# Discrimination and Health: Effects of Internalised Homonegativity, Discriminatory Laws and policies on HIV-related behaviours of men who have sex with men living in sub-Saharan Africa

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Thesis submitted in accordance with the requirements for the degree of
Doctor of Public Health

of the
University of London
February 2023

Department of Infectious Diseases Epidemiology

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# DECLARATION

I, Ngozi O Kalu, confirm that the work presented in this thesis is my own. Where information has been derived from other sources, I confirm that this has been indicated in the thesis.

Signed:

NOKalu

Date 19/12/2022

# Covid-19 Impact statement

This research replaced my intended study with the MTV Shuga team in South Africa. MTV Shuga is a TV series designed for demand-creation for HIV services in Africa. The cross-sectional study was to collect primary data from adolescents in South Africa, including data from MSM communities on sexual behaviour history, relationship status, transactional sex, HIV knowledge and attitudes towards people living with HIV, HIV testing, pre-exposure prophylaxis and exposure to the MTV Shuga media campaign. By early 2020, the survey had been submitted to the ethics committees in South Africa, LSHTM and WHO, and the research team were awaiting approval when the global travel lockdown due to the COVID-19 pandemic was imposed. Due to all the uncertainties around the COVID-19 pandemic, by mid-2020, the team decided to change the study to an online survey which required shortening the questionnaire, and most of the questions on sexual behaviours were removed. This resulted in most of the MSM questions being removed, and the remaining data would not be sufficient for my doctoral thesis. This meant that I needed to find an alternative data source, and I reached out to my advisers, and one put me in touch with Mike Ross, who fortunately had available data from the 2019 Global LGBTI Internet Survey. The data was from LGBTI+ persons in all 46 sub-Saharan African countries. By the end of 2020, I had presented the proposal for the study presented in this thesis and had received verbal confirmation that I could use the data from all the primary investigators of the 2019 Global LGBTI Internet Survey. It wasn't until mid-2021 that I could start data analysis after completing the DrPH review and receiving the dataset from the 2019 Global LGBTI Internet Survey team.

So, although I had experienced about a year's delay due to COVID-19 disruptions, I was able to make up for lost time with the support of my supervisors and advisors. It has been a mammoth effort to juggle all the emotions of dealing with the ups and downs of completing this DrPH programme remotely. Still, the experience has made me more resilient, a skill that will undoubtedly play a major role in the next stages of my career.

# Acknowledgements

# DEDICATION

This thesis is dedicated to the memory of my late father Chief Oko Anya Kalu (my daddyos), who always empowered and supported me, even when I allowed sentiments to lead me down unconventional paths. Thank you for teaching me that seeing the world through my authentic lens is okay.

# Abstract

In 2021, there were an estimated 860,000 new HIV infections in sub-Saharan Africa (SSA). HIV prevalence in the region is reported to be five times higher among men who have sex with men (MSM) than the general population. Despite the availability of targeted interventions, access to and utilisation of HIV services by MSM in the region are still limited. Structural and individual-level factors such as laws criminalising same-sex relationships, targeted HIV policies, and Internalised Homonegativity (IH) has been reported to increase HIV-risk behaviours in MSM. However, there is still little known about the associations of these factors in the SSA region.

In this thesis, I conducted secondary analyses of data from the 2019 Global LGBTI Internet Survey collected online from May to December 2019 without geographical restrictions in 32 languages, 7 of which were official languages in SSA. The survey collected data from all 46 SSA countries, of which this secondary analysis included data from 3,191 adult MSM in 44 SSA countries. Elements from Krieger's ecosocial theory of disease distribution and Meyer's minority stress model were used to frame the study methods. This thesis assessed the associations of laws criminalising same-sex relationships, the presence or absence of targeted HIV policy for MSM and IH with HIV testing and risk behaviour outcomes of MSM in 44 SSA countries.

Paper 1 assessed the associations of legal climate and targeted HIV policy with MSM reporting being ever and recently tested (past 6 months) using linear ecological and logistic multilevel analyses. The findings showed strong evidence that countries with legalised same-sex relationships and targeted national HIV policies for MSM were more likely to report higher testing prevalence across SSA. Individual MSM in these countries also report increased odds of testing. We also highlighted heterogeneity between South Africa and other SSA countries.

Paper 2 used multilevel analysis to explore the associations of IH with HIV testing and HIV-risk behaviours of MSM in SSA and whether these associations differed by the legal climate. There were high levels of IH across SSA MSM and evidence of its association with HIV testing and HIV-risk behaviours. Increasing IH levels resulted in increased odds of ever testing and recently testing in the past 6 months by MSM across SSA. The legal climate modified the associations of IH with transactional sex. With increasing IH levels, MSM in countries where same-sex relationships are legal reported reduced odds of paying for sex, whilst MSM in countries where consensual same-sex

relationships are criminalised reported increased odds of paying for sex. There was suggestive evidence that MSM in countries with legalised same-sex relationships reported increased odds of ever testing. We found no associations of IH with unprotected anal sex in the population surveyed.

These findings support existing evidence that discriminatory laws and policies exacerbate SSA MSM's vulnerabilities to HIV. At the structural level, these factors seem to shape the ability of MSM to initially engage with testing services in SSA. At the individual level, the internalisation of negative societal experiences of MSM in settings that criminalise same-sex relationships leads to additional disadvantages compared to their counterparts with the same level of IH. With very few countries in the region on track to meet the 2030 UNAIDS target, the reformation of these laws and policies is an important enabling first step to increasing HIV status awareness of MSM living in SSA countries and in protecting their human rights.

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# Table of abbreviations

| | |
|---|---|
| ART | Antiretroviral therapy |
| CBCT | Community Based Counselling & Testing |
| EFA | Exploratory Factor Analysis |
| EMIS | European MSM Internet Study |
| ESA | Eastern and Southern Africa |
| FCS | Fully conditional specifications |
| IH | Internalised Homonegativity |
| IHNI | Internalised Homonegativity Inventory Scale |
| ILGA | International Lesbian and Gay Association |
| KMO | Kaiser-Meyer-Olkin |
| KP | Key Populations |
| LGBTI+ | Lesbian, gay, bisexual, transgender, and intersex |
| LGBTQI+ | Lesbian, gay, bisexual, transgender, queer and intersex |
| MAR | Missing at random |
| MCAR | Missing completely at random |
| MI | Multiple imputation |
| MICE | Multiple imputation impute chained |
| MLM | Multilevel Modelling |
| MSM | Men who have sex with men |
| NHAI | Nungesser Homosexual Attitudes Inventory |
| NSF | National Strategic Framework |
| NSP | National Strategic Plan |
| PCA | Principal Components Analysis |
| PEPFAR | US President's Emergency Plan for AIDS Relief |
| PITC | Prescriber Initiated Testing and Counselling |
| PrEP | Pre-exposure Prophylaxis |
| RHS | Reactions to Homosexuality Scale |
| SOGIESC | Sexual orientation, gender expressions and/or sex characteristics |
| SSA | Sub-Saharan Africa |

SSA MSM        Sub-Sahara African men who have sex with men

UNAIDS        United Nations Programme on HIV/AIDS

WCA        Western and Central Africa

WHO        World Health Organization

# 1 Introduction

## 1.1 Background

The 2014 UNAIDS fast-track targets aimed to reduce new HIV infections to 200,000 by 2030[1]. In 2021, there were an estimated 1.5 million new infections globally, with 58% of these in sub-Saharan Africa (SSA)[2]. Key populations (KPs) accounted for 51% of the HIV infections in SSA[3]. Among the most affected KPs are men who have sex with men (MSM). In SSA, the prevalence of HIV infection in MSM is estimated to be 5 times higher than among men in the general population [4]. Evidence indicates that MSM are at increased risk of HIV compared with the general population due to individual, psychosocial, structural and social factors [5].

Structural factors of particular concern within the region are the roles of same-sex criminalisation laws and discriminatory health policy in driving the epidemic[6–8]. Criminal laws and discriminatory health policies are reported as key determinants of health outcomes, increasing vulnerabilities to human rights violations, stigma and discrimination experienced by many vulnerable groups such as MSM[9,10]. At the country level, these can result in MSM concealing their sexuality or avoiding healthcare services out of fear of being outed and arrested [7]. At the individual level, same-sex criminalisation laws create a hostile environment that exposes MSM to negative social experiences that many internalise and develop a negative sense of self [11]. In the literature, internalisation can result in psychological harm, such as internalised homonegativity (IH), which has been reported to have associations with adverse HIV-related outcomes of MSM. In addition, how different aspects of MSM's identities intersect can create unique experiences of oppression [12,13]. The intersections of sexual orientation, involvement in transactional sex, perceived level of masculinity and being from a lower socioeconomic background can increase MSM's vulnerability to HIV [14]. Intersectionality is very important in understanding MSM's susceptibility to HIV in SSA.

Most available studies on same-sex criminalisation and IH's effect on HIV-related outcomes were conducted in Europe and the USA [15–17]. To my knowledge, none have

assessed the associations of targeted policy interventions for MSM with HIV-related outcomes in SSA. The limited pool of evidence from the African region on the impact of these structural and individual level factors on HIV-related outcomes of MSM limits the generalisability of the study findings to MSM in SSA. With very few countries in the region on track to meet the 2030 UNAIDS target, there is an increased need and urgency to use empirical data to understand the role of structural and individual factors in increasing the vulnerabilities of MSM living in SSA to HIV [18].

This DrPH uses data from the 2019 Global LGBTI Internet Survey to examine the associations of country-level and individual-level variables such as same-sex criminalisation laws, the presence of targeted HIV interventions in national policies and IH with HIV testing and HIV-risk behaviour of MSM in SSA[19]. Guided by elements of the ecosocial theory of disease distribution on the biological embodiment of exposures arising from the ecological context and the minority stress model of individual stress coping mechanisms of chronic negative social experiences, I report findings from the analysis of the associations of same-sex criminalisation laws, targeted HIV interventions in national policies and IH with HIV testing and HIV-risk behaviour of MSM in SSA[11,20].

## 1.2   Thesis aim and research questions

The study aims to assess the HIV-risk behaviours and utilisation of HIV-testing services among MSM in SSA and examine their associations with discriminatory laws/policies and IH. The main research questions to support the overarching study aim were as follows:

1. Are contextual effects of legal climate and targeted HIV policy associated with national-level measures of ever HIV tested and HIV-testing in the past 6 months among self-reported MSM?
2. Do observed associations of contextual effects with national-level ever testing and recent testing in the past 6 months persist after adjusting for individual characteristics?

3. What is the level of IH among MSM in sub-Saharan Africa, and how does this vary across different demographic, socioeconomic, and geographic groups, i.e., across age groups, education, and income?

4. Is IH associated with ever HIV testing, HIV testing in the past 6 months, paying for sex in the past 12 months, being paid for sex in the past 12 months and unprotected anal sex in the past 3 months?

5. Do associations between IH and related health outcomes of HIV testing and HIV-risk behaviours differ by whether same-sex relationships are and are not criminalized?

## 1.3 Thesis outline

This is a research paper-style thesis and includes six chapters. This initial chapter briefly introduces the thesis, including the study aim, my role in the research, and funding.

The literature review chapter (chapter 2) is a narrative literature review that focuses on HIV epidemiology in SSA, prevention and treatment, contextualising HIV risk among MSM in SSA, including at the individual level and country level, justification of this study and a review of theoretical frameworks underpinning the study. Chapter 3 provides an overview of the methods used in the two research papers that answer the study questions.

Chapter 4 includes the findings of the first paper (paper 1), which addresses questions 1 and 2 that assess the associations of same-sex criminalisation laws and discriminatory policies with MSM ever testing and recent testing (past 6 months) in SSA. Chapter 5 covers findings from the second paper (paper 2), which addresses questions 3 to 5 that present findings including the levels of IH in SSA countries, its associations with HIV testing and HIV-risk behaviours and mediation of these associations by the legal climate. Chapter 6 summarises the key findings from the previous chapters, including discussions of the study and the implications of the thesis's findings for research and policy. This chapter also includes the dissemination plans. The final chapter (Chapter 7) provides a brief conclusion highlighting the study's main findings and key policy implications.

## 1.4 Role of the candidate

The 2019 Global LGBTI Internet Survey was conceptualised, proposed, awarded and data collected by the Principal Investigators Erik Lamontagne, Michael Ross and Sean Howell. The Principal Investigators granted me access to the fully anonymised and cleaned SSA dataset. As stated in my Covid-19 impact statement, this research replaced my intended study, and as such, I was not involved with the primary data design and collection.

I led all other elements of this DrPH research with support from my supervisors, advisory committee, and upgrading examiners. I conceptualised all the papers for publication included in this thesis, collected the country-level measures on same-sex relationship criminalisation, sourced and reviewed national HIV policies for the inclusion of the WHO recommended interventions for MSM, conducted all the statistical analyses and wrote the draft of the two papers. I coordinated the reviews of the papers by co-authors and incorporated feedback through an iterative process.

## 1.5 Funding

No funding was received and no research affiliations.

## 2 Literature review

MSM are estimated to make up less than 1.5% of the adult male population in SSA[21]. Yet, in 2021, they accounted for 3% of all new infections in eastern and southern Africa (ESA) and 18% in western and central Africa (WCA) [22].

The increased vulnerabilities of MSM to HIV result from complex structural, social, individual and psychosocial factors[23]. Most of the available literature in the region has focused on the role of individual characteristics and behavioural factors; interventions targeting these factors have resulted in notable progress in epidemic control but have not been enough to eliminate new HIV infections [24]. Where studies on structural factors such as associations of same-sex criminalisation laws and their links with fuelling the inequalities in the HIV epidemic exist, these have been from pooled-estimates, based on country-specific analyses or explore the role of individual-level factors in driving the HIV epidemic, including behavioural and biological interventions without considering the role of the environment [25–27]. So far, no study has reported the associations between same-sex criminalisation laws on MSM HIV-related outcomes in Sub-Saharan Africa using empirical data.

The purpose of the following literature review was to provide an overview of the HIV/AIDS epidemic with a focus on the SSA region. Informed by studies identified through a literature search, I first define key terms used in this thesis. Then I give a summary of HIV epidemiology, prevention, and treatment. This section is followed by a review contextualising HIV risk among MSM in SSA and important HIV risk factors going from close-proximal to further-distal elements that facilitate transmission, including internalised homonegativity, discriminatory laws and policies and how these contribute to the inequalities in HIV burden of SSA MSM. The literature review concludes with a justification for this study and a discussion of the theoretical frameworks that served as the foundation for this study's design and reporting.

## Search strategy and identification of studies

To inform this literature review, I searched MEDLINE for peer-reviewed articles published between 1946 to October 27, 2021, without language or geographical location restrictions. The search terms were formulated around the following five concepts: (1) sexual orientation, (2) HIV, (3) sub-Saharan Africa, (4) same-sex criminalisation, and (5) internalised homonegativity. References of relevant studies were reviewed for additional related articles. Table 2.1 details the full search strategy and strings.

Table 2. 1: systematic literature review search strategy and strings

| Searched databases | Search terms | Result |
|---|---|---|
| Ovid MEDLINE(R) ALL <1946 to October 27, 2021> | | |
| Concept 1 (C1) | Homosexuality, Male/ or "Sexual and Gender Minorities"/ or ((men or man or male or males) adj3 (gay or gays or homosexual* or queer*)).mp. or (MSM or "men who have sex with men").mp. | 34,454 |
| Concept 2 (cC2) | exp HIV/ or exp HIV Infections/ or (HIV or HIV1 or HIV2 or Human immunodeficiency virus).mp. | 427,969 |
| Concept 3 (C3) | exp "Africa South of the Sahara"/ or (sub-Saharan Africa or East* Africa or Uganda or Kenya or Burundi or Eritrea v Ethiopia or Madagascar or Malawi or Mauritius or Mozambique or Rwanda or Seychelles or United Republic or Tanzania or Central* Africa or Cameroon or Central African Republic or Chad or Congo or Democratic Republic Of The Congo or Equatorial Guinea or Gabon or South* Africa or Angola or Botswana or Eswatini or Lesotho or Namibia or South Africa or Zambia or Zimbabwe or West* Africa or Benin or Burkina Faso or Cape Verde or Cote D Ivoire or Gambia or Ghana or Guinea or Guinea Bissau or Liberia or Mali or Mauritania or Niger or Nigeria or Senegal or Sierra Leone or South Sudan or Togo).mp. | 250,584 |
| C4 (C1 and C2 and C3) | | 869 |
| Concept 5 (C5) | Criminali*.mp. | 3,822 |
| C6 (C1 and C5) | | 178 |
| Concept 7 (C7) | Internalin* and homo*.mp. | 4653 |
| C8 (C1 and C5) | | 377 |

## 2.1 Definition of key terms and debate around the term MSM

In this thesis, I use several key terminologies popularly used in HIV discourse. I first define some terminologies used throughout this thesis before focusing on prevailing views around using MSM to label a heterogeneous group of people.

KPs refer to populations at an increased risk of HIV acquisition irrespective of epidemic type or local context. KPs mostly lack adequate access to services because of legal or social issues. In the broader context of HIV, KP includes MSM, transgender women, female sex workers, people who inject drugs, people living with HIV and people in prison and detention [28,29]. In the context of this thesis, KP includes MSM, transgender women, female sex workers and people who inject drugs as defined by UNAIDS[30].

National strategic plans (NSPs) for HIV/AIDS are planning documents for each country that include a set of targets to measure progress toward national and international objectives and priorities for programmes and services [31]. NSPs also guide donor funding requests and country resource allocation [32]. Given the high burden of HIV among MSM in SSA, it is crucial to have aims and objectives that address improving the inequalities in access to HIV prevention and control services. Additionally, the extent to which HIV-related intervention targets for MSM in NSPs are disaggregated by targeted interventions has important implications for country data collection, monitoring and programming[32]. The NSP provides a roadmap for a collective response by the public and private partners to prevent and respond to the HIV epidemic in the country[33]. The degree to which NSPs focus on reducing MSM incidence in HIV can be assessed through the inclusion of the recommended targeted interventions specified in the 2016 Consolidated Guidelines on HIV Prevention, Diagnosis, Treatment, and Care for Key Populations by the WHO[29]. National strategic frameworks (NSFs) is a companion document to the NSP that guides how to implement the NSP at the federal, state, and local levels [32].

Legal climate refers to the legal status of same-sex relationships in each country. This term does not include the existence or absence of other policies against discrimination based on sexual orientation. Instead, countries are classed by whether consensual sex between

adult males/same-sex relationships is legal or illegal. Including sexual minorities in protective legislation in SSA is still limited, with only South Africa providing the highest legislative protection for MSM in the region [34].

HIV-related outcomes in this study refer to individual-level behavioural measures such as uptake of HIV testing and HIV-risk behaviours. HIV testing includes a history of ever testing for HIV during the life course and recent HIV testing in the past six months, as recommended by the WHO for KPs. HIV-risk behaviours include being involved in transactional sex, either by selling sex or paying for sex and condomless anal sex with a non-steady partner(s). Exposures refer to factors influencing health-related outcomes, which include discriminatory laws and policies. Examples include same-sex criminalisation laws and a lack of targeted policies to reach MSM with HIV prevention, care and treatment services.

In this thesis, I use the terms homonegativity and internalised homonegativity instead of homophobia because homonegativity is a negative attitude toward homosexuality based on the notion of heterosexism, where there is an assumption that heterosexuality is the norm, both socially and culturally[35,36]. This can manifest in discriminatory attitudes and behaviours toward those who identify as gay or are considered homosexual[35]. Homonegative attitudes and actions can range from minor forms, such as making insulting jokes or remarks, to more severe manifestations, such as violence or exclusion from social or professional contexts [11]. Such homonegative attitudes underpin the principles of stigma frameworks [12,13]. Whilst homophobia is based more on fear or hatred of homosexuals[12,13]. Internalised homonegativity occurs when a person attracted to others of the same gender feels that being LGBTQ+ is bad. Due to their attractions, individuals may feel immoral or otherwise abnormal as this feeling is against the prevailing norm. This can lead to a lot of shame, isolation, and self-hatred[11]. Section 2.4.1.1 through 2.4.1.5 provides more details.

Classification of men who have sex with men or MSM can vary, but in the context of this thesis, it refers to gay men, bisexual men and men who do not identify as either but have sex with other men. The intention is to group based on sexual behaviours, not sexual orientation or sexual identity [23]. Using this umbrella term to group diverse people has received mixed reactions [37]. Although this grouping is helpful clinically, as MSM have unique

healthcare needs linked to sexual behaviours, some have argued that the term strips sexual minority groups of their self-determined sexual identity [37,38]. Many are concerned that the term does not account for the social dimensions of sexuality which influence sexual behaviour and is an essential consideration for public health research [37]. Furthermore, it does not imply that everyone familiar with these terms comprehends them in the same manner or that this understanding is the same as how high-income nations understand them. Interpretations of the terms by participants in the HPTN 075 study serve as an example [39]. A Kenyan participant explained that gay people could be MSM, but maybe not bisexual people, whom he understood to be people with two sexual organs. Due to these possible misunderstandings, the 2019 Global LGBTI Internet Survey did not use this term. Instead, participants answered a series of questions about their assigned birth sex, gender identity and the gender of the person(s) they are sexually attracted to (see appendix 2, for survey questions). I have chosen to use the acronym MSM in this thesis because the included studies focus on behaviours that increase the risk of HIV infection rather than identities. Secondly, MSM is commonly used in the NSP or NSF documents and by epidemiologists to group gay men, bisexual men and men who do not identify as either but have sex with other men in SSA.

## 2.2 HIV Epidemiology, Prevention and Treatment

### 2.2.1 HIV Epidemiology in sub-Sahara Africa

Globally, over 40 million people have died due to HIV, an estimated 38.4 million people were living with HIV in 2021, and about three-quarters (28.7 million) of those living with HIV are on treatment [40]. Recent estimates show that 70% of all new HIV infections in 2021 were in key populations and their partners [40]. SSA is the region most affected by the HIV/AIDS epidemic [24,41]. Current data shows that 58% of the 1.5 million new HIV infections in 2021 were in SSA [2]. The groups with the highest incidence and prevalence of HIV/AIDS in SSA are the poor, the young (15-24 years), women and KPs [22,42]. The virus has highly impacted these groups because they are the most vulnerable, have the least access to resources and often face discriminatory social, legal and policy challenges [22].

There are geographic variations in HIV within SSA, but across the region, KPs are the group most at risk of HIV. Eastern and southern Africa (ESA) continue to be the most severely afflicted by HIV, with an estimated 20.6 million (54%) of all people living with HIV globally [3]. The region has made substantial progress in mobilising resources and lowering new infections and AIDS-related deaths, reducing the number of new HIV infections among all ages by 44% from 2010 to 2021 [22]. By 2020, at least six countries in eastern and southern Africa met the UNAIDS 90-90-90 targets for HIV testing and treatment (Botswana, Eswatini, Malawi, Rwanda, Zambia and Zimbabwe), with four additional countries achieving viral suppression in 73% of people living with HIV (Kenya, Namibia, South Africa and Uganda) [22]. Similarly, most ESA countries have met the second and third of the 95–95–95 targets for 2025 (over 95% of people who know their HIV-positive status are accessing treatment and over 95% of people on treatment have suppressed viral loads), the first target of over 95% of people living with HIV knowing their HIV status has not been met by any country in the region[22].

West and Central Africa (WCA) bears less of the burden of HIV in the region, accounting for an estimated 5 million people living with HIV globally in 2021 [3]. Five countries (Cameroon, Côte d'Ivoire, the Democratic Republic of the Congo, Ghana, and Nigeria) accounted for two-thirds of the HIV burden in WCA [22]. The WCA region lacks mobilising enough resources to fund HIV control programmes domestically and through external donors and has a higher dependency on external resources than ESA region [22]. Despite this, the region has made substantial progress in lowering new HIV infections by 43% from 2010 to 2021 among all ages [22]. In contrast to ESA, none of the WCA countries met the UNAIDS 90-90-90 targets, with only Burundi achieving viral suppression of 73% of people living with HIV patients[43]. Despite this, the region continues to make progress towards the 95-95-95 targets. By 2021, 80% of persons living with HIV were aware of their HIV status, 98% of those who were aware of their HIV-positive status were receiving treatment (78% of all people living with HIV), and 88% of those on treatment had suppressed viral loads (69% of all people living with HIV) [22].

### 2.2.2    HIV Prevention

Key methods for HIV prevention involve a combination approach[44]. These include biomedical methods to prevent transmission of HIV from infected people through various bodily fluids and behavioural and structural interventions [44]. Biomedical prevention consists of the use of male or female condoms; antiretroviral drugs such as Pre-exposure prophylaxis (PrEP) including dapivirine vagina ring and injectable long-acting cabotegravir, post-exposure prophylaxis (PEP); provision of clean injection equipment for injectable drug users (IDU); blood and blood product safety; medical male circumcision; and prevention of mother-to-child transmission [44]. Behavioural components of HIV prevention interventions are designed to provide information to encourage safe choices and motivation, reduce risky behaviours and sustain positive change [29]. Structural interventions focus on factors of the environment that will enable change to HIV risk and vulnerability and support resilience[44]. These can include interventions to address poverty, inadequate housing, and modification of discriminatory laws and policies [45].

### 2.2.3    HIV treatment

Although there is currently no cure for HIV, treatment with antiretroviral therapy (ART) suppresses viral replication, providing an opportunity for the infected individual's immune system to recover. When the diagnosis is timely, and treatment is adhered to, people living with HIV can live a long life similar to others in the general population that are not living with HIV[44].

HIV treatment as prevention is a highly effective strategy for reducing HIV transmission and is an essential prevention tool in HIV control. People who adhere to their ARTs can achieve and maintain undetectable levels of the virus, making them unable to sexually transmit the virus[46]. This is known as U=U, undetectable = untransmissible. Before 2016, the initiation of ART was based on CD4 cell counts [47]. Following accumulated evidence in support of treatment as prevention, the WHO updated recommendations that people of all ages with HIV should be initiated on treatment regardless of the CD4 cell count [47]. This is sometimes referred to as "universal test and treat"[29,44]. This is why regular HIV testing is essential for those at a high risk of HIV, to ensure people living with undiagnosed HIV are initiated on

treatment as early as possible. This is very important for epidemic control among MSM, other KPs and their sexual partners [22,48].

## 2.3 Contextualising HIV risk among men who have sex with men in Sub-Saharan Africa

HIV risk among men who have sex with men in Sub-Saharan Africa is high [22,49]. This is due to several factors, including the high prevalence of HIV in the region, the lack of access to prevention and treatment services, and the stigma and discrimination that men who have sex with men face [22]. Unlike the Global North, where the early responses to HIV/AIDS epidemic focused on MSM as the prevailing view was that it was a disease that affected only homosexual men, in SSA, the epidemic was widely spread within the general population [50,51]. By 2000, HIV was the leading cause of death in SSA [51]. Data on the burden of HIV among MSM in SSA has only emerged in the past decade [52,53]. This was influenced by factors such as the denial of the existence of MSM in the region by many SSA countries, legal barriers and a lack of political will in many countries [22,52].

The HIV epidemic in WCA is mainly concentrated within KPs and their sexual partners, whilst in ESA, the HIV epidemic is among the general population [22]. In 2021, WCA KPs and their sexual partners accounted for 74% of all new HIV infections. In contrast, ESA is the only region where KPs accounted for less than half of all new HIV infections in 2021 (46%). Despite this, they still have a higher relative risk of contracting HIV than the overall population [22,24]. The estimated prevalence of HIV in SSA MSM ranges from 2% in Angola to 41% in Congo (see table 2.2 for more details)[54].

Compared to the slow decline in new HIV infections reported in the general population globally and in SSA, new HIV infections within SSA MSM have remained steady (figure 2.1) [41,54–59].

Table 2. 2: HIV prevalence among men who have sex with men in sub-Saharan Africa

| Country | HIV prevalence 2021 (%) |
|---|---|
| Angola | 2 |
| Benin | 7 |
| Botswana | 14.8 |
| Burundi | - |
| Cameroon | - |
| Central African Republic (the) | 3.4 |
| Chad | 3.9 |
| Congo | 41.2 |
| Côte d'Ivoire | 7.7 |
| Democratic Republic of the Congo (the) | 7.1 |
| Eritrea | - |
| Eswatini | 27.2 |
| Ethiopia | - |
| Gabon | - |
| Gambia | 34.4 |
| Ghana | 4.9 |
| Guinea | 11.4 |
| Guinea-Bissau | 3 |
| Kenya | - |
| Lesotho | - |
| Liberia | - |
| Madagascar | - |
| Malawi | 12.9 |
| Mali | 12.6 |
| Mozambique | - |
| Namibia | 7.8 |
| Nigeria | 25 |
| Rwanda | - |
| Senegal | 27.6 |
| Seychelles | - |
| Sierra Leone | 3.4 |
| South Africa | 29.7 |
| South Sudan | - |
| Togo | 22 |
| Uganda | 12.7 |
| United Republic of Tanzania | 8.4 |
| Zambia | - |
| Zimbabwe | 21.1 |

**New HIV Infections by Global, SSA and SSA MSM Population 2016-2021**
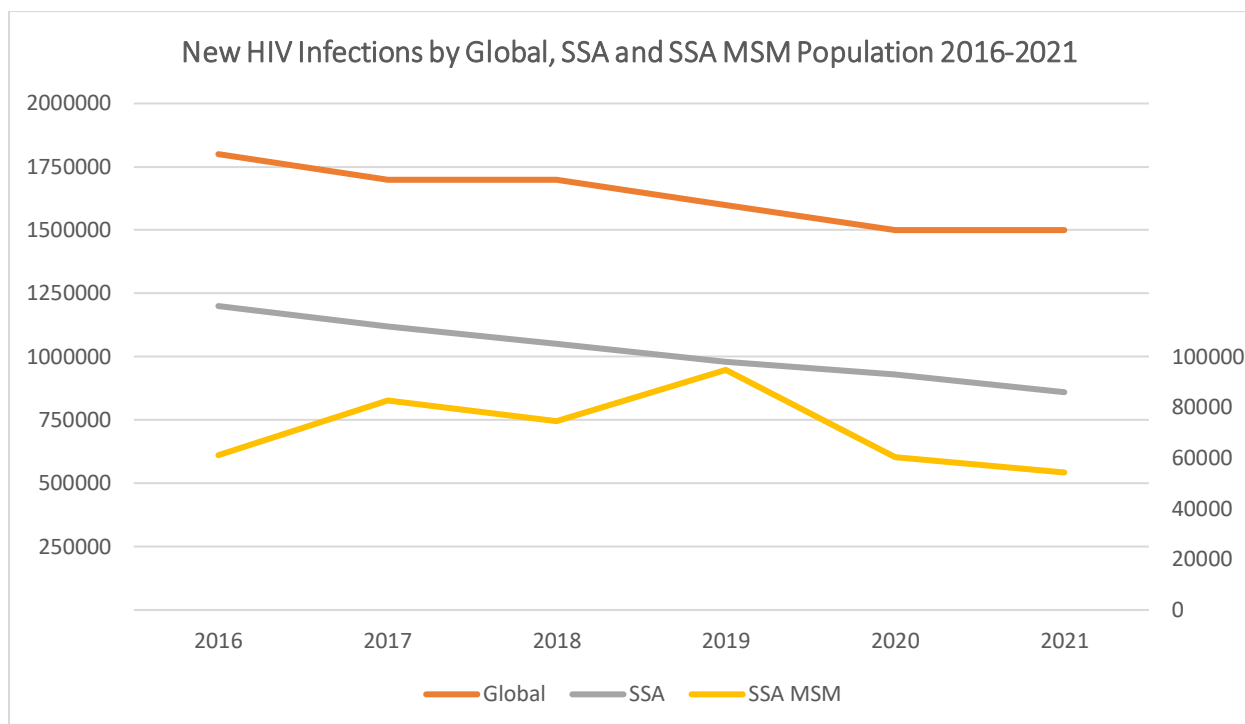
Figure 2. 1. New HIV Infections in all ages Globally, in SSA and SSA MSM Population 2016-2021
*SSA MSM scale measured by the scale on the right

Several factors contribute to the high HIV burden among MSM in sub-Saharan Africa. Operating at the individual level are psychological, biological and behavioural, and sociodemographic factors (section 2.4). At the country level are factors such as coverage of HIV prevention and treatment services, same-sex criminalisation laws and discriminatory policies, which all impact access to services by MSM (section 2.5). I then explore the concept of intersectional stigma (section 2.6).

## 2.4    Individual-level determinants of HIV in MSM

The relationships between biological, behavioural, psychosocial, and sociodemographic factors, stigma and the transmission of HIV in MSM are intricate. This section of the literature review focuses on the primary individual-level risk factors for HIV infection among MSM globally because the epidemiology of HIV within different populations differs and might depend on several factors, including gender, area of residence, sexual orientation, and practice of injecting drugs. When there are risk factors unique to MSM in the SSA region, they are noted along with how they differ from MSM worldwide.

### 2.4.1    Psychosocial determinants of HIV in MSM

MSM are disproportionately affected by mental health problems, including depression and anxiety, compared to men in the general population[38,60]. It is believed that MSM are at higher risk of mental health problems due to the increased social stressors they experience due to their sexual orientation[11]. A growing body of evidence suggests that mental health problems are associated with an increased risk of HIV acquisition among MSM [38]. Some studies have found that mental health problems are associated with an increased risk of HIV infection and that men with mental health problems are more likely to engage in risky sexual behaviours, and use substances [23,38,61]. Many studies have found that mental health problems are associated with an increased risk of HIV disease progression and that men with mental health problems are more likely to experience poorer health outcomes [38,62].

A significant correlate of mental health is internalised homonegativity (IH). The following sections provide a detailed review of the manifestation, clinical presentation, measure and associations of IH with HIV outcomes in MSM.

### 2.4.1.1    Internalised Homonegativity

IH represents an internal and insidious kind of stress in the most proximal place, from the environment to the self [11]. It is characterised by the internalisation of societal homophobic attitudes in MSM which has been found to lead to feelings of guilt, inferiority and lack of self-worth [63,64]. IH impacts most aspects of a person's daily life, from spiritual, mental, career (due to education or impact on career goals), physical (due to substance abuse), social and behavioural [65]. Researchers have found associations between IH and physical health outcomes in MSM such as increasing vulnerabilities to HIV in MSM [16,66–68].

IH as a concept was first explored in the psychology literature by Malyon over three decades ago[69]. It has since remained core in the psychosocial literature on LGBTI. Most of the literature acknowledges the subjective construct of IH[11,70]. Still, it is widely theorised to result from direct and indirect social interactions of people in same-sex relationships, which can be highly context-specific [11,35,71]. Socio-cultural factors that change over time, such as politics, religion, laws, culture and other historical factors, influence the gender norms that exist

within society, and these play out in all our daily interactions. When the socio-structural environment has values that conflict with the act of same-sex relationships, it can lead to interpersonal conflict within MSM persons because the dominant culture, social structures, laws and norms do not reflect theirs, affecting their sense of self. This is further reinforced during social interactions, and health can become compromised[72]. Clinically, the markers of IH range from explicit presentations, such as thoughts of self-harm directly linked to the hatred of one's homosexual identity, or the more subtle presentation in the form of self-subordinating practices[35].

### 2.4.1.2 Differentiating Internalised Homonegativity from Its Outcomes and Correlates

Researchers debated what defines IH and how it differs from related constructs [73–75]. The most significant distinctions have been whether outness, connectedness to LGBT+ community and mental health should be included in the measure of IH [75]. Some have argued that outness is part of IH as it is a positive sign of acceptance of one's sexuality. Still, Meyer argues that the decision to disclose one's sexuality is instead a function of situational and environmental circumstances and not necessarily a product of internal conflict [75]. So, concealing sexuality can be seen as a protective decision, signifying a healthy adjustment to LGBT+ hostile environments [75]. A similar argument to outness is the connectedness to LGBT+ communities. Some assert that individuals with higher levels of IH may avoid participation with gay communities, whilst others argue that other factors such as the opportunities and risks in participation, being single or coupled, are more important determinants of social participation [75]. Regarding associations of IH and mental health problems, a large number of available studies have demonstrated a direct association of IH with mental health outcomes in MSM [11,62,76].

### 2.4.1.3 Validated tools for measuring IH

Considering these overlaps in the indicators of IH from sources across the literature, establishing measures for IH has been difficult, with no right way to measure the construct. Despite this, several validated scales have been developed to measure IH. They have allowed social scientists to conduct quantitative analysis assessing its associations with adverse health outcomes of LGBT+ persons [65]. This means that different studies may use other methods,

which can make it difficult to compare results. Meyer theorises that the variations in the measurement of IH are because it is an expression of collective lived experiences mainly resulting from stigma/stress[11,77].

The Nungesser Homosexual Attitudes Inventory (NHAI), the first scale to incorporate subscales on IH in 1979, is among the measures that are more frequently mentioned. This was not officially an IH scale but a product of Nungesser's research thesis, which was later expanded in a book published in 1983 and included three subscales measuring attitudes towards one's homosexuality, attitudes towards other homosexuals and attitudes towards self-disclosure [74,78]. This scale was revised initially by Shildo and then by Wagner et al. in 1994[79]. The next scales developed contain key factors from the literature that have been identified to be linked to the presentation of IH, focused on factors measuring gay identity, social comfort around other homosexuals etc. The first-factor analytic scale that factored theoretical and clinical components of IH was the Reactions to Homosexuality Scale (RHS) by Ross and Rosser in 1996[73]. This scale contained four factors and 26 items later reviewed, and a shorter validated three-factor, 7-item version of the scale developed for ease of application in surveys [64,80,81]. An Internalised homophobia scale (IHS) with a 9-item measure was used by Cogan et al. to assess IH [11]. Its correlates among LGBTI persons in 1997 and its psychometric properties were later presented by GENCO and Yuksel using a Turkish version [70,82]. Another scale was the Internalised Homonegativity Inventory Scale (IHNI) developed by Mayfield in 2001 and contains a 23-items scale for IH[83]. Most of these scales have been developed and validated on MSM in the Global North, namely the USA. Only the RHS has had cross-cultural validity of its properties investigated in MSM living in Africa, which is very important as considerations of the social and cultural environment are important for understanding the experiences of highly stigmatised identities [84].

### 2.4.1.4   Internalised Homonegativity and homophobic environments

Available studies examining the association among variables with IH found its associations to include hostile homophobic environments, economic inequality, size of settlements, public opinions about homosexuality, and exposure to homophobia-related victimisation[71,85]. Structural or institutional discrimination, such as criminalising same-sex

relationships, significantly impacts development of a sense of self [11]. Criminalisation denies sexual minorities access to social institutions available to heterosexuals, such as marriage or adoption, preventing them from accessing family life and intimacy [11]. It also impacts their ability to express themselves due to the shame and stigma attached to homosexuality in many parts of the world [34,86]. Some LGBTI persons choose not to disclose their sexual orientation, which can affect them socially and lead to further internalisation of experiences [87]. In a South African MSM study, being secretive about one's sexuality acted as a protective behaviour, decreasing the risk of HIV in MSM with IH [88]. In some who withdraw socially to avoid any interactions that might reveal their sexuality, this lack of community belonging can result in poorer health outcomes as social support can be an important mediator of IH, with its effects potentiated by the decrease in population density [76].

### 2.4.1.5   Internalised Homonegativity and its links to HIV health-related outcomes in MSM

Many researchers have shown that IH can result in many adverse health outcomes, such as poor mental and physical health, and influence HIV-related health outcomes through increased high-risk sexual behaviours and poor utilisation of HIV testing services [16,62,71,79,89–92]. Available studies on the role of IH within HIV processes can be broadly classified into three areas; HIV prevention and safer sex decision-making processes, coping strategies of seropositive gay men, and whether IH has any effect on viral progression [79]. Studies of the effect of IH on viral progression studies is limited, but findings show associations between IH and missing hospital appointments or poor engagement with care [93–95]. These considerably weaken stages in the treatment/prevention cascades [96,97].

In HIV prevention, associations of IH with HIV-risk behaviours have been reported across health literature, with higher levels reported by MSM in homophobic European societies [16,71,98]. Behavioural variables assessed in most studies include a history of HIV testing, increased numbers of male sex partners, lower disclosure and discussion of HIV serostatus, receptive or insertive anal sex without any form of protection (condoms or pre-exposure prophylaxis (PrEP)) and use of injectable drugs [62,67,88,90]. Studies on sexual behaviours have had mixed findings of no associations and positive associations with IH, with significant mediators identified, including 'outness' and 'coping strategies' [62,65,71]. The

variability in the findings is consistent across studies, including Black MSM [62,88]. This increased vulnerability to high-risk sexual encounters could be a result of being ill-informed on the availability of protective/safe sex methods resulting from their limited engagement with other gay men in the community, or it could be a result of impaired judgement from substance abuse (drugs and/or alcohol) which has also been reported to have associations to IH[99,100].

Some findings have weak correlations with IH despite the possible theoretical explanations for a relationship. For example, reports of correlations between IH and condom use have typically been weak or inconsistent associations [6,7,101,102]. Ross et al., in their study of 144,177 European MSM, found a small to moderate effect size between IH and unprotected anal sex with non-steady partners in the last 12 months [103]. Smallwood et al., using the 23-item Internalised Homonegativity Inventory (IHNI) scale, found that two of the factors, 'gay affirmation' and 'personal/moral' homonegativity' had direct and significant effects on condom use during both receptive anal intercourse (RAI) and insertive anal intercourse (IAI)[6]. Both were associated with increased use of condoms in the last three months for the 348 African American MSM respondents in the cross-sectional study. Similarly, studies of MSM in Nigeria, and Uganda found that increasing levels of IH were associated with increased sexual-risk behaviour but not with transactional sex[64,104].

IH is not only associated with variables that negatively impact health outcomes. It has also been found to have associations with selecting positive and negative coping strategies [105]. This is an important factor because if the prevailing social beliefs regarding sexuality result in IH, then an assumption can be made that all sexual minorities have a level of IH. Still, then, not all are negatively impacted. Whilst some LGBTI+ choose avoidance/concealment and drug/alcohol use as coping mechanisms, others choose acceptance of their sexual identity. The type of coping mechanism then determines if IH has a detrimental health impact or not. Ross et al. found that IH was indirectly associated with avoidance of HIV testing mediated by 'outness' in their study of European MSM [16]. Jang et al. found that MSM with access to social support, utilise social resources such as gay clubs etc., experienced lower psychological distress[106]. In a South African study, IH was found to have a protective effect on sexual risk behaviours of MSM [88].

Social support is not only a reference to relationships with people but to relationships where the individual is open about their homosexual identity, improving the quality of the resources accessible to them[76,106,107]. This provides access to emotional support, experiences that increase exposure to counter messages (e.g., LGBTI affirmative messages), access to advice or information sharing, and financial assistance [105]. Who is providing the source of social support is also essential. Studies have found that social support from family members, friends or partners of MSM has resulted in reduced levels of IH [68]. Romantic partner support has been shown to effectively buffer the body's physiological response to stress resulting in less internalisation of negative experiences [108]. Despite this, IH is not eliminated in MSM with high social support, as social interactions go beyond one's inner circle and extend into employment and interactions with general community members [109]. Stangl's health and discrimination framework articulate this internalisation of societal stigma as it unfolds across socio-ecological levels and intersects with health-related stigmas [13]. The domains of the framework consider processes that are drivers and facilitators of stigma, as well as organisations and institutional stigma that ultimately impact health[13].

### 2.4.2 Biological and behavioural determinants of HIV in MSM

The HIV literature has extensive reports of the biological and behavioural risk factors that increase MSM's susceptibility to HIV. Research has shown that MSM are likelier to engage in high-risk sexual behaviours than the general population [38]. This includes having multiple sexual partners, unprotected anal intercourse that is sex without a condom, PrEP or with an HIV+ person without an undetectable viral load, transactional sex, using shared or non-sterile needles to inject drugs, drug and alcohol abuse which can reduce individual's inhibition and result in high-risk sexual behaviours[110]. These behaviours increase MSM's risk of other sexually transmitted infections (STIs), which can create an entry point for HIV infection [38]. This association is twofold. Biologically, STIs can result in inflammation and/or ulceration, increasing susceptibility to HIV [111]. Behaviourally, studies have found that those who have STIs are more likely to be engaged in high-risk sex, such as unprotected sex [112,113]. Despite not being exclusive to MSM, these risk factors are more common in MSM communities [38]. Research has found that many MSM use drugs and alcohol as a coping

method resulting from chronic exposure to discrimination and rejection by family and society[38].

In addition to the behavioural risk associated with acquiring HIV, research has found that 'role versatility' is an additional factor that increases the risk of HIV transmission in MSM [114,115]. For example, MSM can be both insertive and receptive during anal sex. Role versatility is not a high-risk sexual behaviour, but unprotected sexual contact increases the risk of transmission, especially for the receptive partner [116,117]. The thin lining of the rectum increases the risk of HIV transmission during anal sex compared to vaginal sex [114]. This increased risk is for both insertive and receptive anal sex, although receptive partners are at a higher risk than the insertive partner [53].

### 2.4.3 Socio-demographic determinants

The literature on HIV shows that age, level of education, demographic location, socioeconomic status and relationship status are risk factors for HIV in SSA MSM [118–120]. Older age is associated with HIV prevalence, while younger age is associated with HIV incidence [120,121]. These increased risks of HIV in young MSM have been linked to the fact that they are likely to have less power to negotiate condom use, more likely to be less educated, more likely to engage in transactional sex and more likely to have more sexual partners[120,122]. High poverty levels among MSM in SSA are reported to be due to increased societal stigma and discrimination levels resulting from social exclusion [123]. This can impact access to quality healthcare and increase the prevalence of transactional sex[124].

Different aspects of MSM's identity intersect to create unique experiences of oppression[13,14]. Intersectionality refers to how multiple identities that are targets of stigmatisation, such as race, gender, sexual orientation, and socio-economic status, intersect or overlap to produce health inequalities [12]. Intersectionality is important in SSA MSM, especially the tensions between perceptions of homosexuality and being African [12–14]. The intersections of Individual-level factors such as sexual orientation, involvement in transactional sex, level of masculinity and being from a lower socioeconomic background can

increase MSM's vulnerability to HIV [14]. These unique intersections of identity can also make it difficult for MSM to find community and acceptance [14].

Two other demographic factors distinguish MSM and heterosexual outbreaks. First, due to the fundamental demographic difference of MSM being a one-sex community, and heterosexuals a two-sex group, MSM can be role-versatile [53,114]. In contrast, heterosexual individuals are compelled to remain "role-segregated" (men always insertive and women always receptive) during sexual activities with high transmission probabilities (vaginal and anal sex) [53,114]. Previous research has shown that when there are disparities in the transmissibility for insertive and receptive roles, role segregation can significantly dampen the efficient spread of HIV through a population [53]. MSM in SSA previously predominantly practiced role segregation, but due to increased exposure to western gay culture, role versatility is becoming widely practised [88]. Second, the predominant form of high-risk contact in heterosexuals is penile-vaginal sex which has a lower chance of transmission than with high-risk MSM contact (penile–anal sex) [114,117]. In SSA, due to high rates of bisexual practices by MSM, the transmission rates are further increased in the region[125,126].

## 2.5 Country-level determinants of HIV in MSM

Beyond individual-level factors, the influence of structural factors on the health outcomes of MSM populations can include both explicit and nonexplicit structures and practices that support stigma and discrimination against minority groups [35]. Structural constructs such as the unequal distribution of resources, laws, policies, rules, and area-based or institutional legacies result in discrimination against minority groups such as MSM [35]. In their very existence, they provide economic, social and biophysical environment advantages to the privileged group over the targeted group [35]. This is witnessed in the response to the HIV epidemic in SSA MSM. For example, in many SSA countries, there are no dedicated services for MSM, and many national health services do not provide targeted interventions for MSM[33]. This means that MSM often have to access services through the general population, which do not meet their sexual health needs and are often stigmatising, which can deter MSM from accessing HIV prevention, testing and treatment services [127]. The following sections explore the coverage of prevention and treatment services in SSA, the

distribution of laws that criminalise same-sex relationships and its links to HIV-related outcomes of SSA MSM in more detail.

### 2.5.1 Coverage of HIV prevention and treatment services

The HIV epidemic response for MSM in SSA can be reviewed through the coverage of HIV prevention and treatment services. This can include three main actors, the national government; international donors; and national and international non-governmental organisations (NGOs).

Despite economic constraints, there have been ongoing efforts by countries in SSA to tackle the high burden of HIV in the general population domestically, but this has not been the case for KPs [128]. Lack of access to prevention and treatment services disproportionately affects MSM in sub-Saharan Africa[129,130]. MSM in many SSA countries do not have access to dedicated nationally funded sexual health services, many services are run by NGOs or CBOs using donor funding [131]. Hence, they must rely on accessing the same services as the general population and face stigma and discrimination [127]. Also, MSM are more likely to experience marginalisation, which limits their ability to access health care [92,132,133].

Additionally, many national health services are underfunded [22]. Many countries only spend a small per cent of their GDP on health, and even less of this is allocated to HIV resources. As a result, the health infrastructure is weak, further hindering access [22,134]. Many SSA countries rely heavily on bilateral and multilateral donor funding for their HIV response [18,22]. Bilateral financing for HIV in Africa comes from various sources, including the United States, the United Kingdom, France, and Germany [135]. Multilateral funding for HIV in Africa comes from multiple sources, including the Global Fund to Fight AIDS, tuberculosis and Malaria and the President's Emergency Plan for AIDS Relief (PEPFAR) [135].

Historically KPs have not received adequate priority in national HIV policies in SSA, especially in countries with generalised epidemics, where transmission is sustained by sexual behaviour in the general population[53,136,137]. This is problematic as evidence shows the occurrence of concentrated epidemics where HIV rapidly spreads within defined vulnerable

populations within a well-established generalised epidemic[138]. Further hindering progress in reaching MSM was that many SSA countries did not have a size estimate for MSM and other KPs to programme for these groups effectively [139]. Over the past decade, many countries have made progress in providing size estimates of the MSM population nationally, and this has improved targeting HIV prevention and control interventions to this group[139]. Not many have integrated bio-behavioural surveys (IBBS) for MSM [140]. IBBS is a community-based systematic survey that measures risk behaviours and the prevalence of HIV and other STDs among KPs [141]. This information is used to track the HIV pandemic and plan programmes better [141].

Many SSA countries rely on the 2003 PEPFAR Relief that currently provides funding to twenty-two SSA countries with programmes focusing on prevention and care interventions for MSM[131,142]. The PEPFAR programmes for MSM included expanding access to voluntary medical male circumcision, increasing HIV testing and counselling, protecting human rights and providing antiretroviral therapy [143]. PEPFAR's work in Africa was carried out through partner organisations. One method was funding partner organisations to expand their programmes and reach more people[8,131]. PEPFAR also collaborated with partner organisations to help them build capacity and improve their service delivery[8]. Furthermore, PEPFAR provided technical assistance to partners to enhance their programmes' quality [131].

In addition, to help countries in planning and developing effective and efficiently acceptable programs for KPs, the WHO 2014 developed consolidated guidelines (updated in 2016) for HIV prevention and treatment for KPs, which outlines a comprehensive package of interventions that includes recommendations for both health sector and for creating an enabling environment amongst other things to be implemented by countries to combat the prevalence of HIV [28,29]. Available data shows that the adoption of these recommended interventions has been slow within SSA countries despite the rise in new HIV infections in KPs across the region [33,54,103,144]. Interestingly, current data showed that many countries with laws that criminalise homosexuality have the WHO KPs guidelines fully or partially included in their HIV policy documents[145]. Irrespective of this, evidence continues to show that it is not enough to have HIV interventions or programming policies if the target population cannot access them due to environmental limitations [146–148].

### 2.5.2    Criminalisation of same-sex relationships in Sub-Saharan Africa

In addition to policy gaps, laws criminalising same-sex relationships are reported as significant determinants of HIV-related health outcomes, impacting access and utilisation of HIV prevention/treatment services among MSM[148,149]. Currently, 26 of the 46 SSA countries have laws that criminalise homosexuality, some recently toughened legislation, with penalisation ranging from death to payment of a fine[139]. The penalties vary across and sometimes within countries[150]. The highest penalty in SSA is a death sentence, which is written into law in two countries, Nigeria and Mauritania[151]. Although there has been no reported official application of such penalties in these countries, reports show that its mere existence impedes efforts to HIV control efforts[100–102,152,153].

These structural factors shape interactions between individuals in society [133]. This includes interactions socially, at places of employment, whilst utilising healthcare services or other public services, down to the household [35,127]. Due to the encompassing impact of the laws on the lives of sexual minorities, many of those living in countries where homosexuality is criminalised are forced to conceal their sexual identity out of fear of arrest or extortion[7,92]. Criminalisation also exposes MSM to constant harassment, arrests or extortion by the police, further impacting the economic inequalities faced by sexual minorities[10].

Due to difficulties in reaching this hidden group in the region, there is limited research reporting on the associations of same-sex criminalisation laws with HIV-related outcomes. Available studies are from the European region, America and the Pacific, with only one study with pooled estimates from a systematic review of studies on African MSM [25,71]. Studies outside the continent cannot be generalised to the SSA context. For example, over half the countries in SSA have discriminatory laws against same-sex relationships, whilst no country in Europe has laws against homosexuality and anti-sodomy laws were ruled unconstitutional by the US Supreme Court in 2003 [154,155]. Such differences in context and social practices show that MSM in SSA countries have distinctly different context-specific experiences, creating unique vulnerability modes to poor health outcomes[156,157].

*2.5.2.1   Colonial History and its links to anti-homosexual laws in sub-Saharan Africa*


Laws and policies are particularly important in the SSA context due to the colonial histories of most of these countries [158]. Most have inherited the laws that criminalise same-sex relationships pre-independence, whilst some in recent years have passed new criminalisation laws or toughed the contents of the pre-independence laws to criminalise same-sex relations between adults expressly; to include women who have sex with women; inclusion of explicit prohibition of social resources for LGBTI or those providing services to the communities [34,39]. MSM living in SSA countries with protective homosexuality laws are not entirely unaffected by discrimination and fears for their safety, as historically, many had anti-homosexuality laws/policies[34,158]. Many of these countries scored low on the LGBT Global Acceptance Index (GIA), which is an index that combines a measure of public beliefs regarding LGBTI people and policies [86].


**2.5.3**   Criminalisation of same-sex relationships and its links to HIV-sexual risk behaviours, access and uptake of HIV services for MSM


Despite extensive discussions of the roles of individual behaviour versus social/policy environmental factors in driving the HIV epidemic in MSM, there is still limited evidence on the role of laws that criminalise same-sex relationships in driving the HIV epidemic in SSA. State-sponsored homophobia creates a hostile environment for LGBTI persons. Globally 72 countries have laws that criminalise homosexuality [155]. MSM from countries with discriminatory laws against homosexuality report high levels of anticipated or experienced stigma and discrimination both socially and when visiting health facilities, [7].


A few studies have reported the impact of the environment on health, more specifically, the effect of criminalisation on HIV control efforts [25,100]. Some countries also have laws and policies to discourage HIV-risk behaviours, such as sexual intercourse between same-sex individuals where one person is HIV-positive, known as 'aggravated homosexuality' [151]. These can encourage discrimination and harassment, driving those at high risk of HIV into isolation and further hindering access to HIV and other sexual health services [7,139,159]. These

increase the risk of HIV acquisition by MSM or non-disclosure, transmission or never-testing for HIV[84,160]. Findings from research in Nigeria, where laws criminalising same-sex relationships were passed in 2014, reported an increase in dropout rates for HIV treatment for MSM living with HIV due to fears of prosecution[161]. In cases where they attend health facilities, there have been reports of mistreatment due to sexual orientation leading to many concealing their identity as LGBTI [127]. Although concealment could prevent the experience of the stigma and discrimination attached to a homosexual identity, it means that they do not receive targeted interventions available to KPs and their partners.

In some countries, the threat of criminalisation is not only towards those from LGBTI communities but also those providing the services to them[100,162]. In his 2014 article on the wave of anti-homosexuality laws and their impacts on health, Beyrer reported several law enforcement raids/disruptions of HIV services across many SSA countries [7]. This report was timely then, as Uganda and Nigeria had just passed new same-sex marriage prohibition laws at a time when the Global North were advancing to legalising same-sex unions[151]. Muller et al. 2018 conducted a qualitative study on adolescent MSMs living in southern Africa (Malawi, Mozambique, Namibia, Zambia and Zimbabwe) and reported cases of fear of arrest and a few instances of actual arrests, both by the service users and by the service providers[152]. The fear led to avoidance of accessing care from health facilities or hesitance of healthcare providers to attend to those identifying as LGBTI [59,64]

## 2.6   Intersectional Stigma

Uptake of HIV prevention and care services is essential for epidemic control among MSM. Yet, in SSA, there are overwhelming reports of stigma and discrimination by healthcare providers against KPs[127,147,163]. Stigma is a social construct where distinguishing traits or characteristics are seen as a mark of social disgrace and used to devalue and oppress certain groups of people [164–166]. Stigma operates across the micro, meso, and macro levels, where the concept of spoiled identity is generated by society and then imposed on the individual[12,167]. Many MSM in SSA have multiple identities that are stigmatised, such as their sexual orientation, perceived femininity, involvement in transactional sex, being from a lower socioeconomic background and any other characteristic that society interprets as a sign of

inferior character [127,168]. Intersectional stigma is the unique experience of stigma faced by individuals belonging to multiple marginalised groups[13].

African MSM are one group of people who experience intersectional stigma. This stigma can come from various sources, including family, friends, and the wider community. They are often marginalised due to their sexual orientation, gender expression (such as how masculine or feminine they are), and socioeconomic and demographic status [14,168]. This marginalisation can lead to social isolation, which can, in turn, increase the risk of HIV acquisition [169]. Intersectional stigma can have several negative impacts on MSM at an individual level, including making it more difficult for them to access HIV prevention and care services and increasing their risk of HIV infection[127]. In addition, intersectional stigma can lead to feelings of isolation, anxiety, and depression[12].

## 2.7   Study justification

According to the literature review, numerous factors affect the disparities in HIV incidence among MSM in SSA. National and international efforts have been made to address some of these factors, but evidence suggests that the gap between MSM and the general population has not yet been closed. Much evidence supporting behavioural and biological interventions has been successfully implemented, but these have not been as marked as those observed in the general population. Additionally, declines in new HIV infections from these interventions have stalled, and there is an urgent need to explore other interventions to halt the spread of HIV among MSM. There are still limited studies on the associations of hostile legal and policy climates with MSM HIV-associated outcomes. Apart from individual country studies reporting the adverse effects of same-sex criminalisation on access to HIV services by MSM, I identified only one systematic review and meta-analysis using studies on MSM in SSA[25]. There are also limited studies on IH and its associations with HIV testing and risk behaviours, including MSM living in SSA[64,104,123]. The closest kinds of literature are studies on African American MSM[62,98,170,171]. Although there is a good literature base on IH in African American men where findings show an even higher prevalence of HIV in Black MSM with high IH, other environmental considerations such as the intersectionality of racism and other institutionalised discriminations in the US could further limit the generalisability to Black

MSM living in Africa[62,98,172]. There are also the colonial histories in SSA countries and their impact on present-day laws. Understanding the paths to the embodiment of environmental factors and how these manifest in the observed HIV disease distribution within the population of MSM in SSA will require consideration.

Data from the cross-sectional 2019 Global LGBTI internet survey provides the opportunity to explore my research aims of assessing the associations of HIV-risk behaviours and utilisation of HIV-testing services among MSM in SSA and examine their associations with discriminatory laws/policies and internalised homonegativity. The survey includes data from LGBTI+ participants living in all 46 countries within the SSA region and allows for the analysis of both country-level and individual-level factors. It is essential to understand how discriminatory laws and policies in SSA affect MSM access and utilisation of HIV prevention services to develop interventions that can improve their HIV-related health outcomes. Addressing these is critical to slowing the spread of HIV and ensuring that those living with HIV can access the care and treatment they need. This study used a multilevel perspective to analyse data from the 2019 Global LGBTI Internet Survey to answer the five research questions mentioned in chapter 1.2. Findings from the analyses and associated recommendations are useful for policymakers and healthcare providers as it highlights any disparities in utilisation of HIV testing between MSM living in countries that criminalise same-sex relationships and those in countries where same-sex relationships are legal placing emphases on exploring more contextually-competent HIV prevention and care programs. Findings may also be useful for researchers to improve the design and reporting using appropriate theory for understanding how different social factors may impact health outcomes of SSA MSM and to identify potential new hypotheses for future research

## 2.8   Theoretical Frameworks

Elements of Krieger's ecosocial theory of disease distribution and Meyer's minority stress model were used to frame the study methods for selecting relevant data to include in the multilevel model (MLM) .[11,173] Each of these looks at different aspects of how discrimination can impact health and can be used to guide research and interventions to reduce the adverse health effects of discrimination.

This thesis does not cover issues of experienced stigma and discrimination by the study participants, so other notable frameworks, such as the health stigma and discrimination framework, are not covered in this review [13]. These concepts were briefly explored in the literature review section of this thesis. This thesis section highlights key aspects of the two theories I used to design and frame this study.

### 2.8.1  The ecosocial theory of disease distribution

Krieger's ecosocial theory of disease distribution is a comprehensive theory that provides a framework for studying how discrimination affects health[20,35,173,174]. This theory proposes that we biologically embody exposures arising from our social and ecological contexts, leading to the observed disease distribution in the population (figure 2.2) [173,174]. The ecosocial theory does not assume disease to be a product of innate characteristics. Instead, it considers the pathways that lead to the embodiment by considering the types and levels of exposure, the period and spatial expanse involved, historical context, and the phenomena that affect susceptibility and/or resistance to the exposures at the macro and micro levels[35].
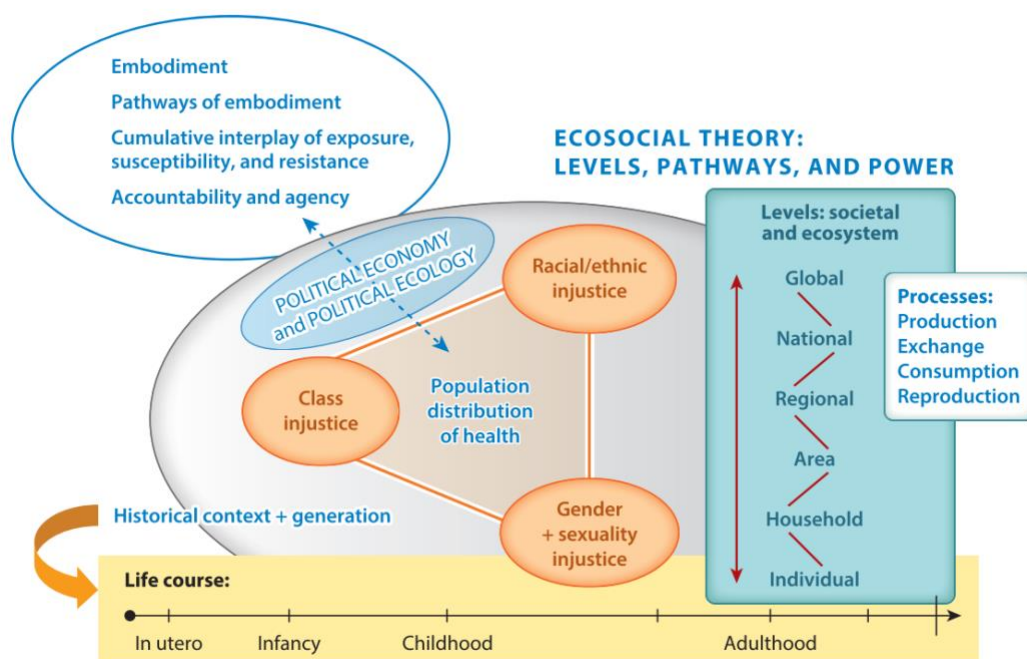


Figure 2. 2: The conceptualisation of the ecosocial theory of disease distribution, showing the relationship between population distributions of health, levels, pathways, and power to clarify how health inequalities constitute biological expressions of injustice in the analysis of racism in the US[173].

The theory suggests four primary constructs that include (I) embodiment; (ii) pathways of embodiment; (iii) cumulative interplay of exposure, susceptibility, and resistance; and (iv) accountability and agency. Embodiment involves lived experiences, such as experienced stigma and discrimination by people in same-sex relationships. The pathways to this embodiment are simultaneously shaped by the history of societal arrangements of power and property, i.e., institutionalised heterosexism, social deprivation through policies that outlaw MSM social clubs/bars etc. The simultaneous focus on exposure, susceptibility and resistance makes it possible to investigate Individual and collective resistance to injustice and its health-harming effects, as well as the resilience that allows them to do so [173]. At this path, considerations of time (i.e., in history or the life course) and place (i.e., national or individual level) where events occur are required. The fourth theoretical concept emphasises accountability and agency, which allows the consideration of those responsible for perpetuating the health inequalities (i.e., the state) and that of public health researchers in terms of their choice of theories in explaining or ignoring the inequalities. An example of the state's involvement in perpetuating the injustice can be seen in the consequences of present legal discrimination of KPs in some countries, which then empowers state law enforcement agencies to arrest, harass or extort KPs, resulting in outcomes that go beyond exacerbating MSMs risk to HIV acquisition, such as increasing their economic vulnerabilities [10,34].

It is not intended for researchers to attempt to measure every pathway at every level and at all relevant spatiotemporal scales, but rather that systematic theorising about what is and is not measured and how, can aid the interpretation of study findings [173]. Krieger posits that a starting point is to account for the intersections of identities, which accounts for the fact that for individual-level data, stating that 'no one is an individual one day, and a member of a population another, they are both simultaneously' [173]. This focus aids with understanding the reference points employed by people in evaluating their experiences. Group-level knowledge is required to understand what constitutes discrimination and for actions to alter future risk[173]. The theory emphasises that the content of the variables chosen and not simply the method of analysis is important and includes considerations for choosing appropriate measures for each level of analysis [35].

The clear distinction between the interactions of individuals and their social and physical environments in the ecosocial theory is vital when studying discriminated groups as it moves away from the traditional narrative where health outcomes are attributed to innate factors, placing the responsibility of poor health squarely on the individual/group after direct comparison with those considered superiors [173]. The theory has been applied by numerous researchers in the study of how discrimination affects health [175–178]. An example of its application was in the study of racial discrimination in the US and how it results in ethnic disparities in health [173]. In this study, Krieger uses the ecosocial theory to highlight the major pathways by which discrimination harms the health of ethnic minorities in the US. Economic and social deprivation, social trauma, health-harming responses to discrimination, and inadequate medical care, among many others, were all identified pathways [173].

In the case of HIV, it was initially seen as a disease of 'gay' men due to the high incidence rate among homosexual men [50,179]. Although HIV was later found in other populations, the stigma on homosexual men has remained, adding to the narrative of heterosexism, which can then be internalised by MSM, resulting in feelings of inferiority [50]. Applying this theory to the context of MSM in SSA, the influence of colonialism on current laws discriminating against same-sex relationships within the region, implicit discriminatory health policies, and the sociocultural importance of heterosexism are all important in shaping HIV disease distribution. Considering and understanding these historical pathways are vital to understanding the impact of discrimination on health in Krieger's theory[173].

Although the ecosocial theory provides a comprehensive conceptual theory for understanding how discrimination leads to adverse health outcomes, minority groups such as MSM have unique experiences that are not accounted for in the ecosocial theory measures. These added nuances can be accounted for by adding a stress model to help tease out the important stressors experienced by MSM to deal with the daily prejudice and discrimination they encounter within their context.

### 2.8.2    The minority stress model

Meyer's minority stress model is based on individual stress coping mechanisms of chronic negative social experiences unique to minority groups (see figure 2.3) [11]. The focus is not just on stress processes but also on coping processes. It is one of the most prominent theoretical and explanatory frameworks for health outcomes in sexual minorities [180,181].
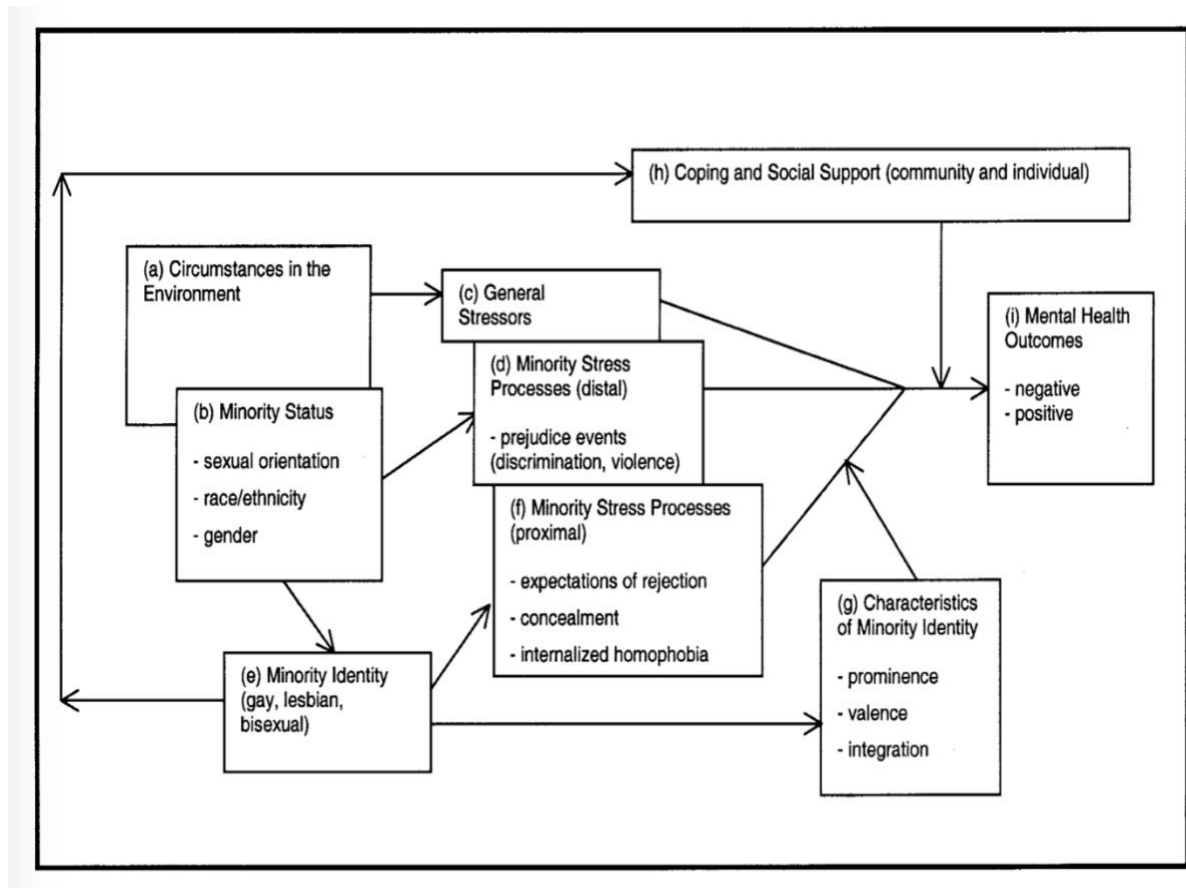


Figure 2. 3: Minority stress process in LGBTI populations as proposed by Meyer [11]. It encompasses the overlapping domains of the stressors involved in the two pathways proposed by the model, the direct and the contingent pathways.

In the model, the pathways to health outcomes are direct and contingent. For the direct/causal pathway, three types of stressors are identified by Meyer, (i) general stress (e.g., those experienced due to sexual orientation), (ii) distal minority stress processes, defined as objective stressors (e.g., discrimination, violence), (iii) proximal minority stress processes which are theorised to result when distal stressors gain psychological importance after cognitive appraisal (e.g., the anticipation of rejection, concealment and IH) [11]. Meyer theorises that proximal stressors have the strongest direct effect on health-related outcomes[11]. This could be because they function through internalised processes which lead

to negative self-concept and other psychological dysfunction[181]. In the contingent pathway, two domains are noted, (i) coping (e.g., coping skills and social support), which is primarily linked to health-related outcomes but as a mediating factor and (ii) minority identity characteristics (e.g., prominence, valence and integration).

The model has been applied to examine many aspects of the experiences of sexual minorities[182–185]. [87]Beyond the study of IH, the model has been used by researchers to analyse the stress pathways for HIV-related discrimination of LGBTI people and identify interventions to improve mental well-being and reduce the risk of transmission of the virus[181,186]. Researchers have also used the model to identify factors vital to developing coping mechanisms in participants that face constant stressors during their daily lives[92,185].

The application of the minority stress model in this thesis aids in identifying the best measures to include in the analysis. Due to the overlaps between IH and its correlates, the researcher needs to identify mediators and effect modifiers. For example, characteristics of minority identity (box g) have been reported to be an important effect modifier associated with the salience of LGBT identity, whilst concealment is an important coping strategy that works as a mediator [11]. Additionally, the minority stress model clearly distinguishes between IH and outness, connectedness to LGBT+ community and mental health. Considering this in the conceptualisation and measuring IH is essential for interpreting findings [11].

Chapter 3 shows how these two theories were operationalised in studying exposures to discriminatory laws and policies and HIV-related health outcomes.

# 3   Methods

In this chapter, I briefly cover the methods used in the 2019 Global LGBTI Internet Survey and the methods used in this secondary analysis. In the first section, I describe the study design of the primary study and how I arrived at the participants and countries included in my study. The following section details the theoretical frameworks that informed this study and the conceptual framework used to guide and frame the study methods.

To answer the research questions, I applied quantitative methods. Guided by elements of the ecosocial theory and the minority stress model, the modelling technique best suited to these is multilevel modelling (MLM). MLM is a statistical technique that can examine how risk factors at different levels, such as individual, societal, and country, impact health outcomes [187,188]. Before performing MLM, I perform an ecological analysis to understand the relationship of discriminatory laws and policies with HIV-related outcomes of MSM in SSA at the country level to see how comparable these findings are to those previously reported. More details of the statistical methods employed in this study are reported in section 3.4.2. The measures identified for inclusion in the models are listed in tables 3.2 and 3.3, and the conceptual framework guiding this study is represented in figure 3.1.

## 3.1   The 2019 Global LGBTI Internet Survey

Data for this study are from the 2019 Global LGBTI Internet Survey[189,190]. The cross-sectional survey is a combined project of the joint United Nations Programmes on HIV/AIDS (UNAIDS), the LGBT Foundation, the University of Aix-Marseille and the Medical School of the University of Minnesota.

The methods used in the survey involved recruiting consenting adult LGBTI participants through their social networks, e.g., the LGBT Foundation social networks, as well as national and regional LGBTI community networks, advocates and celebrities. Facebook

advertisements promoting the study were also used for countries without LGBTI dating apps and UNAIDS country teams to create visibility for the survey.

The questionnaire was disseminated without geographical restrictions in 32 languages, 7 of which are official languages in SSA (appendix 1). All participants completed the survey anonymously. Participants accessed the online survey on Survey Monkey via an encrypted connection link. They were asked preliminary questions, and no personally identifiable information was collected, such as email, phone or person-to-person contact. Exclusion criteria included participants who did not provide consent, reported they were aged under 18 years or did not provide a numerical value for age and those not belonging to LGBTI groups. Appendix 2 summarises the material supplied to participants to get consent and the survey questions.

### Secondary Analysis Study Participants

Overall, the primary study collected data from all 46 SSA countries with 5,851 LGBTI respondents (appendix 3). The inclusion criteria for this secondary analysis were age 18 and over; self-identified gay/bisexual/unsure; born male; and HIV negative. The resulting population size for this study included data from 44 SSA countries, the population size of 3,191 adult MSM (see table 3.1) for distribution of respondents by region). The two SSA countries excluded were solely due to no MSM respondents (appendix 3).

Table 3. 1. Number of respondents per country (n=3,191)

| Country | number of respondents | Percent of total respondents |
|---|---|---|
| South Africa | 568 | 17.8% |
| Democratic Republic of the Congo (the) | 181 | 5.7% |
| Nigeria | 165 | 5.2% |
| Mozambique | 141 | 4.4% |
| United Republic of Tanzania | 130 | 4.1% |
| Congo | 129 | 4.0% |
| Kenya | 124 | 3.9% |
| Côte d'Ivoire | 119 | 3.7% |
| Ethiopia | 111 | 3.5% |
| Angola | 108 | 3.4% |
| Burkina-Faso | 109 | 3.4% |
| Mauritius | 105 | 3.3% |
| Benin | 105 | 3.3% |
| Rwanda | 102 | 3.2% |
| Uganda | 95 | 3.0% |
| Mali | 95 | 3.0% |
| Ghana | 87 | 2.7% |
| Zambia | 78 | 2.4% |
| Gabon | 77 | 2.4% |
| Zimbabwe | 74 | 2.3% |
| Cameroon | 72 | 2.3% |
| Mauritania | 66 | 2.1% |
| Namibia | 62 | 1.9% |
| Chad | 43 | 1.4% |
| Senegal | 40 | 1.3% |
| Eswatini | 30 | 0.9% |
| Botswana | 24 | 0.8% |
| Lesotho | 25 | 0.8% |
| Malawi | 26 | 0.8% |
| Central African Republic (the) | 25 | 0.8% |
| Liberia | 17 | 0.5% |
| Burundi | 13 | 0.4% |
| Niger | * | * |
| Eritrea | * | * |
| Madagascar | * | * |
| Seychelles | * | * |
| South Sudan | * | * |
| Cape verde | * | * |
| Equatorial Guinea | * | * |
| Gambia | * | * |
| Guinea | * | * |
| Guinea-Bissau | * | * |
| Sierra Leone | * | * |
| Togo | * | * |

* countries with <10 responses to prevent unintended disclosure

## 3.2    Thesis Conceptual Frameworks

I applied aspects of the ecosocial theory of disease distribution and the minority stress model in analysing how MSM's lived experiences impact their HIV-related health outcomes. I needed to develop a bespoke framework incorporating factors such as poverty, educational attainment, and sex work, as these all overlap and intersect to shape MSM's experiences and behaviours. Using these theories, I developed a conceptual framework with appropriate national and individual levels measures (figure 3.1). Paper 1 (chapter 4) addressed questions 1 and 2 of this thesis, annotated Q1 and Q2 in the conceptual framework. Paper 2 addressed questions 3 to 5, annotated Q3, Q4 and Q5 in the conceptual framework.

For this study, I focused on the ecosocial theory's first two concepts, especially adverse exposures to discriminatory laws and policies and the pathways of embodiment—Krieger guides on operationalising such exposure to discrimination for health research by defining different measures [35]. For measuring heterosexism, Krieger suggests considerations of exposures to structural and individual factors through measures of explicit, non-explicit and implicit laws, policies, and rules. Table 3.2 provides a list of the measures identified for this study and extracted from the 2019 Global LGBTI Internet Survey and online resources.

Several individual-level factors in the minority stress model were available for use from the measures reported in the 2019 Global LGBTI Internet Survey but were identified as mediators. These included measures of outness and characteristics of minority identity, including salience of masculine or feminine characteristics. Section 3.3.2 lists the "minority status" and "minority identity" measures from figure 2.3, included in the minority stress model.

Table 3. 2. Measures of heterosexism identified for use in the study using the ecosocial theory of disease distribution

| Level | Metric | Measures used |
|---|---|---|
| Structural | Explicit Laws, policies and rules | **Homophobic climate** <br>• Laws criminalising same-sex relationships <br>• 13 laws and legislation index by the International Lesbian, Gay, Bisexual, Trans and Intersex Association (ILGA World) Items on the index include: <br>- Protection against discrimination based sexual orientation <br>   1. Constitutional protection <br>   2. Broad Protection <br>   3. Employment protection <br>   4. Limited/Uneven protection <br>   5. No protection/no crime <br>- criminalisation of consensual same-sex sexual acts between adults <br>   6. De Facto criminalisation <br>   7. Up to 8 years imprisonment <br>   8. 10 years to life in Prison <br>   9. Death Penalty <br>- legal recognition of families <br>   10. marriage or other forms of legal union for same-sex couples <br>   11. Adoption open to same-sex-couples (either jointly or via second parent adoption) <br>- legal barriers to the exercise of rights <br>   12. Legal barriers to freedom of expression on Sexual orientation, gender identity, gender expression and sex characteristics (SOGIESC) issues <br>   13. Legal barriers to the registration or operation of sexual orientation related CSOs |
| | Nonexplicit Laws, policies and rules | • National HIV policy includes the WHO key populations guidelines recommendations |
| Individual: internalisation | Explicit | • Self-reported data on internalised homonegativity |
| | Implicit | N/A |

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Figure 3. 1: study conceptual framework
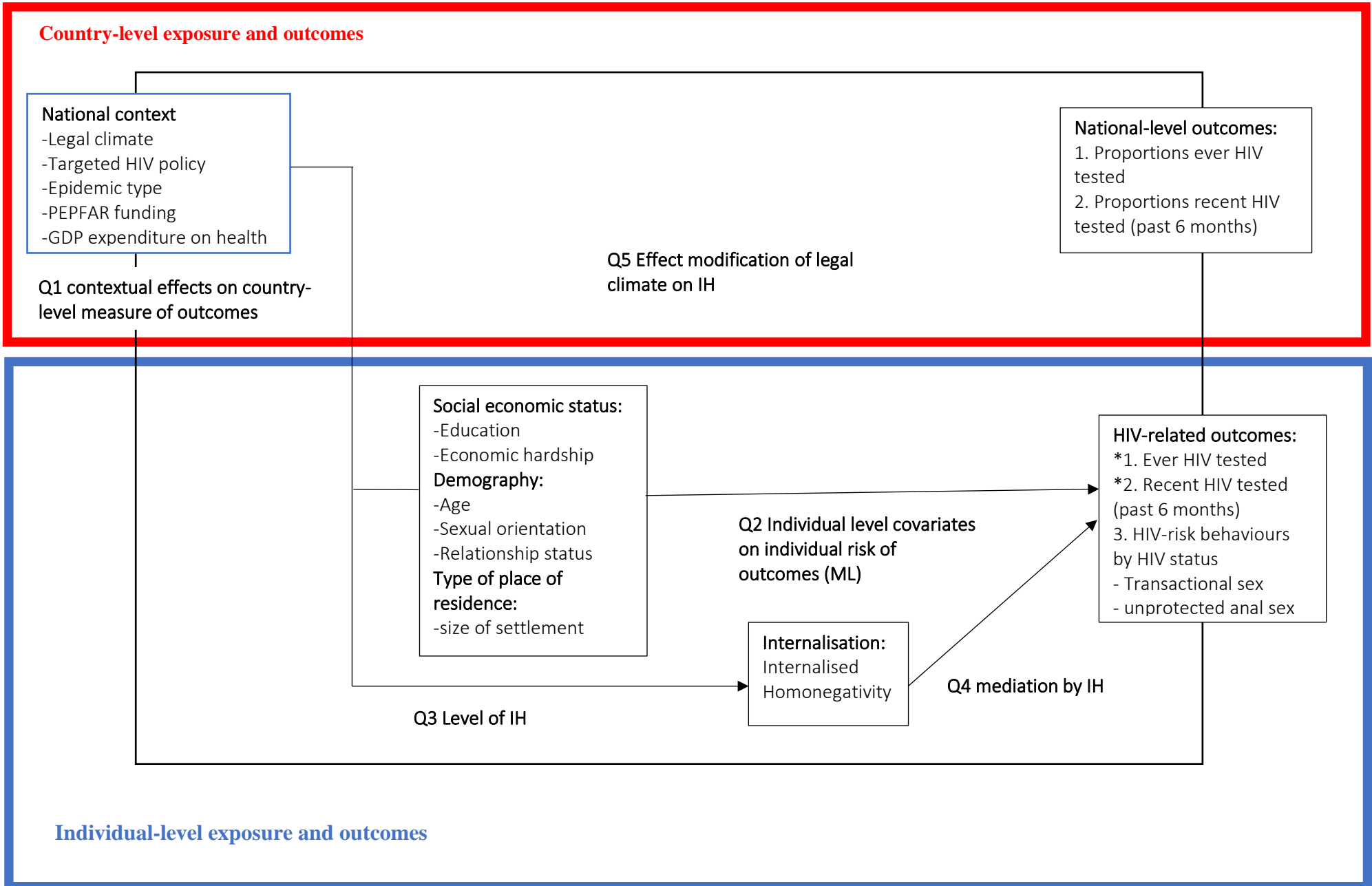
## 3.3    Measures

As discussed in the sections above, various measures are required to study how discrimination harms health, and chosen methods must account for various factors operating at multiple levels[173]. In choosing explanatory variables for inclusion in the analyses, elements from the ecosocial theory and minority stress model were used. The focus was on including identified factors from the literature review that are important minority stressors and are in the pathways of embodiment of the inequalities experienced by SSA MSM. These include socioeconomic and demographic factors. Each identified factor and its distribution are then conceptualised at multiple levels, such as the country and individual levels. The final measures shown in the conceptual framework include four domains of influence on HIV-related outcomes of MSM in SSA (figure 3.1): (i) country level, (ii) socioeconomic, (iii) demographic, and (iv) psychological. These measures are hypothesised to directly or indirectly (mediating effects), singly and in combination affect HIV-related outcomes in SSA MSM. Using both explicit and implicit discrimination measures, as highlighted in table 3.2 and other minority-specific stressors (figure 3.1), I provide further details of the country-level and individual-level measures used for the two papers of this thesis. See table 3.3 for further details on the operationalisation of the measures.

### 3.3.1    Country-level explanatory variables:

Beyond the main country-level exposure measures of same-sex relationship criminalisation and the presence/absence of targeted HIV policy for MSM, other variables were included in the model as explanatory variables. These include factors that were identified in the literature review as influencing the availability of HIV prevention and control services for MSM in SSA countries. Such as PEPFAR-funded programmes, the percentage of GDP expenditure spent on health and if the epidemic type is concentrated among KPs or generalised within the population.

**Legal climate:** As discussed in chapter 2, the legal climate of countries is integral in shaping MSM's experiences and widening their health disparities. This research used laws measured as same-sex relationships legal or illegal based on the country's legal status in 2019

as reported in the ILGA report in 2019 [151,155]. Some researchers that have studied the relationship between the legal climate and HIV-related outcomes of MSM in Europe have used more graded measures of the legal climate, such as grouping countries based on political ideologies of liberal, moderate or conservative [16,71]. In SSA, there is not enough variation in the presence or absence of protective legislation for MSM, as reported in the ILGA World 2019 report [151]. Only South Africa would be categorised as liberal, with most SSA countries in the moderate category (see supplementary analysis in chapter 4).

**Targeted HIV policy:** NSP or NSF HIV policy documents were reviewed for the inclusion of the WHO recommended interventions for MSM in national HIV policies, suggested in the 2014 and 2016 updated guidelines (see Paper 1 chapter 4 supplementary material table 4.3).[28,29] For countries where national HIV policy documents covering 2019/2020 were unattainable, the earlier policy was used with a cut-off date no earlier than 2014 (the year of the first WHO guidelines on key populations). Where the NSP/NSF documents reviewed in the WHO report "focus on key populations in national HIV strategic plans in the African region" were within the required timeframe, I used the findings of these reviews without conducting additional reviews.

**Type of HIV epidemic**: HIV epidemics are said to be "concentrated" when transmission occurs primarily in KPs[138]. In contrast, epidemics are labelled "generalised" if sexual behaviour sustains transmission in the general population (usually defined as a population prevalence of >1%). Using HIV prevalence data from UNAIDS in 2019, the type of HIV epidemic was operationalised as countries with HIV prevalence of >1% as having a generalised epidemic and <1% as concentrated[54].

**GDP expenditure on health**: The log of the percentage of GDP expenditure on health (in 2019) was included as a continuous measure[191]. Sourced from the World Bank.

**PEPFAR funded countries:** was measured as yes or no if countries received PEPFAR funding in 2019 (excluding Regional Programmes as indicated on the PEPFAR website)[142]

### 3.3.2    Individual-level explanatory variables

- **Internalised Homonegativity:** IH was seen as mediating the impact of same-sex criminalisation on MSM HIV-related outcomes. The 2019 Global LGBTI Internet Survey used the validated 7-item IH scale with three factors described by Ross and Smolenski et al. to collect data on IH. The three factors measure dimensions of IH such as personal comfort with a gay identity (PC), public identification as gay (PUBID), and social comfort with gay men (SC) [81]. This measure assesses constructs of IH as defined in the context of the minority stress model, with a clear distinction between IH and outness, connectedness to LGBT+ community and mental health. I adapted this scale to a shortened 5-item version for use in this thesis due to high levels of missingness in the data (see Paper 2 chapter 5 and supplementary analysis paper 2). [192]. Its items have additive scores ranging from 1 (strongly disagree) to 7 (strongly agree). The 5-item scale included two IH factors; (i) factor measuring personal comfort with homosexuality with three items, 'Even if I could change my sexual orientation, I would not'; 'I feel comfortable being sexually attracted to a man'; and 'homosexuality is morally acceptable to me'); and (ii) factor measuring public identification as gay with two items, 'I feel comfortable discussing homosexuality in a public situation'; and 'I feel comfortable being seen in public with an obviously gay person'.
- **Demographics**:  age measured in four categories 18-24, 25-34,35-44,45+); level of education measured as none/primary school, Secondary/high school, University first degree, and Masters/doctorate; attraction measured as gay, bisexual, and don't know; relationship status (single, in a relationship with a man, and both with a man and woman/woman/transgender)
- **Socioeconomic status**: economic hardship (used as a subjective assessment of income status by measuring self-reports of economic pressure of respondents).
- **Type of place of residence**: the size of settlement (measured on a 3-point scale ranging from 'a major city, a medium or small size city, a village or a farm or isolated house).

### 3.3.3    Outcome measures:

1. HIV testing.

   - Respondents were asked when their last HIV test was, and response options included 'within the last 6 months', 'within the last 12 months', 'more than 12 months ago', and 'never'.

2. HIV -risk behaviour:

   - Transactional sex is measured by questions on "paid for sex" in the past 12 months and "paid to have sex" in the last 12 months", with responses 0 (never) or 1 (yes).

   - Unprotected sex with a non-steady partner(s) is measured by anal sex without any kind of HIV prevention in the past 3 months, which was defined as sex without a condom, PrEP or an undetectable HIV viral load. This was measured as 0 (none) or 1 (yes)

Table 3. 3: Description of study variables, including operationalisation

| Variable | Response measures | Operationalisation | References |
|---|---|---|---|
| Country legal climate | No=0<br>Yes=1 | Single response variable | Human dignity trust[155] |
| National HIV policy | No=0<br>Yes Partially =1<br>Fully=2 | Single response variable<br><br>NSF/NSP documents covering the time of the data collection was used where available. For countries where the NSF/NSP covering 2019/2020 were unattainable, the earlier policy document was used with a cut-off date of no earlier than 2014 (the year of the first KP WHO guidelines) | NSF/NSP for each country and WHO report on key populations in African HIV/AIDS (ref) |
| Epidemic type | Generalised=0<br>Concentrated=1 | Countries with HIV prevalence of >1% were classed as having a generalised Epidemic | Aids info UNAIDS[54] |
| PEPFAR country | No=0<br>Yes=1 | classified based on their funding in 2019 and excluding regional programs | PEPFAR official website[142] |
| logGDP expenditure on health | Continuous | log of the %GDP expenditure on health | World Bank[193] |
| Age | Under 18<br>18-24<br>25-34<br>35-44<br>45-54<br>55-64<br>65+ | Single response question<br><br>Collapsed to, due to small sample size in some categories:<br>18-24<br>25-34<br>35-44<br>45+ | Global LGBTI Internet survey research proposal document and the study codebook |

| Sexual orientation | attracted to other men or gay=0<br>attracted to both men and women or bisexual=1<br>I don't know=2 | Single response question<br><br>Additional to birth sex 'male', only participants also indicating 'gay', 'bisexual' and 'I don't know' were included in this study | |
|---|---|---|---|
| Relationship status | Single=0<br>In a relationship with a man=1<br>In a relationship with a transgender person/with a man and a woman=2<br>I don't know=3 | Single response question<br>Collapsed, due to small sample size in some categories:<br>1=both with a man and woman/woman/transgender<br>2=In a relationship with a man<br>3=Single | |
| Education | None=0<br>Primary school=1<br>Secondary/high school=2<br>University first degree=3<br>Masters/doctorate=4 | Single response question<br>Higher levels of education is considered to indicate higher economic level<br>Collapsed to, due to small sample size in some categories:<br>None/primary school=1<br>Secondary/high school=2<br>University first degree=3<br>Masters/doctorate=4 | |
| Income | Really struggling on present income=1<br>Struggling on present income=2<br>Neither comfortable nor struggling on present income=3<br>Living comfortably on present income=4<br>Living really comfortably on present income=5 | Single response question<br><br>This measure is used to represent a subjective assessment of income status by measuring self-reports of economic pressure of respondents. Scored between 1 to 5 as ordinal categorical data. The higher the score, the lower the economic pressure and therefore presumed higher income | |
| Size of settlement | A farm or an isolated house=1<br>A village=2<br>A medium or small size city=3<br>A major city=4 | Single response question<br>Due to small sample size in some categories, collapsed to:<br><br>A village/farm or an isolated house=1<br>A medium or small size city=2<br>A major city=3 | |
| HIV testing | Never=0<br>More than 12 months ago=1<br>Within the last 12 months=2<br>within the last 6 months=3 | Single response question<br>Ever HIV tested:<br>0=Never<br>1-3=Ever<br><br>Percent ever tested is an aggregated measure of all participants that report ever testing. Used in the ecological analysis<br><br>Recent HIV testing (past 6 months) of those who have ever tested:<br><br>.=Never<br>0=More than 12 months ago and within the last 12 months<br>1=Within the last 6 months<br><br>Percent recently tested is an aggregated measure of all participants that report recently testing (past 6 months). Used in the ecological analysis | |

| | | | |
|---|---|---|---|
| Paid for sex | Never=0<br>1-2=1<br>3-10=2<br>11-50=3<br>More than 50=4 | Single response question<br>0=Never<br>1=1+ | |
| Sold sex | Never=0<br>1-2=1<br>3-10=2<br>11-50=3<br>More than 50=4 | Single response question<br>0=Never<br>1=1+ | |
| Unprotected sex | Never=0<br>1, steady=1<br>1, casual=2<br>2=3<br>30-10=4<br>More than 10=5<br>Does not apply to me=97 | Single response question<br>0=Never and steady partner<br>.=97<br>1=2-5 | |
| Internalised homonegativity (7 item) | 1 strongly disagree -<br>7 strongly agree | Items 1 & 2 in the scale excluded. Each item is scored between 0 to 6 and mean scores of IH is calculated for each country. | Ross and Smolenski et al[81] |

## 3.4 Data Management and Analysis

### 3.4.1 Data Management

Data received from UNAIDS was stored securely in an encrypted computer and was only shared with those with permitted access following an agreement with UNAIDS. The data obtained was already cleaned, with all responses not meeting the inclusion criteria removed. No names or other identifying details were collected from respondents. See appendix 4 for the complete data management plan.

### 3.4.2 Statistical analysis

Statistical analyses were conducted using Stata SE16 and MLwiN 3.05 for Paper 1 and Stata SE17 for Paper 2. I used various statistical methods to answer my study's research questions, including linear regression analysis and logistic multilevel modelling. I also performed principal components analysis (PCA), see research question 3 under the multilevel modelling section below and Multiple Imputation (see research question 4 under the multilevel modelling section below).

## I. Regression analysis

**Research Question 1**: Are contextual effects of legal climate and targeted HIV policy associated with national-level measures of ever HIV tested and HIV-testing in the past 6 months among self-reported MSM (Paper 1)?

Ecological analyses were conducted on Stata/IC 16.1 using the least squares method with robust standard errors to estimate the beta coefficients and 95% confidence interval (CI) for associations between HIV testing and country-level variables. For example, the equation for the ever-tested outcome was:

$$\% \, everHIVtested_j$$
$$= \beta 0 + \beta 1(legal_i) + \beta 2(MSM \, Policy \, Intervention_i) + \beta 3(Epidemic \, type_i) + \beta 4(PEPF_i) + \beta 5(\text{logGDP}_i) + \text{e}0_i$$

Where "i" demotes the value on the variable for a given individual

## II. Multilevel modelling

The multilevel measures identified using elements of the ecosocial theory and the minority stress model, as conceptualised in figure 3.1, show a two-level structure. To account for the multilevel structure of the data, i.e., individual-level data are nested within countries, I used random effects models. The approach used was two-level multilevel modelling (MLM) to evaluate the effects of the four conceptual domains of influence on HIV-related outcomes of MSM.

MLM confer the following statistical benefits and drawbacks. MLM considers the individual experiences shaped by the social context and provides a way of incorporating this grouping structure alongside individual differences, i.e., how living in a particular country influences the experiences of MSM within it. It also provides a way to explore the links between macro-level context structures and micro-level individual differences, i.e., how does being MSM influence the individual experiences of its members[188]. Using conventional single-level logistic regression assumes that MSM within countries are independent and will violate the assumption of independence. By not accounting for the potential correlation within groups, the standard errors and estimates will be inaccurate [188]. MLM offers another

advantage. Statistical power depends on the sample size at the highest level, for example, the number of countries at level two [194]. There has yet to be a consensus on the minimum number of groups at the highest level. Some resources indicate a rule of thumb of a minimum of 30 groups, whilst others mention 50 [187,194,195].

There are some limitations to MLM. Like other statistical approaches, MLM will aid in describing, summarising, and quantifying patterns in data[188]. It will not, however, explain these patterns. Another key limitation is that MLM requires a large amount of data to produce reliable results. This concern is usually about the sample size at the higher-level units [195].

Research Question 2: Do any observed associations of contextual effects with national-level ever testing and recent testing in the past 6 months persist after adjusting for individual characteristics (Paper 1)?

For the analysis, logistic MLM on MLwIN was performed after logistic single-level analysis to examine if the multilevel findings would differ from the ecological findings. With an ecological analysis alone, it is impossible to distinguish contextual effects from compositional (individual) effects without committing an ecological fallacy, where we assume the observed relationship at the group level to be the same for individuals [187,188]. The estimation procedure used was the predictive quasi-likelihood method for discrete outcome models, PQL2, as it performs better than the marginal quasi-likelihood where the estimates are biased downwards[196]. I reported the proportion of variation in the model due to systematic differences between countries using the variance partition coefficient (VPC). The Wald test was used to assess the model goodness of fit. First, I fit a null model with country as random effects expressed as (repeated for all outcome variables):

$$logit(ever\ HIV\ tested_{ij}) = \beta0 + u_{oj}(\text{model 0})$$

Ever_HIVtested$_{ij}$ is the proportion ever tested for HIV for individuals in country j, and what is being modelled is the log-odds of ever HIV tested$_{ij}$. B0 is the overall intercept and u$_{0j}$ is the level 2 residual.

Next, I extended the model by including country-level variables/level 2 variables. With country as random effects, I included fixed effects for legal climate, targeted HIV policy, epidemic type, PEPFAR funding and log GDP health expressed as (repeated for all outcome variables):

$$logit\ (ever\ HIV\ tested_{ij})$$
$$= \beta 0 + \beta 1(Legal\ Climate_j)\ + \beta 2(MSM\ Policy\ Intervention_j)$$
$$+\ \beta 3(Epidemic\ type_j) + \beta 4(PEPFAR_j) + \beta 5(logGDP\ health_j) + u_{oj}(model\ 1)$$

The parameters b1(legal$_j$), b2(MSM Policy Intervention$_j$), b3(Epidemic type$_j$), and b4(PEPFAR$_j$) represent the differentials in the log odds of ever HIV testing for countries where homosexuality is illegal (the reference category), with no targeted HIV-policy, generalised HIV epidemics and no PEPFAR funding respectively, whilst b5(logGDP_health) represents the mean centred log odds of ever HIV testing in countries.

Finally, I extended the model to include individual-level explanatory variables expressed as (repeated for all outcome variables):

$$logit\ (ever\ HIV\ tested_{ij})$$
$$= \beta 0 + \beta 1(Legal\ Climate_j)\ + \beta 2(MSM\ Policy\ Intervention_j)$$
$$+\ \beta 3(Epidemic\ type_j) + \beta 4(PEPFAR_j) + \beta 5(logGDP\ health_j) + \beta X6ij - X27_{ij}$$
$$+ u_{oj}(model\ 2)$$

The parameters now represent the log odds of ever HIV testing after adjusting for compositional differences in individuals within each country. BX6$_{ij}$- X27$_{ij}$ includes all the individual level explanatory variables (table 3.3).

**Research Question 3**: What is the level of IH among MSM in Sub-Saharan African and how do these vary across different demographic, socioeconomic, type of place of residence, i.e., across age groups, education, and income (Paper 2)?

Answering this research question involved a three-step process. The first was to assess the level of missingness in the IH response data, which revealed that 33.3% of the data in the items for the 7-item IH data was missing and not at random. Second, I subjected the data to exploratory factor analysis (EFA) using "principal components analysis" (PCA) method.

EFA refers to two models that differ in purpose and computation [197]. PCA was selected over common factor analysis (CFA) because the intention was to decrease data while conserving as much information from the original data set as possible [197]. CFA is useful for finding common factors that explain the variation in a set of data for theory building or development of measuring instruments [197]. I explored the factorial structure of the 7-item IH scale in the SSA sample MSM. I performed the PCA using oblique rotation (see Paper 2 results section for the complete PCA procedures used). The results showed that the 2 items measuring 'social comfort with gay men (SC) do not coalesce with each other or with the other items. The decision was made to drop these items and use the IH measure as a 5-item scale, which had 21.6% missingness overall. Third, the level of IH was calculated for each MSM using the shortened 5-item IH scale and mean IH levels for each SSA country tabulated (see chapter 5, Paper 2).

**Research Question 4:** Is IH associated with HIV-related health outcomes of ever HIV testing, HIV testing in the past 6 months, paying for sex in the past 12 months, being paid for sex in the past 12 months and unprotected anal sex in the past 3 months (Paper 2)?

Before answering this question, I had to address the missingness in the data. Due to technical difficulties with performing Multiple Imputation in MLwIN, which had no inbuilt function to perform MI, I switched to performing the MLM for Paper 2 on Stata SE17[198,199]. The missing data in the 5-item IH scale was determined to be missing at random (MAR) and missing completely at random (MCAR) for the covariates (chapter 5, supplementary analysis). I used the 'mi impute chained (MICE)' to handle the multivariate imputation of the variables with missing values (see chapter 5, for full details of the multiple imputation methods).

Similar to the MLM step for research question 2, I kept country as random effects, then included fixed effects adjusted for all country-level and individual-level explanatory variables expressed as (repeated for all outcome variables):

$$logit\left(everHIVtested_{ij}\right)$$
$$= \beta0 + \beta1\left(IH\ score_{ij}\right) + \beta X2_{ij} - X18_{ij} + \beta19\left(Legal\ Climate_j\right)$$
$$+ \beta20\left(MSM\ Policy\ Intervention_j\right) + u_{oj}(model\ 1)$$

Where *'ever_HIVtested$_{ij}$'* is the proportion ever tested for HIV for individual in country j, and what is being modelled is the log-odds of ever HIV tested$_{ij}$. The parameter b1(IHscore$_{ij}$) represent the differentials in the log odds of ever HIV testing for individuals where IH score is one (the reference category), and *b2 $_{ij}$-b22$_j$* represent the log odds of ever HIV testing after adjusting for compositional and contextual differences within each country.

**Research Question 5:** Do associations between IH and HIV-related health outcomes of HIV testing and HIV-risk behaviours differ by whether same-sex relationships are and are not criminalised (Paper 2)?

Finally, I performed cross-level interactions analysis to model how individual-level relationships are moderated by features at the country-level, i.e., including the interaction term between the level of IH and criminalisation (repeated for all outcome variables):

$$logit\left(ever\ HIV\ tested_{ij}\right)$$
$$= \beta0 + \beta X1_{ij} - X17_{ij} + \beta18\left(MSM\ Policy\ Intervention_j\right)$$
$$+ \beta19\left(legal\ Climate_j X\ IHscore_{ij}\right) + u_{oj}(model\ 2)$$

Where *'IH_ScoreXLegal_climate'* is the interaction term for the moderating effect of legal climate on IH.

## 3.5  Ethical Considerations and Confidentiality

The 2019 Global LGBTI Internet Survey ensured that all participants provided informed consent and were free to withdraw from the study at any time. All data received from participants in the survey were anonymously collected, so they did not contain any personally identifiable details. Ethics approval was granted for the primary data study by the Research Ethics Committee of Aix-Marseille University in March 2019 and by the WHO Research Ethics Review Committee in April 2019 (Appendix 5). Ethical approval for the secondary use of the data for this study was obtained from the primary data owners at UNAIDS after signing a declaration of confidentiality (Appendix 6), and further approval was received from The London School of Hygiene and Tropical Medicine (LSHTM) Ethics Committee (appendix 7).

# 4  Research Paper 1: Association of same-sex criminalisation laws and national HIV policies with HIV testing uptake among African MSM: An ecological single-level and multilevel cross-sectional study of Sub-Saharan African countries (under review)

## Overview of paper 1

In this chapter, I present the findings of the first research paper on the association of same-sex criminalisation laws and national HIV policies with HIV testing in African MSM. This is followed by a supplementary materials section that was included in the submission. To conclude the chapter, I provide information on supplementary analysis performed, detailing the analysis of the anti-LGBTI legislation index by the International Lesbian and Gay Association (ILGA) and the rationale for the final legal climate measure applied in the study. This analysis also informed the sensitivity analysis included in the main paper as it highlighted that South Africa was distinct from the other SSA countries, as it has the highest legislative protection for MSM in the region.

This research paper applies ecological single-level and multilevel analysis on the cross-sectional dataset and has been submitted for peer-review in the Journal of the International AIDS Society (JIAS).

# RESEARCH PAPER COVER SHEET

Please note that a cover sheet must be completed <u>for each</u> research paper included within a thesis.

| Student ID Number | Lsh333933 | Title | Ms |
|---|---|---|---|
| First Name(s) | Ngozi | | |
| Surname/Family Name | Kalu | | |
| Thesis Title | Discrimination and Health: Effects of Internalised Homonegativity, Discriminatory Laws and policies on HIV-related behaviours of men who have sex with men living in Sub-Saharan Africa | | |
| Primary Supervisor | Melissa Neuman | | |

If the Research Paper has previously been published please complete Section B, if not please move to Section C.

## SECTION B – Paper already published

| Where was the work published? | | | |
|---|---|---|---|
| When was the work published? | | | |
| If the work was published prior to registration for your research degree, give a brief rationale for its inclusion | | | |
| Have you retained the copyright for the work?* | Choose an item. | Was the work subject to academic peer review? | Choose an item. |

*If yes, please attach evidence of retention. If no, or if the work is being included in its published format, please attach evidence of permission from the copyright holder (publisher or other author) to include this work.

## SECTION C – Prepared for publication, but not yet published

| Where is the work intended to be published? | the Journal of the International AIDS Society (JIAS) |
|---|---|
| Please list the paper's authors in the intended authorship order: | Ngozi Kalu, Michael Ross, Miriam Taegtmeyer,Erik Lamontagne, Sean Howell, Melissa Neuman |

| Stage of publication | **Submitted** |
|---|---|

## SECTION D – Multi-authored work

| For multi-authored work, give full details of your role in the research included in the paper and in the preparation of the paper. (Attach a further sheet if necessary) | I conceptualised, collected the country-level measures, conducted all the statistical analyses and wrote the draft of the papers. I coordinated the reviews of the paper by co-authors and incorporated feedback through an iterative process |
|---|---|

## SECTION E

| **Student Signature** | NOKalu |
|---|---|
| **Date** | 19/12/22 |

| **Supervisor Signature** | Melissa Neuman |
|---|---|
| **Date** | 19/12/2022 |

# Association of same-sex criminalisation laws and national HIV policies with HIV testing in African MSM: An ecological single-level and multilevel cross-sectional study of Sub-Saharan African countries

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## Evidence before this study

I searched MEDLINE for peer-reviewed articles published between 1946 to October 27, 2021, without language or geographical location restrictions. We used subject heading terms and keywords including "homosexuality", or "sexual and gender minorities", or "MSM", and "criminalisation". Apart from individual country studies reporting the negative effects of same-sex criminalisation on access to HIV services by MSM, I identified only one study that reported findings from a systematic review and meta-analysis using studies on SSA MSM. The review found associations of same-sex criminalisation with HIV testing behaviours of MSM in Sub-Saharan African countries. From the 26 Sub-Saharan African (SSA) countries included in the review, the majority of the studies on ever and recent testing were from east and south African countries. To my knowledge, no study has used data collected from a large sample of SSA countries using similar methods to assess the associations of the legal climate with HIV testing by MSM and none have used multi-level analysis.

## Added value of this study

This study used similar methods and a large sample of SSA countries to assess the associations of same-sex criminalisation with HIV testing behaviours of MSM. Additionally, I included a comprehensive review of the inclusion of the WHO recommended interventions for MSM in the HIV policies (National Strategic Frameworks/National Strategic Plans) and used this in assessing HIV testing behaviours of SSA MSM (appendix 4(pp 5)). Finally, I used two analytical methods, initially single-level analyses to see how comparable my findings are to those previously reported and then multilevel analyses that account for both country-level and individual-level exposures to evaluate if there is a true ecological effect of the legal climate and targeted HIV-policy with reported testing behaviours of SSA MSM. In the ecological analysis we found strong evidence that MSM living in countries with legalised same-sex relationships had higher ever testing prevalence, and those with targeted HIV policies had increased prevalence of ever and recent testing. In multilevel analysis, we found there was strong evidence of an association between the legal climate with ever HIV testing and targeted HIV policies. We observed increased odds of ever testing in countries with

legalised same-sex laws and targeted policies for MSM. We found no evidence of an association of the legal climate and the presence of targeted HIV policies with recent testing.

Our findings highlight the importance of using a multilevel approach to study the role of contextual factors. We report on two possible pathways that country-level variables effect the testing behaviours of MSM in SSA. We found that an enabling legal and policy environment appear to be important in shaping the ability for MSM to initially engage with testing services in SSA. Whilst for recent testing, impact of these discriminatory laws and policies were not observed. Importantly, We highlight the heterogeneity within SSA with important distinctions within South Africa relevant to the study of the effects of context on HIV-related outcomes in the SSA continent.

## Implications of all available evidence

There is a need for deliberate and focused policy and conducive legal environments if MSM are to openly test and get tailored support and prevention. Future research looking at the possible mediating effects of health facility-level predictors on these contextual effects to recent testing behaviours of SSA MSM are needed. Additionally, although not routinely practised, collecting data on the race of study participants in African countries that are racially diverse such as South Africa, could facilitate a greater understanding of the data and how these influence MSM engagement with HIV control programming.

# Abstract

**Background**: HIV incidence among MSM in Sub-Saharan Africa (SSA) remains high compared to the general population. Many countries in the region still criminalise consensual homosexual relationships, and some are yet to adopt WHO recommended interventions for MSM into national HIV policies. This study examines how HIV testing of adult MSM in SSA varies according to the legal climate and presence of targeted HIV policy using data from the cross-sectional 2019 Global LGBTI Internet Survey study.

**Methods**: Using data from 3,191 MSM in 44 Sub-Saharan African countries, we assessed associations of legal climate and HIV policy with ever and recent HIV testing using linear ecological and logistic multilevel analyses. From the single-level analysis, we can compare our findings to previously reported data, then, extending to a 2-level multilevel analysis, we account for the hierarchical structure of the population and simultaneously adjust for differences in context and composition in each country. We then test the sensitivity of our analyses to excluding countries from the model.

**Results**: We find evidence that legalised same-sex relationships were associated with increased odds of ever testing (OR=2.00, 95% CI=1.04,3.82) in multilevel analyses. We also find evidence of an association of targeted HIV-policies with increased odds of ever testing (OR=2.49, 95% CI=1.12,5.52). We did not find evidence of an association of the legal climate (OR=1.01, CI=0.69,1.46) and targeted HIV-policies (OR=1.26, 95% CI=0.78,2.04) with recent testing.

**Conclusions**: This study suggests elimination of discriminatory laws and policies are important for increasing HIV status awareness of MSM, an important first step in epidemic control. Additionally, we highlight heterogeneity between South Africa and other SSA countries, which has implications for studying SSA countries as a homogeneous group.

## Introduction

There were 1.5 million new HIV infections reported globally in 2021 and 58% of these were in Sub-Saharan Africa (SSA).[2] Across SSA, HIV prevalence among men who have sex with men (MSM) was 5 times greater than its prevalence in men in the general population[49]. In 2012, *The Lancet* published a series on MSM highlighting the inequalities in the global response to AIDS, especially the lack of empirical data on MSM in the African region[53]. A decade on, due to difficulties in reaching this hidden population, there is still little known about how structural factors affect MSM access to HIV services.

Structural, social, healthcare-related and individual-level factors all prevent HIV interventions from reaching MSM[16,25,64]. A structural factor of particular concern is the criminalisation of same-sex relationships within the region[6,10,23]. Currently, 26 SSA countries have laws criminalising homosexual acts with penalisation ranging from a fine to death[34]. Legal discrimination is a component of stigma, a social process where individuals with certain characteristics are seen as having less social value than others and consequently, can result in non-explicit forms of structural discrimination[12,164]. An example includes the omission of MSM in national HIV control policies irrespective of same-sex criminalisation, leading to further barriers to accessing HIV services[9,35,200]. Historically, MSM have not received adequate priority in national strategic HIV policies in SSA: this is especially true of countries with generalized epidemics[53,136,137]. This hinders progress in controlling the epidemic[138]. The World Health Organization (WHO) developed consolidated guidelines in 2014 (updated in 2016) for HIV prevention and treatment for key populations (KPs), including MSM, to guide countries in planning and developing effective and acceptable programs but its adoption has been slow in the region[28,29,33]. These guidelines include prevention, harm reduction, HIV testing and counselling, HIV treatment and care, sexual and reproductive health and structural interventions.

In many SSA countries, only a small percent of GDP is spent on health[193]. In most cases, the available resources are channelled to HIV surveillance and programming for the general population, further widening the disparities in HIV prevalence between the general population and KPs[8,134]. Consequently, SSA countries rely heavily on donor funding to support

programmes for MSM, notably the US President's Emergency Plan for AIDS Relief (PEPFAR), which has supported programming through NGOs in many of their focus countries[142].

Available data from the region on the criminalisation of same-sex relationships and MSM engagement with HIV programmes are derived from pooled estimates[25]. To our knowledge, none have assessed the associations of targeted HIV policies with the uptake of HIV services for MSM in the region. With very few countries in the region on track to meet the 2030 target of 95% of people living with HIV aware of their status, there is an urgent need to use empirical data to understand the role of structural factors in preventing MSM from accessing HIV services[18].

We use data from the 2019 Global LGBTI Internet Survey to examine the associations of the legal climate, defined as whether or not consensual same-sex sexual acts are criminalised, and the presence or absence of targeted HIV policy with HIV testing by SSA MSM.[19].

## Methods
We report our findings according to the recommendations of the STROBE guidance.[201]

### Study design and setting
We conducted a secondary analysis of data collected from the 2019 Global LGBTI Internet Survey [19]. Adult (over age 18) LGBTI participants were recruited for the online survey through their social networks, national and regional LGBTI or human rights community networks, advocates and celebrities. Facebook, Instagram, Twitter, WeChat, Weibo, and WhatsApp advertisements promoted the study and UNAIDS country teams created visibility of the study. Facebook was the main promotion platform for countries without LGBTI dating apps. The questionnaire was disseminated online from May to December 2019 without geographical restrictions in 32 languages, 7 of which were official languages in SSA. Participation was voluntary and no incentives were given. Participants accessed the online anonymous survey on SurveyMonkey via an encrypted connection link. Participants who did not provide consent; were under age 18 (or did not provide a numerical value for age) and those not self-identifying as LGBTQI+ were excluded from the analysis.

Overall, survey data were collected from 46 SSA countries. In this secondary analysis, we included data from 44 SSA countries as there were no eligible MSM responses in the 2 countries excluded (figure 4.2). Our inclusion criteria for individuals were self-identified HIV-negative MSM/ don't know/don't want to answer, over age 18; born male; and gay/bisexual/unsure.[201]

**Theoretical frameworks**

Elements from Krieger's ecosocial theory of disease distribution and Meyer's minority stress model were used to guide and frame the study methods (Figure 1).[11,20,35] The ecosocial theory considers the pathways that lead to embodiment of exposures arising from the social and ecological contexts and expressed in populations' patterns of health using multi-level measures of exposure from both life course and historical generation. The minority stress model conceptualises individual stress coping mechanisms of minority groups in response to chronic negative social experiences. We used this to identify individual-level covariates in the multilevel analysis. The combination of both models accounts for the intersections of multiple identities at the micro (e.g., sexual orientation, minority characteristics, socioeconomic status) and macro-level (e.g., discriminatory laws and policies) to produce inequalities in exposure and vulnerability to HIV.

**Measures**

**Outcomes**

Two self-reported HIV testing outcomes were used: ever tested for HIV, and recently tested in the past 6 months.

**Country-level variables**

We included five country-level variables: legal climate, targeted HIV-policy, epidemic type, PEPFAR funding and log GDP expenditure on health. The legal climate was measured as whether same-sex relationships were legal or illegal in 2019 [151,155]. Targeted HIV policy was measured as none, partial or full inclusion of the WHO recommended interventions for MSM in the most recent national HIV policies (supplementary material table 4.1)[28,29]. For countries where national HIV policy documents covering 2019/2020 were unattainable, an earlier policy was used with a cut-off date of no earlier than 2014. For countries that we could not access HIV policies, we grouped them as having 'none'. The percentage of GDP expenditure on health (in 2018, logged) was included as a continuous measure.[193] Type of HIV epidemic

was operationalised as countries with HIV prevalence of >1% in 2019 classed as having a generalised epidemic and <1% as generalised or concentrated.[54] Countries with PEPFAR funding were classified based on their funding in 2019 and excluding regional programs.[142]

**Individual-level variables**

Demographic, socioeconomic, and geographic explanatory variables collected in the survey were used as covariates in the multilevel models (supplementary material table 4.1).[189] These included: age measured in four categories; education measured as none/primary school, Secondary/high school, University first degree, and Masters/doctorate; relationship status measured as single, in a relationship with a man, and both with a man and woman/woman/transgender; economic hardship used as a subjective assessment of income status by measuring self-reports of economic pressure of respondents, scored between 1 to 5 as ordinal categorical data. The higher the score, the lower the economic pressure and therefore presumed higher income; and size of settlement was measured on a 3-point scale ranging from 'a major city, a medium or small size city, and a village/farm or isolated house.
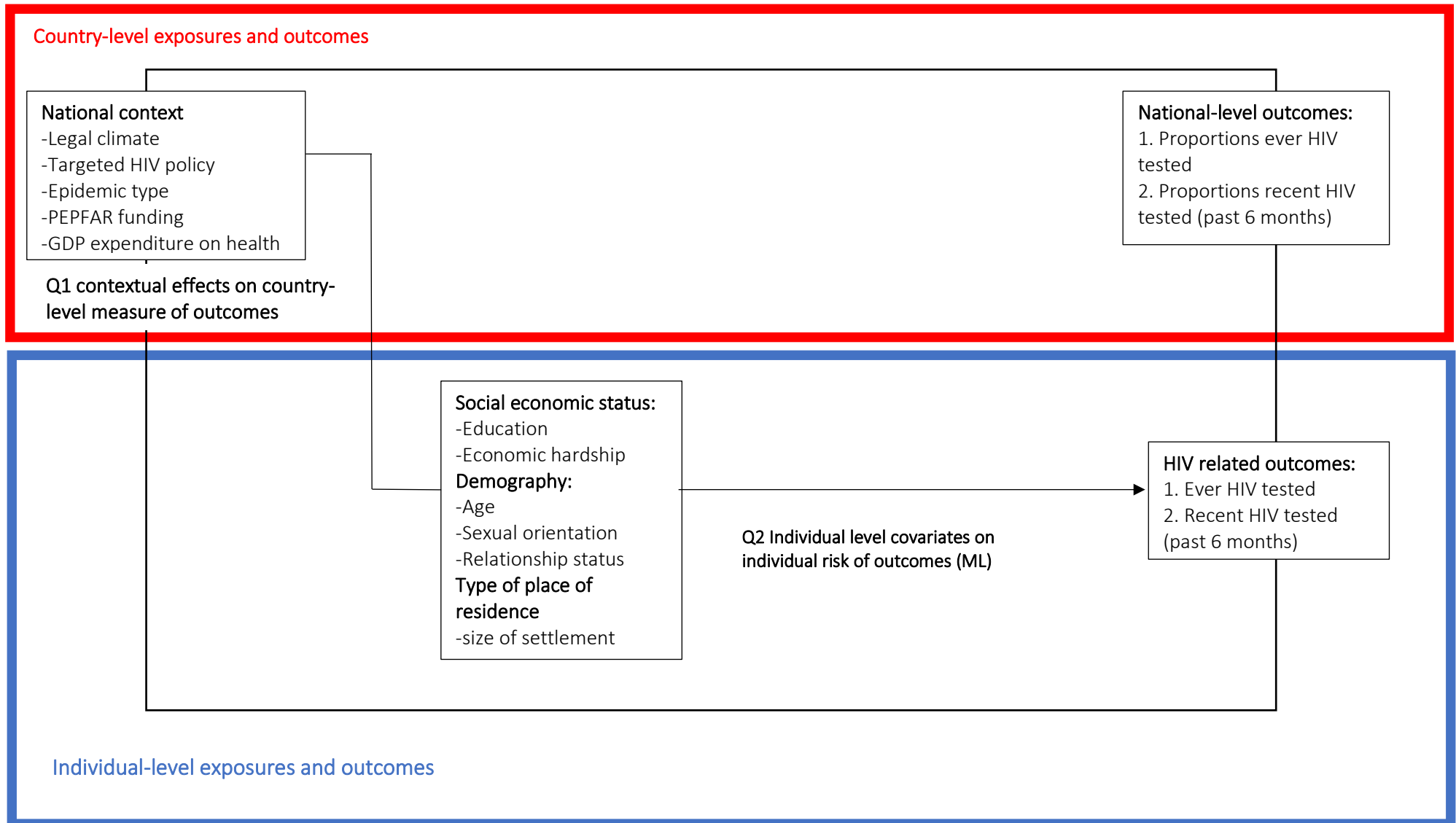
Figure 4. 1. Conceptual framework for analysis of the determinants of ever tested and recent tested outcomes in Sub-Saharan African MSM

## Statistical methods

We applied single-level linear regression to study the associations of legal climate and targeted HIV-policies with ever tested and HIV testing in the past 6 months for MSM groups. We then extended the analysis to 2-level multilevel logistic regression models to account for the hierarchical structure of our data to determine if any observed associations still hold true after accounting for individual-level explanatory variables[188,202]. We used complete case analyses as missing data were <6% overall.

### Ecological single-level analysis

Single-level analyses were conducted on Stata/IC 16.1. For the ecological analysis, we used least squares method with robust standard errors to estimate the beta coefficients and 95% confidence interval (CI) for associations between HIV testing and country-level variables. For example, the equation for the ever tested outcome was:

$$\% \, everHIVtested_j$$
$$= \beta 0 + \beta 1(legal_i) + \beta 2(MSM \, Policy \, Intervention_i) + \beta 3(Epidemic \, type_i)$$
$$+ \beta 4(PEPF_i) + \beta 5(\text{logGDP health}_i) + e0_i$$

Where "i" demotes the value on the variable for a given individual

### Multilevel analysis

We then specified a two-level structure with individuals at level-1 (n=3,191) nested within 44 countries at level-2 using MLwiN 3.05. The estimation procedure used is the predictive quasi-likelihood method for discrete outcome models, PQL2, as it performs better than the marginal quasi-likelihood where the estimates are biased downwards[196]. We report the proportion of variation in the model that is due to systematic differences between countries using the variance partition coefficient (VPC). The multivariate Wald test (joint χ2) was used to assess model goodness of fit. With country as random effects, we include fixed effects for legal climate, targeted HIV-policy, epidemic type, PEPFAR funding and log GDP health expressed as:

$$logit \, (ever \, HIV \, tested_{ij})$$
$$= \beta 0 + \beta 1(Legal \, Climate_j) + \beta 2(MSM \, Policy \, Intervention_j)$$
$$+ \beta 3(Epidemic \, type_j) + \beta 4(PEPFAR_j) + \beta 5(\text{logGDP health}_j) + u_{oj}(\text{model 1})$$

Where 'ever_HIVtested'$_{ij}$ is the proportion ever tested for HIV for individual in country j, and what is being modelled is the log-odds of ever HIV tested$_{ij}$. The parameter b1(legal$_j$), b2(MSM Policy Intervention), b3(Epidemic type$_j$), and b4(PEPFAR$_j$) represent the differentials in the log odds of ever HIV testing for countries where homosexuality is illegal (the reference category), with no targeted HIV-policy, generalised HIV epidemics and no PEPFAR funding respectively, whilst b5(logGDP_health) represents the mean centred log odds of ever HIV testing in countries.

Finally, we extended the model to include individual-level explanatory variables expressed as:

$$logit\ (ever\ HIV\ tested_{ij})$$
$$= \beta0 + \beta1(Legal\ Climate_j) + \beta2(MSM\ Policy\ Intervention_j)$$
$$+ \beta3(Epidemic\ type_j) + \beta4(PEPFAR_j) + \beta5(logGDP\ health_j) + \beta X6ij - X27_{ij}$$
$$+ u_{oj}(model\ 2)$$

The parameters now represent the log odds of ever HIV testing after adjusting for compositional differences in individuals within each country (BX6$_{ij}$- X27$_{ij}$ includes all the individual level explanatory variables).

### Sensitivity analyses

We know the dataset is dominated by a few large countries (South Africa 568 (20%); DRC 6% (181); and Nigeria 6% (165)) (supplementary material table 4.2), and we also know South Africa has more legislative protection for same-sex couples [151]. We conducted three sensitivity analyses (1) excluding each country one at a time from the model; (2) removing responses from MSM that did not want to provide an answer for their HIV status; and (3) analysis omitting countries with no HIV policy documents available (supplementary material table 4.4-4.19 for additional details).

### Ethical Considerations and Confidentiality

Ethics approval was granted for the primary data study by the Research Ethics Committee of Aix-Marseille University in March 2019 (ref 2019-14-004) and by the WHO Research Ethics Review Committee in April 2019. Ethical approval for the secondary use of the data for this study was obtained from the primary data owners, and further approval was

received from The London School of Hygiene and Tropical Medicine (LSHTM) Ethics Committee, ref 26340.

## Results

### Participants

Forty-six SSA countries and 3,275 Adult MSM were potentially eligible. After applying the eligibility criteria, 44 countries and a total of 3,191 participants were retained (figure 4.2).
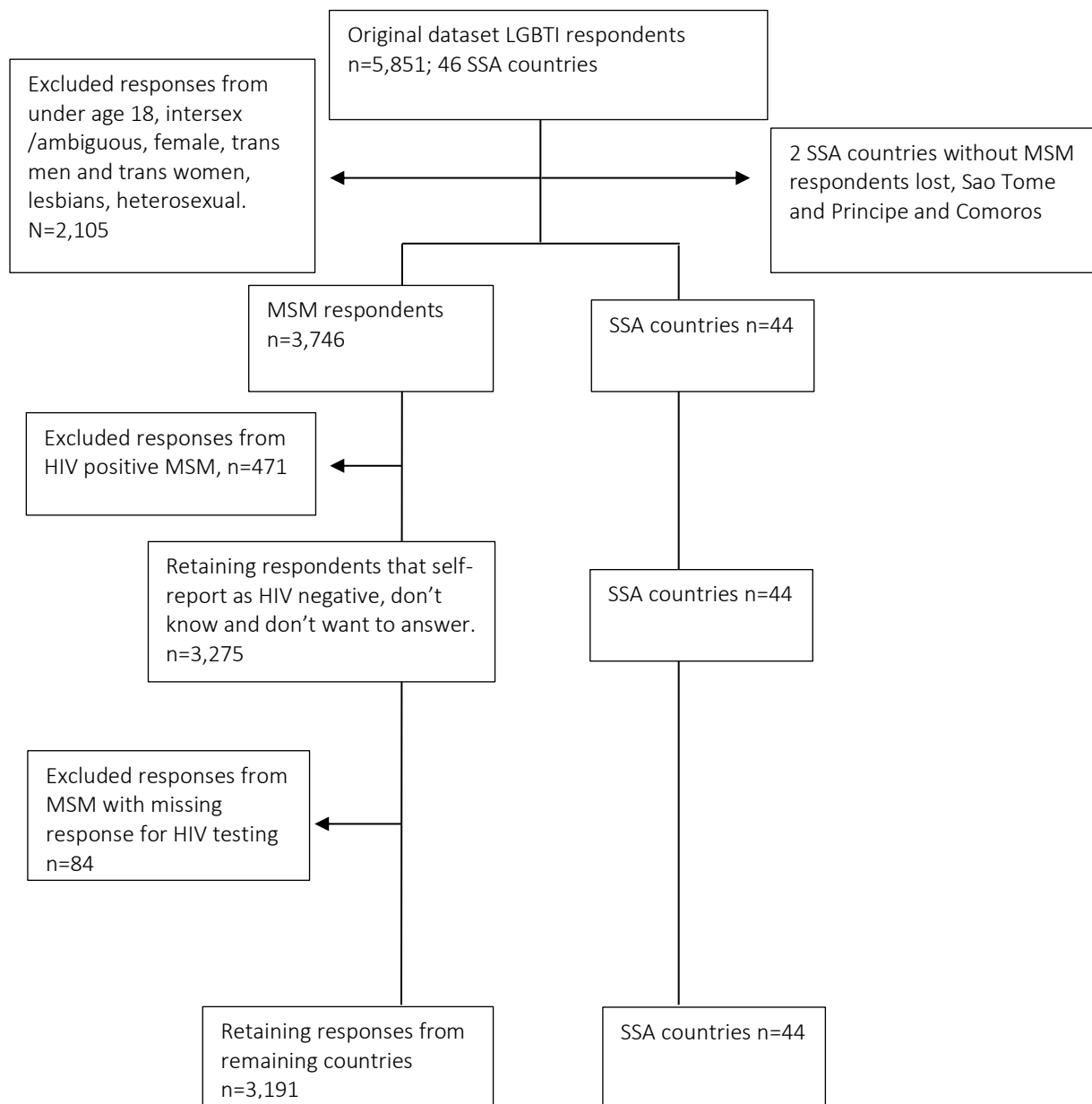


Figure 4. 2. Flow diagram of the selection process for respondents included in the study

### Descriptive analysis

Overall, 2,744/3,191 (86.0%) MSM in the study reported ever testing and 1,819/2,744 (66.3%) of these indicated recent testing in the 6 months prior to the survey (figure 4.3).

Table 4.1 describes the bivariate distribution of ever tested and recently tested by key explanatory variables in the analytic sample. The median age category of the sample was 25-34 (44.1%). The responding MSM primarily self-identify as gay, 2,223 (71.2%), a quarter were bisexual 761 (24.4%) and the remaining 140 (4.5%) were unsure of their sexual orientation. A small proportion of respondents had primary education or less 213 (6.8%), secondary education 1,268 (40.2%), university first degree 1,233 (39.1%), and 439 (13.9%) had postgraduate degrees. Most of the respondents were geographically located in major cities, 1,897 (60.2%), with 987 (31.3%) in medium or small size cities, and 269 (8.5%) living in villages or farms.

Of the 44 SSA countries included, same-sex relationships are legal in 19 (45.1%), 32 (72.7%) had partially included targeted interventions for MSM in their national HIV policies (supplementary material table 4.3), 12 (27.3%) met the first 90 target (2020 target of 90% of people living with HIV aware of their status) (appendix figure 1),[24] 31 (70.5%) had generalised HIV epidemics and 23 (52.3.9%) were PEPFAR countries (figure 4.4). Of countries that did not provide any intervention for MSM (including countries we could not get HIV policy data for), 6 (50.0%) criminalise same-sex relationships, one of which Eritrea and Mauritania have concentrated epidemics and no PEPFAR support.

### Review of national HIV policies

Of the 32 HIV policy documents that provided targeted MSM interventions, not one included all of the WHO recommended interventions for MSM (supplementary material table 4.3). All countries that provided interventions for MSM included condom provision but only 23 (71.9%) provided accompanying condom compatible lubricants. Only 19 (59.4%) included Community based counselling & testing (CBCT) or Provider Initiated counselling and testing (PICT). Harm reduction interventions were the least provided interventions 8 (25.0%).
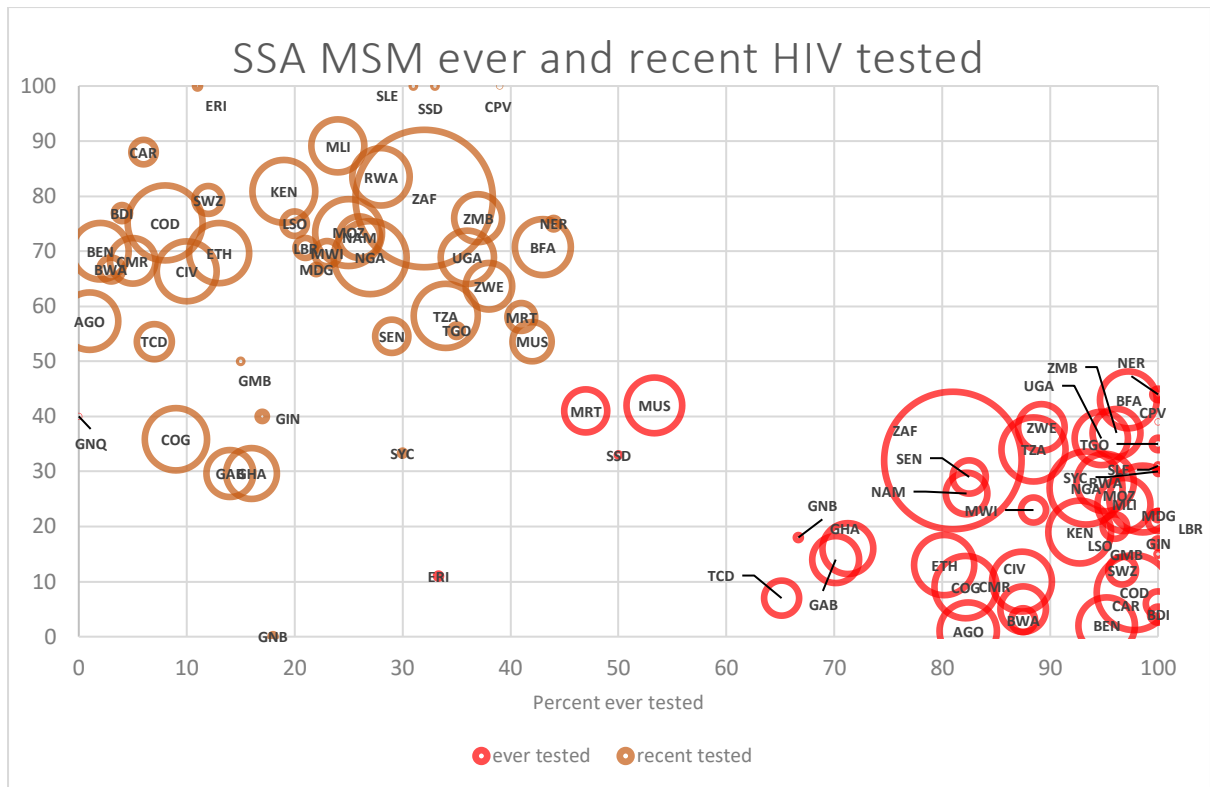
Figure 4. 3. Bubble plots displaying distribution of percentage ever and recent tested across the 44 SSA countries. Bubble area scaled to number of MSM respondents per SSA country (countries coded by the UN standard area codes for statistical use M49.)[203]

Table 4. 1. study characteristics by HIV testing outcomes (n=44 countries)

| | Ever tested n= 2,744 (%) | Never tested n=447 (%) | *P value | Recently tested for HIV n=1,819 (%) | Not recently tested for HIV n=925 (%) | *P value |
|---|---|---|---|---|---|---|
| **Sociodemographic factors** | | | | | | |
| Age, | 2,742 | 446 | <0.001 | 1,819 | 925 | <0.001 |
| 18-24 | 970 (35.4) | 269 (60.3) | | 694 (38.2) | 276 (29.8) | |
| 25-34 | 1,276 (46.5) | 129 (28.9) | | 840 (46.2) | 436 (47.1) | |
| 35-44 | 356(13.0) | 28 (6.3) | | 207 (11.4) | 149 (16.1) | |
| 45+ | 140 (5.1) | 20 (4.5) | | 76 (4.2) | 64 (6.9) | |
| Sexual orientation, n (%) | 2,684 | 440 | <0.001 | 1,776 | 908 | 0.002 |
| Gay | 1,944 (72.4) | 279 (63.4) | | 1,292 (72.8) | 652 (71.8) | |
| Bisexual | 628 (23.4) | 133 (30.2) | | 424 (23.9) | 204 (22.5) | |
| I don't know | 112 (4.2) | 28 (6.4) | | 60 (3.4) | 52 (5.7) | |
| Relationship status, n (%) | 2,653 | 422 | <0.001 | 1,754 | 899 | <0.001 |
| Single | 1,510 (56.9) | 310 (73.5) | | 1,029 (58.7) | 481 (53.5) | |
| In a relationship with a man | 812 (30.6) | 68 (16.1) | | 530 (30.2) | 282 (31.4) | |
| In a relationship with both a man &woman, or woman or transgender person | 331 (12.5) | 44 (10.4) | | 195 (11.1) | 136 (15.1) | |
| **Socioeconomic status** | | | | | | |
| Education, n(%) | 2,711 | 442 | <0.001 | 1,795 | 916 | 0.001 |
| None/ primary school | 158 (5.8) | 55 (12.4) | | 117 (6.5) | 41 (4.5) | |
| Secondary/high school | 1,052 (38.8) | 216 (48.9) | | 739 (41.2) | 313 (34.2) | |
| University first degree | 1,094 (41.4) | 139 (31.5) | | 691 (38.5) | 403 (44.0) | |
| Masters/doctorate | 407 (15.0) | 32 (7.2) | | 248 (13.8) | 159 (17.4) | |
| Income, n(%) | 2,688 | 429 | 0.457 | 1,779 | 909 | 0.008 |
| really struggling on present income | 401 (14.9) | 61 (14.2) | | 264 (14.8) | 137 (15.1) | |
| struggling on present income | 715 (26.6) | 122 (28.4) | | 511 (28.7) | 204 (22.4) | |
| neither comfortable nor struggling on present income | 969 (36.1) | 150 (35.0) | | 617 (34.7) | 352 (38.7) | |
| living comfortably on present income | 356 (13.2) | 59 (13.8) | | 219 (12.3) | 137 (15.1) | |
| living really comfortably on present income | 247 (9.2) | 37 (8.6) | | 168 (9.4) | 79 (8.7) | |
| **Type of place of residence** | | | | | | |
| size of settlement, n(%) | 2,711 | 442 | 0.016 | 1,796 | 915 | 0.155 |
| Farm/isolated house/Village | 221 (8.2) | 48 (10.9) | | 135 (7.5) | 86 (9.4) | |
| Medium or small size city | 831 (30.7) | 156 (35.3) | | 571 (31.8) | 260 (28.4) | |
| Major city | 1,659 (61.2) | 238 (53.9) | | 1,090 (60.7) | 569 (62.2) | |

* In random effects model adjusted for country as random effect, P value was calculated using multivariate Wald test (joint χ2) to compare ever tested and never tested, and those that tested for HIV in the past 6 months and that did not
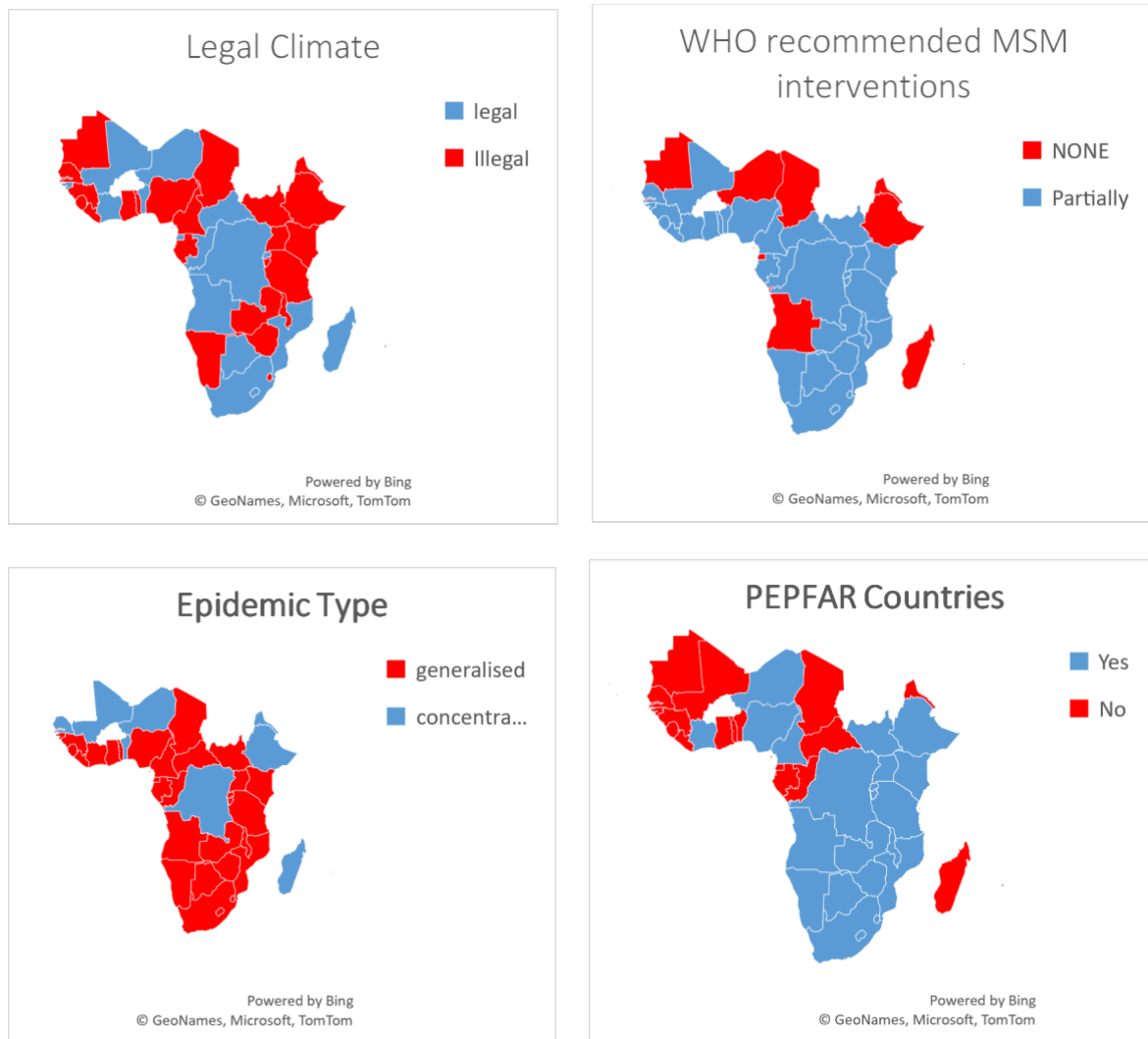
Figure 4. 4. Distribution of country-level explanatory variables across all 44 SSA countries in 2019

Review of national HIV policies

## Ecological single-level analysis

### Ever HIV tested

Non-criminalisation of same-sex relationships (b=6.13, 95% CI=5.33,6.93) showed strong evidence of a positive association with ever HIV tested in the bivariate model (table 4.2). There was also very strong positive association of targeted HIV-policy (b=14.13, 95% CI=13.17, 15.1) with ever HIV tested.

Table 4. 2: Coefficients and 95% Confidence Intervals of bivariate analyses for associations of country-level explanatory variables with proportion ever tested (n=44 countries)

|  | All 44 SSA countries | |
| --- | --- | --- |
|  | Unadjusted B (95% CI) | P value |
| **Country climate (ref illegal)** |  |  |
| **Legal** | 6.13 (5.33,6.93) | <0.001 |
| **Targeted policy interventions (ref none)** |  |  |
| **Partially** | 14.13 (13.17, 15.1) | <0.001 |
| **Type of Epidemic (ref generalised)** |  |  |
| **Concentrated** | -0.93 (-1.91, 0.55) | 0.064 |
| **PEPFAR (no)** |  |  |
| **Yes** | 7.86 (7.00,8.72) | <0.001 |
| **logGDP on health** | 0.04 (-0.62,0.70) | 0.912 |

[a] using robust standard errors

### HIV-tested in the past 6 months

Legalised same-sex relationships (b=-0.02, 95% CI=-0.93,0.88) showed no evidence of a positive association with recent testing in the bivariate model (table 4.3). There was very strong evidence of a positive association of targeted HIV-policy (b=3.23, 95% CI= 2.05, 4.40) with recent testing.

Table 4. 3: Coefficients and 95% Confidence Intervals of bivariate analyses for associations of country-level explanatory variables with HIV testing in the past 6 months (n=44 countries)

|  | All 44 SSA countries | |
| --- | --- | --- |
|  | Unadjusted B (95% CI) | P value |
| **Country climate (ref illegal)** |  |  |
| **Legal** | -0.02 (-0.93,0.88) | 0.959 |
| **Targeted policy interventions (ref none)** |  |  |
| **Partially** | 3.23 (2.05, 4.40) | <0.001 |
| **Type of Epidemic (ref generalised)** |  |  |
| **Concentrated** | -3.18 (-4..25,-2.12) | <0.001 |
| **PEPFAR (no)** |  |  |
| **Yes** | 1.71 (0.72,2.69) | 0.001 |
| **logGDP on health** | -7.03 (-7.70,-6.35) | <0.001 |

[a] using robust standard errors

## Multilevel analysis

### Ever HIV tested

Legal climate and targeted HIV policy were associated with ever testing for HIV (table 4.4). As in the ecological analysis, participants were more likely to have tested in countries where homosexuality is legal (OR=2.00, 95% CI=1.04,3.82) and with targeted HIV policy (OR=2.49, 95% CI=1.12,5.52). This was especially so for MSM of all ages, self-identified as bisexual, are in a relationship with a man and have above secondary education. The VPC change from model 1 (27.1%) to model 2 (14.6%) suggests country-level variables accounted for almost half of the variability in ever testing between countries.

Table 4. 4: Multilevel logistic regression odds ratio (OR) and 95% Confidence Interval (CI) for ever HIV testing in 44 SSA counties

| | All 44 SSA countries | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | M0: Variance components | | | M1: M0 + legal_climate and MSM HIV policy | | | M2: M1 + Individual characteristics | | |
| n (countries) | 3,191 (44) | | | 3,191 (44) | | | 2,980 (43) | | |
| | OR | (95% CI) | p-value | OR | (95% CI) | p-value | OR | (95% CI) | p-value |
| **Fixed effects** | | | | | | | | | |
| **Intercept** | 9.41 | (6.27,14.13) | <0.001 | 1.97 | (0.87,4.44) | 0.102 | 1.33 | (0.51,3.47) | 0.562 |
| **Legal_climate: Ref = illegal** | | | | | | | | | |
| legal | | | | 1.82 | (1.01,3.26) | 0.045 | 2.00 | (1.04,3.82) | 0.036 |
| **Targeted policy interventions: Ref= None** | | | | | | | | | |
| Partially | | | | 3.06 | (1.50,6.24) | 0.002 | 2.49 | (1.12,5.52) | 0.024 |
| **Type of Epidemic; Ref = generalised** | | | | | | | | | |
| concentrated | | | | 1.98 | (0.95,4.13) | 0.069 | 1.72 | (0.76,3.88) | 0.197 |
| **PEPFAR country; Ref= no** | | | | | | | | | |
| yes | | | | 1.55 | (0.82,2.93) | 0.173 | 1.58 | (0.78,3.18) | 0.202 |
| **logGDP health** | | | | 1.70 | (0.93,3.10) | 0.081 | 1.52 | (0.80,2.90) | 0.201 |
| **Age: ref = 18-24** | | | | | | | | | |
| 25-34 | | | | | | | 2.24 | (1.72,2.92) | <0.001 |
| 35-44 | | | | | | | 3.44 | (2.15,5.49) | <0.001 |
| 45+ | | | | | | | 2.09 | (1.20,3.66) | 0.010 |
| **Attraction: ref=gay** | | | | | | | | | |
| Bisexual | | | | | | | 0.70 | (0.53,0.93) | 0.012 |
| Don't know | | | | | | | 0.58 | (0.33,1.02) | 0.056 |
| **Relationship status: ref = single** | | | | | | | | | |
| in a relationship with a man | | | | | | | 1.95 | (1.43,2.66) | <0.001 |
| in a relationship with a woman/ both a man and a woman or transgender person | | | | | | | 1.14 | (0.76,1.73) | 0.521 |
| **Education: Ref = secondary/high school** | | | | | | | | | |
| None/Primary school | | | | | | | 0.65 | (0.42,1.00) | 0.049 |
| University first degree | | | | | | | 1.44 | (1.11,1.90) | 0.006 |
| masters/doctorate | | | | | | | 1.79 | (1.28,3.18) | 0.003 |
| **Income: Ref= neither comfortable nor struggling on present income** | | | | | | | | | |
| living really comfortably on present income | | | | | | | 1.17 | (0.81,1.70) | 0.400 |
| living comfortably on present income | | | | | | | 0.85 | (0.63,1.15) | 0.293 |
| struggling on present income | | | | | | | 0.89 | (0.61,1.29) | 0.527 |
| really struggling on present income | | | | | | | 1.03 | (0.66,1.60) | 0.898 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Size of settlement: ref = major city** | | | | | | | | |
| Village/Farm/an isolated house | | | | | | 1.11 | (0.71-1.74) | 0.640 |
| Medium-or small size city | | | | | | 0.79 | (0.61-1.03) | 0.078 |
| **Random effects variances** | | | | | | | | |
| Country level | 3.39 | (1.32,3.72) | 0.002 | 1.60 | (1.14,2.25) | 0.007 | 1.76 | (1.17,2.63) | 0.006 |
| Variance partition | 0.271 | | | 0.125 | | | 0.146 | | |

## HIV-tested in the past 6 months

There was no evidence of an association of legal climate and targeted HIV-policy with recent testing (model 2, table 4.5). Similar to the ecological analysis, compared to MSM in countries criminalising same-sex relationships the odds of recent testing decreased for MSM in countries where homosexuality is legal (OR=1.01, CI=0.69,1.46) and increased in countries with targeted HIV-policy (OR=1.26, 95% CI=0.78,2.04) when compared to those in countries without targeted HIV-policy. After country-level and individual-level variables were added, again, VPC change (8.0% to 5.0%) suggests country-level variables accounted for almost half of the variability in recent testing between countries

Table 4. 5: Multilevel logistic regression Odds ratio (OR) and 95% Confidence Interval (CI) for HIV testing in past 6 months in 44 SSA counties

| | All 44 SSA countries | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | M0: Variance components | | | M1: M0 + legal_climate and MSM HIV policy | | | M2: M1 + Individual characteristics | | |
| **n (countries)** | 2,744 (43) | | | 2,744 (43) | | | 2,573 (42) | | |
| | OR | (95% CI) | p-value | OR | (95% CI) | p-value | OR | (95% CI) | p-value |
| **Fixed effects** | | | | | | | | | |
| **Intercept** | 2.06 | (1.68,2.52) | <0.001 | 1.19 | (0.69,2.06) | 0.536 | 1.56 | (0.85,2.87) | 0.154 |
| **Legal_climate: Ref = illegal** | | | | | | | | | |
| legal | | | | 1.03 | (0.72,1.49) | 0.403 | 1.01 | (0.69,1.46) | 0.969 |
| **Targeted policy interventions: Ref= None** | | | | | | | | | |
| Partially | | | | 1.22 | (0.76,1.96) | 0.042 | 1.26 | (0.78,2.04) | 0.352 |
| **Type of Epidemic; Ref = generalised** | | | | | | | | | |
| concentrated | | | | 1.62 | (1.02,2.58) | 0.029 | 1.75 | (1.08,2.83) | 0.023 |
| **PEPFAR country; Ref= no** | | | | | | | | | |
| yes | | | | 1.55 | (1.05,2.31) | 0.029 | 1.57 | (1.04,2.35) | 0.031 |
| **logGDP health** | | | | 1.30 | (1.35,3.61) | 0.133 | 1.33 | (0.94,1.89) | 0.105 |
| **Age: ref = 18-24** | | | | | | | | | |
| 25-34 | | | | | | | 0.77 | (0.63,0.94) | 0.011 |
| 35-44 | | | | | | | 0.62 | (0.46,0.82) | 0.001 |
| 45+ | | | | | | | 0.63 | (0.42,0.94) | 0.024 |
| **Attraction: ref=gay** | | | | | | | | | |
| Bisexual | | | | | | | 1.12 | (0.89,1.41) | 0.325 |
| Don't know | | | | | | | 0.50 | (0.32,0.78) | 0.002 |
| **Relationship status: ref = single** | | | | | | | | | |
| in a relationship with a man | | | | | | | 0.89 | (0.73,1.08) | 0.230 |
| in a relationship with a woman/ both a man and a woman or transgender person | | | | | | | 0.65 | (0.49,0.88) | 0.005 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Education: Ref = secondary/high school** | | | | | | | | | |
| None/Primary school | | | | | | | 1.29 | (0.85,1.95) | 0.239 |
| University first degree | | | | | | | 0.78 | (0.63,0.95) | 0.013 |
| masters/doctorate | | | | | | | 0.82 | (0.62,1.07) | 0.142 |
| **Income: Ref= neither comfortable nor struggling on present income** | | | | | | | | | |
| living really comfortably on present income | | | | | | | 1.36 | (0.98,1.88) | 0.069 |
| living comfortably on present income | | | | | | | 0.99 | (0.76,1.30) | 0.960 |
| struggling on present income | | | | | | | 1.30 | (1.04,1.63) | 0.024 |
| really struggling on present income | | | | | | | 1.01 | (0.77,1.32) | 0.949 |
| **Size of settlement: ref = major city** | | | | | | | | | |
| Village/Farm/an isolated house | | | | | | | 0.88 | (0.63,1.23) | 0.454 |
| Medium-or small size city | | | | | | | 1.13 | (0.93,1.38) | 0.225 |
| **Random effects variances** | | | | | | | | | |
| Country level | 7.85 | (5.18-11.89) | <0.001 | 1.19 | (1.05-1.34) | 0.005 | 1.19 | (1.05-1.35) | 0.008 |
| Variance partition | 0.08 | | | 0.05 | | | 0.05 | | |

## Sensitivity Analyses

We performed a number of sensitivity analyses to test the robustness of our findings.

The strength and direction of association in the ecological analysis differed when South Africa was removed, and the strength of the association increased, but the direction did not change in the multilevel analysis. There were less marked changes when other countries were removed (supplementary material table 4.4-4.11).

In the ecological analysis, we found very strong evidence of an association of the legal climate and targeted policy with ever and recent testing when South Africa is omitted from analysis.

In the adjusted multilevel analysis excluding South Africa, legal climate and targeted HIV policy were associated with ever testing (OR= 2.47, 95% CI=1.40,4.34 and OR= 2.58, 95% CI=1.34,4.97) respectively: supplementary material table 4.6). Without South Africa, the between-country variation dropped from 27.8% to 9.3%, suggesting these country-level variables accounted for about 70% of the variability in ever testing between countries.

As in the main multilevel analysis, when South Africa is omitted from analysis, legal climate and targeted HIV-policy did not show evidence of an association with recent testing after adjusting for country-level and individual-level characteristics model 2 (supplementary material table 4.7). When compared to MSM in countries that criminalise same-sex

relationships and have no targeted HIV-policy, the odds of recent testing increased for MSM in countries where homosexuality is legal (OR= 1.07, 95% CI=0.73, 1.58), and with targeted HIV-policy (OR=1.26, CI=0.77, 2.04). The between-country variation dropped from 7.9% to 4.9%, suggesting these country-level variables accounted for about a third of the variability in recent testing between countries.

Our findings remained unchanged when we removed responses from MSM that did not want to provide an answer for their HIV status (supplementary material table 4.12-4.13).

In the analysis omitting countries with no HIV policy documents available, similar to the main analyses, South Africa impacted the strength and directions of the associations (supplementary material table 4.14-4.19). In the adjusted multilevel analysis including South Africa, legal climate and targeted HIV policy were not associated with ever testing or recently testing for HIV. When South Africa was excluded, the strong evidence of an association of the legal climate and targeted HIV policy with ever testing became apparent.

## Discussion

These findings show strong evidence that countries in SSA with legalised same-sex relationships and targeted national HIV policy for MSM had higher prevalence of ever testing, and individual MSM in these countries report increased odds of testing.

An enabling legal and policy environment appears to be important structural factors in shaping the ability of MSM to initially engage with testing services in SSA. Whilst for recent testing, the existence of these discriminatory laws and policies no longer appears important, rather social experiences of homophobia-related stigma (e.g., at health facilities) and individual-level dimensions of stress processes could be influencing the decision to return for services. In the findings of a recent scoping review, the removal of punitive laws and policies were evidenced as important societal enablers to increase the effectiveness of HIV services as a first step in a continuum of other enabling processes.[204] Complex socioeconomic factors at the individual-level such as low educational attainment and poverty are also attributable to the disparities in HIV vulnerabilities in MSM, although this can be of a lesser magnitude to

the effects of the legal climate.[205] Intersectional stigma has been shown to operate at the community level in addition to structural and individual levels and has been reported to influence anticipated/experienced stigma and discrimination at health facilities by MSM.[12,206] Consistent with our findings, are reports from several studies of African MSM in hostile environments that had never tested who indicated avoiding accessing healthcare services due to fear of potential discovery of their sexual orientation, arrest or conviction.[101,127,162,207] Similarly, studies have reported increased utilisation of HIV prevention in settings that invest in providing targeted services for MSM.[208] It is perhaps plausible that better ever testing outcomes in less hostile countries are a result of targeted community and health facility-based services, founded on human rights-based approaches, often delivered by trained healthcare professionals or peer-led services that are often difficult to establish in hostile environments.[26,209]

A larger proportion of the MSM in our study reported being ever tested (87.6%) and recent tested (66.4%) for HIV compared to findings from a 2019 systematic review and meta-analysis of SSA MSM.[25] Our findings could be due to the over-representation of MSM from medium or large cities and higher socioeconomic backgrounds. This could be attributed to the recruitment of participants through LGBTI social and community networks and administration of the survey through the internet, as this could lead to samples with higher response rates from participants of younger age, from urban areas, better educated and more likely to be students.[210] Additionally, some of the criminal laws in SSA specifically prevent the registration/operation of gay clubs, societies or any community networks, further limiting the population reach of the sampling methods.[34,150] We also have broader representation from all parts of the continent, whilst the review had an over-representation of studies from east and southern African counties. Almost all of the data on ever (46 of 55) and recent testing (24 of 33) in the review were from these regions and only three of the countries that legalise same-sex relationships were from west Africa. Also, by 2018, 11 of the SSA countries in our study had implemented HIV self-testing (HIVST) policies, 11 more had supportive HIVST policies that were not yet implemented, and the remaining were under development.[211] Despite increased overall ever testing, we still report lower ever testing

(85.3%) in hostile environments compared to countries that do not criminalise homosexuality (91.1%).

Additionally, the reduced level of ever testing in countries without targeted MSM policies could be a result of a lack of dedicated resources for this group. National HIV policies guide the allocation of both domestic and donor resources, if MSM are not included in policy, funding is not allocated for their programming and access will be via services targeting the general population. This has been reported to result in poorer HIV health outcomes for KPs compared to the general population.[137] Non-government and community-based organisations working in criminalised contexts are often able to advocate in a way that MoH is not able to and are often the only avenue for MSM to receive targeted services, but services are not without a lot of challenges.

We found South Africa was quite distinct from other SSA countries. Similarly, the previous review using pooled proportions also reported sensitivity of their analysis to only South African studies.[25] From our multilevel models, we found South Africa has substantially more variability compared to the other SSA countries in the analyses. Introducing the country and individual effects for both ever tested and recent tested, the VPC reduced by 46% and 38% (67% and 38% excluding South Africa) respectively. Several factors make South Africa unique. It is the only African country with constitutional protection against discrimination based on sexual orientation, permits same-sex marriage, has partnership recognition for same-sex couples, and allows joint or second parent adoption.[151] This was a reason why we used a binary measure of the legal climate since only South Africa fell into the liberal category when we attempted to group SSA countries into liberal, moderate, and conservative. Also, racial diversity in South Africa has epidemiological and historical implications.[35] The history of apartheid is a key feature of the social organisation of South Africa and is believed to have influenced the inequalities in the distribution of HIV.[212] Higher HIV prevalence is reported among Black MSM, who are more likely to be from lower socioeconomic backgrounds, less educated, live in rural areas and have less access to health services compared to other non-Black MSM.[213] The mechanisms of intersectional stigma are therefore different for different groups of MSM in this context, resulting in different HIV testing barriers. The original survey

did not collect data on participant's race, so we were unable to account for this in our analyses.

Whilst every effort was made to reduce bias, caution should be used in generalising the results of this study. An important limitation is selection bias. This could be attributed to the recruitment of participants through LGBTI social and community networks and the administration of the survey through the internet, both constituting non-probability sampling that can lead to geographically constrained samples with higher responses from participants likely to be younger, from urban areas, better educated and more likely to be students.[210] An additional limitation to the sampling methods is that some of the criminal laws in SSA specifically prevent the registration/operation of gay clubs, societies or any community networks.[34,150] We also consider issues of self-selection bias, which adds to the systematic differences observed in the MSM that participated in the study and could explain the higher proportion ever tested and recently tested in our study compared to those reported in other studies within the region. The generalisability of the findings could be limited by the overrepresentation of MSM from medium or large cities and from higher socioeconomic backgrounds.

There is a limited pool of available studies on HIV testing among MSM in SSA using confidential interview methods to reduce reporting bias.[25] Internet-based surveys offer the advantages of reaching previously under-studied and hidden populations, whilst also providing improved confidentiality for respondents, especially those in hostile environments.[214] To our knowledge, this study is the first to use identical methods across countries to collect data from a large sample of SSA countries. Our study includes a comprehensive review of national HIV policies in all 44 SSA countries, assessing these for the inclusion of the WHO recommended HIV services for MSM, which has been used to assess the relationship between the presence or absence of these targeted interventions and uptake of services by the intended population in our study.

## Conclusions

Our study shows associations of HIV testing by MSM across SSA with hostile legal and policy environments. We also find that the SSA populations are quite distinct, which has methodological implications for studying the effects of country-level context on health behavioural outcomes of SSA MSM. Future research should conceptualise specific pathways

through which the complex contextual and compositional factors at play in South Africa influence MSM engagement with HIV control programming. Although not routinely practised, collecting data on the race of study participants in African countries that are racially diverse, could facilitate greater understanding of the data.

## *Authorship*

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## Authors' Contributions

NK conceptualisation, formal analysis, methodology, writing original draft. EK, SH, and MR data collection and investigation. MN data validation. MN, MR, and MT critically reviewed and commented on the drafts and approved the final version of the manuscript.

## Supplementary Materials Research Paper 1

Appendix 4.1: Post-hoc Sample Size Calculation

**Sample size**

We conducted a post-hoc sample size calculation to confirm that there was sufficient power to detect differences in ever and recent HIV testing (within the past 6 months) between areas with greater and less discrimination for the exposure variable of legal climate and primary outcome of HIV testing in the past 6 months. We used the existing data to calculate k (cluster coefficient of variation) for the outcome, which was 0.24. We assumed equal distribution of the two treatments (criminalised and non-criminalised) of 23, with testing prevalence in less discriminatory countries at 72% and 57% in higher discrimination settings. Assuming 80% power and a two-tailed significance of 5%, these gave a sample size per arm of 713 (1,426 total).

APPENDIX TABLE 4. 1: DESCRIPTION OF NATIONAL AND INDIVIDUAL-LEVEL VARIABLES AND RESPONSE

| VARIABLE | RESPONSE MEASURES | OPERATIONALISATION | REFERENCES |
|---|---|---|---|
| Consensual same-sex sexual acts criminalised legal/illegal | No=0<br>Yes=1 | Single response variable | ILGA[151] |
| Presence or absence of targeted HIV interventions for MSM National HIV policy | No=0<br>Yes Partially =1<br>Fully=2 | Single response variable<br><br>NSF/NSP documents covering the time of the data collection was used where available. For countries where the NSF/NSP covering 2019/2020 were unattainable, the earlier policy document was used with a cut-off date of no earlier than 2014 (the year of the first KP WHO guidelines) | NSF/NSP for each country and WHO report on key populations in African HIV/AIDS |
| Epidemic type | No=0<br>Yes=1 | Countries with HIV prevalence of >1% were classed as having a generalised Epidemic | Aids info UNAIDS[54]<br>NSP Seychelles[215] |
| PEPFAR country | No=0<br>Yes=1 | | PEPFAR official website[142] |
| logGDP expenditure on health | Continuous | log of the %GDP expenditure on health | World Bank[193] |
| Age | Under 18<br>18-24<br>25-34<br>35-44<br>45-54<br>55-64<br>65+ | Single response question<br><br>Collapsed to, due to small sample size in some categories:<br>18-24<br>25-34<br>35-44<br>45+ | Global LGBTI Internet survey research proposal document and the study codebook |
| Sexual orientation | attracted to other men or gay=1<br>attracted to other women or lesbian=2<br>attracted to both men and women or bisexual=3<br>I don't know=98 | Single response question<br><br>Additional to birth sex 'male', only participants also indicating 'gay', 'bisexual' and 'I don't know' were included in this study | |
| Relationship status | Single=1<br>In a relationship with a man=2<br>In a relationship with a transgender person=3<br>In a relationship with a man and a woman=4<br>I don't know=98 | Single response question<br>Collapsed to, due to small sample size in some categories:<br>1=both with a man and woman/woman/transgender<br>2=In a relationship with a man<br>3=Single | |
| Education | None=0<br>Primary school=1<br>Secondary/high school=2<br>University first degree=3<br>Masters/doctorate=4 | Single response question<br>Higher levels of education is considered to indicate higher economic level<br>Collapsed, due to small sample size in some categories:<br>None/primary school=1<br>Secondary/high school=2<br>University first degree=3<br>Masters/doctorate=4 | |
| Income | Really struggling on present income=1<br>Struggling on present income=2<br>Neither comfortable nor struggling on present income=3<br>Living comfortably on present income=4<br>Living really comfortably on present income=5 | Single response question<br><br>This measure is used to represent a subjective assessment of income status by measuring self-reports of economic pressure of respondents. Scored between 1 to 5 as ordinal categorical data. The higher the score, the lower the economic pressure and therefore presumed higher income | |
| Size of settlement | A farm or an isolated house=1<br>A village=2<br>A medium or small size city=3<br>A major city=4 | Single response question<br>Due to small sample size in some categories, collapsed to:<br><br>A village/farm or an isolated house=1<br>A medium or small size city=2<br>A major city=3 | |

## APPENDIX TABLE 4. 2. NUMBER OF RESPONDENTS PER COUNTRY BY REGION

| CENTRAL AFRICA | SAME-SEX RELATIONSHIP CRIMINALISED | NUMBER OF RESPONDENTS TO SURVEY |
|---|---|---|
| Cameroon | illegal | 72 |
| Central African Republic (the) | legal | 25 |
| Chad | illegal | 43 |
| Congo | legal | 129 |
| Democratic Republic of the Congo (the) | legal | 181 |
| Equatorial Guinea | legal | * |
| Gabon | illegal | 77 |
| Eastern Africa | | |
| Burundi | illegal | 13 |
| Eritrea | illegal | * |
| Ethiopia | illegal | 111 |
| Kenya | illegal | 124 |
| Madagascar | legal | * |
| Malawi | illegal | 26 |
| Mauritius | Illegal | 105 |
| Mozambique | legal | 141 |
| Rwanda | Legal | 102 |
| Seychelles | legal | * |
| United Republic of Tanzania | illegal | 130 |
| Uganda | illegal | 95 |
| Southern Africa | | |
| Angola | legal | 108 |
| Botswana | legal | 24 |
| Eswatini | illegal | 30 |
| Lesotho | legal | 25 |
| Namibia | illegal | 62 |
| South Africa | legal | 568 |
| Zambia | Illegal | 78 |
| Zimbabwe | illegal | 74 |
| Western Africa | | |
| Benin | legal | 105 |
| Burkina-Faso | Legal | 109 |
| Cape Verde | legal | * |
| Côte d'Ivoire | legal | 119 |
| Gambia | illegal | * |
| Ghana | illegal | 87 |
| Guinea | illegal | * |
| Guinea-Bissau | legal | * |
| Liberia | illegal | 17 |
| Mali | legal | 95 |
| Mauritania | Illegal | 66 |
| Niger | Legal | * |
| Nigeria | illegal | 165 |
| Senegal | illegal | 40 |
| Sierra Leone | illegal | * |
| South Sudan | illegal | * |
| Togo | illegal | * |

* countries with <10 responses to prevent unintended disclosure

APPENDIX TABLE 4. 3: SUMMARY OF WHO RECOMMENDED TARGETED INTERVENTIONS FOR MSM INCLUDED IN NATIONAL HIV POLICIES

| COUNTRY | POLICY YEAR | PREVENTION | | | | HARM REDUCTION | | | HIV TESTING AND COUNSELLING | | HIV TREATMENT & CARE | SEXUAL & REPRODUCTIVE HEALTH |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | CONDOMS | CONDOM COMPATIBLE LUBRICANTS | PREP | PEP | NEEDLE AND SYRINGE PROGRAMMES | OPIOID SUBSTITUTION THERAPY | NALOXONE | *CBCT | *PITC | EQUITABLE ART | STI SCREENING AND TREATMENT |
| Angola[216] | 2015-2018 | | | | | | | | | | | |
| Benin[217] | 2019-2023 | ■ | ■ | ■ | | ■ | | | ■ | ■ | ■ | ■ |
| Botswana[218] | 2019-2023 | ■ | | ■ | | | | | ■ | ■ | ■ | |
| Burundi[219] | 2018-2022 | ■ | ■ | | | | | | ■ | ■ | ■ | ■ |
| Cameroon[220] | 2018-2022 | ■ | ■ | ■ | | | | | ■ | ■ | ■ | ■ |
| Central African Republic[33] | 2016-2020 | ■ | | | | | | | | | | ■ |
| Chad[221] | 2018-2022 | | | | | | | | | | | |
| Congo[33] | 2014-2018 | ■ | ■ | | | | | | | | | ■ |
| Côte d'Ivoire[33] | 2016-2020 | ■ | ■ | ■ | | | | | | ■ | | |
| DRC[222] | 2018-2022 | ■ | | | | ■ | | | ■ | | ■ | ■ |
| Eritrea[223] | 2017-2021 | | | | | | | | | | | |
| Eswatini[224] | 2018-2023 | ■ | ■ | | | | | | ■ | ■ | ■ | ■ |
| Ethiopia[33] | 2015-2020 | | | | | | | | | | | |
| Gabon[225] | 2018-2022 | ■ | | | | ■ | | | ■ | ■ | ■ | ■ |
| Gambia[226] | 2014-2020 | | | | | | | | | | | |
| Ghana[33] | 2016-2020 | ■ | ■ | | | | | | ■ | ■ | ■ | ■ |
| Guinea[227] | 2018-2022 | ■ | | | | | | ■ | ■ | | ■ | ■ |
| Guinea-Bissau[33] | 2015-2020 | ■ | | | | | | | | | | |
| Kenya[33] | 2014/2015-2018/2019 | ■ | ■ | | | ■ | ■ | | ■ | | ■ | ■ |
| Lesotho | 2018-2023 | ■ | | | | | | | ■ | ■ | ■ | ■ |
| Liberia[33] | 2015-2020 | ■ | | | | | | | | | | ■ |
| Madagascar | 2018-2022 | | | | | | | | | | | |
| Malawi[33] | 2015-2020 | ■ | | | | | | | ■ | ■ | ■ | ■ |
| Mali[228] | 2017-2021 | ■ | ■ | | | ■ | | | ■ | | ■ | ■ |
| Mozambique[33] | 2015-2019 | ■ | ■ | | | | | | ■ | ■ | ■ | |
| Namibia[229] | 2018-2024 | ■ | ■ | | | | | | ■ | ■ | ■ | ■ |
| Senegal[230] | 2018-2022 | ■ | ■ | | | ■ | | | ■ | ■ | ■ | ■ |
| Seychelles[215] | 2019-2023 | ■ | ■ | ■ | | | | | ■ | ■ | ■ | ■ |
| Sierra Leone[33] | 2016-2020 | ■ | | | | | | | ■ | ■ | ■ | ■ |
| South Africa[231] | 2017-2022 | ■ | ■ | ■ | ■ | | | | ■ | ■ | ■ | ■ |
| South Sudan[232] | 2018-2022 | ■ | | | | | | | ■ | ■ | ■ | |
| Togo[33] | 2016-2020 | ■ | ■ | | | | | | | ■ | | |
| Uganda[33] | 2015-2020 | ■ | | | | | | | | | | ■ |
| Tanzania[233] 2017-2022 | | ■ | | | | | ■ | | ■ | ■ | ■ | |
| Zambia[234] | 2017-2021 | ■ | | | | | | | ■ | ■ | ■ | ■ |
| Zimbabwe[235] | 2015-2020 | ■ | | ■ | ■ | | | | ■ | ■ | ■ | |

■ Included

*Community based counselling & testing (CBCT), Provider Initiated counselling and testing (PICT)
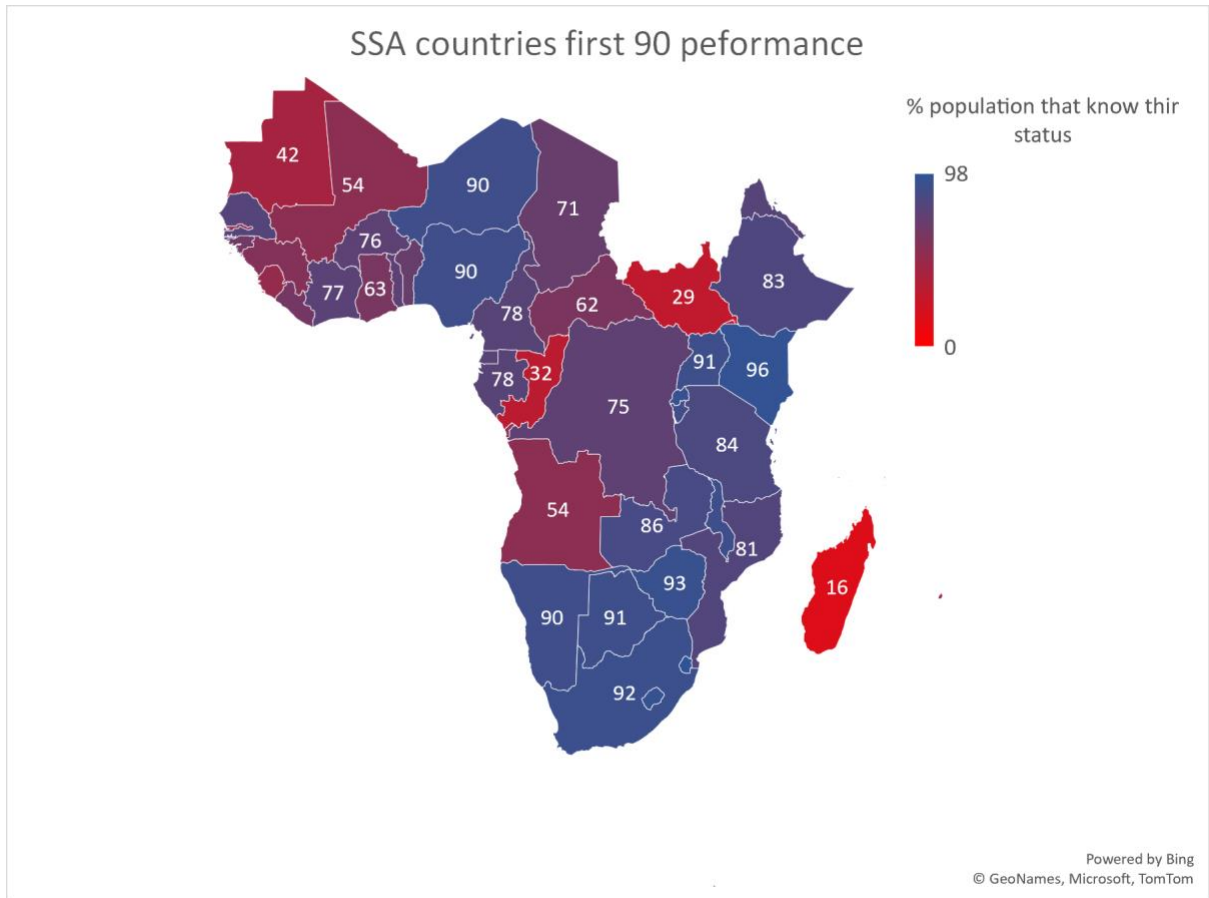
# Sensitivity analysis removing one country at a time

Appendix table 4. 4: SENSITIVITY ANALYSIS, EXCLUDING SOUTH AFRICA; COEFFICIENTS AND 95% CONFIDENCE INTERVALS OF BIVARIATE AND MULTIVARIABLE ANALYSES FOR ASSOCIATIONS OF COUNTRY-LEVEL EXPLANATORY VARIABLES WITH EVER TESTING (N=44 COUNTRIES)

| | Unadjusted B (95% CI) | P value |
|---|---|---|
| Country climate (ref illegal) | | |
| Legal | 9.72 (8.80,10.64) | <0.001 |
| Targeted policy interventions (ref none) | | |
| Partially | 16.12 (15.09, 17.15) | <0.001 |
| Type of Epidemic (ref generalised) | | |
| Concentrated | -2.40 (-3.50,-1.31) | <0.001 |
| PEPFAR (no) | | |
| Yes | 10.22 (9.27,11.17) | <0.001 |
| logGDP on health | 1.08 (0.34,1.82) | 0.004 |

[a] using robust standard errors

Appendix table 4. 5: SENSITIVITY ANALYSIS, EXCLUDING SOUTH AFRICA; COEFFICIENTS AND 95% CONFIDENCE INTERVALS OF BIVARIATE AND MULTIVARIABLE ANALYSES FOR ASSOCIATIONS OF COUNTRY-LEVEL EXPLANATORY VARIABLES WITH HIV TESTING IN THE PAST 6 MONTHS (N=44 COUNTRIES)

| | Unadjusted B (95% CI) | P value |
|---|---|---|
| Country climate (ref illegal) | | |
| Legal | 2.40 (1.32,3.47) | <0.001 |
| Targeted policy interventions (none) | | |
| Partially | 4.78 (3.48, 6.07) | <0.001 |
| Type of Epidemic (ref generalised) | | |
| Concentrated | -4.92 (-6.10,-3.73) | <0.001 |
| PEPFAR (no) | | |
| Yes | 3.58 (2.46,4.69) | <0.001 |
| logGDP on health | -6.48 (-7.25,-5.71) | <0.001 |

[a] using robust standard error

Appendix table 4. 6: SENSITIVITY ANALYSIS, EXCLUDING SOUTH AFRICA; MULTILEVEL LOGISTIC REGRESSION ODDS RATIO (OR) AND 95% CONFIDENCE INTERVAL (CI) FOR EVER HIV TESTING IN 44 SSA COUNTIES

| | SM1: VARIANCE COMPONENTS | | | SM1: SM0 + LEGAL_CLIMATE AND MSM HIV POLICY | | | SM2: SM1 + INDIVIDUAL CHARACTERISTICS | | |
|---|---|---|---|---|---|---|---|---|---|
| n (countries) | 2,623 (43) | | | 2,623 (43) | | | 2,435 (42) | | |
| | OR | (95% CI) | p-value | OR | (95% CI) | p-value | OR | (95% CI) | p-value |
| Fixed effects | | | | | | | | | |
| Intercept | 9.71 | (6.38,14.78) | <0.001 | 1.81 | (0.91,3.63) | 0.093 | 1.39 | (0.60,3.21) | 0.444 |
| Legal_climate: Ref = illegal | | | | | | | | | |
| legal | | | | 2.23 | (1.33,3.77) | 0.003 | 2.47 | (1.40,4.34) | 0.002 |
| Targeted policy interventions: Ref= None | | | | | | | | | |
| Partially | | | | 3.06 | (1.67,5.59) | <0.001 | 2.58 | (1.34,4.97) | 0.004 |
| Type of Epidemic; Ref = generalised | | | | | | | | | |
| concentrated | | | | 1.82 | (0.96,3.45) | 0.065 | 1.64 | (0.82,3.27) | 0.159 |
| PEPFAR country; Ref= no | | | | | | | | | |
| yes | | | | 1.78 | (1.02,3.08) | 0.041 | 1.77 | (0.98,3.20) | 0.059 |
| %GDP health | | | | 1.82 | (1.07,3.10) | 0.028 | 1.63 | (0.94,2.85) | 0.084 |
| Age: ref = 18-24 | | | | | | | | | |
| 25-34 | | | | | | | 1.76 | (1.31,2.38) | <0.001 |
| 35-44 | | | | | | | 2.29 | (1.35,3.89) | 0.002 |
| 45+ | | | | | | | 1.04 | (0.55,1.95) | 0.904 |
| Attraction: ref=gay | | | | | | | | | |
| Bisexual | | | | | | | 0.71 | (0.52,0.97) | 0.032 |
| Don't know | | | | | | | 0.85 | (0.43,1.68) | 0.648 |
| Relationship status: ref = single | | | | | | | | | |
| in a relationship with a man | | | | | | | 1.64 | (1.78,2.30) | 0.004 |
| in a relationship with a woman/ both a man and a woman or transgender person | | | | | | | 1.06 | (0.69,1.63) | 0.780 |
| Education: Ref = secondary/high school | | | | | | | | | |
| None/Primary school | | | | | | | 0.63 | (0.41,0.97) | 0.037 |
| University first degree | | | | | | | 1.49 | (1.08,2.04) | 0.014 |
| masters/doctorate | | | | | | | 1.76 | (1.08,2.87) | 0.024 |
| Income: Ref= neither comfortable nor struggling on present income | | | | | | | | | |
| living really comfortably on present income | | | | | | | 1.02 | (0.61,1.69) | 0.952 |
| living comfortably on present income | | | | | | | 0.81 | (0.56,1.40) | 0.599 |
| struggling on present income | | | | | | | 0.88 | (0.57,1.13) | 0.215 |
| really struggling on present income | | | | | | | 1.08 | (0.71,1.63) | 0.728 |
| Size of settlement: ref = major city | | | | | | | | | |
| Village/Farm/an isolated house | | | | | | | 1.20 | (0.75,1.94) | 0.470 |
| Medium-or small size city | | | | | | | 0.92 | (0.68,1.25) | 0.595 |
| Random effects variances | | | | | | | | | |
| Country level | 3.56 | (1.60,7.94) | 0.002 | 1.35 | (1.03,1.77) | 0.028 | 1.40 | (1.04,1.89) | 0.028 |
| Variance partition | 0.278 | | | 0.084 | | | 0.093 | | |

**Appendix table 4. 7: SENSITIVITY ANALYSIS, EXCLUDING SOUTH AFRICA; MULTILEVEL LOGISTIC REGRESSION ODDS RATIO (OR) AND 95% CONFIDENCE INTERVAL (CI) FOR HIV TESTING IN PAST 6 MONTHS IN 44 SSA COUNTIES.**

| | M0: VARIANCE COMPONENTS | | | M1: M0 + LEGAL_CLIMATE AND MSM HIV POLICY | | | M2: M1 + INDIVIDUAL CHARACTERISTICS | | |
|---|---|---|---|---|---|---|---|---|---|
| n (countries) | 2,284 (42) | | | 2,284 (42) | | | 2,130 (41) | | |
| | OR | (95% CI) | p-value | OR | (95% CI) | p-value | OR | (95% CI) | p-value |
| Fixed effects | | | | | | | | | |
| Intercept | 2.08 | (1.69,2.57) | <0.001 | 1.18 | (0.69,2.02) | 0.686 | 1.70 | (0.91,3.17) | 0.098 |
| Legal_climate: Ref = illegal | | | | | | | | | |
| legal | | | | 1.11 | (0.76,1.60) | 0.593 | 1.07 | (0.73,1.58) | 0.733 |
| Targeted policy interventions: Ref= None | | | | | | | | | |
| Partially | | | | 1.23 | (0.77,1.95) | 0.388 | 1.26 | (0.77,2.04) | 0.358 |
| Type of Epidemic; Ref = generalised | | | | | | | | | |
| concentrated | | | | 1.55 | (0.98,2.46) | 0.064 | 1.70 | (1.04,2.76) | 0.033 |
| PEPFAR country; Ref= no | | | | | | | | | |
| yes | | | | 1.59 | (1.08,2.36) | 0.020 | 1.60 | (1.06,2.40) | 0.025 |
| %GDP health | | | | 1.32 | (0.94,1.85) | 0.106 | 1.36 | (0.96,1.94) | 0.083 |
| Age: ref = 18-24 | | | | | | | | | |
| 25-34 | | | | | | | 0.70 | (0.56,0.88) | 0.002 |
| 35-44 | | | | | | | 0.54 | (0.39,0.75) | <0.001 |
| 45+ | | | | | | | 0.51 | (0.30,0.87) | 0.013 |
| Attraction: ref=gay | | | | | | | | | |
| Bisexual | | | | | | | 1.25 | (0.97,1.61) | 0.082 |
| Don't know | | | | | | | 0.47 | (0.29,0.75) | 0.001 |
| Relationship status: ref = single | | | | | | | | | |
| in a relationship with a man | | | | | | | 0.91 | (0.73,1.14) | 0.402 |
| in a relationship with a woman/ both a man and a woman or transgender person | | | | | | | 0.63 | (0.46,0.86) | 0.004 |
| Education: Ref = secondary/high school | | | | | | | | | |
| None/Primary school | | | | | | | 1.23 | (0.80,1.88) | 0.339 |
| University first degree | | | | | | | 0.75 | (0.60,0.94) | 1.014 |
| masters/doctorate | | | | | | | 0.80 | (0.59,1.08) | 0.147 |
| Income: Ref= neither comfortable nor struggling on present income | | | | | | | | | |
| living really comfortably on present income | | | | | | | 1.18 | (0.81,1.71) | 0.394 |
| living comfortably on present income | | | | | | | 0.83 | (0.60,1.15) | 0.263 |
| struggling on present income | | | | | | | 1.24 | (0.97,1.59) | 0.091 |
| really struggling on present income | | | | | | | 0.98 | (0.73,1.32) | 0.893 |
| Size of settlement: ref = major city | | | | | | | | | |
| Village/Farm/an isolated house | | | | | | | 0.93 | (0.66,1.33) | 0.703 |
| Medium-or small size city | | | | | | | 1.23 | (0.98,1.54) | 0.073 |
| Random effects variances | | | | | | | | | |
| Country level | 1.33 | (1.11,1.59) | 0.002 | 1.18 | (1.05,1.32) | 0.007 | 1.19 | (1.04,1.35) | 0.010 |
| Variance partition | 0.079 | | | 0.047 | | | 0.049 | | |

**Appendix table 4. 8SENSITIVITY ANALYSIS, EXCLUDING DEMOCRATIC REPUBLIC OF CONGO AND NIGERIA; COEFFICIENTS AND 95% CONFIDENCE INTERVALS OF BIVARIATE AND MULTIVARIABLE ANALYSES FOR ASSOCIATIONS OF COUNTRY-LEVEL EXPLANATORY VARIABLES WITH EVER TESTING (N=37 COUNTRIES)**

| | EXCLUDING DRC | | | EXCLUDING NIGERIA | |
|---|---|---|---|---|---|
| | UNADJUSTED B (95% CI) | P VALUE | | UNADJUSTED B (95% CI) | P VALUE |
| Country climate (ref illegal) | | | | | |
| Legal | 6.85 (6.02,7.70) | <0.001 | | 7.56 (6.73,8.39) | <0.001 |
| Targeted policy interventions (ref none) | | | | | |
| Partially | 14.58 (13.59,15.56) | <0.001 | | 13.79 (12.80,14.77) | <0.001 |

*mutually adjusted for epidemic type, PEPFAR funding and log of GPD expenditure on health

**Appendix table 4. 9: SENSITIVITY ANALYSIS, EXCLUDING DEMOCRATIC REPUBLIC OF CONGO AND NIGERIA; COEFFICIENTS AND 95% CONFIDENCE INTERVALS OF BIVARIATE AND MULTIVARIABLE ANALYSES FOR ASSOCIATIONS OF COUNTRY-LEVEL EXPLANATORY VARIABLES WITH RECENT TESTING (N=37 COUNTRIES)**

| | EXCLUDING DRC | | | EXCLUDING NIGERIA | |
|---|---|---|---|---|---|
| | UNADJUSTED B (95% CI) | P VALUE | | UNADJUSTED B (95% CI) | P VALUE |
| Country climate (ref illegal) | | | | | |
| Legal | 3.29 (2.50,4.08) | <0.001 | | 0.52 (-0.44,1.48) | 0.287 |
| Targeted policy interventions (ref none) | | | | | |
| Partially | 5.40 (4.39,6.40) | <0.001 | | 2.98 (1.77,4.19) | <0.001 |

*mutually adjusted for epidemic type, PEPFAR funding and log of GPD expenditure on health

Appendix table 4. 10 SENSITIVITY ANALYSIS, EXCLUDING DEMOCRATIC REPUBLIC OF CONGO AND NIGERIA; MULTILEVEL LOGISTIC REGRESSION ODDS RATIO (OR) AND 95% CONFIDENCE INTERVAL (CI) FOR EVER HIV TESTING IN 37 SSA COUNTIES (INCLUDING ALL COUNTRY-LEVEL AND INDIVIDUAL-LEVEL EXPLANATORY VARIABLES)

| | EXCLUDING DRC | | | | | | EXCLUDING NIGERIA | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | M0: VARIANCE COMPONENTS | | | M2: M0 + LEGAL_CLIMATE, MSM HIV POLICY AND INDIVIDUAL CHARACTERISTICS | | | M0: VARIANCE COMPONENTS | | | M2: M0 LEGAL_CLIMATE, MSM HIV POLICY AND INDIVIDUAL CHARACTERISTICS | | |
| n (countries) | 3,010 (42) | | | 2,805 (42) | | | 2,826 (42) | | | 2,553 (37) | | |
| | OR | (95% CI) | p-value | OR | (95% CI) | p-value | OR | (95% CI) | p-value | OR | (95% CI) | p-value |
| Fixed effects | | | | | | | | | | | | |
| Intercept | 8.90 | (5.95,13.32) | <0.001 | 1.33 | (0.50,3.51) | 0.567 | 9.33 | (6.13,14.19) | <0.001 | 1.40 | (0.54,3.64) | 0.494 |
| Legal_climate: Ref = illegal | | | | | | | | | | | | |
| legal | | | | 2.01 | (1.04,3.89) | 0.037 | | | | 2.09 | (1.09,4.00) | 0.026 |
| Targeted policy interventions: Ref= None | | | | | | | | | | | | |
| Partially | | | | 2.55 | (1.14,5.71) | 0.023 | | | | 2.39 | (1.08,5.28) | 0.031 |
| Random effects variances | | | | | | | | | | | | |
| Country level | 3.17 | (1.51,6.68 ) | 0.002 | 1.78 | (1.18,2.69) | 0.006 | 3.56 | (1.59,7.96) | 0.002 | 1.74 | (1.16,2.62) | 0.008 |
| Variance partition | 0.260 | | | 0.149 | | | 0.278 | | | 0.144 | | |

Appendix table 4. 11SENSITIVITY ANALYSIS, EXCLUDING DEMOCRATIC REPUBLIC OF CONGO AND NIGERIA; MULTILEVEL LOGISTIC REGRESSION ODDS RATIO (OR) AND 95% CONFIDENCE INTERVAL (CI) FOR RECENT HIV TESTING IN 37 SSA COUNTIES (INCLUDING ALL COUNTRY-LEVEL AND INDIVIDUAL-LEVEL EXPLANATORY VARIABLES)

| | EXCLUDING DRC | | | | | | EXCLUDING NIGERIA | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | M0: VARIANCE COMPONENTS | | | M1: M0 + LEGAL_CLIMATE, MSM HIV POLICY AND INDIVIDUAL CHARACTERISTICS | | | M0: VARIANCE COMPONENTS | | | M1: M0 + LEGAL_CLIMATE, MSM HIV POLICY AND INDIVIDUAL CHARACTERISTICS | | |
| n (countries) | 2,567 (42) | | | 2,402 (41) | | | 2,590 (42) | | | 2,235 (37) | | |
| | OR | (95% CI) | p-value | OR | (95% CI) | p-value | OR | (95% CI) | p-value | OR | (95% CI) | p-value |
| Fixed effects | | | | | | | | | | | | |
| Intercept | 2.03 | (1.65,2.50) | <0.001 | 1.43 | (0.81,2.54) | 0.217 | 2.05 | (1.67,2.53) | <0.001 | 1.57 | (0.84,2.92) | 0.155 |
| Legal_climate: Ref = illegal | | | | | | | | | | | | |
| legal | | | | 0.98 | (0.70,1.38) | 0.908 | | | | 1.02 | (0.70,1.50) | 0.917 |
| Targeted policy interventions: Ref= None | | | | | | | | | | | | |
| Partially | | | | 1.33 | (0.85,2.07) | 0.207 | | | | 1.26 | (0.77,2.06) | 0.367 |
| Random effects variances | | | | | | | | | | | | |
| Country level | 1.32 | (1.11,1.59 ) | 0.002 | 1.13 | (1.02,1.25) | 0.016 | 1.33 | (1.11,1.60) | 0.002 | 1.20 | (1.05,1.36 ) | 0.008 |
| Variance partition | 0.079 | | | 0.037 | | | 0.080 | | | 0.052 | | |

# SENSITIVITY ANALYSIS WITH RESPONSES FROM MSM THAT DID NOT WANT TO DISCLOSE THEIR HIV STATUS REMOVED

Appendix table 4. 12. EXCLUDING MSM THAT DID NOT WANT TO DISCLOSE THEIR HIV STATUS; MULTILEVEL LOGISTIC REGRESSION ODDS RATIO (OR) AND 95% CONFIDENCE INTERVAL (CI) FOR EVER HIV TESTING IN 44 SSA COUNTIES (INCLUDING ALL COUNTRY-LEVEL AND INDIVIDUAL-LEVEL EXPLANATORY VARIABLES)

|  | All 44 SSA countries | | | | | |
|---|---|---|---|---|---|---|
|  | M0: Variance components | | | M2: M0+ Individual characteristics | | |
| **n (countries)** | 3,023 (44) | | | 2,823 (43) | | |
|  | OR | (95% CI) | p-value | OR | (95% CI) | p-value |
| **Fixed effects** | | | | | | |
| **Intercept** | 9.24 | (6.20,13.77) | <0.001 | 1.16 | (0.46,2.90) | 0.754 |
| **Legal_climate: Ref = illegal** | | | | | | |
| legal | | | | 2.15 | (1.13,4.09) | 0.019 |
| **Targeted policy interventions: Ref= None** | | | | | | |
| Partially | | | | 2.73 | (1.24,5.97) | 0.012 |
| **Random effects variances** | | | | | | |
| Country level | 3.19 | (1.54,6.58) | 0.002 | 1.74 | (1.17,2.58) | 0.006 |
| Variance partition | 0.261 | | | 0.144 | | |

Appendix table 4. 13. EXCLUDING MSM THAT DID NOT WANT TO DISCLOSE THEIR HIV STATUS; MULTILEVEL LOGISTIC REGRESSION ODDS RATIO (OR) AND 95% CONFIDENCE INTERVAL (CI) FOR RECENT HIV TESTING IN 44 SSA COUNTIES (INCLUDING ALL COUNTRY-LEVEL AND INDIVIDUAL-LEVEL EXPLANATORY VARIABLES)

|  | All 44 SSA countries | | | | | |
|---|---|---|---|---|---|---|
|  | M0: Variance components | | | M2: M1 + Individual characteristics | | |
| **n (countries)** | 2,601 (43) | | | 2,439 (42) | | |
|  | OR | (95% CI) | p-value | OR | (95% CI) | p-value |
| **Fixed effects** | | | | | | |
| **Intercept** | 2.11 | (1.72,2.59) | <0.001 | 1.51 | (0.87,2.64) | 0.143 |
| **Legal_climate: Ref = illegal** | | | | | | |
| legal | | | | 1.03 | (0.73,1.46) | 0.852 |
| **Targeted policy interventions: Ref= None** | | | | | | |
| Partially | | | | 1.35 | (0.87,2.11) | 0.183 |
| **Random effects variances** | | | | | | |
| Country level | 1.32 | (1.10,1.58) | 0.003 | 1.14 | (1.02,1.28) | 0.018 |
| Variance partition | 0.077 | | | 0.039 | | |

# SENSITIVITY ANALYSIS OMITTING COUNTRIES WITH NO HIV POLICY DOCUMENTS AVAILABLE

Appendix table 4. 14: analysis omitting countries with no HIV policy documents available: Coefficients and 95% Confidence Intervals of bivariate and multivariable analyses for associations of country-level explanatory variables with proportion ever tested (n=38 countries)

|  | All 38 SSA countries | |
|---|---|---|
|  | Unadjusted B (95% CI) | P value |
| **Country climate (ref illegal)** | | |
| **Legal** | 1.85 (1.22,2.48) | <0.001 |
| **Targeted policy interventions (ref none)** | | |
| **Partially** | 9.79 (8.78, 10.80) | <0.001 |
| **Type of Epidemic (ref generalised)** | | |
| **Concentrated** | 5.50 (4.73,6.28) | <0.001 |
| **PEPFAR (no)** | | |
| **Yes** | 4.64 (3.91,5.37) | <0.001 |
| **logGDP on health** | 1.10 (0.36,1.84) | 0.004 |

[a] using robust standard errors

Appendix table 4. 15: analysis omitting countries with no HIV policy documents available: Coefficients and 95% Confidence Intervals of bivariate and multivariable analyses for associations of country-level explanatory variables with HIV testing in the past 6 months (n=38 countries)

|  | All 38 SSA countries | |
|---|---|---|
|  | Unadjusted B (95% CI) | P value |
| **Country climate (ref illegal)** | | |
| **Legal** | -0.35 (-1.29,0.59) | 0.267 |
| **Targeted policy interventions (ref none)** | | |
| **Partially** | 3.62 (2.04, 5.20) | <0.001 |
| **Type of Epidemic (ref generalised)** | | |
| **Concentrated** | 10.01 (8.89,11.14) | <0.001 |
| **PEPFAR (no)** | | |
| **Yes** | 9.60 (8.55,10.66) | <0.001 |
| **logGDP on health** | 6.28 (5.20,7.35) | <0.001 |

[a] using robust standard errors

Appendix table 4. 16: analysis omitting countries with no HIV policy documents available: Multilevel logistic regression Odds ratio (OR) and 95% Confidence Interval (CI) for ever HIV testing in 38 SSA counties

| | All 38 SSA countries | | | | | | | | |
| | M0: Variance components | | | M1: M0 + legal_climate and MSM HIV policy | | | M2: M1 + Individual characteristics | | |
|---|---|---|---|---|---|---|---|---|---|
| **n  (countries)** | 2,901 (38) | | | 2,901 (38) | | | 2,707 (38) | | |
| | OR | (95% CI) | p-value | OR | (95% CI) | p-value | OR | (95% CI) | p-value |
| **Fixed effects** | | | | | | | | | |
| **Intercept** | 10.09 | (7.05,14.45) | <0.001 | 2.28 | (0.91,5.72) | 0.086 | 1.46 | (0.50,4.28) | 0.486 |
| **Legal_climate: Ref = illegal** | | | | | | | | | |
| legal | | | | 1.51 | (0.86,2.64) | 0.147 | 1.53 | (0.83,2.83) | 0.17 |
| **Targeted policy interventions: Ref= None** | | | | | | | | | |
| Partially | | | | 2.69 | (1.20,6.01) | 0.016 | 2.13 | (0.88,5.19) | 0.096 |
| **Random effects variances** | | | | | | | | | |
| Country level | 2.21 | (1.32,3.72) | <0.001 | 1.42 | (1.08,1.87) | 0.013 | 1.52 | (1.10,2.10) | 0.011 |
| Variance partition | 0.195 | | | 0.10 | | | 0.11 | | |

Appendix table 4. 17: analysis omitting countries with no HIV policy documents available: Multilevel logistic regression Odds ratio (OR) and 95% Confidence Interval (CI) for HIV testing in past 6 months in 38 SSA counties

| | All 38 SSA countries | | | | | | | | |
| | M0: Variance components | | | M1: M0 + legal_climate and MSM HIV policy | | | M2: M1 + Individual characteristics | | |
|---|---|---|---|---|---|---|---|---|---|
| **n (countries)** | 2,542 (38) | | | 2,542 (38) | | | 2,382 (37) | | |
| | OR | (95% CI) | p-value | OR | (95% CI) | p-value | OR | (95% CI) | p-value |
| **Fixed effects** | | | | | | | | | |
| **Intercept** | 2.09 | (1.65,2.66) | <0.001 | 1.22 | (0.63,2.32) | 0.561 | 1.54 | (0.76,3.13) | 0.233 |
| **Legal_climate: Ref = illegal** | | | | | | | | | |
| legal | | | | 0.98 | (0.68,1.38) | 0.890 | 0.98 | (0.68,1.40) | 0.890 |
| **Targeted policy interventions: Ref= None** | | | | | | | | | |
| Partially | | | | 1.14 | (0.65,2.00) | 0.653 | 1.10 | (0.62,1.96) | 0.736 |
| **Random effects variances** | | | | | | | | | |
| Country level | 1.35 | (1.11-1.63) | <0.001 | 1.15 | (1.03-1.29) | 0.012 | 1.15 | (1.03-1.30) | 0.017 |
| Variance partition | 0.08 | | | 0.04 | | | 0.04 | | |

Appendix table 4. 18: analysis omitting countries with no HIV policy documents available: APPENDIX TABLE 6: SENSITIVITY ANALYSIS, EXCLUDING SOUTH AFRICA; MULTILEVEL LOGISTIC REGRESSION ODDS RATIO (OR) AND 95% CONFIDENCE INTERVAL (CI) FOR EVER HIV TESTING IN 37 SSA COUNTIES

| | SM1: VARIANCE COMPONENTS | | | SM1: SM0 + LEGAL_CLIMATE AND MSM HIV POLICY | | | SM2: SM1 + INDIVIDUAL CHARACTERISTICS | | |
|---|---|---|---|---|---|---|---|---|---|
| n (countries) | 2,333 (37) | | | 2,333 (37) | | | 2,135 (37) | | |
| | OR | (95% CI) | p-value | OR | (95% CI) | p-value | OR | (95% CI) | p-value |
| Fixed effects | | | | | | | | | |
| Intercept | 10.50 | (7.25,15.20) | <0.001 | 1.83 | (0.93,3.61) | 0.080 | 1.33 | (0.58,3.07) | 0.506 |
| Legal_climate: Ref = illegal | | | | | | | | | |
| legal | | | | 1.93 | (1.23,3.03) | 0.005 | 2.02 | (1.24,3.28) | 0.005 |
| Targeted policy interventions: Ref= None | | | | | | | | | |
| Partially | | | | 2.60 | (1.43,4.70) | 0.002 | 2.15 | (1.12,4.12) | 0.021 |
| Random effects vhhariances | | | | | | | | | |
| Country level | 2.25 | (1.31,3.88) | | 1.15 | (0.98,1.35) | | 1.18 | (0.98,1.41) | 0.073 |
| Variance partition | 0.198 | | | 0.041 | | | 0.047 | | |

Appendix table 4. 19: analysis omitting countries with no HIV policy documents available: APPENDIX TABLE 7: SENSITIVITY ANALYSIS, EXCLUDING SOUTH AFRICA; MULTILEVEL LOGISTIC REGRESSION ODDS RATIO (OR) AND 95% CONFIDENCE INTERVAL (CI) FOR HIV TESTING IN PAST 6 MONTHS IN 37 SSA COUNTIES.

| | M0: VARIANCE COMPONENTS | | | M1: M0 + LEGAL_CLIMATE AND MSM HIV POLICY | | | M2: M1 + INDIVIDUAL CHARACTERISTICS | | |
|---|---|---|---|---|---|---|---|---|---|
| n (countries) | 2,082 (37) | | | 2,082 (37) | | | 1,939 (36) | | |
| | OR | (95% CI) | p-value | OR | (95% CI) | p-value | OR | (95% CI) | p-value |
| Fixed effects | | | | | | | | | |
| Intercept | 2.12 | (1.69,2.67) | <0.001 | 1.08 | (0.60,1.93) | 0.806 | 1.47 | (0.75,2.87) | 0.259 |
| Legal_climate: Ref = illegal | | | | | | | | | |
| legal | | | | 1.11 | (0.80,1.54) | 0.636 | 1.08 | (0.77,1.53) | 0.644 |
| Targeted policy interventions: Ref= None | | | | | | | | | |
| Partially | | | | 1.13 | (0.68,1.89) | 0.610 | 1.09 | (0.64,1.85) | 0.757 |
| Random effects variances | | | | | | | | | |
| Country level | 1.36 | (1.11,1.67) | | 1.11 | (1.01,1.21) | | 1.11 | (1.00,1.22) | 0.041 |
| Variance partition | 0.085 | | | 0.029 | | | 0.033 | | |

Supplementary analysis Paper 1

Anti-LGBTI legislations index

The ILGA's annual Global Legislation Overview of the State-Sponsored Homophobia report provides updates on the progress of countries towards legal protection for same-sex couples. The report covers four domains, (1) protection against discrimination based on sexual orientation; (2) criminalisation of consensual same-sex sexual acts between adults; (3) legal recognition of families and (4) legal barriers to the exercise of rights.

I used the ILGA 2019 report which corresponded to the legal climate at the time of the survey and assigned scores to each SSA country based on the absence of legislative protection in each domain (0= no repressive laws to 14 = most repressive laws) (supplementary analysis table 4.6). Following tabulation, the overall scores were further categorised into 0-4 = liberal, 5-9 = moderate and 10-14 = conservative.

1. Protection against discrimination based on sexual orientation - This domain consisted of six areas of protective legislation, with one point awarded for each absent law. Countries could score a maximum of six points for the domain if they have no protective laws.

2. Criminalisation of consensual same-sex sexual acts between adults - The domain consisted of four categories of punishment for same-sex practices and scores were awarded based on the severity of the punishment amounting to a maximum of four points. The lowest penalty "De Facto criminalisation" was given one point, two points were awarded to countries that have up to eight years imprisonment, three points for penalties of 10 years to life and the most server penalty "death penalty" received four points. No points were awarded to countries where same-sex relationships are legal.

3. Legal recognition of families – This domain included marriage and adoption rights as the two areas of progressive legislation. Countries were awarded one point for "No

marriage or other forms of legal union for same-sex couples" and "No adoption open to same-sex couples", amounting to a maximum of two points.

4. Legal barriers to the exercise of rights – similarly, this domain measured two areas with one point awarded for the existence of each barrier. Countries could score a maximum of two points for having "Legal barrier to freedom of expression on sexual orientation, gender expressions and/or sex characteristics SOGIESC issues" and "Legal barriers to the registration or operation of sexual orientation related CSOs".

After collating the scores, only South Africa was in the 'Liberal' category with most of the other SSA countries in the 'Conservative' category, so it was evident that a binary measure of 'legal' and 'illegal' could be better for the SSA dataset. The information elicited from this index was important when evaluating the findings from the sensitivity analysis in the first paper (see Paper 1 below).

Supplementary Analysis Table 4. 6. Absence Of Legislative Protection Using The ILGA 2019 Report Measures

| Country | Protection against discrimination based sexual orientation | | | | | | criminalisation of consensual same-sex sexual acts between adults | | | | legal recognition of families | | legal barriers to the exercise of rights | | Total score |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | No Constitutional protection | No Broad Protection | No Employment protection | No criminal liability for hate crime | No prohibition of incitement to hatred, violence, or discrimination | No bans on 'conversion therapy' | De Facto criminalisation | Up to 8 years imprisonment | 10 years to life in Prison | Death Penalty | No marriage or other forms of legal union for same-sex couples | No adoption open to same-sex couples | Legal barrier to freedom of expression on SOGIESC issues | Legal barriers to the registration or operation of sexual orientation related CSOs | |
| South Africa | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 |
| Angola | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 5 |
| Cabo Verde | 1 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 7 |
| Botswana | 1 | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 8 |
| Mozambique | 1 | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 8 |
| Seychelles | 1 | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 8 |
| Benin | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 9 |
| Central African Republic (the) | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 9 |
| Congo | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 9 |
| Côte d'Ivoire | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 9 |
| Equatorial Guinea | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 9 |
| Guinea-Bissau | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 9 |
| Lesotho | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 9 |
| Madagascar | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 9 |
| Mauritius | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 9 |
| Niger | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 9 |

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Rwanda | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 9 |
| Chad | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 10 |
| Democratic Republic of the Congo (the) | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 10 |
| Mali | 1 | 1 | 1 | 0 | 1 | 1 | 0 | 2 | 0 | 0 | 1 | 1 | 1 | 1 | 10 |
| Eritrea | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 2 | 0 | 0 | 1 | 1 | 1 | 0 | 11 |
| Eswatini | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 2 | 0 | 0 | 1 | 1 | 1 | 0 | 11 |
| Gabon | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 2 | 0 | 0 | 1 | 1 | 1 | 0 | 11 |
| Ghana | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 2 | 0 | 0 | 1 | 1 | 1 | 0 | 11 |
| Guinea | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 2 | 0 | 0 | 1 | 1 | 1 | 0 | 11 |
| Liberia | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 2 | 0 | 0 | 1 | 1 | 1 | 1 | 11 |
| Namibia | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 2 | 0 | 0 | 1 | 1 | 1 | 0 | 11 |
| Togo | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 2 | 0 | 0 | 1 | 1 | 1 | 0 | 11 |
| Zimbabwe | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 2 | 0 | 0 | 1 | 1 | 1 | 0 | 11 |
| Burundi | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 2 | 0 | 0 | 1 | 1 | 1 | 1 | 12 |
| Cameroon | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 2 | 0 | 0 | 1 | 1 | 1 | 1 | 12 |
| Ethiopia | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 2 | 0 | 0 | 1 | 1 | 1 | 1 | 12 |
| Gambia | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 0 | 3 | 0 | 1 | 1 | 1 | 0 | 12 |
| Kenya | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 2 | 0 | 0 | 1 | 1 | 1 | 0 | 12 |
| Senegal | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 3 | 0 | 1 | 1 | 1 | 1 | 12 |
| Sierra Leone | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 3 | 0 | 1 | 1 | 1 | 0 | 12 |
| South Sudan | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 3 | 0 | 1 | 1 | 1 | 0 | 12 |
| United Republic of Tanzania | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 3 | 0 | 1 | 1 | 1 | 1 | 12 |
| Malawi | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 3 | 0 | 1 | 1 | 1 | 1 | 13 |
| Uganda | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 3 | 0 | 1 | 1 | 1 | 1 | 13 |
| Zambia | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 3 | 0 | 1 | 1 | 1 | 1 | 13 |
| Mauritania | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 4 | 1 | 1 | 1 | 1 | 14 |
| Nigeria | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 4 | 1 | 1 | 1 | 1 | 14 |

## Reviews of National Strategic Frameworks/National Strategic Plans in SSA

The NSP/NSF documents of 38 SSA countries were reviewed for the inclusion of the WHO recommended interventions for MSM. These are a combination of HIV prevention, diagnosis, care and treatment interventions focused on high-risk behaviours with the intention to avert new HIV infections.

Review included the use of a checklist (supplementary analysis table 4.7) and NSP/NSF documents had to meet a set of criteria's to be deemed as including targeted interventions for MSM. These included:

The mention of combination HIV prevention interventions for MSM had to specifically and explicitly mentioned MSM separately. Any mention of combination HIV prevention interventions under the general population only was not accepted.

If there was not a separate section for MSM interventions but objectives with indicators measuring interventions that target MSM were included anywhere within the NSF/NSP, this was accepted.

If MSM is mentioned in the NSF/NSP but no interventions are mentioned, for example, in the case of planning for size estimation for MSM populations, this was not accepted.

Table 4. 7. Interventions checklist

| HIV prevention | | Yes | No |
|---|---|---|---|
| condoms | Is **condom programming** targeting key populations recommended? | | |
| Lubricants | Is programming for **condom-compatible lubricants** recommended? | | |
| PrEP | Is it recommended to offer oral **pre-exposure prophylaxis (PrEP)** to key populations (as an additional prevention choice)? | | |
| PEP | **Is post-exposure prophylaxis (PEP)** available for eligible key populations (on a voluntary basis)? | | |
| Harm reduction for people who inject drugs | | Yes | No |

| | | Yes | No |
|---|---|---|---|
| Needle and syringe programmes | Is **needle and syringe programming** recommended? | | |
| Opioid substitution therapy | Is **opioid substitution therapy** recommended? | | |
| Naloxone | Is **community distribution of naloxone** recommended? | | |
| **HIV Testing and Counselling** | | **Yes** | **No** |
| Community-based HIV testing and counselling | Is **community-based HIV testing and counselling** recommended? | | |
| provider-initiated testing and counselling | Is **provider-initiated testing and counselling** recommended? | | |
| Self-testing | Is **self-testing** recommended? | | |
| **HIV Treatment and Care** | | **Yes** | **No** |
| Equitable ART | Is it recommended that key populations living with HIV have the same access to **antiretroviral therapy (ART)** as other populations? | | |
| **Sexual and reproductive health** | | **Yes** | **No** |
| STI screening and treatment | Is routine offer of **screening, diagnosis and/or treatment of sexually transmitted infections** for key populations recommended? | | |

Note: The checklist was adapted from the interventions checklist from the 'Focus on key populations in national HIV strategic plans in the African region [33].

# 5 Research paper 2: Associations of Internalised Homonegativity with HIV testing and HIV risk behaviours of MSM in sub-Saharan Africa (under review)

This chapter first presents findings on the associations of Internalised Homonegativity with HIV testing and HIV risk behaviours of MSM in Sub-Saharan Africa, which is followed by a supplementary materials section.

Then in the supplementary analysis section, I detailed methods applied in the analysis of the second paper which are not included in the paper. I present an overview of the distribution of the responses by MSM in SSA on the 7-items IH scale, highlighting the missingness in the data. I then show a detailed exploration of the scale using principal components analysis and how the decision was made to use the reduced 5-item scale in this dataset. Finally, I provide further details of the multiple imputation methods used in the analysis.

This research paper applies multilevel analysis on the cross-sectional dataset and has been submitted for peer-review in BMC Public Health.

# RESEARCH PAPER COVER SHEET

Please note that a cover sheet must be completed <u>for each</u> research paper included within a thesis.

SECTION A – Student Details

| Student ID Number | Lsh333933 | Title | Ms |
|---|---|---|---|
| First Name(s) | Ngozi | | |
| Surname/Family Name | Kalu | | |
| Thesis Title | Discrimination and Health: Effects of Internalised Homonegativity, Discriminatory Laws and policies on HIV-related behaviours of men who have sex with men living in Sub-Saharan Africa | | |
| Primary Supervisor | Melissa Neuman | | |

If the Research Paper has previously been published please complete Section B, if not please move to Section C.

SECTION B – Paper already published

| Where was the work published? | | | |
|---|---|---|---|
| When was the work published? | | | |
| If the work was published prior to registration for your research degree, give a brief rationale for its inclusion | | | |
| Have you retained the copyright for the work?* | Choose an item. | Was the work subject to academic peer review? | Choose an item. |

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SECTION C – Prepared for publication, but not yet published

| Where is the work intended to be published? | BMC Public Health |
|---|---|

| Please list the paper's authors in the intended authorship order: | Ngozi Kalu, Michael Ross, Miriam Taegtmeyer, Neil Spicer, Sylvia Adebajo, Rotimi Owolabi, Erik Lamontagne, Sean Howell, Melissa Neuman |
|---|---|
| Stage of publication | **Submitted** |

## SECTION D – Multi-authored work

| For multi-authored work, give full details of your role in the research included in the paper and in the preparation of the paper. (Attach a further sheet if necessary) | I conceptualised, collected the country-level measures, conducted all the statistical analyses and wrote the draft of the papers. I coordinated the reviews of the paper by co-authors and incorporated feedback through an iterative process |
|---|---|

## SECTION E

| Student Signature | NOKalu |
|---|---|
| Date | 19/12/22 |

| Supervisor Signature | Melissa Neuman |
|---|---|
| Date | 19/12/2022 |

**Title:** Associations of Internalised Homonegativity with HIV testing and HIV risk behaviours of MSM in Sub-Saharan Africa

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**Suggested running head:** Internalised Homonegativity, HIV testing and HIV-risk behaviours

**Declarations**

## Abstract

**Background**: In sub-Saharan Africa (SSA), prevalence of HIV is estimated to be five times higher among men who have sex with men (MSM) than men in the general population. Chronic exposure to homophobia can culminate in psychological harm such as Internalised homonegativity (IH), which is characterised by the internalisation of negative attitudes and assumptions about homosexuality. This study assesses the associations of IH with HIV testing and risk behaviours of adult MSM in SSA, and effect modification by the legal climate, using data from the cross-sectional 2019 Global LGBTI Internet Survey study

**Methods**: We assessed the associations of IH with ever and recent HIV testing, paying for sex, selling sex and unprotected anal sex of 3,191 MSM in 44 SSA countries using logistic multilevel analyses. We also assessed if the legal climate modifies any of the associations of IH with the study outcomes.

**Results**: Our findings showed high levels of IH in MSM across SSA (mean[SD]=5.3 (1.36)). We found that MSM with higher IH levels were more likely to have ever (aOR=1.18, 95%CI=1.02,1.36) and recently tested (aOR=1.19, 95%CI=1.07,1.32) but no evidence of an association with paying for sex (aOR=1.00, 95%CI=0.90,1.12), selling sex (aOR=1.06, 95%CI=0.95,1.19), and unprotected sex (aOR=0.99, 95%CI=0.89,1.09). However, we observed strong evidence that a favourable legal climate modifies the associations of IH paying for sex (aOR=0.75, 95%CI=0.59,0.93) Increasing levels of IH had a negative association with paying for sex in countries where same-sex relationships are legal. We found no associations of IH with unprotected anal sex in the population surveyed.

**Conclusions**: We confirm that IH is widespread across SSA but in countries that legalise same-sex relationships, MSM report better testing and sexual risk outcomes compared to those in countries where homosexuality is criminalised.

**What is already known on this topic –**

- Men who have sex with men are disproportionately affected by HIV in sub-Saharan Africa
- Same-sex relationship criminalisation exposes men who have sex with men to increased levels of homophobia that can result in Internalised homonegativity
- Internalised homonegativity has been associated with negative HIV-related behavioural outcomes of MSM but there are limited studies of these associations in sub-Saharan Africa.

**What this study adds -**

- We report high levels of Internalised homonegativity across sub-Saharan Africa
- Our findings show that the associations of internalised homonegativity with HIV-related behavioural outcomes vary depending on the legal climate of the country.
- Increasing level of internalised homonegativity is associated with reduced odds of paying for sex by MSM in countries with legalised same-sex relationships compared to those in countries where homosexuality is illegal.

**How this study might affect research, practice and policy -**

- Removal of same-sex criminalisation laws is an important first step in reducing the inequalities in HIV acquisition by MSM in sub-Saharan Africa, but this alone will not result in adequate HIV control in this population. Further research is needed into comprehensive interventions that adequately account for the complex country-level and individual-level processes that influence MSM's vulnerabilities to HIV in sub-Saharan Africa.

## Introduction

Globally, declines in the number of new HIV infections have stalled. In 2021, there were around 1.5 million new cases of HIV of which 58% were in Sub-Saharan Africa (SSA). Since 2010, there has only been a decline of new cases by 31%, which is a far cry from the UNAIDS target of 75% by 2020. In SSA one of the population's most affected by HIV are MSM, who are five times as likely to be living with HIV than men in the general population.[49]

Countries in the region have adopted combination structural, behavioural and biomedical HIV prevention interventions for MSM to varying degrees, but the absence of an enabling environment such as inclusive policies, and access to non-stigmatising health services are greatly reducing their impact[236]. Notably, more than half of the countries in the SSA region have failed to create an enabling environment, as many have laws that criminalise same-sex relationships.[34] Structural discrimination such as same-sex criminalisation laws violate human rights and causes psychological harm that impacts the development of a sense of self in MSM.[71]

A psychosocial factor of particular interest to researchers has been Internalised Homonegativity (IH), which encompasses the internalisation of negative attitudes and assumptions about homosexuality, leading to feelings of guilt, inferiority and lack of self-worth.[11,16] Studies into IH in MSM have reported associations with the legal environment and increased HIV-risk behaviours[16,71]. In criminalised climates, MSM report higher levels of human rights violations such as harassment and extortions by law enforcement and experiences of social rejection.[237] Processing these chronic stressors result in internalisation which leads to developing either protective or harmful coping mechanisms. Researchers in Europe and the USA have reported IH as playing significant roles in HIV-related health outcomes of MSM but there is still very little known about IH and its related health vulnerabilities in SSA.[16,65] Literature on South African, Nigerian and Ugandan MSM have reported both protective and negative outcomes of IH.[104] MSM with IH can adopt avoidance as a coping mechanism, including not seeking care or avoiding affiliations with other MSM. Coping through avoidance has implications for HIV control programming for MSM as effective methods to reach these hidden populations with HIV interventions rely on

community networks. MSM who are not linked to any community groups as a result of IH or fear of legal repercussions might not be reached with vital HIV intervention messaging. With limited progress being made in reducing the number of new infections, there is an urgent need to understand the role of IH in the HIV epidemic in SSA MSM.

Using data from the 2019 Global LGBTI Internet, we report findings from multilevel analyses of MSM in 44 SSA countries. We measured the level of IH in SSA and examined the association of IH with HIV testing and HIV-risk behaviours of MSM in SSA. We then accessed effect modification by the legal climate.

## Methods

### *Study design and setting*

We conducted a secondary analysis of data collected from the 2019 Global LGBTI+ Happiness Survey. The study was a combined project of the Joint United Nations Programmes on HIV/AIDS (UNAIDS), the LGBT Foundation, the University of Aix-Marseille and the Medical School of the University of Minnesota.[19] The methods for the study have been described in detail elsewhere.[19] Briefly, adult LGBTI participants were recruited through their social networks, e.g., the LGBT Foundation social networks, as well as national and regional LGBTI or human rights community networks, advocates and celebrities. Facebook, Instagram, Twitter, Wechat, Weibo, and WhatsApp advertisements promoting the study were also used. Facebook was the main promotion platform for countries without LGBTI dating apps and UNAIDS country teams supported creating visibility of the study in these locations. The questionnaire was disseminated online from May to December 2019 without any geographical restrictions in 32 different languages, 7 of which are official languages in SSA. Participation was voluntary and no monetary incentives were given. Participants accessed the online anonymous survey on SurveyMonkey via an encrypted connection link. The survey exclusion criteria were participants who did not provide consent, were under the age of 18 or did not provide a numerical value for age and those did not self-identify as LGBTI+.

Overall, data were collected online from 46 SSA countries, and in these secondary analyses, we looked at data from 44 SSA countries. The two SSA countries excluded did not

have responses from MSM. Our inclusion criteria were self-identified HIV-negative MSM, age 18 and over; born male; gay/bisexual/unsure; and living in countries with available national HIV policy documents covering the survey time frame.

## Theoretical frameworks

Meyer's minority stress model and Krieger's ecosocial theory of disease distribution were used to frame the study and guide the selection of study covariates.[11,20,35] The minority stress model provides a focused theory for conceptualising internalised homophobia and its relationships with other outcomes of individual stress coping mechanisms by minority groups in response to chronic negative social experiences.[63]

## Measures

## Outcomes

Our response variables are self-reported binary indicators of ever tested for HIV, recently tested in the past 6 months (from those who reported ever testing), Transactional sex (paying for and being paid for sex in the past 12 months), and unprotected anal sex (that is without a condom or PrEP) with a non-steady partner.

## Exposure variables

We included measures of country-level and individual-level covariates identified in the literature to have associations with IH and the study outcomes.

## Country-level variables

We included two country-level covariates in the models: legal climate and targeted HIV-policy. Countries are classified as legal or illegal based on whether same-sex relationships are or are not criminalized, using the legal classification reported in the International Lesbian, Gay, Bisexual, Trans and Intersex Association (ILGA World)[151]. We included targeted policy, measured as none, partial or full inclusion of the WHO recommended interventions for MSM in the national HIV policies covering the survey period [28,29].

## Individual-level variables

All individual-level measures used in the analysis are based on self-reported data

## Main Exposure

The main exposure variable IH is measured using a shorter 5-item version of the 7-item scale.[238] Each item is measured on a 7-point Likert scale (1= lowest IH score to 7=highest level of IH).

## Covariates

Demographic, socioeconomic and geographic explanatory variables collected in the survey are used as covariates, such as age measured in four categories; education measured as none/primary school, Secondary/high school, University first degree, and Masters/doctorate; reports of economic pressure of respondents scored between 1 to 5 as ordinal categorical data. The higher the score, the lower the economic pressure and therefore presumed higher income; and size of settlement was measured on a 3-point scale ranging from 'a major city, a medium or small size city, and a village/farm or isolated house.

## Study size

Forty-four SSA countries and 3,275 Adult MSM were potentially eligible. After we applied the eligibility criteria, 44 countries and 3,191 MSM were retained. We could not access the HIV policy documents in 6 of the countries included in our analysis, so these were coded as providing no targeted interventions for MSM.

## Statistical methods

All statistical analyses were conducted on Stata/SE 17.0.

We used descriptive statistics to summarise the distribution of our study outcomes and IH distribution by legal climate and sociodemographic characteristics of MSM including age, education, sexual orientation, income and Type of place of residence.

We applied logistic 2-level multilevel analyses to study the associations of IH with the study outcomes. The hierarchical structure had individuals at level-1 (n=3,191) nested within 44 countries at level-2. Using multilevel models, we explored between-country variation in HIV-related behavioural outcomes. The estimation procedure used was the maximum

likelihood estimation procedure using adaptive quadrature points (7 integration points used unless otherwise stated), which is the only procedure in Stata[239].

We performed bivariate multi-level analyses with country as random effects, to assess the associations of IH with the country-level and individual-level covariates. Keeping country as random effects, we included fixed effects adjusted for all country-level and individual-level explanatory variables (supplementary material, model equation 1). Finally, we performed a cross-level interaction. We allowed the effect of IH on HIV testing and risk behaviour outcomes to depend on the legal climate and include an interaction between IH and legal climate (supplementary material, model equation 2). For each model, we used the margins command to obtain predicted probabilities for evert testing by MSM with IH in countries where same-sex relationships are legal and illegal. These steps are then repeated for all outcome variables.

### Missingness

We conducted a systematic assessment of missingness for each variable, all but the IH variable were considered to be missing completely at random (MCAR) with less than 4% missing data. We determined that the IH variable mechanism of missing data was missing at random (MAR). We applied multiple imputation (MI) using fixed effects suitable for multilevel models to handle the missing data in the variables used in the models (appendix pp2).

### Measuring Internalised Homonegativity

IH was measured using a 5-item scale with two IH factors. The scores were additive, ranging from 1 (strongly agree) to 7 (strongly disagree). For example, the first item from the factor measuring personal comfort with homosexuality, 'even if I could change my sexual orientation, I would not'; denoted a positive attitude to a homosexual identity and was assigned a score of 1 for strongly agree, 4 for undecided and 7 for strongly disagree. All the scores from the scores were added and the average was calculated. A higher IH score represents higher levels of IH. The scores were used as a continuous measure in the analysis. We conducted exploratory factor analyses "principal components analysis (PCA)" with oblique rotation, to verify the factorial structure of the 7-item IH scale in the sample of SSA MSM (See results section for the full details)

*Sensitivity analyses*

We conducted sensitivity analyses for all the study outcomes by comparing complete case analysis results with those from MI analysis.

**Patient and Public Involvement statement**

Patients were not involved.

## Results

### Descriptive analysis

Among the MSM included in the study, 2,743/3,188 (86.0%) had ever tested, 1,818/2,743 (66.3%) have recently tested in the past 6 months, 566/2,759 (20.5%) reported paying for sex in the past 12 months, 688/2,754 (25.0%) have been paid for sex in the past 12 months, and 1,030/2,549 (40.4%) have had unprotected anal sex in the past 3 months. Mean level of IH across SSA was 5.3 (std 1.36), range 4.1 to 7.0, in non-criminalised countries, IH mean 5.6 (std 1.32), range 4.4 to 7.0, and in criminalised countries, IH mean 5.0 (std 1.35) range 4.1 to 6.0. Table 5.1 describes the bivariate distribution of IH and key explanatory variables in the analytic sample. The median age category of 24-34 1,403/3,185 (44.1%), the proportion of respondents with above secondary education 1,670/3,150 (53.0%), most of the respondents resided in major cities, 1,896/3,150 (60.2%), and most were single 1,818/3,073 (59.2%). Strong evidence of a positive association of IH with increasing age, sexual orientation and being in a relationship. We observed a negative association of IH with increasing levels of education

### Internalised Homonegativity

There was large amount of missingness in the main study exposure IH using the initial 7-item scale with three factors (n= 1,079 (33.9%)). After tabulating each item on the IH scale, we found that the data were MAR and over 25% of the responders had missing values for the factor measure for 'social comfort with gay men (SC)', which included items 'I feel comfortable in gay bars' and 'Social situations with gay men make me feel uncomfortable'. The Kaiser-Meyer-Olkin measure confirmed the sampling adequacy of the analysis, KMO = 0.760. Bartlett test of sphericity $\chi^2(21)$ = 2934.894, p<0.001, indicated that the correlation structure was adequate for factor analysis.

In the PCA with promax rotation, 2 factors were extracted with good internal consistency, Cronbach's alpha= 0.704 (see table 5.2). The results showed that the 2 items measuring SC don't correlate with each other or with the other items (supplementary material, table 5.1 and 5.2). The decision was made to drop these items and use the IH measure as a 5-item scale. Retained factors included:

Factor 1 "Personal comfort with a gay identity" includes the same 2 items from the original measure.

Factor 2 "Public identification as gay (PUBID)" includes the same 3 items from the original measure

Overall, the mean IH scores using the 5-item scale was 5.3 std 1.36, with national-level mean ranging from 4.1 to 7.0 (supplementary material, table 5.3). We used multiple imputation to handle the remaining missing data (21.6%).

## IH and HIV Testing Behaviours

In the models adjusted for country-level and individual-level covariates (table 5.3 and appendix table 5.4), there was strong evidence of a positive association of IH with increased odds of MSM having ever tested (aOR 1.18, 95%= 1.02,1.36) and recently tested (aOR=1.19, 95% CI= 1.07,1.32).

## HIV Risk Behaviours

After adjusting for country-level and individual-level characteristics there was no evidence of an association of IH with HIV risk behaviours of paying for sex (aOR=1.00, 95% CI=0.90,1.12), selling sex (aOR=1.06, 95% CI=0.95,1.19), and unprotected sex (aOR=0.99, 95% CI=0.89,1.09), (see table 5.3 and supplementary material table 5.4).

## Cross-level interaction between legal climate and internalised homonegativity

To assess if the legal climate modifies any of the relationships of IH with the study outcomes, we add an interaction term to the model ( see table 5.4 and supplementary material table 5.5). We found strong evidence that the legal climate moderates the association between IH with transactional sex in SSA MSM. IH was associated with reduced odds of paying for sex (aOR 0.75, 95% CI= 0.59,0.93) by MSM in countries where same-sex relationships are legal and with increasing odds of paying for sex (aOR 1.15, 95% CI= 0.98,1.36) by MSM in same-sex criminalised settings. There was suggestive evidence that predicted odds of ever testing by MSM increased with increasing IH levels in countries where same-sex relationships are legal (aOR 1.29 95% CI= 0.98,1.69), compared with the increased

predicted odds of ever testing (aOR 1.04, 95% CI= 0.86,1.26) in countries where same-sex relationships are illegal. In contrast, we found suggestive evidence that MSM in countries where same-sex relationships are illegal had increased odds of recent testing (aOR 1.15, 95% CI= 0.99,1.35), compared with the increased predicted odds in countries where same-sex relationships are legal (aOR 1.06, 95% CI= 0.86,1.30).

## Sensitivity analyses

In the sensitivity analyses, we observed minimal changes in the effect estimates using complete case analysis (supplementary material table 5.6 and 5.7). The strength of the effect modification by the legal climate on the association between IH with ever testing became stronger (aOR 1.40, 95% CI= 1.07,1.85).

Table 5. 1: study characteristics by Internalised Homonegativity (n=44 countries)

| | IH n=2,503 (%) | 5.36 (1.36) | | *P value |
|---|---|---|---|---|
| **Sociodemographic factors** | | M | SD | |
| **Age,** | 2,501 | 5.32 | 1.36 | 0.002 |
| 18-24 | 969 (38.7) | 5.27 | 1.38 | |
| 25-34 | 1,102 (44.1) | 5.26 | 1.33 | |
| 35-44 | 294 (11.8) | 5.49 | 1.43 | |
| 45+ | 136 (5.4) | 5.81 | 1.18 | |
| **Sexual orientation, n (%)** | 2,485 | 5.33 | 1.36 | <0.001 |
| Gay | 1,853 (74.6) | 5.51 | 1.29 | |
| Bisexual | 572 (23.0) | 4.82 | 1.40 | |
| I don't know | 60 (2.4) | 4.57 | 1.70 | |
| **Relationship status, n (%)** | 2,445 | 5.33 | 1.36 | <0.001 |
| Single | 1,456 (59.6) | 4.79 | 1.38 | |
| In a relationship with a man | 740 (30.3) | 5.60 | 1.25 | |
| In a relationship with both a man &woman, or woman or transgender person | 250 (10.2) | 5.28 | 1.37 | |
| **Socioeconomic status** | | | | |
| **Education, n(%)** | 2,496 | 5.32 | 1.36 | 0.002 |
| None/ primary school | 159 (6.4) | 5.29 | 1.25 | |
| Secondary/high school | 1,014 (40.6) | 5.44 | 1.31 | |
| University first degree | 974 (39.0) | 5.30 | 1.36 | |
| Masters/doctorate | 349 (14.0) | 5.05 | 1.47 | |
| **Income, n(%)** | 2,466 | 5.32 | 1.36 | 0.218 |
| really struggling on present income | 350 (14.2) | 5.29 | 1.34 | |
| struggling on present income | 663 (26.9) | 5.23 | 1.31 | |
| neither comfortable nor struggling on present income | 915 (37.1) | 5.30 | 1.38 | |
| living comfortably on present income | 328 (13.3) | 5.49 | 1.36 | |
| living really comfortably on present income | 210 (8.5) | 5.48 | 1.44 | |
| **Type of place of residence** | | 5.32 | 1.36 | |
| **size of settlement, n(%)** | 2,496 | 5.35 | 1.34 | 0.359 |
| Farm/isolated house/Village | 200 (8.0) | 5.28 | 1.33 | |
| Medium or small size city | 783 (31.4) | 5.34 | 1.38 | |
| Major city | 1,513 (60.6) | 5.32 | 1.36 | |
| **Structural variables** | | | | |
| **Legal Climate** | 2,503 | 5.32 | 1.36 | 0.011 |
| Criminalised | 1,089 (43.5) | 5.00 | 1.35 | |
| Non-criminalised | 1,414 (56.5) | 5.67 | 1.32 | |

* In random effects model adjusted for country as random effect, P value was calculated using multivariate Wald test (joint χ2)
Note: Descriptive sample characteristics reported here are before multiple imputation to address missing data.

Table 5. 2: Principal components analysis of the short Internalised Homonegativity Scale

| | Item | n with IH score | Factor | | Dimensions |
|---|---|---|---|---|---|
| | | | 1 | 2 | |
| 6 | Homosexuality is morally acceptable to me | 2,715 | **0.81** | 0.18 | **Personal comfort with a gay identity (PC)** |
| 5 | I feel comfortable being a homosexual man | 2,708 | **0.78** | 0.19 | |
| 7 | Even if I could change my sexual orientation, I wouldn't | 2,642 | **0.69** | 0.15 | |
| 3 | I feel comfortable being seen in public with an obviously gay person | 2,655 | 0.20 | **0.80** | **Public identification as gay (PUBID)** |
| 4 | I feel comfortable discussing homosexuality in a public situation | 2,666 | 0.27 | **0.76** | |
| *2 | Social situations with gay men make me feel uncomfortable | 2,543 | -0.16 | **0.50** | **Social comfort with gay men (SC)** |
| *1 | I feel comfortable in gay bars | 2,357 | 0.36 | **0.43** | |

Notes. Extraction method; maximum likelihood; rotation method; Promax with kaiser off. Loadings of 0.4 or larger are in bold

*measure not included in the final analysis

Table 5. 3: Multilevel logistic regression Odds ratio (OR) and 95% Confidence Interval (CI) HIV testing  and HIV risk behaviours

| | Ever tested | | Recent tested | | Paid for sex | | Sold sex | | Unprotected sex | |
|---|---|---|---|---|---|---|---|---|---|---|
| **n  (countries)** | 43 | | 43 | | 43 | | 42 | | 42 | |
| | aOR (95% CI) | p-value | aOR (95% CI) | p-value | aOR (95% CI) | p-value | aOR (95% CI) | p-value | aOR (95% CI) | p-value |
| **Intercept** | 1.76 (0.80,3.74) | 0.159 | 2.12 (1.24,3.63) | 0.008 | 0.14 (0.73,0.27) | <0.001 | 0.26 (0.11,0.62) | 0.002 | 0.54 (0.31,0.97) | 0.038 |
| ***Internalised Homonegativity (range 1-7)** | 1.18 (1.03,1.35) | 0.019 | 1.19 (1.07,1.32) | 0.001 | 1.00 (0.89,1.12) | 0.952 | 1.06 (0.95,1.20) | 0.312 | 0.99 (0.89,1.09) | 0.788 |
| **Legal_climate: Ref = illegal** | | | | | | | | | | |
| legal | 2.36 (1.18,4.74) | 0.015 | 1.16 (0.76,1.76) | 0.487 | 0.88 (0.53,1.46) | 0.623 | 1.39 (0.68,2.84) | 0.305 | 1.10 (0.70,1.76) | 0.674 |
| **Random effects variances** | | | | | | | | | | |
| Country level | 2.41 (1.80,3.23) | <0.001 | 1.70 (1.44,2.00) | <0.001 | 1.79 (1.47,2.17) | <0.001 | 2.69 (2.01,3.60) | <0.001 | 1.84 (1.53,2.22) | <0.001 |
| Variance partition | 0.211 | | 0.139 | | 0.166 | | 0.231 | | 0.156 | |

*standardised values of the IH score

Table 5. 4: Effect modification/cross-level interaction Odds ratio (OR) and 95% Confidence Interval (CI) HIV testing  and HIV risk behaviour's

| | Ever tested | | Recent tested | | Paid for sex | | Sold sex | | Unprotected sex | |
|---|---|---|---|---|---|---|---|---|---|---|
| | aOR (95% CI) | p-value | aOR (95% CI) | p-value | aOR (95% CI) | p-value | aOR (95% CI) | p-value | aOR (95% CI) | p-value |
| **IH x Legal_climate** | 1.29 (0.98,1.69) | 0.068 | 1.06 (0.86,1.30) | 0.587 | 0.75 (0.60,0.94) | 0.012 | 1.05(0.83,1.33) | 0.679 | 0.93 (0.77,1.13) | 0.492 |
| **IH at legal** | 1.29 (0.98,1.69) | 0.068 | 1.06 (0.86,1.30) | 0.587 | 0.75 (0.60,0.94) | 0.012 | 1.05(0.83,1.33) | 0.679 | 0.93 (0.77,1.13) | 0.492 |
| IH at illegal | 1.04 (0.86,1.26) | 0.661 | 1.15 (0.99,1.35) | 0.073 | 1.15 (0.98,1.36) | 0.094 | 1.05 (0.89,1.25) | 0.544 | 1.02 (0.89,1.18) | 0.771 |

## Discussion

Our findings show high levels of IH in MSM across SSA. We found that with increasing IH levels, MSM living in SSA were more likely to have ever tested and recently tested. We found no associations of IH with transactional sex and unprotected anal sex in the population surveyed. However, after we account for the effect modification of the legal climate, we found strong evidence that the legal climate modified the effect of IH with transactional sex. We observed that as levels of IH increased, MSM in countries with legalised same-sex laws were less likely to pay for sex whilst MSM in countries where same-sex relationships are criminalised were more likely to pay for sex in the past 12 months. There was suggestive evidence of effect modification of the association between IH with ever testing and recent testing by the legal climate. With increasing IH levels, MSM in countries where same-sex relationships are legal had higher odds of ever testing than those in countries where same-sex relationships are illegal but increased odds of recent testing by MSM in countries where same-sex relationships are illegal than those in countries where same-sex relationships are legal. No effect modification of the legal climate on selling sex or unprotected anal sex was observed.

Compared to the mean national level of IH found in SSA MSM, MSM across European countries (EMIS study) reported lower mean national levels of IH (range 1.22 to 2.58), although measured using the 7-item IH scale[16]. Importantly, another study on the European data showed that the 7-item IH scale was useful for people who identified themselves as gay, but not for those who identified as bisexual, who presumably did not identify as homosexual leading to lower IH scores[238]. Additionally, our findings show that the effects of IH are different on MSM in the SSA context compared to MSM in the European context where increases in IH levels resulted in a reduction in HIV testing and increased condomless sex with non-steady partners[16]. Studies in the USA comparing IH levels across different races found African American MSM to have higher IH levels compared to European American, Latino and MSM of other races/ethnicities, but the levels reported were still not as high as those we report in our SSA sample[65]. This could be due to sociocultural factors such as politics, religion, laws, culture and other historical factors that influence the gender norms that exist within societies and impact the daily interactions of SSA MSM[240]. This is also in line with Meyer's

assertion that IH is socially based and therefore unique to their minority status[11]. Findings of the association of IH with HIV risk behaviours in SSA are varied. In part, our findings on HIV-related risk behaviours are similar to those reported by other researchers in SSA. In a South African study, IH was found to have a protective effect on sexual risk behaviours of MSM.[88] In contrast, studies of MSM in Nigeria, and Uganda found that increasing levels of IH were associated with increased sexual-risk behaviour but not with transactional sex[64,104]. It is important to note that studies on IH associations have used various scales in measuring IH with varying reliability and validity and there is still limited research related to the measure of IH in SSA MSM.

While high IH levels are reported in both legal and illegal climates in SSA, an important distinction influencing health outcomes could be the availability of social networks in countries where same-sex relationships are legal. Laws criminalising same-sex relationships can include the prohibition of any homosexual clubs or group gatherings, depriving MSM access to group support[151]. LGBTI online networking sites could be a source for accessing peer support for MSM in hostile settings, but this also has limited accessibility for those from lower socioeconomic backgrounds or not in major cities[241]. Unsurprisingly, items measuring social comfort with gay men had the highest percentage of missingness in our data, which we theorise to be yet another outcome of the barriers in operating social spaces for LGBTI+ communities in countries that criminalise same-sex relationships. If there aren't opportunities to mingle with other MSM safely, then these items may be too culturally bound to the assumed existence of a gay subculture. The findings from the PCA provided further evidence in support of the uniqueness of these items measuring social comfort in our dataset. Complex social factors at the individual-level such as enacted and anticipated stigma and discrimination can also contribute to the high levels of IH in SSA MSM[85]. Many countries with legalised same-sex laws score quite low on their LGBT Global Acceptance Index (GIA), which is an index that combines a measure of public beliefs regarding LGBTI people and policies[86]. Such contrasts in legal climate and social climate can provide some understanding of why researchers still report high levels of violence and discrimination against MSM in countries with legalised same-sex relationships in SSA[242,243]. Such contrasts between social and legal factors can also explain why MSM in our study living in countries where same-sex relationships are legal reported higher levels of IH compared to those in same-sex

criminalised settings. In addition, the opportunities to socialise and to live openly could also mean that MSM in same-sex legalised settings are more likely to experience circumstances in the social environment that lead to exposure to minority stressors such as discrimination or violence as proposed in the minority stress model [11]. Such experiences involve minority stress processes which are more proximal to the individual, resulting in IH.

IH has also been found to have associations with the selection of both positive and negative coping strategies[105]. Whilst some LGBTI choose avoidance as a coping mechanism, others choose acceptance of their sexual identity. The type of coping mechanism chosen then determines if IH has a detrimental health impact or not. As such, MSM in our study from countries where same-sex relationships are legal most likely have greater opportunities to choose positive coping mechanisms. As an example, research suggests that the opportunities for and risks in engaging socially are more important determinants than the function of internalisation[63,65]. In the minority stress model, access to social support is an important coping mechanism for dealing with minority stress [63]. Belonging to a community can lessen the psychological aspect of stress process, most especially for single MSM[75]. Research has shown that in the absence of group-level resources, even the most resourceful individuals have been found to struggle to cope[11]. Furthermore, MSM will tend to hold themselves to the values of the group rather than that of the dominant culture[11]. A study in South Africa found that sexual-risk behaviours of MSM were linked to MSM social network affiliation[244]. Peers have been an effective way of reaching MSM with information on sexual health interventions and linkage to safe health facilities to access testing services, e.g., respondent-driven sampling[209,245,246]. It is plausible that MSM that are disconnected from peers or LGBTQ+ networks are less likely to meet sexual partners socially and will also have less access to peer information/support for safer sex[79].

Important considerations should be applied in generalising our findings. A limitation of our study is the over representation of highly educated MSM and those from urban areas, which can be a result of this being an internet-based study using purposive sampling methods. MSM on the fringes are more likely to be living in poverty and are the ones more likely to have less access to HIV prevention services, sell sex and have less power to negotiate condom use. Nevertheless, this study expands the limited knowledge base of data on IH from

SSA countries. Additionally, it is the first to use identical methods to collect data from a large sample of SSA countries and to use multilevel analysis to account for the hierarchical structure of the data and simultaneously account for country-level and individual-level explanatory variables

Our study highlights that IH is high across SSA compared with European MSM populations. We also found that the criminalisation of same-sex relationships is widening the inequalities in HIV risk-related behaviours of MSM within the region. We highlight that structural homophobia potentially defines the boundaries of MSM's ability to cope with minority related stressors, resulting in worse sexual risk outcomes compared to those in environments where same-sex relationships are legal. We emphasise that the removal of legal barriers is an essential important first step but the complex social factors at play within each country require a comprehensive approach to interventions for MSM in SSA.

# SUPPLEMENTARY MATERIAL PAPER 2

Appendix Model equation 1:

**ML model**

$$logit\left(ever\ HIV\ tested_{ij}\right)$$
$$= \beta0 + \beta X1(IH)_{ij} + \beta X2_{ij} - X18_{ij} + \beta19(Legal\ Climate_j)$$
$$+ \beta20(MSM\ Policy\ Intervention_j) + u_{oj}(model\ 2)$$

Where *'ever_HIVtested$_{ij}$'* is the proportion ever tested for HIV for individual in country j, and what is being modelled is the log-odds of ever HIV tested$_{ij}$. The parameter b1(*IH$_{ij}$*) represent the differentials in the log odds of ever HIV testing for individuals where IH score is one (the reference category), and *b2 $_{ij}$-b22$_j$* represent the log odds of ever HIV testing after adjusting for compositional and contextual differences within each country.

Appendix Model equation 2:

**ML cross**

$$logit\left(ever\ HIV\ tested_{ij}\right)$$
$$= \beta0 + \beta X1(IH\ X\ Legal\ Climate)_{ij} + \beta X2_{ij} - X18_{ij}$$
$$+ \beta19(MSM\ Policy\ Intervention_j) + u_{oj}(model\ 2)$$

Where *'IH_ScoreXLegal_climate'* is the interaction term for the moderating effect of legal climate on IH.

## Appendix Multiple Imputation:

We determined the pattern of missingness was arbitrary, so required an iterative method to fill in missing values. For multivariate imputation of the variables with missing values, I used the 'mi impute chained (MICE)'. The imputation step was performed for multiple variables using linear regression methods to impute the IH variable, ordered logistic regression for the ordinal variables and multinominal logistic regression for the nominal variables. We also included the following auxiliary variables: country, legal climate, history of HIV testing and knowledge of HIV status of the partner they had unprotected sex with. Stata SE 17.0 MICE command was used to create 50 multiply imputed datasets.

# Exploratory Factor Analysis: Principal Components Analysis (PCA)

APPENDIX TABLE 5. 1: correlations from the PCA of the 7-item IH scale

|  | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|
| 1. I feel comfortable in gay bars | 1.0000 | | | | | | |
| 2. Social situations with gay men make me feel uncomfortable | 0.0842 | 1.0000 | | | | | |
| 3. I feel comfortable being seen in public with an obviously gay person | 0.2914 | 0.0998 | 1.0000 | | | | |
| 4. I feel comfortable discussing homosexuality in a public situation | 0.2754 | 0.1033 | 0.5811 | 1.0000 | | | |
| 5. I feel comfortable being a homosexual man | 0.2921 | 0.0891 | 0.2764 | 0.3274 | 1.0000 | | |
| 6. Homosexuality is morally acceptable to me | 0.2728 | 0.0747 | 0.2834 | 0.2681 | 0.3374 | 1.0000 | |
| 7. Even if I could change my sexual orientation, I wouldn't | 0.2241 | 0.0652 | 0.2586 | 0.2681 | 0.3622 | 0.4159 | 1.0000 |

APPENDIX TABLE 5. 2: Rotated factor loadings (pattern matrix) and unique variances sorted

| Variable | Factor1 | Factor2 | Uniqueness |
|---|---|---|---|
| 6. Homosexuality is morally acceptable to me | **0.81** | 0.18 | 0.31 |
| 5. I feel comfortable being a homosexual man | **0.78** | 0.19 | 0.35 |
| 7. Even if I could change my sexual orientation, I wouldn't | **0.69** | 0.15 | 0.51 |
| 3. I feel comfortable being seen in public with an obviously gay person | 0.20 | **0.80** | 0.33 |
| 4. I feel comfortable discussing homosexuality in a public situation | 0.27 | **0.76** | 0.34 |
| 2. Social situations with gay men make me feel uncomfortable | -0.16 | **0.50** | 0.72 |
| 1. I feel comfortable in gay bars | 0.36 | **0.43** | 0.68 |

## Appendix table 5. 3. Mean IH levels across SSA countries

| Country | Number of respondents with IH scores | Mean IH level |
|---|---|---|
| Equatorial Guinea | - | - |
| Ethiopia | 75 | 4.1 |
| Burkina-Faso | 80 | 4.4 |
| Guinea | * | 4.5 |
| Sierra Leone | * | 4.5 |
| Cameroon | 48 | 4.6 |
| Mali | 73 | 4.6 |
| Côte d'Ivoire | 112 | 4.7 |
| Malawi | 15 | 4.7 |
| Senegal | 21 | 4.7 |
| Gabon | 66 | 4.8 |
| Mauritania | 56 | 4.8 |
| Zambia | 65 | 4.8 |
| Nigeria | 129 | 4.9 |
| Gambia | * | 5 |
| Ghana | 65 | 5.0 |
| Madagascar | * | 5.0 |
| Zimbabwe | 62 | 5 |
| Togo | * | 5.1 |
| Uganda | 60 | 5.1 |
| United Republic of Tanzania | 92 | 5.1 |
| Central African Republic (the) | 22 | 5.2 |
| Kenya | 99 | 5.2 |
| Chad | 30 | 5.3 |
| Eswatini | 27 | 5.4 |
| Liberia | 13 | 5.4 |
| Niger | * | 5.4 |
| Rwanda | 80 | 5.4 |
| Benin | 77 | 5.5 |
| Botswana | 20 | 5.5 |
| Congo | 164 | 5.5 |
| Mauritius | 6 | 5.5 |
| Eritrea | * | 5.7 |
| Lesotho | 19 | 5.7 |
| Seychelles | * | 5.7 |
| Democratic Republic of the Congo (the) | 83 | 5.8 |
| Namibia | 80 | 5.8 |
| South Sudan | * | 5.8 |
| Angola | 83 | 5.9 |
| Guinea-Bissau | * | 5.9 |
| South Africa | 489 | 5.9 |
| Burundi | 11 | 6 |
| Mozambique | 129 | 6 |
| Cape verde | * | 7 |

* countries with <10 responses to prevent unintended disclosure

APPENDIX TABLE 5. 4: Multilevel logistic regression Odds ratio (OR) and 95% Confidence Interval (CI) HIV testing and HIV risk behaviour's

| | Ever tested | | Recent tested | | Paid for sex | | Sold sex | | Unprotected sex | |
|---|---|---|---|---|---|---|---|---|---|---|
| **n (countries)** | 43 | | 43 | | 43 | | 42 | | 42 | |
| | aOR (95% CI) | p-value | aOR (95% CI) | p-value | aOR (95% CI) | p-value | aOR (95% CI) | p-value | aOR (95% CI) | p-value |
| **Intercept** | 1.76 (0.80,3.74) | 0.159 | 2.12 (1.24,3.63) | 0.008 | 0.14 (0.73,0.27) | <0.001 | 0.26 (0.11,0.62) | 0.002 | 0.54 (0.31,0.97) | 0.038 |
| **\*Internalised Homonegativity (range 1-7)** | 1.18 (1.03,1.35) | 0.019 | 1.19 (1.07,1.32) | 0.001 | 1.00 (0.89,1.12) | 0.952 | 1.06 (0.95,1.20) | 0.312 | 0.99 (0.89,1.09) | 0.788 |
| **Age: ref = 18-24** | | | | | | | | | | |
| 25-34 | 2.27 (2.75,2.94) | <0.001 | 0.76 (0.62,0.93) | 0.007 | 1.73 (1.34,2.21) | <0.001 | 0.83 (0.66,1.04) | 0.113 | 1.23(1.01,1.50) | 0.036 |
| 35-44 | 3.19 (2.02,5.3) | <0.001 | 0.60 (0.45,0.80) | <0.001 | 2.83 (2.18,4.25) | <0.001 | 0.67 (0.47,0.96) | 0.030 | 1.43 (1.07,1.92) | 0.017 |
| 45+ | 1.98 (1.15,3.41) | 0.014 | 0.55 (0.37,0.82) | 0.003 | 4.24 (2.63,6.84) | <0.001 | 0.59 (0.32,1.08) | 0.088 | 1.29 (0.83,1.99) | 0.254 |
| **Attraction: ref=gay** | | | | | | | | | | |
| Bisexual | 0.72 (0.55,0.95) | 0.022 | 1.19 (0.95,1.50) | 0.135 | 0.94 (0.72,1.23) | 0.663 | 0.63 (0.48,0.83) | 0.001 | 1.09 (0.87,1.36) | 0.457 |
| Don't know | 0.58 (0.34,0.98) | 0.043 | 0.58 (0.38,0.89) | 0.013 | 0.89 (0.51,1.56) | 0.682 | 1.21 (0.71,2.06) | 0.490 | 1.10 (0.66,1.84) | 0.705 |
| **Relationship status: ref = single** | | | | | | | | | | |
| in a relationship with a woman/ both a man and a woman or transgender person | 1.24 (0.82,1.88) | 0.309 | 0.68 (0.51,0.91) | 0.010 | 2.20 (1.60,3.03) | <0.001 | 1.59 (1.13,2.24) | 0.008 | 0.93 (0.69,1.26) | 0.652 |
| in a relationship with a man | 1.90 (1.39,2.59) | <0.001 | 0.87 (0.71,1.06) | 0.157 | 1.22 (0.96,1.55) | 0.103 | 1.37 (1.08,1.73) | 0.010 | 0.91 (0.74,1.11) | 0.340 |
| **Education: Ref = secondary/high school** | | | | | | | | | | |
| None/Primary school | 0.60 (0.39,0.92) | 0.018 | 1.30 (0.85,1.97) | 0.223 | 1.05 (0.70,1.57) | 0.818 | 1.30 (0.90,1.89) | 0.166 | 1.23 (0.84,1.79) | 0.284 |
| University first degree | 1.50 (1.16,1.96) | 0.002 | 0.81 (0.67,0.99) | 0.039 | 0.76 (0.60,0.97) | 0.029 | 0.56 (0.44,0.71) | <0.001 | 0.92 (0.76,1.13) | 0.442 |
| masters/doctorate | 1.89 (1.22,2.94) | 0.005 | 0.86 (0.66,1.13) | 0.277 | 0.91 (0.66,1.26) | 0.572 | 0.43 (0.30,0.62) | <0.001 | 0.68 (0.51,0.92) | 0.011 |
| **Income: Ref= neither comfortable nor struggling on present income** | | | | | | | | | | |
| really struggling on present income | 1.13 (0.79,1.62) | 0.504 | 1.02 (0.78,1.33) | 0.880 | 1.18 (0.87,1.62) | 0.289 | 1.64 (1.21,2.22) | 0.001 | 1.19 (0.91,1.56) | 0.192 |
| struggling on present income | 0.86 (0.64,1.16) | 0.318 | 1.36 (1.09,1.70) | 0.006 | 0.98 (0.75,1.26) | 0.847 | 1.19 (0.92,1.53) | 0.186 | 0.95 (0.76,1.18) | 0.631 |
| living comfortably on present income | 0.90 (0.63,1.30) | 0.576 | 0.99 (0.76,1.29) | 0.950 | 0.80 (0.56,1.14) | 0.216 | 0.73 (0.50,1.06) | 0.100 | 0.66 (0.50,0.89) | 0.006 |
| living really comfortably on present income | 1.03 (0.67,1.58) | 0.903 | 1.36 (0.99,1.88) | 0.061 | 1.07 (0.71,1.60) | 0.747 | 1.10 (0.73,1.65) | 0.652 | 0.70 (0.49,0.98) | 0.037 |
| **Size of settlement: ref = major city** | | | | | | | | | | |
| Village/Farm/an isolated house | 0.99 (0.65,1.53) | 0.982 | 0.82 (0.59,1.13) | 0.224 | 0.84 (0.55,1.28) | 0.414 | 1.45 (0.98,2.15) | 0.063 | 1.02 (0.73,1.43) | 0.887 |
| Medium-or small size city | 0.80 (0.62,1.03) | 0.085 | 1.12 (0.92,1.36) | 0.267 | 1.14 (0.90,1.44) | 0.285 | 1.16 (0.92,1.47) | 0.213 | 1.01 (0.83,1.23) | 0.918 |
| **Legal_climate: Ref = illegal** | | | | | | | | | | |
| legal | 2.36 (1.18,4.74) | 0.015 | 1.16 (0.76,1.76) | 0.487 | 0.88 (0.53,1.46) | 0.623 | 1.39 (0.68,2.84) | 0.305 | 1.10 (0.70,1.76) | 0.674 |
| **Targeted policy interventions: Ref= None** | | | | | | | | | | |
| Partially | 2.71 (1.23,5.96) | 0.013 | 1.28 (0.78,2.13) | 0.331 | 1.23 (0.67,2.28) | 0.504 | 1.15 (0.49,2.68) | 0.747 | 1.41 (0.81,2.46) | 0.230 |
| **Random effects variances** | | | | | | | | | | |
| Country level | 2.41 (1.80,3.23) | <0.001 | 1.70 (1.44,2.00) | <0.001 | 1.79 (1.47,2.17) | <0.001 | 2.69 (2.01,3.60) | <0.001 | 1.84 (1.53,2.22) | <0.001 |
| Variance partition | 0.211 | | 0.139 | | 0.166 | | 0.231 | | 0.156 | |

\* standardised values of the IH score

APPENDIX TABLE 5. 5: Effect modification/cross-level interaction Odds ratio (OR) and 95% Confidence Interval (CI) HIV testing  and HIV risk behaviour's

| | Ever tested | | Recent tested | | Paid for sex | | Sold sex | | Unprotected sex | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Number of countries** | 43 | | 43 | | 43 | | 43 | | 43 | |
| | OR (95% CI) | p-value | OR (95% CI) | p-value | OR (95% CI) | p-value | OR (95% CI) | p-value | OR (95% CI) | p-value |
| \|**Intercept** | 1.71 (0.77,3.78) | 0.188 | 2.11 (1.23,3.62) | 0.007 | 0.14 (0.07,0.27) | <0.001 | 0.26 (0.11,0.62) | 0.002 | 0.55 (0.31,0.97) | 0.040 |
| ***Internalised Homonegativity (range 1-7)** | 1.04 (0.86,1.26) | 0.661 | 1.15 (0.99,1.35) | 0.073 | 1.15 (0.98,1.36) | 0.094 | 1.05 (0.89,1.25) | 0.544 | 1.02 (0.89,1.18) | 0.492 |
| **Age: ref = 18-24** | | | | | | | | | | |
| 25-34 | 2.28 (1.76,2.96) | <0.001 | 0.76 (0.62,0.93) | 0.008 | 1.72 (1.35,2.20) | <0.001 | 0.83 (0.66,1.04) | 0.113 | 1.23 (1.01,1.50) | 0.038 |
| 35-44 | 3.23 (2.04,5.09) | <0.001 | 0.60 (0.46,0.80) | <0.000 | 3.01 (2.15,4.21) | <0.001 | 0.67 (0.47,0.96) | 0.030 | 1.43 (1.06,1.92) | 0.018 |
| 45+ | 1.99 (1.15,3.43) | 0.014 | 0.55 (0.37,0.82) | 0.003 | 4.22 (2.62,6.81) | <0.001 | 0.59 (0.32,1.08) | 0.088 | 1.29 (0.83,1.99) | 0.256 |
| **Attraction: ref=gay** | | | | | | | | | | |
| Bisexual | 0.72 (0.55,0.95) | 0.022 | 1.19 (0.95,1.51) | 0.134 | 0.93 (0.71,1.22) | 0.604 | 0.64 (0.48,0.83) | 0.001 | 1.09 (0.87,1.36) | 0.473 |
| Don't know | 0.57 (0.34,0.97) | 0.039 | 0.58 (0.38,0.89) | 0.012 | 0.89 (0.51,1.56) | 0.682 | 1.21 (0.71,2.06) | 0.490 | 1.10 (0.66,1.84) | 0.703 |
| **Relationship status: ref = single** | | | | | | | | | | |
| in a relationship with a woman/ both a man and a woman or transgender person | 1.22 (0.81,1.85) | 0.341 | 0.68 (0.51,0.91) | 0.009 | 2.21 (1.61,3.05) | <0.001 | 1.59 (1.13,2.24) | 0.008 | 0.93 (0.69,1.27) | 0.657 |
| in a relationship with a man | 1.90 (1.39,2.59) | <0.001 | 0.86 (0.71,1.05) | 0.149 | 1.24 (0.97,1.57) | 0.082 | 1.37 (1.08,1.73) | 0.010 | 0.91 (0.74,1.11) | 0.352 |
| **Education: Ref = secondary/high school** | | | | | | | | | | |
| None/Primary school | 0.59 (0.39,0.91) | 0.016 | 1.29 (0.85,1.96) | 0.230 | 1.07 (0.71,1.61) | 0.750 | 1.30 (0.90,1.89) | 0.168 | 1.24 (0.85,1.80) | 0.271 |
| University first degree | 1.49 (1.15,1.94) | 0.003 | 0.81 (0.67,0.99) | 0.038 | 0.77 (0.60,0.99) | 0.032 | 0.56 (0.44,0.71) | <0.001 | 0.93 (0.76,1.13) | 0.452 |
| masters/doctorate | 1.93 (1.24,3.01) | 0.004 | 0.8 (0.66,1.13) | 0.291 | 0.89 (0.64,1.23) | 0.470 | 0.43 (0.30,0.62) | <0.001 | 0.68 (0.51,0.91) | 0.010 |
| **Income: Ref**= neither comfortable nor struggling on present income | | | | | | | | | | |
| really struggling on present income | 1.13 (0.79,1.63) | 0.500 | 1.02 (0.78,1.33) | 0.893 | 1.20 (0.88,1.64) | 0.260 | 1.64 (1.21,2.22) | 0.001 | 1.20 (0.92,1.56) | 0.186 |
| struggling on present income | 0.85 (0.63,1.14) | 0.273 | 1.36 (1.09,1.70) | 0.007 | 0.99 (0.77,1.29) | 0.965 | 1.24(0.95,1.63) | 0.190 | 0.95 (0.76,1.19) | 0.661 |
| living comfortably on present income | 0.90 (0.62,1.29) | 0.561 | 0.99 (0.76,1.29) | 0.942 | 0.79 (0.56,1.13) | 0.205 | 0.73 (0.50,1.06) | 0.100 | 0.67 (0.50,0.89) | 0.007 |
| living really comfortably on present income | 1.02 (0.66,1.56) | 0.944 | 1.36 (0.99,1.88) | 0.061 | 1.08 (0.73,1.62) | 0.691 | 1.10 (0.73,1.65) | 0.656 | 0.70 (0.50,0.98) | 0.039 |
| **Size of settlement: ref = major city** | | | | | | | | | | |
| Village/Farm/an isolated house | 1.00 (0.65,1.54) | 0.992 | 0.82 (0.59,1.13) | 0.227 | 0.83 (0.54,1.27) | 0.385 | 1.45 (0.98,2.15) | 0.063 | 1.02(0.73,1.43) | 0.894 |
| Medium-or small size city | 0.81 (0.63,1.04) | 0.104 | 1.12 (0.92,1.36) | 0.264 | 1.14 (0.90,1.44) | 0.293 | 1.16 (0.92,1.47) | 0.213 | 1.01 (0.83,1.23) | 0.933 |
| **IH x Legal_climate** | 1.29 (0.98,1.69) | 0.068 | 1.06 (0.86,1.30) | 0.587 | 0.75 (0.60,0.94) | 0.012 | 1.05(0.83,1.33) | 0.679 | 0.93 (0.77,1.13) | 0.771 |
| **Legal_climate: Ref = illegal** | | | | | | | | | | |
| legal | 2.50 (1.24,5.04) | 0.010 | 1.17 (0.77,1.78) | 0.468 | 0.86 (0.52,1.43) | 0.566 | 1.39 (0.68,2.84) | 0.362 | 1.10 (0.69,1.75) | 0.689 |
| **Targeted policy interventions: Ref= None** | | | | | | | | | | |
| Partially | 2.70 (1.22,5.96) | 0.014 | 1.28 (0.77,2.13) | 0.335 | 1.23 (0.67,2.28) | 0.504 | 1.15 (0.49,2.68) | 0.748 | 1.41 (081,2.46) | 0.227 |
| **Random effects variances** | | | | | | | | | | |
| Country level | 2.44 (1.81,3.27) | <0.001 | 1.70 (1.45,1.99) | <0.001 | 1.93 (1.59,2.35) | <0.001 | 2.69 (2.01,3.61) | <0.001 | 1.84 (151,2.24) | <0.001 |
| Variance partition | 0.213 | | 0.139 | | 0.167 | | 0.231 | | 0.156 | |

* standardised values of the IH score

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APPENDIX TABLE 5. 6: Sensitivity analysis using complete case analysis, Multilevel logistic regression Odds ratio (OR) and 95% Confidence Interval (CI) HIV testing and HIV risk behaviour's

| | Ever tested | | Recent tested | | Paid for sex | | Sold sex | | Unprotected sex | |
|---|---|---|---|---|---|---|---|---|---|---|
| n (countries) | 43 | | 42 | | 43 | | 43 | | 43 | |
| | aOR (95% CI) | p-value | aOR (95% CI) | p-value | aOR (95% CI) | p-value | aOR (95% CI) | p-value | aOR (95% CI) | p-value |
| **Intercept** | 1.82 (0.77,4,28) | 0.170 | 2.20 (1.28,4.51) | 0.003 | 0.15 (0.07,0.30) | <0.001 | 0.23 (0.09,0.59) | 0.002 | 0.59 (0.32,1.07) | 0.083 |
| ***Internalised Homonegativity (range 1-7)** | 1.19 (1.03,1.37) | 0.018 | 1.21 (1.09,1.35) | 0.001 | 1.02 (0.91,1.16) | 0.691 | 1.08 (0.95,1.22) | 0.235 | 0.99 (0.90,1.10) | 0.892 |
| **Legal_climate: Ref = illegal** | | | | | | | | | | |
| legal | 2.14 (1.02,4.47) | 0.043 | 1.21 (0.74,1.98) | 0.443 | 0.90 (0.40,1.09) | 0.713 | 1.66 (0.78,3.56) | 0.190 | 1.09 (0.68,1.76) | 0.716 |
| Random effects variances | | | | | | | | | | |
| Country level | 2.25 (1.27,3.97) | 0.003 | 1.48 (1.14,1.91) | 0.001 | 1.63 (1.17,2.28) | 0.002 | 3.03 (1.53,6.03) | 0.001 | 1.46 (1.16,1.85) | 0.001 |
| Variance partition | 0.198 | | 0.106 | | 0.130 | | 0.252 | | 0.104 | |

* standardised values of the IH score

Appendix Table 5. 7: **Sensitivity analysis using complete case analysis, Effect modification/cross-level interaction Odds ratio (OR) and 95% Confidence Interval (CI) HIV testing and HIV risk behaviour's**

| | Ever tested | | Recent tested | | Paid for sex | | Sold sex | | Unprotected sex | |
|---|---|---|---|---|---|---|---|---|---|---|
| n (countries) | 43 | | 42 | | 43 | | 43 | | 43 | |
| | aOR (95% CI) | p-value | aOR (95% CI) | p-value | aOR (95% CI) | p-value | aOR (95% CI) | p-value | aOR (95% CI) | p-value |
| **Intercept** | 1.76 (0.74,4,17) | 0.199 | 2.39 (1.27,4.50) | 0.007 | 0.15 (0.07,0.30) | <0.001 | 0.23 (0.09,0.59) | 0.002 | 0.59 (0.32,1.08) | 0.086 |
| ***Internalised Homonegativity (range 1-7)** | 1.00 (0.82,1.22) | 0.997 | 1.16 (1.00,1.36) | 0.062 | 1.24 (1.05,1.48) | 0.012 | 1.06 (0.89,1.27) | 0.527 | 1.04 (0.90,1.20) | 0.575 |
| **Legal_climate: Ref = illegal** | | | | | | | | | | |
| legal | 2.30 (1.09,4.83) | 0.029 | 1.22 (0.74,2.01) | 0.427 | 0.65 (0.39,1.07) | 0.666 | 1.67 (0.78,3.57) | 0.190 | 1.09 (0.68,1.75) | 0.735 |
| **IH x Legal_climate** | 1.40 (1.07,1.85) | 0.016 | 1.08 (0.87,1.34) | 0.469 | 0.68 (0.54,0.86) | 0.001 | 1.03 (0.81,1.31) | 0.810 | 0.91 (0.74,1.11) | 0.345 |
| Random effects variances | | | | | | | | | | |
| Country level | 2.29 (1.30,4.05) | 0.002 | 1.49 (1.16,1.92) | 0.001 | 1.65 (1.18,2.30) | 0.002 | 3.03 (1.53,6.03) | 0.001 | 1.46 (1.16,1.85) | 0.001 |
| Variance partition | 0.201 | | 0.108 | | 0.132 | | 0.252 | | 0.104 | |

* standardised values of the IH score

Supplementary Analysis Paper 2

Exploratory Factor Analysis of the 7-item IH scale

Principal components analysis (PCA) was chosen over common factor analysis (CFA)

Factor analysis

Instruments. The full IH scale by Ross and Rosser contains 7 items and factor structure of three latent dimensions (Personal comfort with a gay identity (PC), Social comfort with gay men (SC) and Public identification as gay (PUBID) (supplementary analysis table 5.5). Each item is measured on a seven-point Likert scale (1 = lowest IH score to 7 = highest level of IH) and Item two of the scale was reverse scored. Reliability estimates for the 7-item IH scale have been reported as 0.77 in European MSM and found to have a good fit to data of Ugandan MSM in confirmatory factor analysis[81,238].

Analyses. I conducted the analysis with Stata/SE 17.0. Bartlett's test of sphericity was used to test that the correlation structure and the Kaiser-Meyer-Olkin (KMO) measure of the strength of the partial correlation between the variables was required to be more than 0.5. After confirming that the correlation structure was adequate for factor analysis, principal components analysis (PCA) was chosen over common factor analysis because the intention was to decrease data while conserving as much information from the original data set as possible. The findings supported decisions over the number of factors in the IH 7-item scale to retain.

Table 5. 5. Sorted Rotated Factor Loadings

| Item | Factor | | uniqueness | Dimensions |
|------|--------|--------|------------|------------|
| | 1 | 2 | | |
| 6. Homosexuality is morally acceptable to me | 0.81 | 0.18 | 0.31 | Personal comfort with a gay identity (PC) |
| 5. I feel comfortable being a homosexual man | 0.78 | 0.19 | 0.35 | |
| 7. Even if I could change my sexual orientation, I wouldn't | 0.69 | 0.15 | 0.51 | |
| 3.I feel comfortable being seen in public with an obviously gay person | 0.20 | 0.80 | 0.33 | Public identification as gay (PUBID) |
| 4. I feel comfortable discussing homosexuality in a public situation | 0.27 | 0.76 | 0.34 | |
| 2. Social situations with gay men make me feel uncomfortable | -0.16 | 0.50 | 0.72 | Social comfort with gay men (SC) |
| 1. I feel comfortable in gay bars | 0.36 | 0.43 | 0.68 | |

## Results

Of the 3,191 respondents, 832 were missing item 1, 645 were missing item 2, 534 missing item 3, 522 missing item 4, 480 missing item 5, 473 missing item 6, and 546 missing item 7. Bartlett test of sphericity $\chi^2(21)$ = 2934.894, p<0.001, indicated that the correlation was not random, and the Kaiser-Meyer-Olkin (KMO) was 0.760, measure confirmed the sampling adequacy of the analysis. These confirmed that the structure was adequate for factor analysis.

The analysis showed that the first principal component is strongly correlated with three of the IH scale items, Homosexuality is morally acceptable to me, I feel comfortable being a homosexual man and Even if I could change my sexual orientation, I wouldn't. This suggests that these three items vary together, and as one increases, so do the others. This component corresponds with the measure of personal comfort with a gay identity (PC). Although a correlation above 0.5 is deemed as important, the second principal component most strongly correlates with the items 'I feel comfortable being seen in public with an obviously gay person' and Social situations with gay men make me feel uncomfortable', based on the correlations of 0.80 and 0.76 this factor can be seen to primarily measure dimensions for public identification as gay (PUBID). The items 'Social situations with gay men make me feel uncomfortable' and 'I feel comfortable in gay bars' do not coalesce with each other or the other items given their high uniqueness. Given these findings, a two-factor 5-items scale was accepted as an adequate measure of IH with the participants in this study.

## Multiple Imputation

In addition to missing data in the IH variable, the explanatory variables also had some missing data. Supplementary analysis table 5.6 shows the missingness for each variable included in the model. Due to the large number of missing data in the IH variable, using complete-case analysis would likely result in biased results. Complete-case analysis discards all observations with missing data and will only use data from non-missing responses, which can result in the analysis being based on a non-representative sample of SSA MSM [247]. Also, the smaller sample size may lead to less power, larger standard errors, and wider confidence intervals.

Table 5. 6. missingness for each variable included in the model

| Variable | Percent missing |
|----------|-----------------|
| IH | 21.6% |
| Age | 0.1% |
| Education | 1.2% |
| City | 2.2% |
| Attraction | 2.2% |
| relationship | 3.6% |

To handle the missing data, I used multiple imputation (MI). Multiple imputation involves replacing each missing value by creating multiple imputations that account for the sampling variability due to the missing data [199,247]. MI involves three steps, (i) the imputation step, where the imputations are generated under the chosen imputation model; (ii) the completed-data analysis (estimation) step, where the required analysis is completed separately on each imputation (depending on the number of imputations specified); and (iii) the pooling step, where the results obtained from the separate completed-data analyses are combined into a single MI result. In Stata, steps 2 and 3 are combined during the analysis step [199].

The pattern of missingness was determined to be arbitrary, so required an iterative method to fill in missing values. For multivariate imputation of the variables with missing values, I used the 'mi impute chained (MICE)'. Chained equations use sequences of univariate imputation methods with fully conditional specifications (FCS) and accommodates arbitrary missing-value patterns and are also suitable for multilevel imputation. The imputation step was performed for multiple variables, using linear regression methods to impute the IH variable, ordered logistic regression for the ordinal variables (age, education and city) and multinominal logistic regression for the nominal variables (attraction and relationship status), Stata SE 17.0 MICE command was used to create 50 multiply imputed datasets.

# 6   General discussion

This thesis explores how discriminatory laws and policies impact HIV-related health outcomes of MSM in SSA countries. This chapter critically assesses the key findings of the thesis, then reviews the study's strengths and limitations, and then concludes with recommendations for research and policy.

## 6.1   Key findings

In this section, I summarise the key findings of the thesis research questions outlined in Chapter 1.

**Research Q1: Are contextual effects of legal climate and targeted HIV policy associated with national-level measures of ever HIV tested and HIV-testing in the past 6 months among self-reported MSM (Paper 1)?**

The first research question aimed to establish if there were evidence of ecological differences in the odds of ever and recent testing between MSM living in SSA countries that criminalise same-sex relationships compared to those in non-criminalised countries and countries with targeted HIV policy interventions for MSM and those with none.

I conducted the ecological analysis using data from MSM in 44 SSA countries and then performed a sensitivity analysis where each country was excluded one at a time from the model. The main analysis found strong evidence that MSM living in countries with legalised same-sex relationships had higher ever testing prevalence, and those with targeted HIV policies had increased prevalence of ever and recent testing. There was no evidence of the legal climate being associated with the study population's recent testing outcomes of MSM.

In the sensitivity analysis, with South Africa excluded, the results showed very strong evidence that MSM in countries with legalised same-sex relationships had higher ever testing and recent testing prevalence. This was a change in the strength and direction of the associations between the legal climate and the study outcomes compared to the findings of

the main analysis. The strong evidence of a positive association of targeted HIV policies with the study outcomes remained.

By conducting this analysis, we strengthen the evidence that at the ecological level, same-sex criminalisation laws result in lower HIV testing by MSM and provide new evidence for policymakers and implementing partners that the availability of targeted HIV interventions for MSM in SSA is increasing the uptake of HIV testing across SSA.

### Research Q2: Do any observed associations of contextual effects with national-level ever testing and recent testing in the past 6 months persist after adjusting for individual characteristics (Paper 1)?

The second research question was also addressed in Paper 1, where a multilevel analysis of the data was conducted to account for the hierarchical structure of the data. Similar to the ecological analysis, I performed the main analysis with data from all 44 SSA countries, followed by a sensitivity analysis as described previously. The main findings showed that after accounting for individual-level explanatory factors, there was strong evidence of an association between the legal climate with ever HIV testing and targeted HIV policies. I observed increased odds of ever testing in countries with legalised same-sex laws and targeted policies for MSM. I found no evidence of an association of the legal climate and the presence of targeted HIV policies with recent testing.

Similar to the ecological analysis, the sensitivity analysis revealed that SSA countries are not homogeneous. With South Africa excluded from the model, the strength of associations changed. The evidence of a positive relationship of legalised same-sex relationships with increased odds of ever testing and the evidence of an association between the presence of targeted HIV policies with increased odds of ever testing became stronger. No evidence of an association of the legal climate or targeted policy with recent HIV testing in the past 6 months was found.

The impact of this multilevel analysis is significant as it provides new evidence of the negative impact of same-sex criminalisation and the absence of targeted HIV interventions

for MSM HIV testing behaviours still holds after accounting for individual-level explanatory variables. The findings show that these discriminatory laws and policies are important pathways by which discrimination harms the health of MSM in SSA. This paper provides new evidence to support eliminating discriminatory laws and policies as the first step in HIV epidemic control for SSA MSM.

**Research Q3: What is the level of IH among MSM in sub-Saharan Africa, and how do these vary across different demographic, socioeconomic, and geographic groups, i.e., across age groups, education, and income (Paper 2)?**

The first part of Paper 2 findings addressed the third research question. The initial intention was to measure the level of IH in SSA MSM using the 7-item IH scale with three factors. After looking at the distribution of the scale items, the factor 'measuring social comfort with gay men' was not applicable across many SSA countries due to the legal climate. The two items in this factor, 'I feel comfortable in gay bars' and 'Social situations with gay men make me feel uncomfortable', had the highest missingness in the scale. Conducting principal components analysis confirmed the suitability and reliability of using a shorter 5-item scale measuring the two factors 'Personal comfort with a gay identity (PC)' and 'Public identification as gay (PUBID)'.

The 5-item IH scale showed that there were high national levels of IH across MSM in SSA. This finding is significant as this shows much higher national levels than European MSM and that IH levels are high among MSM SSA irrespective of the legal climate.

**Research Q4: Is IH associated with HIV-related health outcomes of ever HIV testing, HIV testing in the past 6 months, paying for sex in the past 12 months, being paid for sex in the past 12 months and unprotected anal sex in the past 3 months (Paper 2)?**

The fourth research question was also addressed in Paper 2. A multilevel model showed that increasing levels of IH were associated with increased odds of ever and recent testing but no associations with transactional sex and unprotected anal sex. The findings from this paper suggested that IH in SSA MSM has a protective effect which in part was

similar to findings from research on South African MSM where IH had a protective effect on sexual risk behaviours but in contrast to findings in Nigerian, Ugandan and European MSM where increasing IH levels were associated with increased sexual-risk behaviour and reduction in testing respectively.

These findings suggested that IH in SSA MSM resulted in a positive choice of coping with minority stress, evidenced by increased utilisation of HIV testing services. Still, conclusions could not be drawn without confirming if the legal climate modified these observations.

**Research Q5: Do associations between IH and HIV-related health outcomes of HIV testing and HIV-risk behaviours differ by whether same-sex relationships are or are not criminalised (Paper 2)?**

The fifth research question was again addressed in Paper 2, where I aimed to establish if the legal climate does modify the effect of internalised homonegativity observed in SSA MSM. The findings showed that the legal climate modified the association between IH and paying for sex. There were reduced odds of MSM paying for sex with increasing IH levels in same-sex legal climates. There was no evidence of an effect modification of the legal climate on testing, selling sex or having unprotected sex observed.

These findings and those from research questions 3 and 4 are useful for researchers and policymakers in understanding that there are high levels of psychosocial stress across the SSA region. The impact on health seems to be determined by the legal climate, as this sets the boundaries for coping resources available to SSA MSM. As emphasised by the ecosocial theory, simultaneously focusing on exposure, susceptibility and resistance provide evidence on the important pathways of embodiment across multi-levels., along with factors that affect susceptibility and resistance to exposure.

## 6.2   Contribution to knowledge

### Contribution to empirical findings

These two papers are the first to consider the multilevel influences of same-sex criminalisation and the lack of targeted policy on HIV testing and HIV-risk behaviours of SSA MSM using a large sample of SSA countries and data collected from similar methods. Findings from these papers can help identify interventions to reduce the disparities in HIV incidence among SSA MSM. Beyond these collective contributions to knowledge of both papers, each paper's findings make additional contributions:

Paper 1 makes several notable contributions to knowledge. First, before this paper, the only other available data from the region on the criminalisation of same-sex relationships and MSM engagement with HIV programmes were derived from pooled estimates in a systematic review[25]. Other studies on the associations of same-sex criminalisation with health outcomes of MSM have usually been from self-reported individual-level measures of discrimination [26,27]. The findings of this paper supported previous evidence of an ecological association of the legal climate with HIV-related health outcomes of SSA MSM and further confirmed this association with multilevel modelling. Second, this paper included a comprehensive review of 38 SSA countries' national strategic frameworks/national strategic plans for the inclusion of the recommended interventions for MSM by the WHO[28,29]. This review extends the scope of existing policy reviews in the region[33]. The key findings of the review were that none of the policy documents reviewed included all the WHO recommendations, and six SSA countries did not include any targeted interventions for MSM. The third contribution of this paper is that it is the first to include the assessment of the associations of policy content with HIV testing uptake by SSA MSM which was a non-explicit measure of further structural discrimination of MSM. A final contribution of Paper 1 is that SSA is not homogeneous. The inclusion of South Africa in our models weakened the strength of the associations of discriminatory laws and policies with HIV testing by MSM. This paper is the second to show evidence of the heterogeneity between South Africa and other SSA countries, first reported in the systematic review [25]. This has both research and policy implications.

Similarly, Paper 2 is the first to measure IH levels and its associations with HIV testing and risk behaviours in MSM across multiple SSA countries. Findings showed that IH was high in both legal climates in SSA but resulted in the adoption of positive coping mechanisms by MSM in countries where same-sex relationships are legal. The suggestive evidence that increasing IH levels resulted in reduced odds of ever testing by MSM in same-sex criminalised countries but increased odds of recent testing compared to MSM where same-sex relationships are legal might highlight the wide reach of HIV testing campaigns in the region, which has narrowed the inequalities in access by MSM in the region. These findings highlight that targeting MSM with IH, especially those living in countries that criminalise same-sex relationships with interventions designed to support the adoption of positive coping mechanisms, can increase HIV testing uptake and reduce their involvement in transactional sex.

## Contribution to methods

As highlighted in the study's conceptual model (figure 3.1), the pathways that discriminatory laws and policies, such as same-sex criminalisation and the absence of targeted HIV interventions, impact HIV testing and risk behaviours of SSA MSM are multi-layered. These two papers are the first to explore the associations of these multilevel measures of discrimination using multilevel analysis. The papers are also the first to employ the two frameworks: the ecosocial theory of disease distribution and the minority stress model, to frame and identify suitable measures of discrimination both at the country and individual level and report findings of these associations with HIV-related outcomes of MSM in SSA [11,35].

Overall, the findings from Papers 1 and 2 highlight the importance of using legal and policy measures and multilevel frameworks drawn from theory to investigate these questions using multilevel models. The findings showed that structural and individual-level interventions are only a part of the steps needed to reduce the vulnerabilities of SSA MSM to HIV. Regarding HIV testing, interventions at these levels can influence the initial engagement of MSM with HIV services but do not seem to be significant in influencing decisions to remain engaged with services. For HIV-related risk behaviour such as paying for sex, IH alone is not a

determinant of negative health outcomes but social barriers, such as policies preventing MSM from accessing social clubs for peer support. These limit MSMs' access to meeting sexual partners socially, driving demand for transactional sex to engage in same-sex sexual activities.

## 6.3    Implications for research

This study has highlighted the complex interplay of country-level and individual-level factors influencing HIV-related outcomes of SSA MSM. This section broadly lays out this thesis's research implications, including the findings' generalisability.

### Need for routine collection of data on race/ethnicity in SSA

Findings from this thesis suggest that future researchers in SSA need to collect data on the respondent's race to aid the interpretation and generalisability of findings, especially studies from South Africa.

### Need for further research

Although none of the countries at the time of the survey included all the recommended interventions for MSM in their NSF/NSP, the partial inclusion of any combination of the WHO recommended interventions was associated with an increase in ever testing by SSA MSM. Further research is needed to explore which interventions are or are not taken up by countries and what MSM in SSA would want included in their targeted interventions. This work will inform the design of interventions that will be more acceptable to MSM and potentially provide a more economical way for countries to efficiently spend their limited resources for HIV control.

There is also the additional need for further research that includes the population not fully represented in this study, such as MSM with a lower level of education and those living outside major cities. This limitation and others are discussed in section 6.6.2 below. From my

findings, involving peers in the participant recruitment/identification would increase participation by those MSM who might not be involved socially with MSM groups or who are in locations where social gatherings by MSM are prohibited by law.

## 6.4    Implication for policy

### Need for the elimination of laws criminalising same-sex relationships

This thesis shows that criminalisation of same-sex relationships results in reduced odds of ever testing by MSM and possibly increased vulnerabilities to the negative impact of internalised homonegativity compared to their peers in same-sex legal climates. I recommend that findings from the papers included in this thesis are used in advocacy by NGOs and human rights organisations/activists to increase pressure on countries to reform these punitive laws to increase status awareness of SSA MSM.

### Acceleration of activities to support countries in creating an enabling environment

Reformation of laws takes time, and even if same-sex criminalisation laws are removed, without policies that protect the rights of MSM, including services that provide respectful and LGBTQI+ sensitive services, stigma and discrimination will continue to drive the inequalities in HIV-related outcomes of MSM. As demonstrated in the findings reported in chapters 4 and 5, the legal climate was not associated with MSM recent uptake of HIV testing services. Therefore, more urgent work is needed to address the stigma and discrimination at healthcare facilities and socially. This can be through more policies that protect against discrimination based on sexual orientation in countries that already have legalised same-sex relationship laws and increased funding to support more capacity building for services that are MSM friendly.

### Need to advocate for the Inclusion of targeted HIV interventions for MSM in national policies

There is a need to advocate for the inclusion of targeted HIV interventions for MSM in the six countries identified as not having any in their NSF/NSP document, and the other six countries that I could not retrieve any HIV policy document covering the period of the 2019 Global LGBTI Internet Survey study. This will enable targeted use of the limited resources in these countries to reach MSM populations most in need of HIV control services. Government or non-government organisations in these countries can use the findings from this study to inform the strategies for the next round of NSF/NSP policies.

### Need for continued demand creation for HIV testing services

In addition to creating an enabling environment, there should also be a focus on creating demand for HIV testing services in SSA as my findings show, a little over 50 per cent of the study respondents self-reported recent testing for HIV in the 6 months prior to the survey. Findings from a recent systematic review and meta-analysis that I co-authored on demand creation for HIV services showed that SMS, couple-oriented counselling, peer-led interventions and conditional fixed value incentives are all interventions that significantly and substantially increased HIV testing services uptake in studies that included MSM popualtions[248].

### Need to increase PrEP and PEP access

My research also emphasises the significance of expanding PrEP and PEP access in SSA. Many of the participants admitted to engaging in high-risk sexual behaviour. Still, just 18 nations provide PrEP for MSM interventions, and only seven of them also provide PEP, according to the analysis of HIV policies (see Paper 1, appendix table 4.3). In addition, as data from a recent systematic review and meta-analysis that I also co-authored revealed, integrating PrEP or PEP services with HIV testing services as part of an HIV preventive package for HIV-negative MSM could be an important intervention to decrease the risk of HIV acquisition in this population[249].

### Inclusion of psychosocial support as an intervention for MSM

There were high levels of IH reported across the region. This thesis found evidence that MSM in countries that do not criminalise same-sex relationships are reporting better HIV-related outcomes when compared to MSM in settings that criminalise same-sex relationships. A key aspect of the observed difference could be the social support available to MSM in non-criminalised settings. Peers are an important source of psychosocial support, which can help MSM build resilience and make good HIV-related choices [250]. CBOs and NGOs providing health services to MSM in same-sex criminalised settings will benefit from adopting interventions that Include safe spaces for social interactions with other MSM. Additionally, the HIV sector should adopt the new mental health care strategy in the region that sets 2030 targets for African countries following the recent session by the WHO Regional Committee for Africa, which highlighted that the African region has one psychiatrist for over 500,000 inhabitants [251]. This presents an excellent opportunity for the integration of services to include vital psychosocial support for communities such as MSM who experience high levels of minority stress.

## 6.5   Implication for donors, NGOs and CBOs

The findings of this research have several implications for donor organisations. In particular, they suggest that:

Increased funding from donor organisations is needed to strengthen MSM programming in SSA, including financing for safe spaces for MSM in same-sex criminalised countries to meet with their peers. There is also a need to provide more funding to research organisations to research the needs of MSM, especially in targeted interventions, as previously mentioned. More support is also needed to be delivered to organisations working with MSM in SSA, such as non-governmental organisations (NGOs) and community-based organisations (CBOs). CBOs and NGOs are uniquely positioned to come across MSM from various sociodemographic backgrounds and are pivotal to providing healthcare services to MSM, adding to the limited literature base on MSM in the region and assisting researchers in accessing the MSM community. They are uniquely positioned to support work on piloting interventions co-produced with MSM communities.

## 6.6 Study strengths and limitations

This section covers the general strengths and limitations of this thesis study. Those specific to Papers 1 and 2 were noted within the manuscripts.

### 6.6.1 General strengths

This study has many strengths, which can be categorised into three parts, strengths in the 2019 Global LGBTI Internet Survey study design, theoretical frameworks used to guide the analysis and reporting of the study and the statistical methods.

The strength of the primary study method is that the 2019 Global LGBTI Internet Survey team collected data from all 46 SSA countries, including a wide age range of (18-65+); large numbers of SSA men that self-identified as gay, bisexual and sexually ambiguous; a wide variety of income scales and in-country geographical locations. Another strength of the study is the use of the 7-point IH index, which had been validated on both European and African MSM[73,81].

Using the ecosocial theory of disease distribution and the minority stress model to guide this secondary analysis of the survey data provided the principles of thinking through what measuring HIV-related health discrimination of MSM should entail. This broadened the scope of measures included and improved the conceptual and methodological rigour of the study.

Multilevel analysis accounts for the multilevel structure of the data, which considers the potential correlation within MSM in the same countries and overcomes the assumption of independence in single-level logistic regression [188]. MLM offers the advantage that statistical power depends on the sample size at the highest level, for example, the number of countries at level two, making it possible to utilise all data from the primary survey, even from countries with low response rates [194].

### 6.6.2 General Limitations

This study used cross-sectional data, which limits the ability to draw causal inferences or determine temporality. Selection bias is another limitation of the study methods. Participant recruitment was conducted through LGBTI social and community networks, which are not fully representative of MSM population. This limitation is particularly important to my study as this selection bias could lead to the exclusion of participants with high IH or who have sex with men but do not identify as homosexual. Both are unlikely to be involved in LGBTI networks. Also, over half the countries in SSA criminalise same-sex relationships, and those countries are likely to have hidden LGBTI social/community networks that would be difficult to reach by outsiders. Issues of self-selection bias mean that those MSM that participated in the Global LGBTI Internet Survey study may be systematically different from those who didn't, so the study could have a bias towards individuals who are more likely to complete online surveys because they have higher socioeconomic status or live-in urban areas. This can mean that the impact of the study exposures is underestimated based on the higher socioeconomic and demographic positioning of most of the participants.  Bias due to confounding was addressed using stratification methods. Not having data on the race of the MSM respondents from the survey further limits the generalisability and interpretation of the variability in the findings of South African MSM.

Another limitation is the generalisability of findings to MSM across sub-Saharan Africa. The generalisability of the data could be limited as MSM at the margins could have been missed, such as those living in rural locations, who might have lower socioeconomic backgrounds and therefore have limited access to the internet or gay communities. They might also have increased vulnerability to selling sex to generate income and be unable to negotiate condom use.

There were also limitations in the validity of the measure for transactional sex. Only "paid" sex was measured, which implies monetary exchange, excluding gifts and other things that might be important to the respondent as an exchange[252]. This could lead to

underreporting of transactional sex, resulting in non-differential misclassification of the study outcome. This can mean that the impact of IH on transactional sex is underestimated.

Given these limitations, interpreting the findings should be restricted to the population captured by the study.

## 6.7 Dissemination

### 6.7.1 Scientific community

My findings from this research have been submitted for publication in several peer-review journals, including Journal of the International AIDS Society and AIDS and Behaviour. I aim to present findings from these papers at scientific conferences in 2023. I will also present my findings to staff and students at LSHTM at a pre-VIVA seminar in January 2023.

### 6.7.2 Non-academic audience

Prepared dissemination activities are audience specific, varying to address the respective interests of stakeholders from the research outcomes:

| Product | Target Date | Audience | Lead Contributors | Dissemination platform | Status |
|---|---|---|---|---|---|
| Written products | | | | | |
| Objective 1: To inform regional UNAIDS offices of the proposed research, and anticipated timelines | | | | | |
| Research progress update, inc. timelines | April 2020 | UNAIDS regional office for Eastern and Southern Africa (ESA) and for West and Central Africa (WCA) | Ngozi Kalu | Emails and zoom | Done |
| Objective 2: To provide collaborating stakeholders in the community and at National level a snapshot of the research outcomes and policy implications | | | | | |
| Factsheet with research outcomes | January 2023 | LGBTI community members (inc. activists) and organisations, National HIV/AIDS councils (all 46 sub-Sahara African countries), Program managers of NGOs and CBOs working on LGBTQI HIV programmes | Ngozi Kalu/ support from UNAIDS | Emails | Planning |
| Presentations | | | | | |

| Objective 3: Leveraging on contacts from UNAIDS, The Initiative for Equal Rights (TIERS), International Centre for Advocacy on the Rights to Health (ICARH) and Terrence Higgins Trust (THT), disseminate findings to National HIV/AIDS councils of all SSA countries, program managers and policymakers and to Black African MSM communities in diaspora | | | | | |
|---|---|---|---|---|---|
| Virtual dissemination of finding with a focus on policy implications | January 2023 | Program managers of NGOs and CBOs working on LGBTQI HIV programmes, National HIV/AIDS councils of all SSA countries, policy makers and THT | Ngozi Kalu, Study PIs and UNAIDS Nigeria for WCA region and UNAIDS SA for ESA region | Zoom | Planning |
| Civil society forum to discuss finding and receive feedback | Early 2023 | SA National AIDS Council and national LGBTQI organisations | Ngozi Kalu, Tabita and Christoforos | Zoom | Planning |

# 7 Conclusion

To my knowledge, this study presents the first examination of the associations of internalised homonegativity, discriminatory laws and policies with HIV-related outcomes of MSM in SSA using a large sample of countries and multilevel modelling. Guided by the conceptual model, I confirm that the pathways by which discrimination increases the susceptibility of MSM in SSA to adverse HIV-related outcomes involve same-sex criminalisation laws and the absence of targeted HIV policies. MSM living in countries that criminalise same-sex relationships and with no targeted HIV policies for MSM are less likely to test. At the individual level, internalised homonegativity, although high across MSM in SSA was protective for HIV testing. I also find that the pathway to susceptibility and resistance to the effects of internalised homonegativity with transactional sex is influenced by the legal climate, resulting in increased involvement with paying for sex by MSM in countries with laws criminalising same-sex relationships and to reduced odds of paying for sex by MSM in countries with legalised same-sex laws. Laws criminalising same-sex relationships potentially define the boundaries of MSM's ability to cope with minority-related stressors, by removing the opportunities for engaging socially with peers, resulting in worse sexual risk outcomes compared to those in environments where same-sex relationships are legal.

This thesis highlights several policy implications from the findings of the studies, with recommendations for multisector interventions at multiple levels. To address improving uptake of HIV testing and reduction of HIV-risk behaviours of MSM in Africa, at the country level, I highlight that there is need for the elimination of laws criminalising same-sex relationships, acceleration of activities to support countries in creating an enabling environment and a need to advocate for the Inclusion of targeted HIV interventions for MSM in national policies. Implementing these will address many barriers MSM in SSA experience when accessing HIV control services. At the individual level I emphasise the need for continued demand creation for HIV testing services, increased PrEP and PEP access and the inclusion of psychosocial support as an intervention for MSM, preferably integrated into HIV services. These are part of the steps required to reduce the vulnerabilities faced by MSM in the SSA region.

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## Appendix 1: The 2019 Global LGBTI Internet Survey Languages

Green box represents languages officially spoken in SSA countries

| | |
|---|---|
| 🟩 | Amharic |
| 🟩 | Arabic |
| | Bengali |
| | Chinese Simplified |
| | Chinese traditional |
| 🟩 | English |
| | Farsi |
| 🟩 | French |
| | French Haiti (Créole) |
| | Georgian |
| | Gurajati |
| | Hindi |
| | Indonesian |
| | Italian |
| | Japanese |
| | Kannada |
| | Khmer |
| 🟩 | KiSwahili |
| | Korean |
| | Malay |
| | Malayalam |
| | Marathi |
| | Myanmar |
| 🟩 | Portuguese Brazilian |
| | Russian |
| 🟩 | Spanish |
| | Telugu |
| | Thai |
| | Turkish |
| | Ukrainian |
| | Urdu |
| | Vietnamese |

## Appendix 2: The 2019 Global LGBTI Internet Survey Questions

The LGBT Foundation and the United Nations (UNAIDS) partnered with the Universities of Aix-Marseille and Minnesota for this quick survey on happiness, sex and quality of life. You may find more information on the survey, its purpose and first findings on: *(to be completed asap)*

Your responses are completely anonymous.

You can choose to skip any question you would prefer not to answer.

You must be at least 18-year-old to perform this survey. To be in touch, make any information requests, alert us on eventual risks, or exercise your right of withdrawal: research@foundation.lgbt.com

exit

An exit button is always available at the beginning of each module. Respondent can always scroll back to it

☐ OK *(click is required)*

1. *I consent and wish to enter the study anonymously (*required)
   - ☐ yes
   - ☐ no

2. What sex were you assigned at birth?
   - ☐ intersex / ambiguous
   - ☐ female
   - ☐ male

3. How do you define your gender identity? (tick as many as apply)
   - ☐ man
   - ☐ trans man (female to male)
   - ☐ trans woman (male to female)
   - ☐ woman
   - ☐ non-binary gender (Third gender, Hijra)

4. How do you afford your hormones therapy or sex affirmation surgeries? (tick as many as apply)
   - ☐ does not apply to me
   - ☐ most of it is covered by the medical scheme of my country
   - ☐ my private health insurance covers most of it
   - ☐ from my own pocket
   - ☐ I'm working extra hours to afford it
   - ☐ I'm doing sex work to afford it
   - ☐ I regularly sacrifice a meal to pay for it
   - ☐ I can't afford it
   - ☐ I don't need / don't want hormones or sex affirmation surgery for the time being
   - ☐ it is illegal in my country
   - ☐ other

5. How masculine or feminine are you perceived to be by those around you?
   - ☐ very masculine
   - ☐ masculine
   - ☐ neither masculine or feminine
   - ☐ feminine
   - ☐ very feminine

6. What country do you currently live in?

7. Which of the following best reflects why you live in this country: (tick as many as apply)

☐ was born here, or my parents moved here
☐ to study
☐ to work
☐ to follow a partner
☐ to live more openly as gay/bi/lesbian/trans
☐ to seek asylum
☐ I came as a refugee
☐ other

8. How old are you?

9. Would you say that you are open (out) as gay, lesbian, bisexual, or trans [answer 1 for not at all open (in) and answer 5 for open (out to all or most people, you know), or answer some place in between]:

☐ 1 not at all open (in)
☐ 2
☐ 3
☐ 4
☐ 5 open (out) to all or most people I know

10. In general, would you say that your health is

☐ excellent
☐ very good
☐ good
☐ fair
☐ poor

*[Section on wellbeing and happiness (note: text in blue does not appear in the questionnaire)]*

11. On the whole, I am satisfied with myself.

☐ strongly agree
☐ agree
☐ disagree
☐ strongly disagree
☐ I don't know

12. How willing are you to take risks, in general?

☐ 10  very willing
☐ 9
☐ 8
☐ 7
☐ 6
☐ 5
☐ 4
☐ 3
☐ 2
☐ 1
☐ 0    very unwilling

13. I only act to satisfy immediate concerns, figuring that I will take care of future problems that may occur at a later date

- ☐ extremely characteristic of me
- ☐ somewhat characteristic of me
- ☐ uncertain
- ☐ somewhat uncharacteristic of me
- ☐ extremely uncharacteristic of me

*[sub-section: PHQ4]*

For the next four questions, think back over the last 2 weeks, how often have you been bothered by the following problems:

14. Feeling down, depressed or hopeless

- ☐ not at all
- ☐ several days
- ☐ more than half the days
- ☐ nearly every day

15. Little interest or pleasure in doing things

- ☐ not at all
- ☐ several days
- ☐ more than half the days
- ☐ nearly every day

16. Feeling nervous, anxious or on edge

- ☐ not at all
- ☐ several days
- ☐ more than half the days
- ☐ nearly every day

17. Not being able to stop or control worrying

- ☐ not at all
- ☐ several days
- ☐ more than half the days
- ☐ nearly every day

18. Imagine a ladder with steps representing happiness in life.
On which step of the ladder do you stand at this time? *(Answer 1 for worst possible life for me, answer 10 for best possible life, or choose a step in between that correspond to you)*

- ☐ 10 best possible life for me
- ☐ 9
- ☐ 8
- ☐ 7
- ☐ 6
- ☐ 5
- ☐ 4
- ☐ 3
- ☐ 2
- ☐ 1
- ☐ 0 worst possible life for me

19. My family accepts me as I am

☐   strongly agree
☐   agree
☐   disagree
☐   strongly disagree
☐   I don't know

20. There is someone I can count on if things go wrong

☐   strongly agree
☐   agree
☐   disagree
☐   strongly disagree
☐   I don't know

21. There are people around me who like the same activities I do

☐   strongly agree
☐   agree
☐   disagree
☐   strongly disagree
☐   I don't know

22. There is someone who counts on me to lend a hand when they need it

☐   strongly agree
☐   agree
☐   disagree
☐   strongly disagree
☐   I don't know

*[Section on body appearance]*

23. I consider myself physically attractive

☐   strongly agree
☐   agree
☐   disagree
☐   strongly disagree
☐   I don't know

24. Most people would consider me good-looking

☐   strongly agree
☐   agree
☐   disagree
☐   strongly disagree
☐   I don't know

25. I think I am:

☐   very underweight
☐   somewhat underweight

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□ about normal weight

□ somewhat overweight

□ very overweight

*[Section on experience of homophobic reactions]*

26. Have you ever been **stared at or intimidated** because someone knew or presumed your sexual orientation or your gender identity? If yes, when was the last time?

□ no, never

□ yes, within the last 12 months

□ yes, more than 12 months ago

27. Have you ever heard **verbal insults** directed at you because someone knew or presumed your sexual orientation or your gender identity? If yes, when was the last time?

□ no, never

□ yes, within the last 12 months

□ yes, more than 12 months ago

28. Have you ever been **physically assaulted** because someone knew or presumed your sexual orientation or your gender identity? If yes, when was the last time?

□ no, never

□ yes, within the last 12 months

□ yes, more than 12 months ago

*[sub-section on access to healthcare services]*

29. When did you last have an HIV test?

□ within the last 6 months

□ within the last 12 months

□ more than 12 months ago

□ never

30. In the last 12 months, have you avoided going to or delayed going to a health care facility for sexual health or for HIV-related services? (tick as many as apply)

□ would be too risky for me

□ I can't pay

□ I'm embarrassed

□ last time I felt stigmatised

□ I'm worried someone may learn about my sexual orientation

□ it's not convenient (transport, time, distance)

□ I could not find the times

□ it was not important to me

□ I did not avoid or delay my health consultation

□ other

31. Did you experience any of the following the last time you went to a health facility (tick as many as apply)

□ I felt welcomed

□ I had no negative experience

- ☐ verbal abuse (yelling, scolding, name calling, …)
- ☐ physical abuse (pushing, hitting, physically hurt…)
- ☐ was given a condition (requirement) to change my sexual behaviour prior to treatment
- ☐ was given a condition (requirement) to change to change my gender identity prior to treatment
- ☐ refused to help me
- ☐ other

*[sub-section on stigma & discrimination at workplace]*

32. In the last 12 months, have you experienced any of the following at your current work or when you applied for a job? (tick as many as apply)

- ☐ I faced no discrimination
- ☐ my application was refused because I am gay, bi, lesbian, trans
- ☐ I was harassed or ridiculed at the workplace
- ☐ I was not promoted because I am gay, bi, lesbian, trans
- ☐ I was told not to show me being gay, bi, lesbian, trans
- ☐ I was denied certain work-related benefits because I am gay, bi, lesbian, trans
- ☐ I was told not to work with clients
- ☐ I'm not working
- ☐ I didn't apply because I'm gay, bi, lesbian, trans
- ☐ other

33. At work, do you earn less than your nearest heterosexual (straight) counterpart who does the same kind of work

- ☐ yes
- ☐ no
- ☐ don't know
- ☐ does not apply

*[Section on quality of sex]*

34. Over the past three months, how satisfied are you with the quality of your sexual life?

- ☐ 10 really satisfied
- ☐ 9
- ☐ 8
- ☐ 7
- ☐ 6
- ☐ 5
- ☐ 4
- ☐ 3
- ☐ 2
- ☐ 1 really not satisfied

35. I would like to have sex

- ☐ a lot more often
- ☐ a little more often
- ☐ I have enough sex as is
- ☐ a little less often
- ☐ a lot less often

*[Section on sociodemographic data]*

36. Your relationship situation

☐ single
☐ in a relationship with a man
☐ in a relation with a transgender person
☐ in a relationship with a woman
☐ both with a man and a woman
☐ I don't know

37. Education (highest degree completed):

☐ none
☐ primary school
☐ secondary /high school
☐ university first degree
☐ masters/doctorate

38. Current employment status:

☐ employed
☐ self-employed
☐ doing casual or part-time work
☐ unemployed
☐ student
☐ retired
☐ other

*[Section on economic situation]*

39. Which comes closest to your feelings about your income these days?

☐ living really comfortably on present income
☐ living comfortably on present income
☐ neither comfortable nor struggling on present income
☐ struggling on present income
☐ really struggling on present income

40. Considering all debts or loans of whatever type, were you behind with payments by more than 3 months at any time during the last 12 months?

☐ never
☐ rarely
☐ occasionally
☐ most of the time
☐ all the time
☐ does not apply

41. How often have there been times in your life when you have lived in poverty by the standards of that time?

☐ never
☐ rarely
☐ occasionally
☐ most of the time

*[Section on social situation]*

42. Think of a ladder representing where people stand in **your country**

At the **top** of the ladder are the people who are the **best off**. At the **bottom** are the people who are the **worst off.** Where would you place yourself on this ladder at this moment?

☐ 10 among those having most money, most education and

most respected jobs

- ☐ 9
- ☐ 8
- ☐ 7
- ☐ 6
- ☐ 5
- ☐ 4
- ☐ 3
- ☐ 2
- ☐ 1 among those having the least money, least education and least respected jobs or no job

43. Now, think of a ladder representing where people stand in your **local community**
Where would you place yourself on this ladder at this moment?

- ☐ 10 highest social standing in my community
- ☐ 9
- ☐ 8
- ☐ 7
- ☐ 6
- ☐ 5
- ☐ 4
- ☐ 3
- ☐ 2
- ☐ 1 lowest social standing in my community

44. You would say you live in:

- ☐ a major city
- ☐ a medium- or small-size city
- ☐ a village
- ☐ a farm or an isolated house

45. People are different in their sexual attraction to other people. Which best describes your feelings? are you…

- ☐ attracted to other men or gay
- ☐ attracted to other women or lesbian
- ☐ attracted to both men and women or bisexual
- ☐ Straight or heterosexual
- ☐ I don't know

*Note: respondents answering 1 (gay), 3 (bisexual) or 5 (I don't know) will be offered to complete module 2*

*Respondents answering 2 (lesbian) or 4 (straight) will be redirected to question 61 (do you know your HIV status?)*

**exit**

*The following few questions are more specific for gay, bi, transgender and men attracted to other men*

☐ OK *(click is required)*

An exit button is always available at the beginning of each module. Respondent can always scroll back to it

**[Section on HIV prevention and exposure to HIV infection]**

46. In the past 3 months, with how many **different** sexual partners did you have **anal sex without any kind of HIV prevention method**? That is without condoms, PrEP or an undetectable HIV viral load?

☐ 0
☐ 1, steady
☐ 1, casual
☐ 2
☐ 3 to 10
☐ more than 10
☐ Does not apply to me

47. Thinking about your last **anal sex partner without any kind of HIV prevention method** (that is without condom, PrEP or an undetectable viral load), how did it go?

☐ my partner fucked me (I was receptive)
☐ I fucked him/her (I was insertive)
☐ I both fucked and got fucked (I was both receptive and insertive)
☐ does not apply to me

48. Thinking about your last **anal sex partner without any kind of HIV prevention method** (that is without condom, PrEP or an undetectable viral load), did you know his HIV status? tick as many as apply

☐ I didn't ask
☐ s/he's HIV negative
☐ s/he's HIV positive and I don't know his/her viral load
☐ s/he's HIV positive AND undetectable
☐ I was on PreP
☐ s/he was on PreP
☐ I don't remember
☐ I had more than one partner and I do not know everyone's HIV status
☐ does not apply to me

49. In the last 3 months, how much of the sex you've had with men has been under the influence of alcohol or any other drug?

- ☐ none of it
- ☐ almost none of it
- ☐ less than half
- ☐ about half
- ☐ more than half
- ☐ almost all of it
- ☐ all of it
- ☐ does not apply to me

50. In the past 3 months, did you share drug injecting equipment (needles, syringes) with someone else?

- ☐ yes, once
- ☐ yes, several times
- ☐ no, I don't share my equipment
- ☐ no, I don't inject drugs

51. What do you do if your potential date/sexual partner tells you they are is HIV positive? (tick as many as you like)

- ☐ I do not see them again
- ☐ I am not comfortable having sex with them
- ☐ I am comfortable having sex with them because we use a condom, I am on PrEP and/or he is undetectable
- ☐ I'm HIV positive too

52. In the last 12 months, how often have **you paid someone** to have sex with you?

- ☐ never
- ☐ 1-2
- ☐ 3-10
- ☐ 11-50
- ☐ more than 50 times

53. In the last 12 months, how often have **you been paid** to have sex

- ☐ never
- ☐ 1-2
- ☐ 3-10
- ☐ 11-50
- ☐ more than 50 times

54. I feel comfortable in gay bars

- ☐ 7 strongly agree
- ☐ 6
- ☐ 5
- ☐ 4 undecided
- ☐ 3
- ☐ 2
- ☐ 1 strongly disagree
- ☐ does not apply

55. Social situations with gay men make me feel uncomfortable

- ☐ 7 strongly agree

- ☐ 6
- ☐ 5
- ☐ 4 undecided
- ☐ 3
- ☐ 2
- ☐ 1 strongly disagree
- ☐ does not apply

56. I feel comfortable being seen in public with an obviously gay person
- ☐ 7 strongly agree
- ☐ 6
- ☐ 5
- ☐ 4 undecided
- ☐ 3
- ☐ 2
- ☐ 1 strongly disagree
- ☐ does not apply

57. I feel comfortable discussing homosexuality in a public situation
- ☐ 7 strongly agree
- ☐ 6
- ☐ 5
- ☐ 4 undecided
- ☐ 3
- ☐ 2
- ☐ 1 strongly disagree
- ☐ does not apply

58. I feel comfortable being sexually attracted to other men
- ☐ 7 strongly agree
- ☐ 6
- ☐ 5
- ☐ 4 undecided
- ☐ 3
- ☐ 2
- ☐ 1 strongly disagree
- ☐ does not apply

59. Homosexuality is morally acceptable to me
- ☐ 7 strongly agree
- ☐ 6
- ☐ 5
- ☐ 4 undecided
- ☐ 3
- ☐ 2
- ☐ 1 strongly disagree
- ☐ does not apply

60. Even if I could change my sexual orientation, I wouldn't
- ☐ 7 strongly agree

- ☐ 6
- ☐ 5
- ☐ 4 undecided
- ☐ 3
- ☐ 2
- ☐ 1 strongly disagree
- ☐ does not apply

61. Do you know your HIV status?

- ☐ I'm HIV-negative
- ☐ I'm HIV-positive
- ☐ I don't know
- ☐ I don't want to answer

- ☐ PREV *(clicking here brings the respondent to earlier module in case she/he would like to change)*
- ☐ DONE *(brings the respondent to a thank you message)*

*Note: participants that have answered "I'm HIV-positive" at question will be offered to participate to module 3 (see next page)*

*(Thank you message)*

Thank you very much for your support.

Sign up to get the results of this study and participate in future studies, your information is completely anonymous, any IP address is decoupled, encrypted and deleted at the end of the study. *https://lgbt-token.org/research_signup*You may share the survey via: *https://www.research.net/r/LGBTHappinessResearch*

Get tested for HIV regularly. For more information: *https://hornet.com/about/know-your-status/*

*(Only participant who answered I'm HIV positive are offered to participate to module 3 below)*

**Module 3: HIV-related stigma and discrimination**

*If you are HIV-positive, you may face stigma. Let's talk about it*

*Choose how you feel about each statement. We understand some questions might sound disturbing. Please share your experience. It will help to create a more inclusive environment for everyone*

- ☐ OK *(click is required)*

62. I am not as comfortable as I used to be in dating since I learned I have HIV
    - ☐ strongly agree
    - ☐ agree
    - ☐ disagree
    - ☐ strongly disagree
    - ☐ I don't know

63. I disclosed my HIV status on my online profile in the main app I'm using
    - ☐ yes
    - ☐ no

64. If no, is there any reason you don't mention your HIV status? (tick as many as apply)
    - ☐ I revealed it before and couldn't meet anybody
    - ☐ I'm afraid of rejection
    - ☐ I say I am looking for safe sex (like with a condom) and I do not need to tell them my HIV+ status
    - ☐ I don't need to mention it
    - ☐ I'm undetectable
    - ☐ I don't want to mention it
    - ☐ other
    - ☐ does not apply to me (I disclosed my HIV+ status on my profile)

65. I changed the way I have sex since I know I'm HIV positive
    - ☐ yes
    - ☐ no
    - ☐ I don't know
    - ☐ does not apply

66. Since I've known that I'm HIV-positive, I have sex with:
    - ☐ people regardless of their HIV status
    - ☐ only HIV-positive partners
    - ☐ I don't have sex anymore
    - ☐ does not apply

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67. Some people avoid touching me once they know I have HIV

    ☐    strongly agree
    ☐    agree
    ☐    disagree
    ☐    strongly disagree
    ☐    I don't know

68. People I care about stopped contacting me after learning I have HIV

    ☐    strongly agree
    ☐    agree
    ☐    disagree
    ☐    strongly disagree
    ☐    I don't know

69. I have lost friends by telling them I have HIV

    ☐    strongly agree
    ☐    agree
    ☐    disagree
    ☐    strongly disagree
    ☐    I don't know

70. Telling someone I have HIV is risky

    ☐    strongly agree
    ☐    agree
    ☐    disagree
    ☐    strongly disagree
    ☐    I don't know

71. I work hard to keep my HIV a secret

    ☐    strongly agree
    ☐    agree
    ☐    disagree
    ☐    strongly disagree
    ☐    I don't know

72. I am very careful whom I tell that I have HIV

    ☐    strongly agree
    ☐    agree
    ☐    disagree
    ☐    strongly disagree
    ☐    I don't know

73. People with HIV are treated like outcasts

    ☐    strongly agree
    ☐    agree
    ☐    disagree
    ☐    strongly disagree
    ☐    I don't know

74. Most people believe a person who has HIV is dirty

    ☐    strongly agree

- ☐ agree
- ☐ disagree
- ☐ strongly disagree
- ☐ I don't know

75. Most people are uncomfortable around someone with HIV
- ☐ strongly agree
- ☐ agree
- ☐ disagree
- ☐ strongly disagree
- ☐ I don't know

76. I feel guilty because I have HIV
- ☐ strongly agree
- ☐ agree
- ☐ disagree
- ☐ strongly disagree
- ☐ I don't know

77. People's attitudes about HIV make me feel worse about myself
- ☐ strongly agree
- ☐ agree
- ☐ disagree
- ☐ strongly disagree
- ☐ I don't know

78. I feel I'm not as good a person as others because I have HIV
- ☐ strongly agree
- ☐ agree
- ☐ disagree
- ☐ strongly disagree
- ☐ I don't know

79. In the last 12 months, have you ever been excluded from social gatherings or activities (e.g., weddings, funerals, parties, clubs) because of your HIV status?
- ☐ yes, once
- ☐ yes, several times
- ☐ no
- ☐ I don't know
- ☐ it doesn't apply to me

80. Are you currently taking HIV (antiretroviral) treatment? (choose one)

☐ yes
☐ no, medication is not available at the clinic or pharmacy
☐ no, medication is not affordable for me
☐ no, I am unable to collect medications at the clinic or pharmacy
☐ no, I cannot tolerate medication side effects or am worried about taking the pills
☐ no, I do not feel treatment is needed
☐ no, I am worried someone would find out my HIV status
☐ no, I am not ready to deal with my HIV infection
☐ no, I am worried the healthcare workers would treat me badly or disclose my HIV status without my consent
☐ no, I do not qualify for treatment in my country because my CD4s are too high
☐ no, for other reasons

81. In the last 12 months, have you been told you have an undetectable viral load or are virally suppressed ("good viral load")?

☐ yes
☐ no, I have not had a viral load test in the last 12 months
☐ no, I had a viral load test and am waiting for the results
☐ no, the virus was detectable/I am not virally suppressed
☐ I don't know what viral load or viral suppression are
☐ I don't have treatment

82. Living with HIV can open new horizons and positively affects us deep inside. Which of the following have been positively affected by your HIV status (tick as many as apply)

☐ My self confidence
☐ My self-respect
☐ My ability to respect others
☐ My ability to cope with stress
☐ My ability to better take care of my health
☐ My ability to contribute to my community
☐ Other
☐ None of the above

☐ PREV *(clicking here brings the respondent to earlier module in case she/he would like to change)*
☐ DONE *(brings the respondent to a thank you message)*

*(Thank you message) see p 12*

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## APPENDIX 3: Number Of LGBT+ Respondents Per Country In Primary Dataset (N=5,851)

| Country | number of respondents | Percent of total respondents |
|---|---|---|
| Angola | 209 | 3.6 |
| Benin | 178 | 3.0 |
| Botswana | 44 | 0.8 |
| Burkina-Faso | 151 | 2.6 |
| Burundi | 16 | 0.3 |
| Cameroon | 153 | 2.6 |
| Cape verde | * | * |
| Central African Republic (the) | 35 | 0.6 |
| Chad | 68 | 1.2 |
| +Comoros | * | * |
| Congo | 361 | 6.2 |
| Côte d'Ivoire | 148 | 2.5 |
| Democratic Republic of the Congo (the) | 170 | 2.9 |
| Equatorial Guinea | * | * |
| Eritrea | * | * |
| Eswatini | 108 | 1.9 |
| Ethiopia | 180 | 3.1 |
| Gabon | 137 | 2.3 |
| Gambia | * | * |
| Ghana | 156 | 2.7 |
| Guinea | 12 | 0.2 |
| Guinea-Bissau | * | * |
| Kenya | 201 | 3.4 |
| Lesotho | 77 | 1.3 |
| Liberia | 40 | 0.7 |
| Madagascar | * | * |
| Malawi | 64 | 1.1 |
| Mali | 152 | 2.6 |
| Mauritania | 144 | 2.5 |
| Mauritius | 302 | 5.2 |
| Mozambique | 246 | 4.2 |
| Namibia | 141 | 2.4 |
| Niger | 15 | 0.3 |
| Nigeria | 313 | 5.4 |
| Rwanda | 183 | 3.1 |
| +Sao Tome and Principe | * | * |
| Senegal | 63 | 1.1 |
| Seychelles | * | * |
| Sierra Leone | * | * |
| South Africa | 1,004 | 17.2 |
| South Sudan | * | * |
| Togo | 255 | 4.4 |
| Uganda | 19 | 0.3 |
| United Republic of Tanzania | 167 | 2.9 |
| Zambia | 146 | 2.5 |
| Zimbabwe | 152 | 2.6 |

* Countries with <10 responses to prevent unintended disclosure

+ Countries with no MSM respondents

# Data Management Plan for Research Students

| Project title | Discrimination and Health: Effects of Internalised Homonegativity, Discriminatory Laws and policies on HIV related behaviours of men who have sex with men living in Sub-Saharan Africa |
|---|---|
| **Author name** | Ngozi Kalu |
| **Supervisor** | Melissa Neuman |
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| **Date of last edit** | |

Guidance on writing a Data Management Plan can be found at
https://lshtm.sharepoint.com/Research/Research-data-management/
and http://servicedesk.lshtm.ac.uk
Advice and feedback can be obtained from:
researchdatamanagement@lshtm.ac.uk

**DESCRIBE YOUR RESEARCH**

1. What digital resources – data, code, collection tools, etc. - will you collect/obtain and use? Relevant details to mention: topics covered, type (e.g. survey), source (collected by self or others), format (e.g. STATA) and amount (e.g. 10 interviews). Draw attention to human or other data that require additional protection.

I will receive datasets from the cross-sectional Global LGBTI internet survey. A total of 5,794 respondents from Sub-Saharan Africa will be in the excel file. Received data will be stored securely in an encrypted personal computer.

2. What hardware and software will be used in your research?
List any hardware and software to be used, their intended purpose (e.g. collection, analysis), and (if relevant) the number needed. E.g. 20 Samsung 10" tablets, LSHTM's Open Data Kit software, STATA and MS Access for analysis.

I plan to use STATA vs 16 for data analysis.

3. What data-related activities will be performed during the research? List key data-related activities that you and/or others will perform during the research. For instance, trial draft survey in month 6, collect data in month 8-10, clean and anonymise data in month 11, analyse data in month 12-18.

| Task | Description |
|---|---|
| Data analysis | Month 30 - 34 |

4. What quality checks will you perform to ensure resources are fit for purpose?
Outline any quality checks to be performed <u>before, during and after</u> the above activities, e.g. to ensure data are captured correctly, remain accurate and complete, or ensure you avoid recognised problems. The UK Data Services offers guidance at http://ukdataservice.ac.uk/manage-data/format/quality.aspx.


5. How will you address ethical & legal issues within your research?
- What permissions are needed? E.g. to collect data in country, analyse data for specific purpose, share data
- From whom must approval be obtained? E.g. study participant, ethics committees, data provider
- How will permissions be provided? E.g. ask participants to sign a consent form, sign a Data Transfer Agreement

I will be using secondary data which already has Ethics approval granted for the primary data collection by the Research Ethics Committee of Aix-Marseille University in March 2019 and by the WHO Research Ethics Review Committee in April 2019. Ethical approval for the secondary use of the data for this study would be sought from the primary data owners, UNAIDS and further approval sought from LSHTM Ethics Committee.

6. What documentation will be created to ensure resources can be understood?
What aspects of the research will be documented and how? E.g. processes could be documented in Standard Operating Procedures, workflows applied described in a lab book, a codebook written to describe variables, etc.

**STORAGE AND SECURITY**

7. Where will resources be stored at key stages of your research?

Identify where resources will be held during capture, processing, analysis and other stages, and who will have access to them. Consult https://lshtm.sharepoint.com/Services/IT-Services/ServiceDesk/LSHTM-data-storage-options.pdf

The datasets for analysis and drafts of manuscripts will be stored on my personal computer that is backed up every hour to an external drive. The student, supervisory and advisory team will have access to these files, which will be sent with In-transit encryption through OneDrive. Or is an open data kit a better option since access is fully encrypted?(speak to IT)

8. What labelling conventions will you apply to manage your resources?

Briefly describe any naming conventions or classification systems you will apply to resources. E.g.
- Filenames: key characteristics you will record to group files, e.g. FG1_transcript_2018-10-01
- Variable: conventions to be used for question IDs, completed responses & missing variables
- Versions: how will you identify changes to resources over time (e.g. v1.1, v1.2)

Filenames will include key characteristics of the file (e.g. codebook) and the date. Versions will be numbered, and the last author who edited the document will include their initials in the filename

9. How will you keep data safe and secure? (choose one or more)

| Only anonymised data will be used - personal, sensitive, or otherwise confidential data is not needed for the research | yes | Store personal details in a separate secure location & link it via an identifier | | Delete personal & confidential details at earliest opportunity (specify when below) | |
|---|---|---|---|---|---|
| Use digital storage that require a username/password or other security feature | | Physical security (such as locked cabinet or room) | | Protect portable devices using security features, e.g. biometric | yes |
| Encrypt storage devices | yes | Encrypt during transfer | yes | Avoid cloud services located outside EU | yes |
| Take 'Information Security Awareness training' | | Ensure backups are also held securely | yes | | |
| Notes: | | | | | |
| Identify additional steps you will take to avoid, reduce, or eliminate risks that may affect your resources. | | | | | |
| | | | | | |

**ARCHIVING & SHARING**

10. What resources should be kept as evidence of your research?

Research often has value beyond the lifespan of the project that produced it. For this reason, many researchers are required to keep data for a set time period, typically 10 years following completion, to comply with funding or journal publication requirement. List the resources in Q1 that will be kept and for how long. If some resources can't be retained for some reason (e.g. it contains personal data), state the reason that this is not permitted.

Codebooks and analysis files will be kept for 10 years.

11. Where will these resources be hosted?

Identify where each resource will be hosted following research completion. E.g.

- Files intended for sharing may be hosted in the LSHTM data repository (http://datacompass.lshtm.ac.uk) or a 3rd party repository, such as UK Data Service, ArrayExpress, Zenodo, etc.
- Internal and confidential files can be held on the LSHTM Secure Server
- My supervisor will look after them


Not sure yet as I do not own the data, will follow agreement with PIs


12. When will the resources be made available? (choose one or more)

| During the research life | | At the same time as findings are published in an academic journal | yes | A set time after research end, e.g. 12 months. Specify below | |
|---|---|---|---|---|---|
| Resources already available (provide details below) | | On completion of my thesis | yes | Other (provide details below) | |
| Further information / Other | | | | | |
| | | | | | |

13. How will you make other researchers aware that the resources exist?

| Publish a metadata record describing the resources in a repository or other catalogue | | Obtain a Digital Object Identifier (DOI) or other permanent ID | yes |
|---|---|---|---|
| Cite resources in future research papers, e.g. in the data access statement or reference list | yes | Cite resources in project reports | yes |
| Publish a description for the project website | | Write and publish a Data Paper | |
| Add resources to a list of your academic outputs | | | |
| Other measures / Further details | | | |
| | | | |

14. What steps will you take to ensure resources are easy to analyse and use in future research? (choose one or more)

| Prepare a codebook or other documentation that provides an accurate description of content | yes | Store resources in open file formats such as CSV, Rich Text, etc. See https://www.ukdataservice.ac.uk/manage-data/format/recommended-formats | |
|---|---|---|---|
| Write a user guide that provides a high-level overview of research | | Apply a standard licence that allows a broad range of uses (e.g. Creative Commons, Open Data Commons) | |
| Designate a corresponding author / data custodian who will handle data-related questions | yes | Use domain-specific standards that make it easy to import and analyse data | |
| Other / Further information | | | |
| | | | |

15. If resources can be made available, but not openly, what conditions on access/use must be met? E.g. data can be used for specific types of research only. Leave blank if not applicable.

| Requirement: | To be addressed by: |
|---|---|
| N/A | |
| | |
| | |

**RESOURCING**

16. What are the primary data management challenges in your research? E.g. uncertainty on data management practice, data security, data-related costs, staff resources, etc.

None of the data will contain person identifiable information but safe storage of the dataset in accordance with requirements by the primary data owner might be

17. How can LSHTM & others help you to better manage your data?

LSHTM can help by providing the secure servers and secure channels through which confidential data can be transferred and shared

**Aix*Marseille**
université

**Comité d'éthique de l'université d'Aix-Marseille**

Objet : Avis du Comité d'éthique.
N/Réf dossier : 2019-14-03-004
  Dossier suivi par :DRV-Audrey Janssens

Pièce(s) jointe(s) : 1 document

Marseille, le samedi 16 mars 2019

Le projet de recherche présenté par l'investigateur principal Dr. Ventelou Bruno, Directeur de recherche au Laboratoire AMSE, UMR AMU CNRS EHESS de l'Université Aix-Marseille et l'investigateur secondaire Lamontagne Erik, PhD et Economiste principal-ONUSIDA , intitulé **«Enquête sur les inégalités sociales et économiques et les facteurs de risque à l'infection au VIH de la communauté LGBT.»** a été soumis pour avis au Comité d'éthique en sa séance du jeudi 14 mars 2019.

Après audition des rapporteurs, le comité a jugé que le projet ne pose pas de problème éthique ou règlementaire.

Le Comité d'éthique de l'Université d'Aix-Marseille émet donc un avis favorable.

Le Président du Comité d'éthique

Pierre-Jean Weiller

Dear Colleague,

We would like to inform you that your project ERC.0003175 has received Final Approval by the Ethics Review Committee. The approval summary can be found in the database (https://extranet.who.int/ercweb/login.php) by clicking on: Review outcome available and then selecting the corresponding protocol at the bottom of the page.

Please note that this approval is valid for one year only. You will receive a reminder for submitting a progress report and continuing review form 2 months before the end of this approval. If you have any questions, please do not hesitate to contact us at ercsec@who.int.

Kind regards,

ERC Secretariat.

Link to the WHO-ERC database: https://extranet.who.int/ercweb/

MSG_COD:f_rev_ro

## DECLARATION OF CONFIDENTIALITY AND DATA PRIVACY

**to be signed by all persons involved in the 1st Global LGBT+ Foundation and UNAIDS Survey on Happiness, Sex and Quality of life)**

I will be bound by all the terms and conditions of the confidentiality undertaking signed by the duly designated representative of my research entity and will use the dataset indicated in the research proposal in accordance with the terms of use attached to the confidentiality undertaking.

I understand that I must treat all data related to the LGBTI Global Survey in accordance with the EU Directive 95/46/EC and as amended, replaced or superseded from time to time, including by the EU General Data Protection Regulation 2016/679 (GDPR)

I will:
(a) use the dataset only for the purposes specified in the research proposal;
(b) safeguard the dataset and any usernames and passwords associated with it;
(c) ensure that any results of analyses will not be disclosive or potentially disclosive in conjunction with other publicly available information;
(d) acknowledge the dataset and its source in any research report or publication and also state that the results and conclusions are mine and not those of the LGBT+ Foundation, UNAIDS, Aix-Marseille University or University of Minnesota;
(e) provide the LGBT+ Foundation and UNAIDS with references to publications and other research reports based on this dataset;
(f) preserve the confidentiality of information pertaining to identifiable individuals, households and/or organisations, such as those using the email address provided in the survey to exercise their right of withdrawal;
(g) submit the final complete output of my work for the confidentiality check to the competent LGBT+ Foundation or UNAIDS staff (in case of access to secure use files);
(h) destroy the dataset and any data or variables derived from it at the end of the research period specified in the research proposal and sign a declaration to the effect that it has been ensured that all data have been destroyed;
(i) abide by any other conditions notified to me by LGBT+ Foundation and UNAIDS (e.g. guidelines for publication);
(j) inform the LGBT+ Foundation and UNAIDS immediately about any breach of the confidentiality rules laid down in the confidentiality undertaking or in the terms of use of confidential data for scientific purposes.

I will not:
(a) use the data (scientific use files) outside the premises of my research entity;
(b) allow non-authorised users to access the dataset (authorized users are named in the research proposal);
(c) use the data for research purposes before it is checked for confidentiality by the LGBT+ Foundation and UNAIDS (in case of access to secure use files)
(d) remove the data or any part of it (in case of access to secure use files);

(e) attempt to link the data to other (including public) datasets, whether or not provided by the LGBT+ Foundation and UNAIDS, if not expressly agreed;

(f) attempt to identify any individual record (individual, household, business, etc.) in the dataset, or claim to have done so;

(g) release or publish any information or results which identify any individual record or may lead to the identification of any individual record.

I certify that I have read all of the above clauses, that I understand that I am accountable for correct and responsible use of the data and data access system, and that I understand that if I fail to comply with these clauses, my access to the dataset will be withdrawn and I will be liable to any other sanctions that may be determined by my research entity or are specified in the applicable civil or penal law.

Name: …………………………………Signature: ………………………..Date: ……………………

**Appendix 7: LSHTM Ethics Approval For Secondary Data Analysis**

LONDON
SCHOOL *of*
HYGIENE
&TROPICAL
MEDICINE

# This is to certify that
Ngozi Kalu

successfully completed the

Research Ethics

e-learning course

with a score of

80.00 %

Comprising of modules covering:

- Introduction to the History of Research Ethics
- Fundamental Ethical Principles, including:
    - Respect for persons
    - Beneficence
    - Justice
- Responsibilities of Research Ethics Committees
- Understanding Vulnerability
- Privacy and Confidentiality

On

June 12, 2021

Provided by

London School of Hygiene & Tropical Medicine

This course meets the requirements for protection of human subjects training required by individuals
involved in the design and/or conduct of National Institutes of Health (NIH) funded human subjects research.

London School of Hygiene & Tropical Medicine
Keppel Street, London WC1E 7HT
United Kingdom
Switchboard: +44 (0)20 7636 8636

www.lshtm.ac.uk

LONDON
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MEDICINE

**Observational / Interventions Research Ethics Committee**

Miss Ngozi Kalu

LSHTM

18 June 2021

Dear Miss Ngozi Kalu

**Study Title:** Discrimination and Health: Effects of Internalised Homonegativity, Discriminatory Laws and policies on HIV related behaviours of men who have sex with men living in Sub-Saharan Africa

**LSHTM Ethics Ref:** 26340

Thank you for responding to the Observational Committee's request for further information on the above research and submitting revised documentation.

The further information has been considered on behalf of the Committee by the Chair.

**Confirmation of ethical opinion**

On behalf of the Committee, I am pleased to confirm a favourable ethical opinion for the above research on the basis described in the application form, protocol and supporting documentation as revised, subject to the conditions specified below.

**Conditions of the favourable opinion**

Approval is dependent on local ethical approval having been received, where relevant.

**Approved documents**

The final list of documents reviewed and approved by the Committee is as follows:

| Document Type | File Name | Date | Version |
|---|---|---|---|
| Local Approval | Aix-Marseille University ethics approval | 16/03/2019 | 1 |
| Local Approval | WHO ethics approval | 29/04/2019 | v1 |
| Local Approval | LGBTI_GIS_Research Proposal_WHO_ERC_29April_external | 29/04/2019 | 1 |
| Consent form | LGBTI_GIS_Research Proposal_WHO_ERC_29April_external | 29/04/2019 | 1 |
| Consent form | declaration confidentiality | 11/03/2021 | 1 |
| Protocol / Proposal | DrPH review document Ethics Application | 07/06/2021 | 2 |
| Other | Research_Ethics_online_training_certificate | 12/06/2021 | 1 |
| Investigator CV | Ngozi Kalu CV21 | 12/06/2021 | 1 |
| Covering Letter | Ethics Application Clarifications 1 | 15/06/2021 | 1 |

**After ethical review**

The Chief Investigator (CI) or delegate is responsible for informing the ethics committee of any subsequent changes to the application. These must be submitted to the Committee for review using an Amendment form. Amendments must not be initiated before receipt of written favourable opinion from the committee.

The CI or delegate is also required to notify the ethics committee of any protocol violations and/or Suspected Unexpected Serious Adverse Reactions (SUSARs) which occur during the project by submitting a Serious Adverse Event form.

An annual report should be submitted to the committee using an Annual Report form on the anniversary of the approval of the study during the lifetime of the study.

At the end of the study, the CI or delegate must notify the committee using an End of Study form.

All aforementioned forms are available on the ethics online applications website and can only be submitted to the committee via the website at: http://leo.lshtm.ac.uk

Additional information is available at: www.lshtm.ac.uk/ethics