates (ever testing, testing in past 12 months, HIV-positive aware of their status). Not all studies reported key participant characteristics, including age, HIV prevalence, and selling sex, with stigma the most poorly reported variable. Future studies should report on stigma alongside testing and treatment outcomes.

Our analysis included studies of generally moderate quality, and reporting biases were possible because most outcomes were self-reported and most studies used non-confidential interview methods. Pooled estimates were influenced by study quality and, in particular, tended to be lower for studies that adjusted for complex study design (eg, weighted RDS), with less confidential interview methods (testing outcomes) or with higher quality scores (albeit not significantly). Under-reporting has been previously documented among African MSM. In the HPTN 075 study,[121] 22% of MSM living with HIV self-reported a positive status; however antiretroviral drugs were detected in 58% of them. One study in Uganda found that approximately half of virally suppressed MSM (probably due to suppressive antiretroviral therapy) reported not knowing their HIV-positive status.[32] Thus, our pooled estimates might underestimate status awareness and antiretroviral therapy use. Obtaining representative samples of MSM is difficult, even with RDS sampling, with samples often biased towards younger, more visible (ie, self-identified gay) MSM.[140] However, our pooled estimates did not differ by mean age. Many of the RDS studies included here did not report weighted estimates, potentially, but not necessarily, reducing their representativeness.[141]

Included studies used varied definitions of MSM and most did not disaggregate transgender women from MSM, which did not influence pooled study outcome estimates. However, it would be preferable in future to provide disaggregated estimates to gain a better understanding of the health needs of transgender women. There was no evidence of publication bias for any outcome except status awareness, and only in subgroup analysis comparing directly reported and self-calculated estimates.

Our anti-LGBT legislation index only captures information about legislation, not how legislation is implemented. Only arrests data after 2013 were available to measure implementation, and for few African nations;[20] therefore, we might not have fully captured the effect of changes in legislation implementation. More implementation data are needed. Nonetheless, our novel anti-LGBT legislation index reflected complex African legislation over time and enabled detailed analysis of our data in a legal context. Although no other measures or indexes are currently available specifically for Africa, our index correlates well with the recent global Homophobic Climate Index (data not shown).[142]

Engagement with the HIV treatment cascade among MSM in Africa remains low, despite improvements in HIV testing. Lower testing and status awareness levels were associated with more hostile legislation. More studies are needed on HIV testing and, particularly, the HIV treatment cascade for MSM across Africa, especially northern and central Africa. Future studies should use confidential interview methods to reduce reporting biases and collect standardised stigma data.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Research in context

Evidence before this study

Gay, bisexual, and other men who have sex with men (MSM) are disproportionately burdened with HIV globally, with particularly high prevalence in Africa. Engagement in all stages of the HIV treatment cascade (including testing, status awareness, engagement in care, and antiretroviral therapy use) might be particularly challenging in many African countries where existing legislation criminalises same-sex relations. We searched Embase, Global Health, MEDLINE, Scopus, and Web of Science, for studies published between Jan 1, 1980, and Oct 10, 2018, reporting on HIV testing and the HIV treatment cascade among MSM in Africa. Abstracts of non-English articles were translated, when possible, and full texts received and translated, if potentially relevant. We included peer-reviewed cross-sectional or longitudinal studies recruiting at least ten MSM and excluded mathematical modelling studies, qualitative studies, conference abstracts and reviews, and studies reporting cascade outcomes using self-reported HIV status to derive the number of MSM living with HIV in the denominator. We did not make exclusions based on language. Although several studies have reported negative effects of specific anti-LGBT legislation on HIV treatment and care in countries including Uganda and Nigeria, no study has systematically reviewed the evidence on the influence of legislation on HIV testing and the treatment cascade across Africa. Additionally, the HIV treatment cascade has never been comprehensively reviewed and summarised for MSM in Africa. The most recent literature review of the treatment cascade among key populations (done in 2015) reported on MSM, sex workers, and people who inject drugs globally, but only three studies on MSM in Africa were included.

Added value of this study

To our knowledge, this is the first systematic review and meta-analysis of the engagement of MSM in Africa with HIV testing and all stages of the HIV treatment cascade, which also assesses progress over time and the relationship between HIV testing and treatment and the severity of anti-LGBT legislation. We included data from 75 independent studies from 28 countries and estimated pooled proportions of HIV testing, status awareness, engagement in care, antiretroviral therapy use, and viral suppression for 44 993 MSM. Our analysis of available HIV testing data over time suggests that after 2011, pooled estimates of levels of testing ever (67%) and in the past 12 months (50%) were significantly higher than before 2011, with the greatest increases in western Africa. Despite this increase, pooled estimates of status awareness after 2011 suggest that it is still low (19%). Our pooled estimates after 2011 also suggested that MSM on antiretroviral therapy can achieve relatively high viral suppression (76%). However, among all MSM living with HIV, current antiretroviral therapy use (24%) and viral suppression (25%) remain extremely low. We found that more severe anti-LGBT legislation was statistically significantly associated with lower levels of testing and status awareness. We also showed that despite a substantial increase in the number of studies on the HIV treatment cascade among MSM in Africa over the past few years, data remain scarce for all outcomes except HIV testing, especially from central and northern Africa.

Implications of all the available evidence

Despite improvements in HIV testing among MSM in Africa, particularly since 2011, and levels of testing among MSM exceeding those among all men in all regions, HIV status awareness, antiretroviral therapy coverage, and overall viral suppression have remained very low, with HIV status awareness and antiretroviral therapy coverage among MSM much lower than among all men, despite higher testing. Additional efforts are urgently needed to reach the UNAIDS 90–90-90 targets among MSM across Africa. Furthermore, our findings support previous evidence suggesting an association between anti-LGBT legislation and access to testing and treatment. Further research is needed to assess the effect of repealing such legislation on access to HIV services for MSM. Additionally, in spite of an increase over time in the number of studies, more data are still needed on the engagement of MSM in all stages of the HIV treatment cascade, particularly status awareness, engagement in care, antiretroviral therapy use, and viral suppression, and more research needs to be done in northern and central Africa, where few data were available.

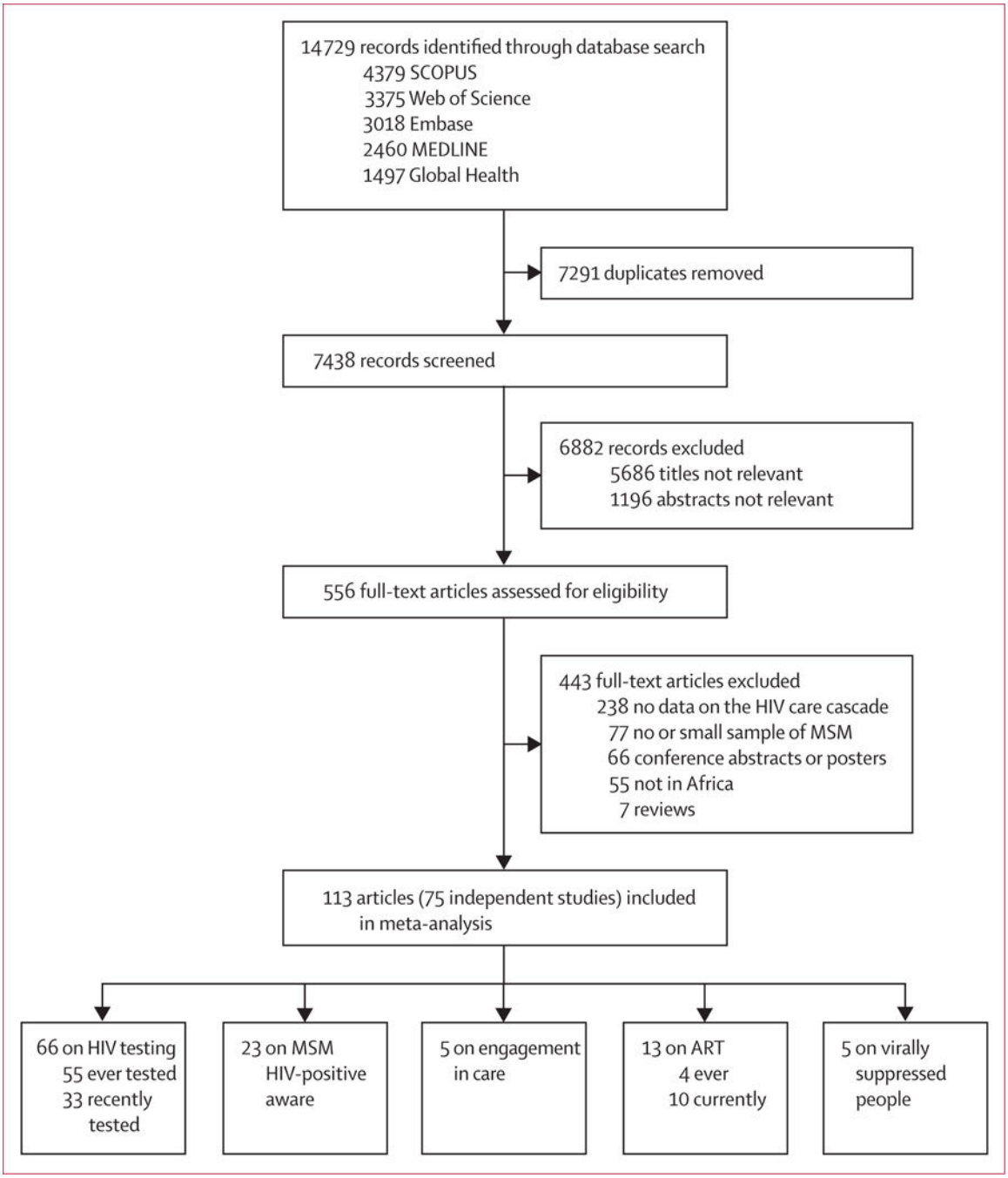

Figure 1: Study selection

MSM=men who have sex with men. ART=antiretroviral therapy.

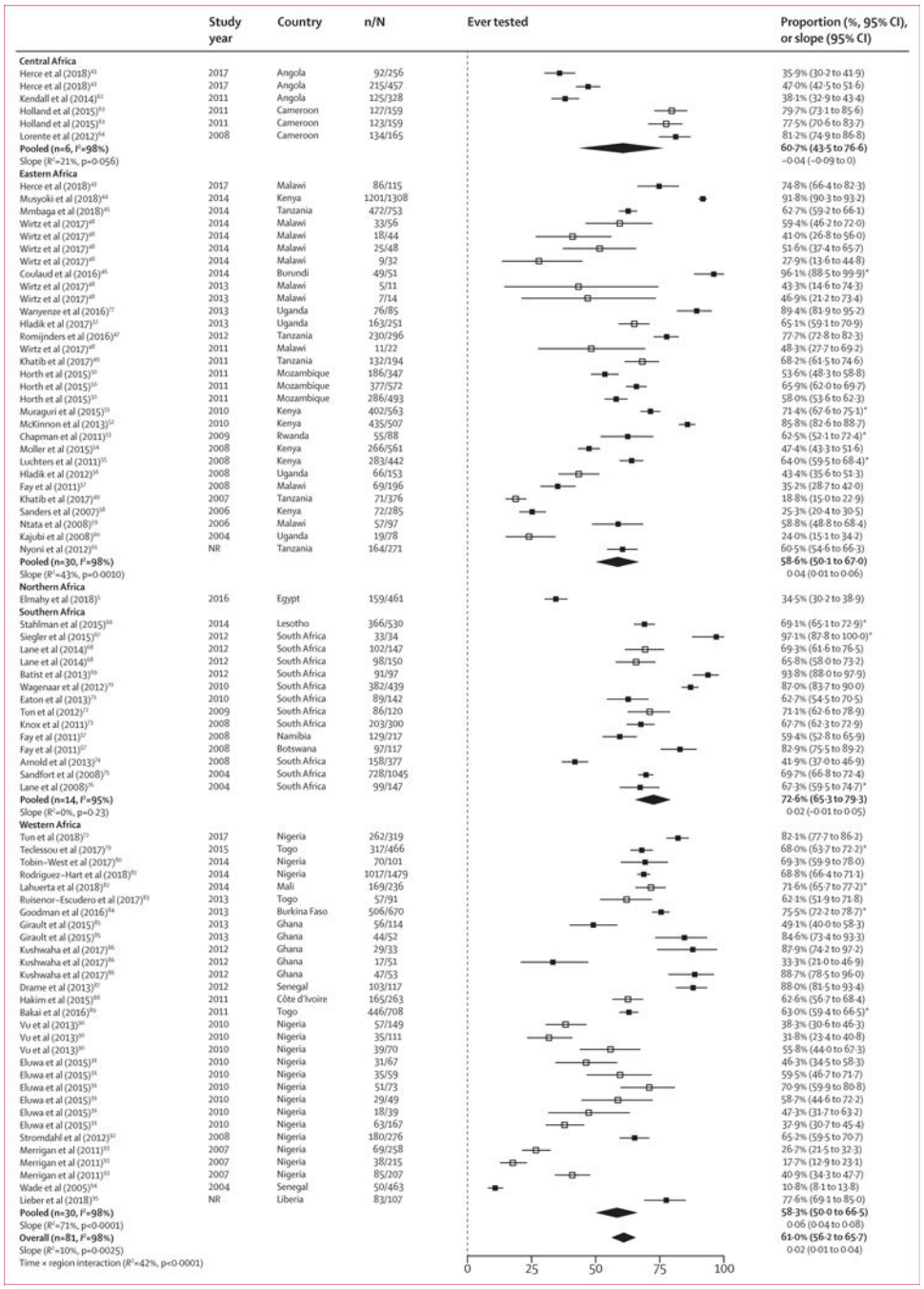

Figure 2: Forest plot of the proportions of African men who have sex with men who ever tested for HIV

Weighted (blank squares) and unweighted (filled squares) study estimates and their 95% CIs, and pooled estimates (diamonds) and their 95% Cls are shown for proportions of men who have sex with men in Africa who ever tested for HIV (self-reported), overall and stratified by region of Africa. Numerators and denominators of weighted study estimates were derived from the effective sample size (appendix pp 3, 4). *Self-calculated estimates.

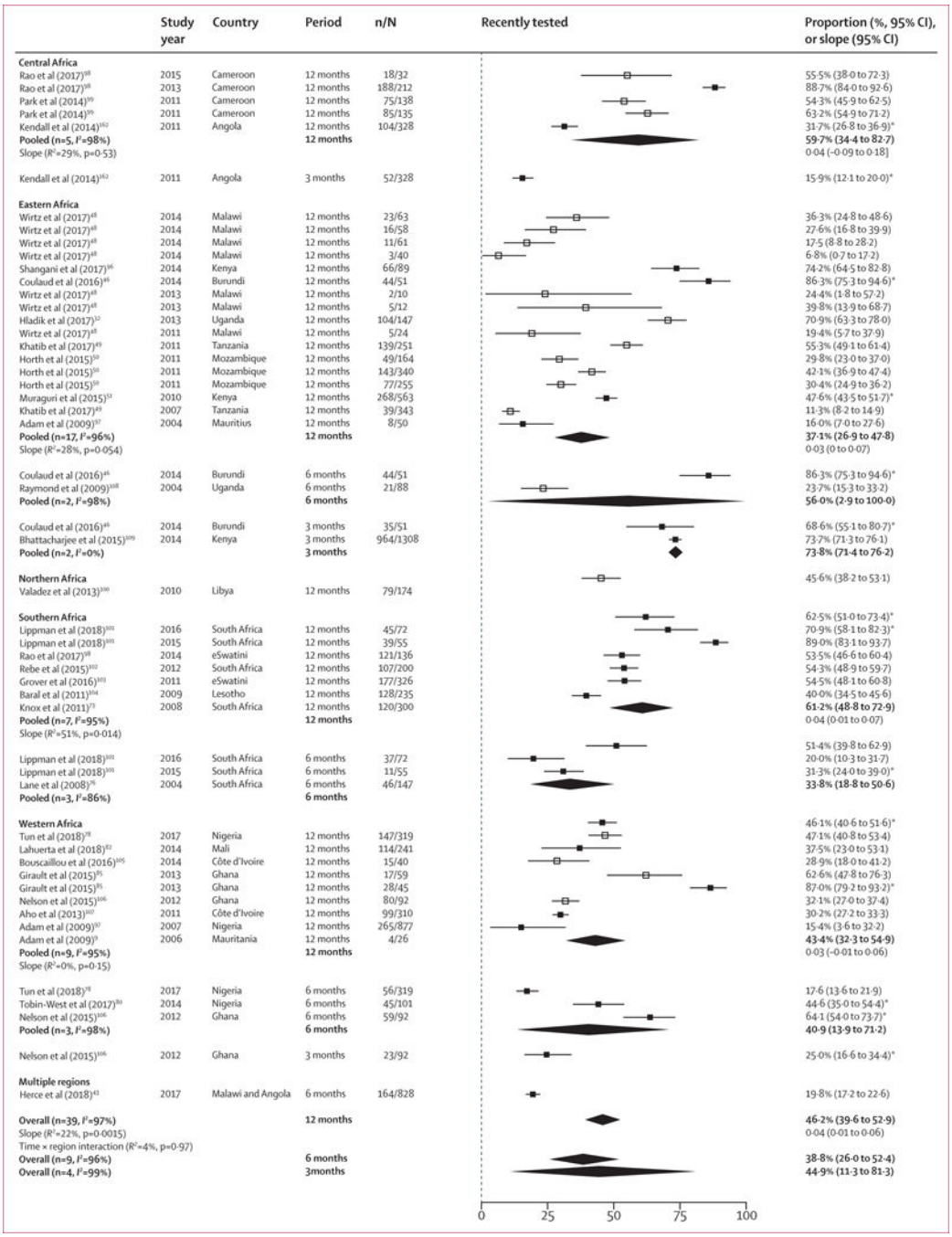

Figure 3: Forest plot of the proportions of African men who have sex with men tested in the past 12, 6, and 3 months

Weighted (blank squares) and unweighted (filled squares) study estimates and their 95% CIs and pooled estimates (diamonds), and their 95% CIs are shown for proportions of men who have sex with men in Africa tested for HIV (self-reported) in the past 12 months, 6 months, and 3 months, overall and stratified by region of Africa. Numerators and denominators of weighted study estimates were derived from the effective sample size (appendix pp 3, 4). *Self-calculated estimates.

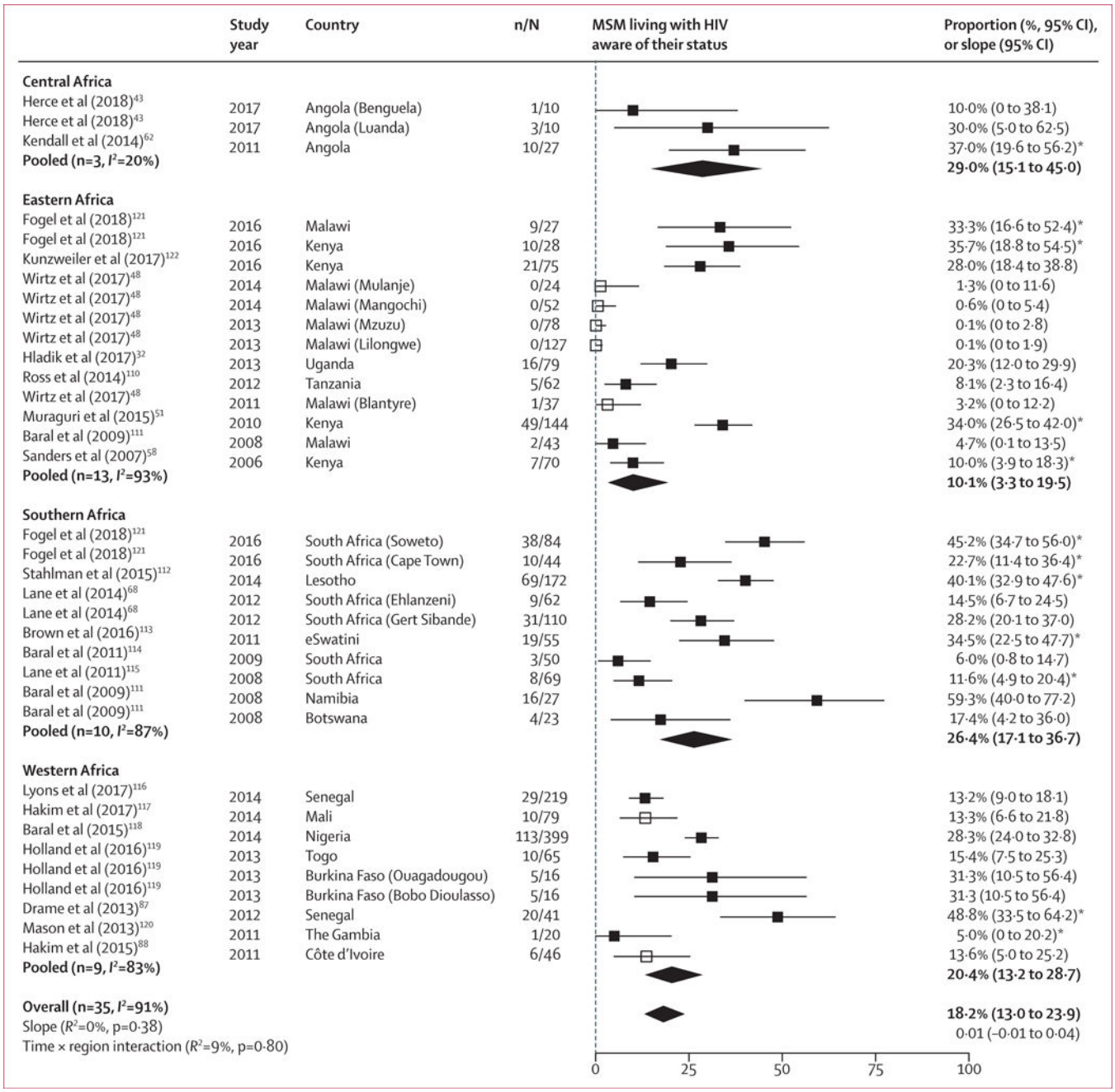

Figure 4: Forest plot of the proportions of African men who have sex with men (MSM) with HIV who are aware of their status

Weighted (blank squares) and unweighted (filled squares) study estimates and their 95% CIs, and pooled estimates (diamonds) and their 95% CIs are shown for proportions of men who have sex with men in Africa who are HIV-positive aware of their status, overall and stratified by region of Africa. Men who have sex with men who are HIV-positive aware of their status are those who reported living with HIV before testing positive during the study. Numerators and denominators of weighted study estimates were derived from the effective sample size (appendix pp 3, 4). *Self-calculated estimates.

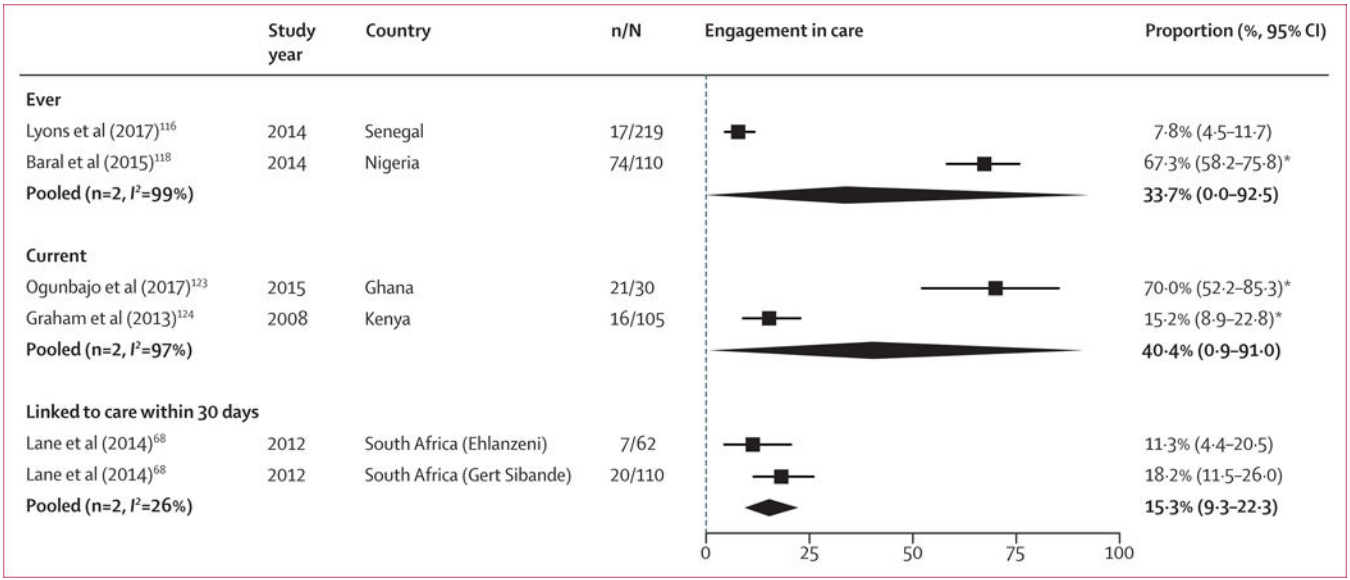

Figure 5: Forest plot of the proportions of African men who have sex with men living with HIV ever or currently engaged in care, or linked to care within 30 days of diagnosis

Study estimates and their 95% CIs and pooled estimates (diamonds) and their 95% CIs are shown for proportions of men who have sex with men in Africa living with HIV ever or currently engaged in care (self-reported), or linked to care within 30 days of diagnosis, overall and stratified by region of Africa. All study estimates were unweighted. Men who have sex with men living with HIV are those who tested positive during the study. Numerators and denominators of weighted study estimates are rounded to the nearest whole number. *Self-calculated estimates.

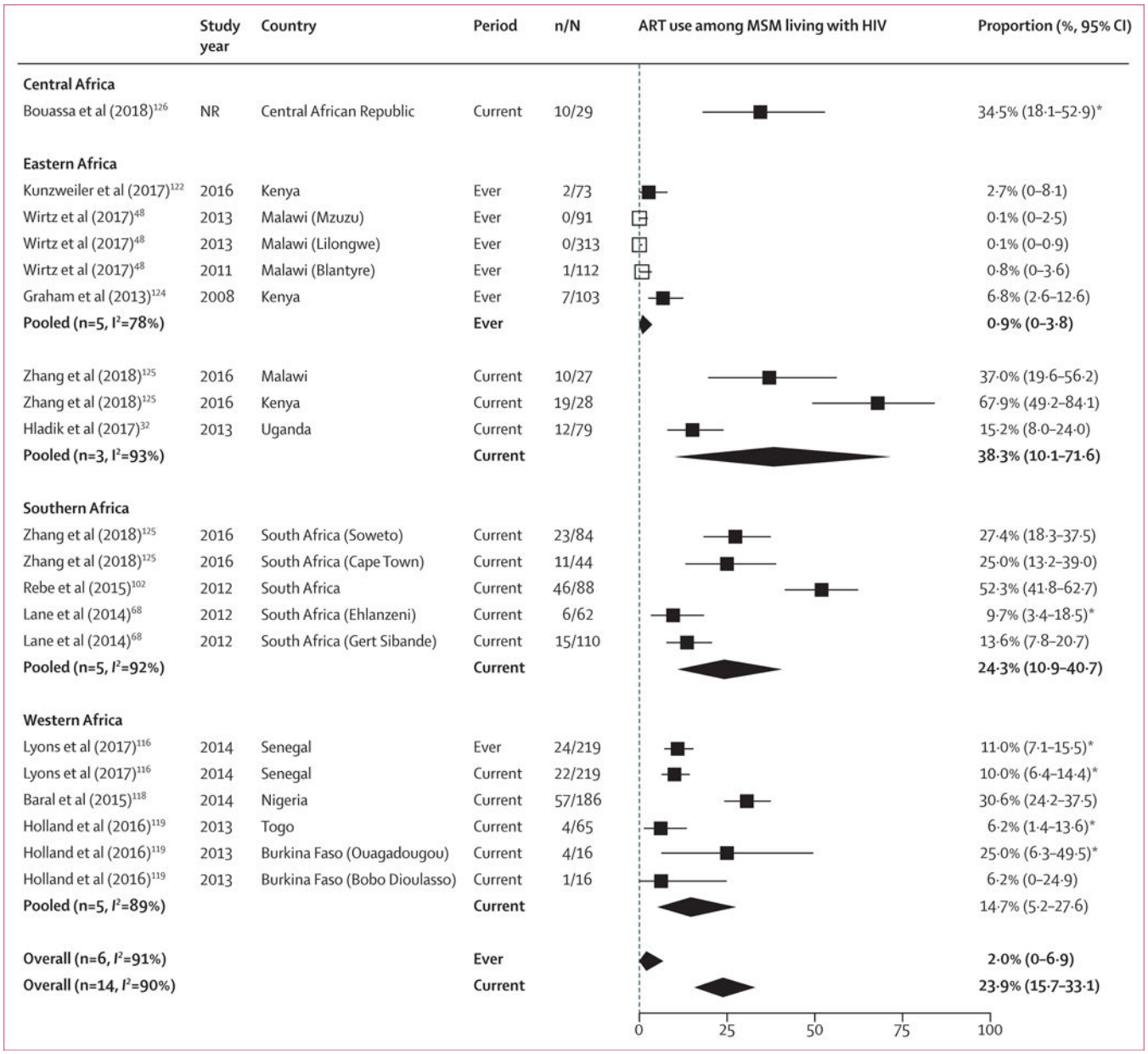

Figure 6: Forest plot of the proportions of African men who have sex with men (MSM) living with HIV ever or currently on antiretroviral therapy (ART)

Weighted (blank squares) and unweighted (filled squares) study estimates and their 95% CIs, and pooled estimates (diamonds) and their 95% CIs are shown for proportions of men who have sex with men in Africa living with HIV ever or currently on antiretroviral therapy (self-reported), overall and stratified by region of Africa. Men who have sex with men living with HIV are those who tested positive during the study. Numerators and denominators of weighted study estimates were derived from the effective sample size (appendix pp 3, 4). NR=not reported. *Self-calculated estimates.

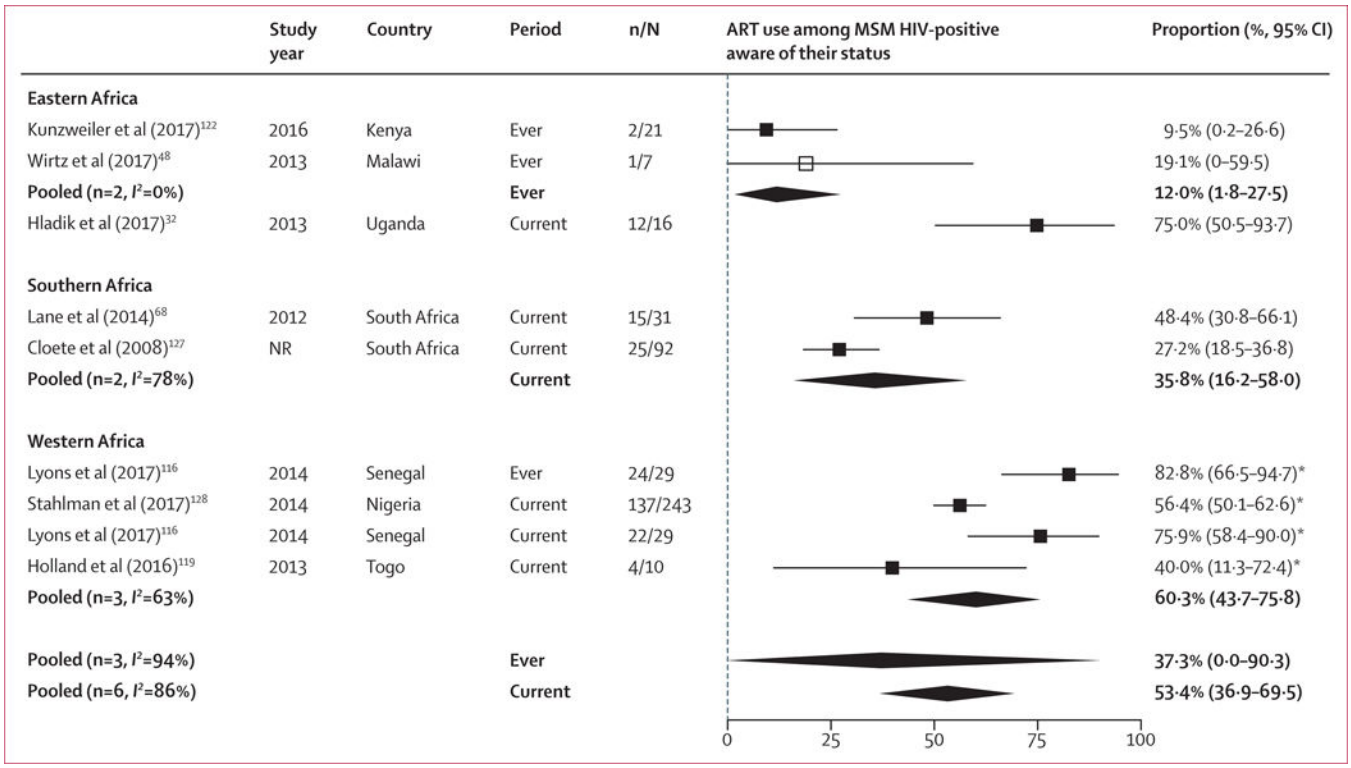

Figure 7: Forest plot of the proportions of African men who have sex with men (MSM), HIV-positive aware of their status, ever or currently on antiretroviral therapy

Weighted (blank squares) and unweighted (filled squares) study estimates and their 95% CIs, and pooled estimates (diamonds) and their 95% CIs are shown for proportions of MSM HIV-positive aware of their status ever or currently on antiretroviral therapy (self-reported), overall and stratified by region of Africa. MSM HIV-positive aware of their status are those who reported living with HIV before testing positive during the study. Numerators and denominators of weighted study estimates were derived from the effective sample size (appendix pp 3, 4). ART=antiretroviral therapy. *Self-calculated estimates.

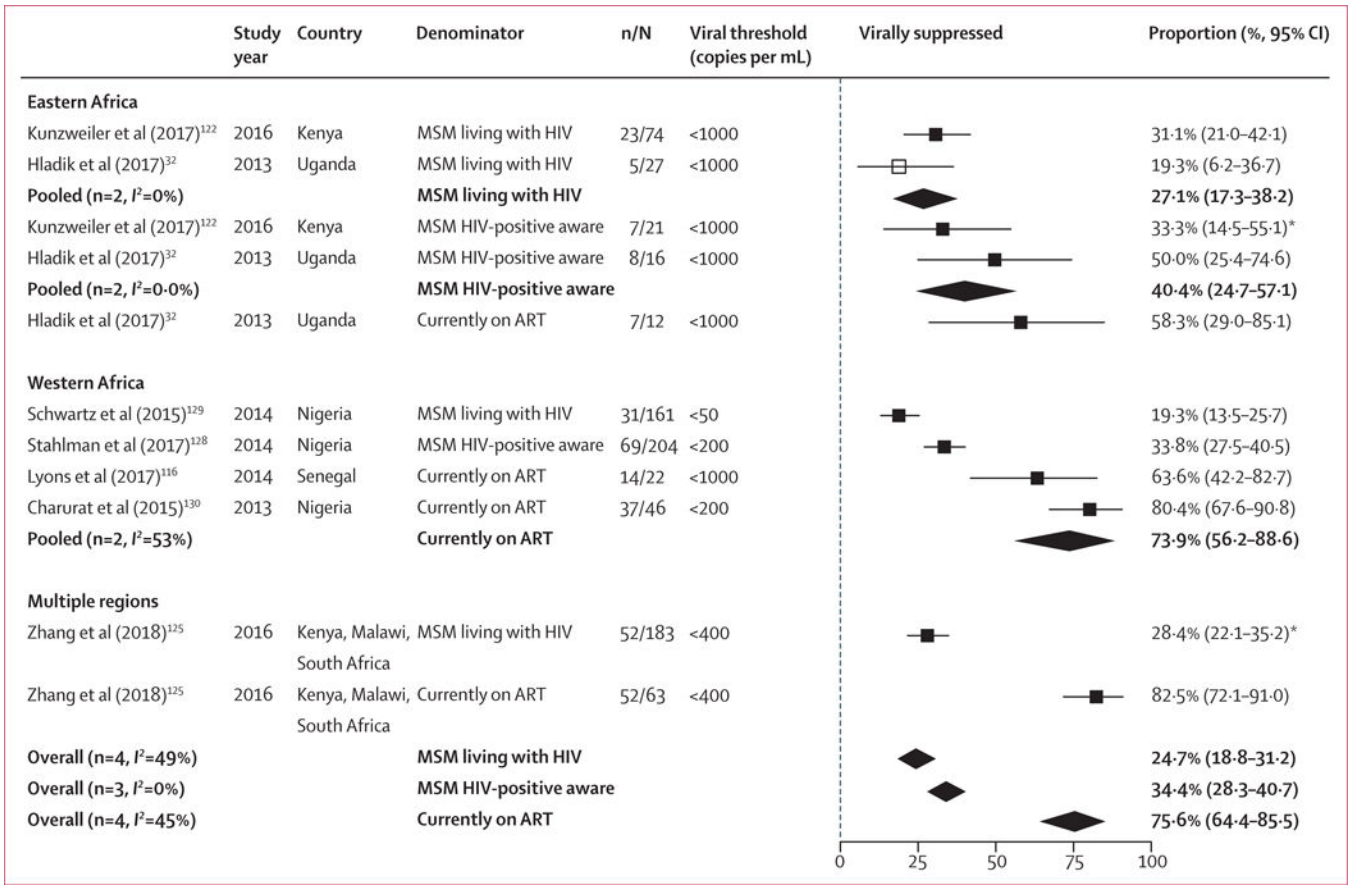

Figure 8: Forest plot of the proportions of African men who have sex with men (MSM) living with HIV, HIV-positive aware of their status, and currently on antiretroviral therapy (ART) who were virally suppressed

Weighted (blank squares) and unweighted (filled squares) study estimates and their 95% CIs, and pooled estimates (diamonds) and their 95% CIs are shown for proportions of MSM in Africa living with HIV, HIV-positive aware of their status, and currently on ART (self-reported) who were virally suppressed, overall and stratified by region of Africa. MSM HIV-positive aware of their status are those who reported living with HIV before testing positive during the study. Numerators and denominators of weighted study estimates were derived from the effective sample size (appendix pp 3, 4). Viral suppression was measured within studies with viral load testing using thresholds defined by the study authors. *Self-calculated estimates.

Table 1:

Summary of HIV testing and treatment cascade outcomes, participant characteristics, stigma variables, anti-LGBT legislation variables of studies included in the analyses, and study characteristics and quality indicators

	Unique studies* (n=75)	References
Testing and treatment cascade outcomes		
HIV testing		
Ever	55 (73%)	32,43–95
Recently tested	33 (44%)	··
Last 12 months	28 (37%)	32,46,48–51,62,73,78,82,85,96-107
Last 6 months	8 (11%)	43,46,76,78,80,101,106,108
Last 3 months	4 (5%)	46,62,106,109
HIV-positive aware of their status	23 (31%)	··
Self-reported	23 (31%)	32,43,48,51,58,62,68,87,88, 110–122
Engagement in care	5 (7%)	
Ever	2 (3%)	116,118
Currently	2 (3%)	123,124
Within 30 days of diagnosis	1 (1%)	68
ART use	13 (17%)	··
MSM living with HIV	12 (16%)	··
Ever	4 (5%)	48,116,122,124
Currently	9 (12%)	32,68,102,116,118,119, 125,126
MSM HIV-positive aware of their status	8 (11%)	··
Ever	3 (4%)	48,116,122
Currently	6 (8%)	32,68,116,119,127,128
Viral suppression	5 (7%)	··
MSM living with HIV	4 (5%)	32,122,125,129
MSM HIV-positive aware of their status	3 (4%)	32,122,128
MSM currently on ART	4 (5%)	32,116,125,130
Participant characteristics		
Population		
General MSM	60 (80%)	32,43–45,47–51,53,56–59,62–70,72–84,86,88–96,98–101,103,104,106,107,109–120,122,123,127–130
High-risk MSM†	9 (12%)	52,54,55,71,102,103,121,124–126
Low-risk MSM‡	1 (1%)	85
MSM organisations§	2 (3%)	46,87
NR	3 (4%)	61,97
Region of Africa¶		
Central	7 (9%)	43,62–64,98,99,126

	Unique studies* (n=75)	References
Eastern	27 (36%)	32,43–61,77,97,108–111,121,122,124,125
Northern	2 (3%)	65,10
Southern	19 (25%)	57,66–76,98,101–104,111–115,121,125,127
Western	23 (31%)	78–82,84–95,97,105–107,116–120, 123,128–130
Mean or median age (years)¶		
≤25	40 (53%)	32,46–48,50,52,53,55–57,60,61,63,64,66,67,69,73,76–80,82,83,85,86,88–91,93,96,97,99,100,103,107,108,110–114,116–120,126
>25	37 (49%)	44,45,49,51,54,57–59,65,68,70–73,75,81,84,87,92,94,95,98,101,102,104,105,109,111,115,119,121–125,127–130
NR	4 (5%)	43,62,97
HIV prevalence (%)¶		
≤20%	26 (35%)	32,43,48–51,54,56,57,62,66,68,74,78,79,82–84,88,90,93,100,101,103,107,111–113,115,117,119,120,122
>20%	22 (20%)	45,47,48,51,52,57,58,63,66–68,70,81,85,87,90,94,99,101,102,105,110–112,114,116,118,126,128–130
NR	33 (44%)	44,46,53,55,59–61,64,65,69,71–73,75–77,80,86,89,91,92,95–98,104,106,108,109,121,123–125,127
Proportion of participants who ever sold sex (%)¶		
≤35%	9 (12%)	53,57,59,60,68,69,101,104,108,111,114,127
>35%	9 (12%)	32,44,49,56,57,74,80,87,92,109,111,115
NR	58 (77%)	43,45–52,54,55,58,61–67,70–73,75–79,81–86,88–91,93–100,102,103,105–107,110,112,113,116–126,128–130
Proportion of participants who sold sex recently (%)¶//		
≤41%	12 (16%)	50,53,66,72,82,88,91,93,97,100,102,103,107,112,113,117, 122
>41%	10 (13%)	44,49,50,54,58,90–92,105,109
NR	55 (73%)	32,43,45–48,51,52,55–57, 59–65,67–71,73–81,83–87,89,94–99,101,104,106,108,110,111, 114–116,118–121,123–130
Stigma variables		
Proportion of participants who disclosed being MSM to health-care workers (%)¶		
≤20%	6 (8%)	57,66,82–84,111,112,114,117,119
>20%	8 (11%)	32,48,56,57,81,98,104,111,118, 128–130
NR	62 (83%)	43–55,58–65,67–80,85–103,105–110,113,115,116,120–121
Proportion of participants who disclosed being MSM to family (%)¶		
≤20%	4 (5%)	32,57,66,82,111,112,117
>20%	12 (16%)	48,57,65,69,79,81,92,98,103, 104,111,113,118,128–130
NR	60 (80%)	43–56,58–64,67,68,70–78,80,83–91,93–97,99–102,105–109,110,114–116,119–121
Proportion of participants blackmailed for being MSM (%)¶		
≤20%	6 (8%)	46,57,59,81,82,111,111,118,120,128–130
>20%	7 (9%)	57,66,83,98,103,104,111–113,119
NR	63 (84%)	32,43–45,47–56,58,60–65,67–80,84–102,105–109,110,114–116,119,121–121
Anti-LGBT legislation		
Same-sex relations illegal¶		

	Unique studies* (n=75)	References
Yes	55 (73%)	32,43–52,54–65,77–81,83,85–87,89–100,103,104,106,108–111, 113,116,118–125,128–130
No	21 (28%)	53,66–76,82,83,88,101,102,105,101,112,114,115,117,119,121, 125–127
Repressive¶		
0	13 (17%)	66–74,101,102,112,114,115,121,125,126
1	13 (17%)	75,76,82,84,88,90–93,97,104,105,107,117,119
2	35 (47%)	43,44,50–52,54,55,57,58,60,62–64,79,83,85–87,89,91,93–99,103,106,108,109,111,113,116,119–125
3–5	20 (21%)	32,43,45–49,56,57,59,61,65,77,78,80,81,97,100,110–111,118,121,125,128–130
Indeterminable	1 (1%)	127
Absence of protective legislation¶		
0	14 (19%)	67–76,101,102,114,115,121,125
1–2	62 (83%)	32,43–52,54–66,77–100,103–113,116–126,121–130
Indeterminable	1 (1%)	127
Absence of progressive legislation¶		
0	11 (15%)	67–74,101,102,114,115,121,125
1–2	64 (85%)	32,43–66,75–100,103–116,116–126,128–130
Indeterminable	1 (1%)	127
Penalties¶		
0	23 (31%)	53,57,66–76,82,84,88,101,102,104,105,107,111,112,114,115, 117,119,121,125,126
1	3 (4%)	43,50,62
2	39 (52%)	44,46,51,52,54,55,57,58,63–65,78–81,83,85–87,89–100,103,106,109,111,113,116,118–125,128–130
3–5	17 (23%)	32,43,45,47–49,56,57,59–61,77,91,93,97,108,110,111,121,125
Indeterminable	1 (1%)	127
Arrests 2014–17¶		
Yes	43 (57%)	32,43–45,47–49,51,52,54–61,63–65,77,78,80,81,87,90–94,96–100,103,108–111,113,116,118,120–122,124,125,128–130
No	35 (43%)	43,46,50,53,57,62,66–76,79,82,83–86,88,89,95,97,101,102,104–07,111,112,114,115,117,119,121,123,125–127
Global score¶		
≤5	21 (28%)	53,66–76,82,84,88,101,102,104,105,107,112,114,115,117,119,121,125,126
6–8	37 (49%)	43,44,50–52,54,55,57,58,62–64,83,85–87,89–99,103,106,109,111,113,116,119–125
>9	23 (31%)	32,43,45–49,56,57,59–61,65,77,78,80,81,91,93,97,100,100,110–111,118,121,125,128–130
Indeterminable	1 (1%)	127
Study characteristics and quality indicators		
Study year		
Before 2011	30 (40%)	49,51–55,57–60,64,70–16,90–94,97,100,104,108,111,114,115,124
After 2011	41 (55%)	32,43–50,56,62,63,65–69,77–89,96,98,99,101–103,105–107,109–110,112,113,116–123,125,128–130
NR	4 (5%)	61,95,126,127

	Unique studies* (n=75)	References
Study design¶		
Cross-sectional	64 (85%)	32,43–51,53,55–57,59–77,79,80,82–86,88–100,102–117,119,120,123,126,127
Cohort-baseline	10 (13%)	52,54,58,78,81,87,101,118,121,122,124,125,128–130
NR	2 (3%)	97
Sampling method		
RDS	30 (40%)	32,45,47–51,56,60,62,63,66,68,72,74,79,81–85,88,90,91,93,97–101,103,105,107,108,110,112,113,115, 117–119, 128–130
Cluster or time-venue	3 (4%)	43,44,55,108
Snowball	18 (24%)	53,57,59,64,67,77,78,86,89,94,96,98,104,106,111,120–122,124,125
Purposive or convenience	17 (23%)	46,54,58,65,69–71,73,75,80,92, 95,102,114,123,126, 127
Mix	3 (4%)	52,76,116
NR	4 (5%)	61,87,97
Interview method¶		
FTFI	54 (72%)	43,45,48–55,57–60,62–64,66–68,72,74,76–79,81–85,88,89,91–105,107,108,110–120,123,126,128–130
Confidential**	16 (21%)	32,44,46,47,56,65,69–71,73,75,80,86,106,109,110,121,122,125,127
ACASI and FTFI mix	2 (3%)	90,124
NR	4 (5%)	61,87,97

Continuous variables were dichotomised at the median value. ACASI=audio computer-assisted self-interview software. ART=antiretroviral therapy. FTFI=face-to-face interview. MSM=men who have sex with men. NR=not reported. RDS=respondent-driven sampling.

*Number of referenced articles differs from the number of studies when multiple articles report on the same study and provide different estimates for different testing, cascade outcomes, or both, or a single article reports on multiple studies.

†High-risk MSM include male sex workers, people who inject drugs, MSM recruited from drinking venues and sexually transmitted infections clinics, and MSM identified as high risk by study authors.

‡Low-risk MSM include people who do not inject drugs and MSM self-reported to be HIV-negative. § MSM organisations include MSM recruited from MSM or LGBT organisations or prevention activities.

¶Same study included in more than one subcategory when a study reports multiple estimates across different levels of the variable.

‖Proportion of participants sold sex recently includes MSM who have sold sex in the past 12, 6, or 3 months.

**Confidential interview methods include ACASI (n=5), polling booth surveys (n=1), and self-administered questionnaires (n=10).

Table2:

Pooled estimates of the proportions of African men who have sex with men accessing HIV testing and different stages of the treatment cascade

	Number of Pooled estimate	Pooled estimate (%, 95% CI)	I^2
HIV testing (among all MSM)			
Ever	81	61·0% (56·2–65·7)	98%
Recently	51	..	..
Past 12 months	39	46·2% (39·6–52·9)	97%
Past 6 months	8	38·8% (26·0–52·4)	96%
Past 3 months	4	44·9% (11·3–81·3)	99%
HIV-positive aware of their status			
Among MSM living with HIV	35	18·2% (13·0–23·9)	91%
Engagement in care (among MSM living with HIV)			
Ever*	2	33·7% (0–92·5)	99%
Current†	2	40·4% (0·9–91·0)	97%
Linked within 30 days of diagnosis	2	15·3% (9·3–22·3)	26%
Antiretroviral therapy use			
Among MSM living with HIV			
Ever	6	2·0% (0–6··9)	91%
Current	14	23–9% (15·7–33·1)	90%
Among MSM HIV-positive aware of their status			
Ever	3	37·3% (0–90·3)	94%
Current	6	53·4% (36·9–69·5)	86%
Viral suppression			
Among MSM living with HIV	4	24·7% (18·8–31·2)	49%
Among MSM HIV-positive aware of their status	3	34·4% (28·3–40·7)	0%
Among MSM currently on antiretroviral therapy	4	75·6% (64·4–85·5)	45%

HIV status of MSM living with HIV and MSM HIV-positive aware of their status was confirmed in the studies with an HIV test. MSM=men who have sex with men.

*Includes ever received a CD4 test.

†includes currently using cotrimoxazole and engaged in care at the start of the study.