Mapping the current knowledge in syndemic research applied to Men who have Sex with Men: a Scoping Review

Maxence R. Ouafik1, Laetitia Buret2, Beatrice Scholtes3

1 Research Unit of Primary Care and Health, General Practice Department, University of Liège, Liège, Belgium; Quartier Hôpital B23 Avenue Hippocrate 13, 4000, Liège [maxence.ouafik@uliege.be](mailto:maxence.ouafik@uliege.be) OrcID <https://orcid.org/0000-0002-9795-5721>

2 [laetitia.buret@uliege.be](mailto:laetitia.buret@uliege.be) OrcID <https://orcid.org/0000-0002-5653-615X>

3 [beatrice.scholtes@uliege.be](mailto:beatrice.scholtes@uliege.be) OrcID <https://orcid.org/0000-0001-5274-822X>

\*corresponding author: [maxence.ouafik@uliege.be](mailto:maxence.ouafik@uliege.be) <https://orcid.org/0000-0002-9795-5721>

# Abstract

Men who have sex with Men (MSM) represent a population affected by numerous health conditions. Syndemic theory has been used as a framework to study the health of MSM for nearly 20 years. However, the literature is plagued by a lack of consensus regarding what constitutes a synergy in a syndemic and recent reviews have shown that most of the papers published thus far have failed to demonstrate a synergy nor describe the bio-social interaction needed to account for a true syndemic. Moreover, to our knowledge, none of the existing reviews have focused specifically on MSM.

This scoping review aims to fill this gap by mapping in detail how syndemic research on MSM has been conducted. A systematic database search was conducted between 2020 and 2021 and 115 studies were included. Our findings showed a lack of diversity regarding the location, design, subpopulation, and outcomes studied. In addition, the syndemic conditions as well as their measurement were not focused enough to ensure the robustness and reproducibility of the findings. Furthermore, our results support previous reviews showing a lack of empirical data to support disease interaction in syndemic research applied to MSM. Our review offers some important recommendations to help move the field forward in future work and describes some promising methodological advances.

# Introduction

## Background

Men who have sex with men (MSM) represent a population disproportionately affected by numerous health conditions. They represent 70% of new HIV diagnoses ([Center for Disease Control and Prevention, 2020](#X4cf13d81533c7b267d16e8ce422f52a6b94e857)) in the United States of America (USA) and more than half of new HIV diagnoses in the European Union/European Economic area ([European Centre for Disease Prevention and Control & WHO Regional Office for Europe, 2019](#Xe9d1574ea3592c13d78cb3440bd26eb0dba677a)). They are also more prone to contract other sexually transmitted diseases and *Neisseria Gonorrhoea* strains from MSM exhibit higher antimicrobial resistance ([Centers for Disease Control and Prevention, 2019](#Xac65d4e2802ef6640efb692e7711ad3535446e3)). Furthermore, mental health conditions such as depression, anxiety, suicide attempts or self-harm are more prevalent among MSM ([Liu et al., 2019](#ref-Liu2019); [Luo et al., 2017](#ref-luo2017); [Ross et al., 2018](#ref-ross2018)) and substance use is more common than for their heterosexual counterparts ([Medley et al., 2016](#ref-Medley2016)). Moreover, those adverse health outcomes are enmeshed within structural disadvantages such as violence, stigma, discrimination ([Collier et al., 2013](#ref-collier2013); [Lea et al., 2014](#ref-Lea2014); [J. H. Lee et al., 2016](#ref-Lee2016)) as well as with poverty, unemployment, unstable housing and poor access to healthcare ([Ayhan et al., 2020](#ref-ayhan2020); [Closson et al., 2018](#ref-closson2018)).

For more than 20 years, syndemic theory has provided a framework to examine the interrelations between social conditions, mental health, and physical health ([Singer et al., 2017](#ref-singer2017)). Described for the first time in 1996 by Merrill Singer ([Singer, 1996](#ref-singer1996)), a syndemic consists of two or more interacting epidemics producing an excess burden in a population due to harmful social conditions ([Singer & Clair, 2003](#ref-singer2003)). To speak of a syndemic, three conditions must be met ([Mendenhall & Singer, 2020](#ref-mendenhall2020)):

1. Two or more conditions cluster in a given population.
2. This clustering is due to an adverse social context such as poverty or stigmatisation.
3. There is some form of biological, social and/or behavioural interaction between the conditions, significantly worsening the health of the affected population.

A syndemic is thus a holistic framework describing interactions both between diseases themselves and between diseases and the social environment contributing to their emergence, clustering and spread ([Singer et al., 2017](#ref-singer2017)). As such, its value for studying the health of marginalised populations such as MSM is undeniable.

## Rationale

Nevertheless, this framework is frequently misused by researchers. A systematic review conducted in 2015 showed the inadequacy of most of the literature in supporting one of its core tenets ([Tsai & Burns, 2015](#ref-tsai2015)). Indeed, that paper demonstrated that, although synergistic interaction between diseases lies at the core of the theory, most papers failed to use relevant statistics to demonstrate the existence of a synergy. More recently, a scoping review published in 2020 confirmed this finding that most recently published citations did not describe the interactions between diseases needed to account for a true syndemic ([Singer et al., 2020](#ref-Singer2020)). Scholars in the field have been calling for greater clarity in the use of the concept and have urged researchers to describe more precisely the interactions they observe between health conditions ([Singer et al., 2021](#ref-singer2021); [Mendenhall & Singer, 2020](#ref-mendenhall2020)).

However, to our knowledge none of the existing reviews or recommendations have focused on syndemic literature applied specifically to MSM. We thus sought to fill this gap by conducting a scoping review with the objective to map the following:

1. the study design used,
2. the subpopulations of MSM studied,
3. the psychosocial conditions considered as forming a syndemic and how they were measured,
4. the outcomes studied,
5. the statistics used to evaluate the concept of interaction,
6. the hypothesis for biological and sociobiological interactions proposed by the authors, when available,
7. relevant frameworks that may compliment syndemic theory to better understand the health of MSM and,
8. the key findings of these studies.

With these data, we wanted to better understand the state of the art in the current literature, identify knowledge gaps and suggest recommendations to guide future research in the field.

# Materials and Methods

The complete protocol of this scoping review was published in 2020 (Author, 2020. Details omitted for double-blind review).

We applied the framework suggested by Arskey and O’Malley ([Arksey & O’Malley, 2005](#ref-arksey2005)), with enhancements from Levac et al. ([Levac et al., 2010](#ref-levac2010)). We also considered the recommendations formulated by Colquhoun et al. ([Colquhoun et al., 2014](#ref-colquhoun2014)) and the updated guidance by Peters and colleagues ([Peters et al., 2020](#ref-peters2020)). We followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) ([Tricco et al., 2018](#ref-Tricco2018)). The completed checklist can be found in Table **1** of the supplementary materials.

Screening and data charting were completed using DistillerSR (Evidence Partners, Ottawa, Canada). Scripts, statistics, charts, tables, and the present paper was generated using R ([R Core Team, 2020](#ref-rcoreteam2020)), RStudio ([RStudio Team, 2020](#ref-rstudioteam2020)) and the appropriate packages. To ensure the complete transparency and reproducibility of this article, the lead author uploaded all data used to generate this article on Open Science Framework (DOI omitted for double blind review).

Our main research question: *“What is known about Syndemic Theory applied to MSM”* was subdivided into three sub-questions:

1. *“How are studies concerning Syndemic Theory applied to MSM conducted?”*
2. *“How is the concept of interaction explored in syndemic research applied to MSM?”* and
3. *“What were the key findings of these studies?”*

To answer these questions, we conducted a systematic search strategy in the following databases: Medline, PsycInfo, Scopus, Cochrane Central Register of Controlled Trials and ProQuest Sociological Abstracts using complex search equations to include every synonym for “men who have sex with men.” The complete search strategy for each database can be found in the Supplementary Material of our protocol. No date limit was applied given the relative novelty of the syndemic literature. A first search using this strategy was conducted on the 11th of June 2020 and was subsequently updated on the 9th of February 2021 and finally on the 11th of November 2021.

Search results were downloaded into .RIS files and imported into DistillerSR. After duplicate removal, we screened the title and abstracts for eligibility, using forms generated with DistillerSR by the authors. Articles that met the inclusion criteria or for which eligibility was unclear underwent a second screening in which the full texts were assessed for eligibility. As per the protocol, 10% of the titles and abstracts were screened by two reviewers. A Kappa inter-rater reliability score was computed using DistillerSR and was equal to 0.86. As it exceeded our cutoff of 0.8, the rest of the screening process was conducted by the main investigator only. Articles were included if they met the following criteria:

* MSM was either the only population studied in the paper or, if studied alongside other populations, such as transgender women, disaggregated data must have been available for MSM.
* The syndemic framework was the main focus of the study
* Studies were cohort, case-control, cross-sectional, controlled trials, mixed studies, qualitative studies, systematic reviews, or meta-analyses. We excluded letters, commentaries, conference abstracts, editorials, or narrative reviews.
* Language was English
* The article was published in a peer-reviewed journal

After inclusion of relevant studies, we hand-searched the reference lists to manually add pertinent studies. The same selection process was then applied, and these papers are marked as “Additional records identified through other sources” in the study selection flow diagram (Figure [**1**](#PRISMA)).

Data charting was also performed using forms generated in DistillerSR by the authors. The complete list of all variables for which data were sought can be found in our protocol (Author, 2020]. Furthermore, the README file of our *Data* subdirectory contains an exhaustive definition of every variable included. Two amendments were made to our initial protocol:

1. We included a variable to chart any additional frameworks the authors might have used.
2. We included variables to chart data for systematic reviews and meta-analyses. These two kinds of studies were omitted from our initial protocol as we were not aware of the existence of such reviews at the time we published the protocol. The variables included were general characteristics (authors, years, location, design, total sample size), purpose of the review, number of studies included, hypotheses for biological or bio-social interaction, key findings, and additional frameworks.

Data were then collated, summarised, and reported using R, RStudio and relevant packages. Charts were generated to better visualise years of publication, location, population and syndemic conditions studied. Tables were generated to summarise the main variables of every article as well as the measurement methods of the most studied syndemic conditions. These tables can be found respectively in part B and C of the supplementary materials of this paper. Additionally, we generated an online report accessible at (link omitted for double-blind review). This report contains all studies included in the review and provides researchers in the field the opportunity to search relevant studies using multiple filters.

# Results

This section summarises the findings relevant to our research questions. Table [**2**](#RefTabQuant), [**3**](#RefTabQual) and [**4**](#RefTabRev) in the supplementary material, summarise every reference identified and the variables extracted to answer our research questions for quantitative studies, qualitative studies and reviews, respectively.

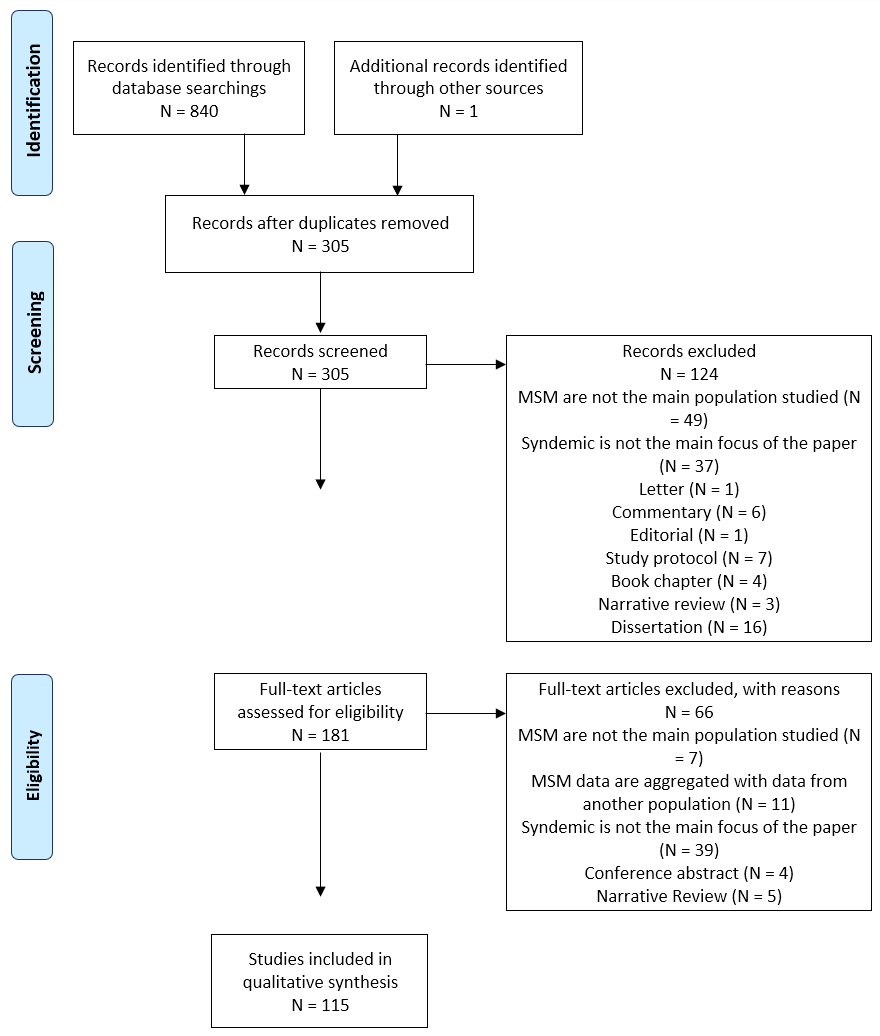
## Literature Search

The electronic search identified 840 references and our hand search of reference lists resulted in the addition of the seminal study by Stall and colleague ([Stall et al., 2003](#ref-Stall2003)). After removing duplicates, 305 records were screened for inclusion.

After screening the title and abstract, 124 records were excluded. The two main reasons for the exclusion at this stage were that MSM were not the main study population (n=49) and that syndemic was not the main focus of the paper (n=37). Thirty-eight studies were excluded because the type of publication did not meet our inclusion criteria.

The full texts of the 181 remaining references were obtained and read. Sixty-six were excluded after this phase. During the previous step, we had decided to tentatively include papers in which the sample was not entirely comprised of MSM. After reviewing the full paper, we decided to exclude studies if the MSM data were aggregated with data from another population (n=11), most commonly transgender women. The rationale for this decision was to keep the focus clearly on MSM.

The PRISMA flowchart generated by DistillerSR can be found in Figure [**1**](#PRISMA)

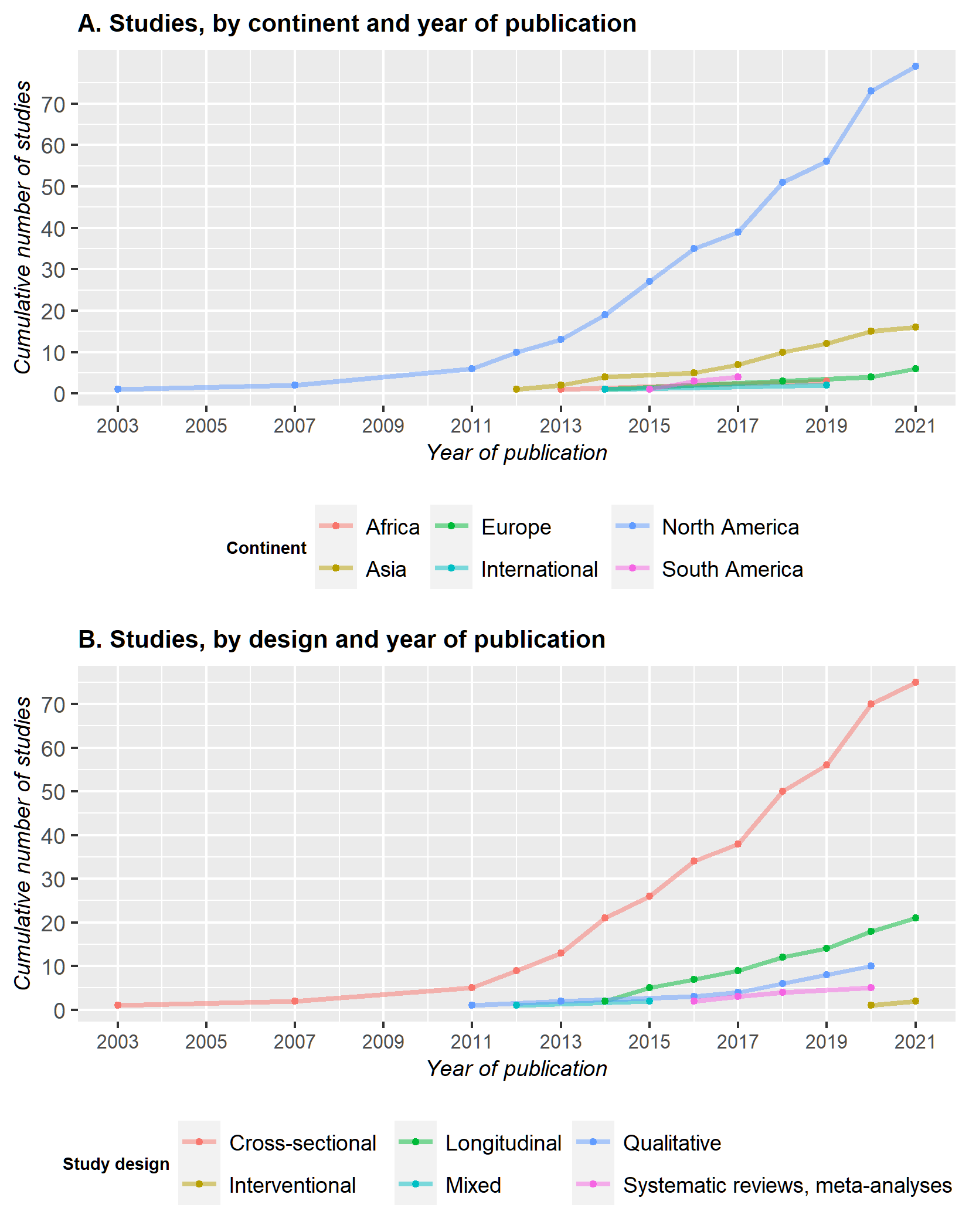


**Figure****1**: PRISMA flowchart of the search strategy

## How are studies concerning syndemic theory applied to MSM conducted?

### General characteristics of included studies

The publication date of the studies ranges from 2003 to 2021 with a marked increase in the number of papers published annually from 2013 forward as illustrated in Figure [**2**](#PlotYear). There is also an increase in the diversity of the studies, both in the study design used and the continents where the studies were conducted.



**Figure****2**: Plot of the cumulative number of studies published yearly

However, despite the increasing diversity, the vast majority of the studies were conducted in North America (N = 79), with a large predominance of studies in the USA (N= 67). The majority of the remaining studies were then located in Asia (N = 16) or in Europe (N = 6). South America (N = 4) and Africa (N = 3) are the least represented continents.

In terms of design, a similar pattern appears, with most of the studies employed a cross-sectional design (N = 75). The number of longitudinal studies has grown steadily since 2014 and represents 18% of the papers. The duration of longitudinal studies ranged from 6 to 120 months.

Compared to quantitative studies, qualitative studies are under-represented, with only 10 papers. In terms of analysis method, the most common is thematic (content) analysis (N= 5). The rest of the studies consists of framework analysis (N = 2), grounded theory (N = 1), analytic induction (N = 1) and constant comparative analysis (N = 1).

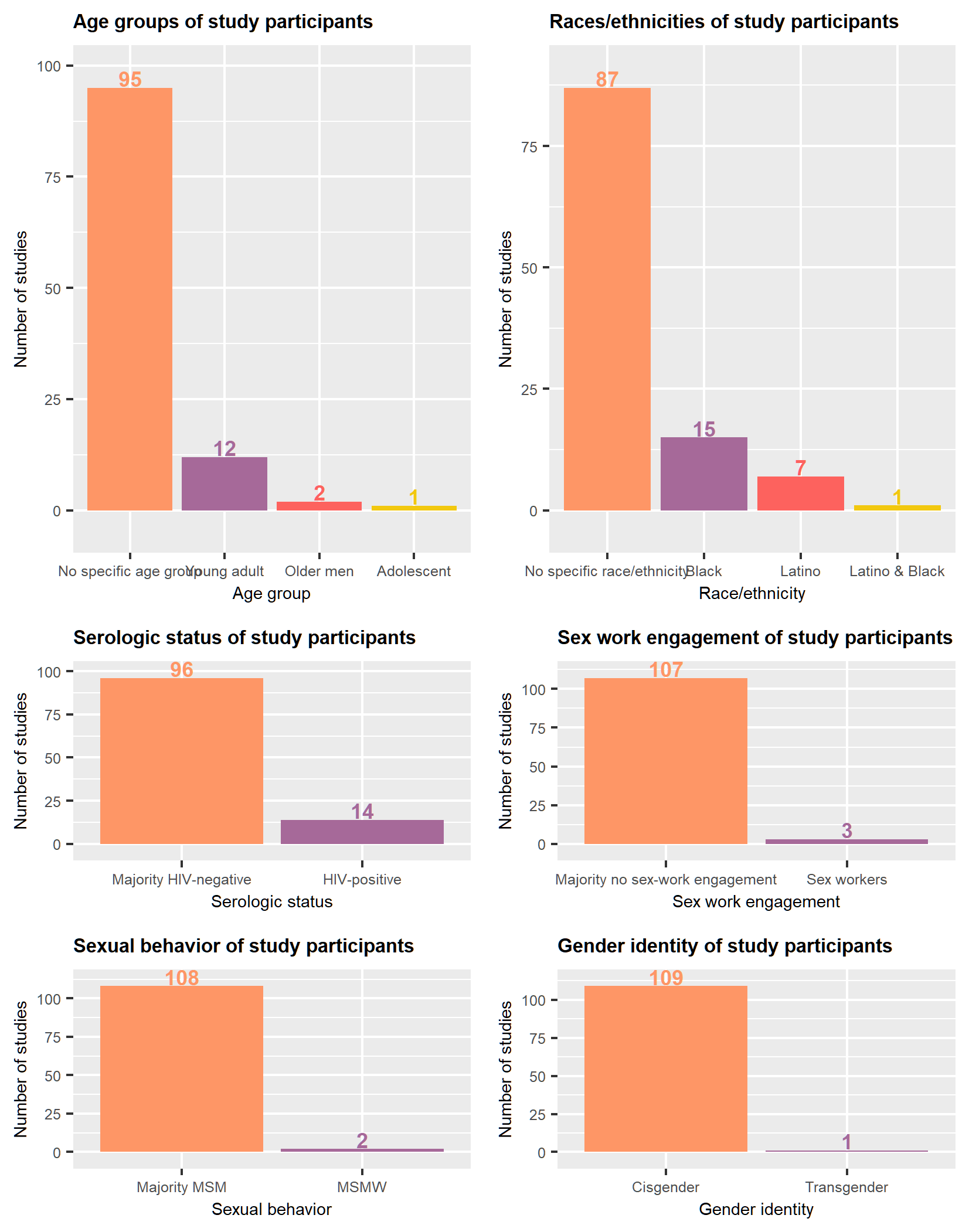
We identified 2 papers employing mixed methods design ([Buttram & Kurtz, 2015](#ref-buttram2015); [Halkitis et al., 2012](#ref-Halkitis2012)); Buttram et al. used a cross-sectional design for the quantitative part and in-depth interviews analysed through grounded theory for the qualitative part while Halkitis et al. used a cross-sectional quantitative survey and in-depth discovery interviews.

The first systematic reviews and meta-analyses were published in 2016, while the first interventional studies were published in 2020.

Finally, the median sample size of the studies is 454.5 (range: 15 - 24,274) and the mean age of the participants, when reported, ranges from 16 to 58 years.

### Subpopulations studied

Less than half of the studies (N = 51) focus on a subpopulation of MSM; of those, we identified seven types of MSM subpopulations: (a) young MSM; (b) older MSM; (c) MSM from a racial/ethnic minority; (d) MSM living with HIV; (e) MSM engaged in sex work; (f) Men who have Sex with Men and Women (MSMW); and (g) transgender MSM.  
Among studies focusing on a specific age group, 12 studies focus on young adults, two studies focus on older MSM ([Halkitis et al., 2012](#ref-Halkitis2012); [Zepf et al., 2020](#ref-zepf2020)) and one study focuses on adolescents ([Perry et al., 2019](#ref-Perry)). Black MSM (BMSM) are the most studied MSM from a racial/ethnic minority (N= 15) but studies focusing on them still represent only 14% of our sample. Seven studies focus on Latino MSM (LMSM) and one study focus on both BMSM and LMSM ([Cassels et al., 2020](#ref-cassels2020)). Concerning the serologic status of MSM in syndemic literature, 14 studies are entirely comprised of a sample of MSM living with HIV. Notably, we didn’t identify any studies focusing on racial minority MSM living with HIV. Finally, the least represented subpopulation of MSM in this review are MSM engaged in sex work (N = 3), MSMW (N = 2) and transgender MSM (N = 1). Figure [**3**](#PlotPop) gives a visual representation of MSM subpopulation’s representation in the studies included in this paper. In order to obtain the most comprehensive knowledge of the representation of MSM subpopulations in syndemic literature, we also took into account studies that do not focus on any subpopulation in particular but present disaggregated data and analyses for one or more MSM subpopulations. Eight studies present such data: one for Black MSMW ([Dyer et al., 2020](#ref-dyer2020)), four for MSMW ([Branstrom & Pachankis, n.d.](#ref-branstrom); [Ferlatte, Salway, Trussler, et al., 2018](#ref-ferlatte2018); [Friedman et al., 2014](#ref-friedman2014); [Mustanski et al., 2014](#ref-Mustanski2014)), two for MSM living with HIV ([Kurtz et al., 2012](#ref-Kurtz2012); [Ng et al., 2020](#ref-ng2020)) and one for Latino and Black MSM ([Mustanski et al., 2017](#ref-Mustanski2017)).



**Figure****3**: Number of studies focusing on a MSM subpopulation

### Syndemic conditions and their measurement

#### Number and type of syndemic conditions identified

We identified 46 different syndemic conditions in the 100 quantitative studies we included.

The health-related conditions we identified are: depression (N = 80), alcohol use disorder (AUD) (N = 21), sexual compulsivity (N = 19), suicidal thoughts and/or attempts (N = 16), anxiety (N = 15), substance use disorder (SUD) (N = 14), post-traumatic stress disorder (PTSD) (N = 10), general mental distress (N = 5), internalised homophobia (N = 4), low self-esteem (N = 4), sexually transmitted infections (STI) (N = 3), involuntary subordination (N = 2), HIV diagnosis (N = 3), hostility (N = 2), stress (N = 2), experience of trauma (N = 2), alexithymia (N = 1), attention deficit hyperactivity disorder (ADHD) (N = 1), cognitive escape (N = 1), hypersexuality (N = 1), impulsivity (N = 1), poor physical health (N = 1) and sleep disturbance (N = 1).

Alongside these health-related conditions, we also identified numerous social conditions: substance use (N = 48), intimate partner violence (IPV) (N = 47), childhood sexual abuse (CSA) (N = 37), polysubstance use (N = 27), binge drinking (N = 22), experiences of violence (N = 17), sexual risk behaviours (N = 15), alcohol use (N = 12), discrimination (N = 10), chemsex (N = 7), loneliness (N = 6), incarceration (N = 5), unstable housing (N = 5), tobacco use (N = 5), childhood abuse (N = 4), low social support (N = 4), exchange sex (N = 3), intravenous drug use (IDU) (N = 2), poverty (N = 2), unemployment (N = 2), poor healthcare access (N = 2), frequenting gay social venues (N = 1) and school bullying (N = 1).

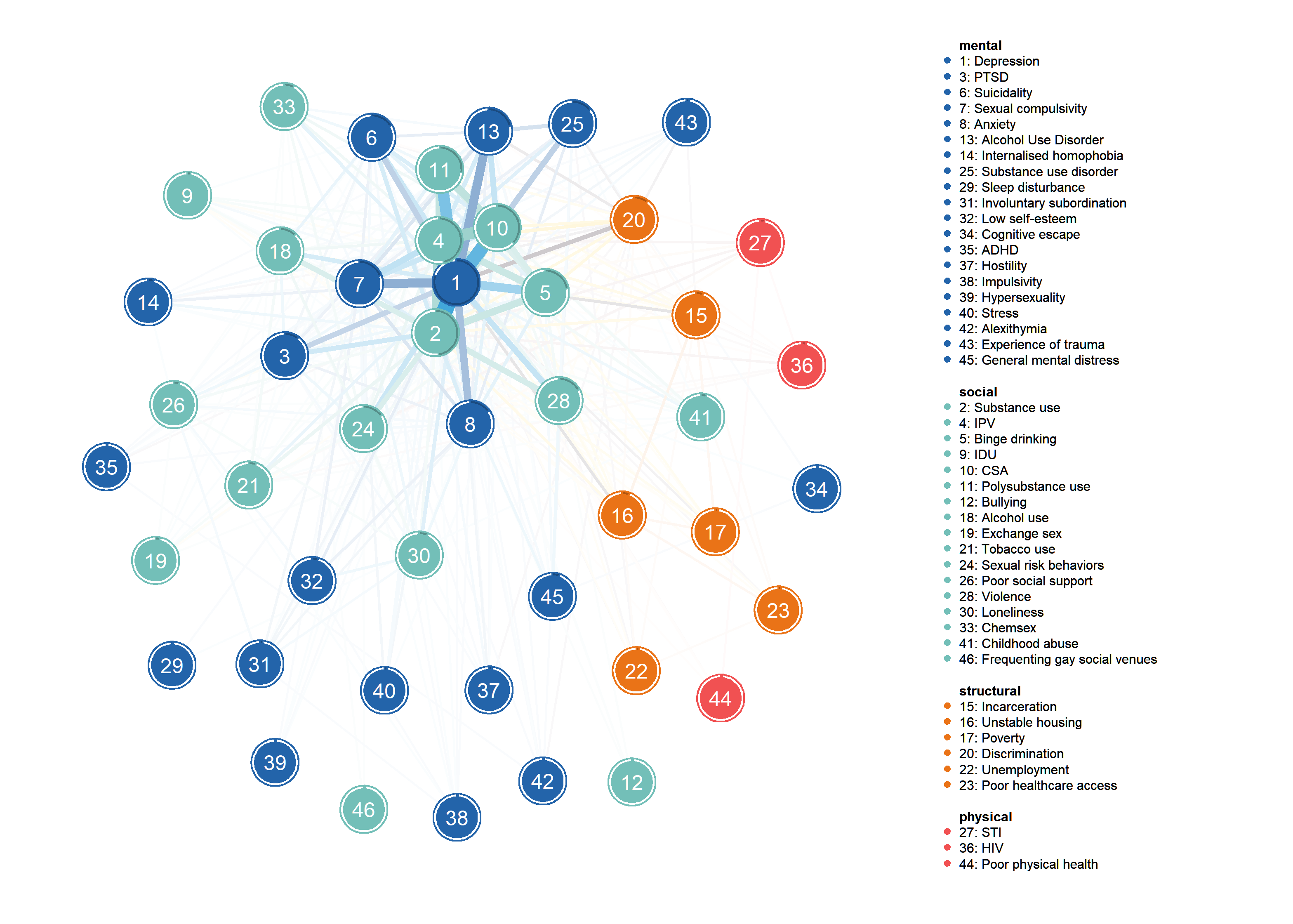
We chose to distinguish between AUD, binge drinking and alcohol use instead of merging them into a broad “alcohol-related syndemic condition”. Some authors also considered “heavy drinking” ([Martinez et al., 2016](#ref-Martinez2016a); [Martinez et al., 2020](#ref-martinez2020)) or “heavy alcohol use” ([Mimiaga et al., 2015](#ref-Mimiaga2015b)) but we chose to aggregate these conditions under “binge drinking” for clarity. Similarly, we distinguish between substance use, substance use disorder, intravenous drug use, polysubstance use, marijuana use, tobacco use and chemsex since they differ in terms of potential harm and the context of use.

#### Network Analysis of the syndemic Conditions

In order to better understand the connections between the syndemic conditions in the studies, we elaborated a network plot (Figure [**4**](#SyndemicNetwork)). Nodes represent the syndemic conditions studied in the literature and edges (connectors) are drawn between two nodes when two conditions are studied in the same research paper. Edges between nodes are thicker if the two conditions are frequently studied together and the outline of the nodes represent pie chart of their frequency in syndemic literature. For example, depression, the most studied condition, appears in 80% of our sample. As such, the node is circled by a chart representing this proportion. Moreover, as a force-directed graph, the location of the nodes gives an indication regarding their importance in terms of frequency and linkage to other conditions. As such, depression occupies a more central position than ADHD, which was only studied once.

In this figure, we divided the conditions studied into four categories: mental health (e.g. depression, anxiety, PTSD) in blue, social conditions (e.g. substance use, loneliness) in teal, structural conditions (e.g. unemployment, healthcare access) in orange and physical health (e.g. STI, HIV) in red. The figure shows that structural syndemic conditions and physical health-related syndemic conditions are much less central, therefore much less studied, than social syndemic conditions and mental health-related syndemic conditions which are located toward the centre of the figure.

Regarding the edges of the network, we identified 341 pairs of syndemic conditions. However, nearly half of these pairs of conditions (N = 156) appear in only one research paper. On the other hand, the most studied pairs of syndemic conditions were depression and IPV (N = 37), depression and substance use (N = (N = 36), depression and CSA (N = 30), IPV and CSA (N = 26) and depression and polysubstance use (N = 25).



**Figure****4**: Network of the syndemic conditions studied in quantitative research. The most studied and interconnected conditions are the most central. Each node is circled by a pie chart of their frequency in the review. The thickness of the edges linking two nodes reflects the number of studies in which the two conditions were studied together.

#### Measurement of the syndemic Conditions

The next part of our research question was to examine how the syndemic conditions were studied in the literature. For the most often studied syndemic conditions, we found a high degree of variability in their measurement. Different authors used different scales or criteria and, even when the same scale or criteria were used, the cutoff or reference period differed among studies. For the sake of brevity, we will only provide a detailed description of the measurement method for the five most studied syndemic conditions. Detailed information on the syndemic conditions most impacted by methodology heterogeneity is presented in the supplementary material, part C ([**5**](#DepressionTab) to [**12**](#AnxietyTab)).

For depression, 20 different scales or criteria are used among the 80 studies in which this condition was studied. The most frequently used scales are the full Center for Epidemiologic Studies-Depression scale (CESD) (N = 26) and the 10-item version of this scale (CESD-10) (N=11), the 9-item version of the Patient Health Questionnaire (PHQ-9) (N=9) and the Beck Depression Inventory (BDI-II) (N = 5).  
Cutoff for these scales varied the most for the CESD (range: 16 to 27) and the PHQ-9 (range: 5 to 15).  
When a scale is not used, the most frequent criteria to assess the presence of depression is the participant being on medication for depression in the past 12 months (N = 4).

For substance use, we looked at the class of substances explicitly screened by the authors and the reference period used. The most frequently screened class of substance is stimulants (i.e. cocaine/crack, amphetamines; N = 42), followed by depressants (i.e. GHB/GBL, benzodiazepines without prescriptions; (N = 21), opioids (i.e. opioids misuse and heroin; N = 21), marijuana (N = 18), ecstasy/MDMA (N = 18), hallucinogens (i.e. ketamine, psilocybin, phencyclidine; N = 18), inhalants (nitrous oxide, popper; N = 15) and new psychoactive substances (i.e. synthetic cannabinoids, cathinones; N = 3).  
Reference periods range from the past month to over the lifetime.

For polysubstance use, 18 studies consider that there is polysubstance use when three or more classes of substances are used while nine studies define polysubstance use as more than one class of substance being used. Furthermore, six studies exclude marijuana from the class of substances screened and two studies exclude stimulants, because stimulants were already screened in another syndemic condition.

Five types of IPV were identified: physical violence (N = 38), psychological violence (N = 25), sexual violence (N = 23), gay-related violence (e.g. threats to reveal the partner’s sexual orientation; N = 3) and HIV-related violence (e.g. threats to disclose the partner’s serologic status; N = 1). Reference periods vary from the past month to over the lifetime.

For CSA, we identified 14 different definitions and three scales among the 37 studies. The various definitions differ regarding the age at which sexual intercourse occurred to be qualified as childhood sexual abuse, the age gap between the victim and the perpetrator and whether the sexual intercourse was unwanted. The most frequent definition is Finkelhor’s definition ([Finkelhor, 1994](#ref-finkelhor1994)): any sexual experience before 13 years old with someone at least five years older or any sexual experience between 13 and 17 years old with someone at least ten years older (N = 7).

### Outcomes and their measurement

We identified 22 different outcomes in our sample of quantitative studies. Sexual risk behaviour is the most frequently studied outcome, appearing in 60 research papers. The second most studied outcome is HIV diagnosis (N = 20), followed by STI diagnosis (N = 10), adherence to antiretroviral therapy (N = 6), pre-exposure prophylaxis (PrEP) use (N = 4), healthcare use (N = 4) and the syndemic conditions themselves (N = 4). Less often, researchers also use viral load (N = 3), suicidality (N = 3) or engaging in exchange sex (N = 3) as outcomes.

The other outcomes are only studied once: HIV screening ([Chandler, Bukowski, Matthews, Hawk, Markovic, Egan, et al., 2020](#ref-Chandler2019b)), HIV transmission ([Satyanarayana et al., 2021](#ref-satyanarayana2021)), engagement in HIV care ([Biello et al., 2016](#ref-Biello2016)), sexual violence ([Semple et al., 2017](#ref-semple2017)), substance use ([Turpin et al., 2020](#ref-turpin2020)), engagement in chemsex ([Friedman et al., 2014](#ref-friedman2014)), having sexual intercourse with both men and women ([Eaton et al., 2013](#ref-eaton2013)), help-seeking behaviours ([Achterbergh et al., 2021](#ref-achterbergh2021)), physical activity ([Zhang et al., 2019](#ref-Zhang2019)), glycaemic control ([Byg et al., 2016](#ref-Byg2016)), hypothalamic-pituitary-adrenal (HPA) axis dysregulation ([Carrico et al., 2018](#ref-carrico2018)) and elevation in rectal cytokines/chemokines ([Tapia et al., 2021](#ref-tapia2021)).

There is a high degree of variability in the definition of what constitutes sexual risk behaviours, though the most frequently used proxy is, by far, condomless anal sex (N = 57).

Used in conjunction with condomless anal sex, other proxies for sexual risk are number of partners (N = 11), substance use during sex (N = 3), condomless vaginal sex (N = 2), condomless oral sex (N = 1), sexual intercourse with female partners (N = 1), engaging in group sex (N = 1) and non-disclosure of HIV serostatus before first sexual intercourse with current main partner (N = 1).

When HIV is used as an outcome, it is self-reported in more than half of the studies (11 studies out of 20). Similarly, for STI diagnosis, self-reporting is used in five papers out of ten.

### Interventions

We identified only two interventional studies guided by syndemic theory ([Achterbergh et al., 2021](#ref-achterbergh2021); [Chakrapani et al., 2020](#ref-Chakrapani)). Chakrapani et al. used a pre-test/post-test non-equivalent group design and the intervention consisted of motivational interviews. The goal of this intervention was to reduce condomless anal intercourse by enhancing condom self-efficacy and addressing co-occurring syndemic conditions. Achterbergh et al. conducted a randomised controlled trial and the intervention consisted of tailored feedback and help-seeking advice on mental health screening. The primary endpoint was to increase help-seeking behaviours; the secondary endpoints were reducing sexual risk behaviour and STI incidence. The intervention lasted for 12 months in both studies.

In Chakrapani et al. the intervention was successful in reducing the psychosocial conditions investigated (depression, alcohol use and internalised homophobia) and improving condom use. Furthermore, synergy, as measured by interaction on the additive and multiplicative scales, is present for depression and alcohol use as well as for depression and internalised homophobia on inconsistent condom use. Finally, a mediation analysis revealed that the improvement in consistent condom use was due to an improvement in condom self-efficacy caused by a reduction in alcohol use and internalised homophobia. On the other hand, the RCT conducted by Achterbergh et al. failed to impact the primary endpoint nor the two secondary endpoints.

### Summary of reviews

We identified three systematic reviews ([Lassiter & Parsons, 2016](#ref-Lassiter2016); [Lewis & Wilson, 2017](#ref-lewis2017); [Woodward et al., 2017](#ref-woodward2017)) and two meta-analyses ([Pantalone et al., 2020](#ref-Pantalone2020); [Rooney et al., 2018](#ref-Rooney2018a)) in our review.

Woodward et al. aimed to identify a set of resilience resources among MSM burdened with minority stress and psychosocial condition in order to improve HIV prevention ([Woodward et al., 2017](#ref-woodward2017)). They included 20 studies in their reviews and identified 31 resilience resources, with social support and financial incomes as the two most frequently cited. Of note, most of these resources are associated with a lower HIV risk.

Lassiter et al. aimed to propose a framework to include religion and spirituality into HIV research with MSM ([Lassiter & Parsons, 2016](#ref-Lassiter2016)). They found that religion and spirituality had a mixed effect on syndemic conditions but could be more beneficial for MSM of colour than for white MSM. Of note, the review is relatively small (including nine studies) as these two factors are very rarely studied in syndemic literature.

Lewis and Wilson sought to examine the HIV prevalence and associated risk behaviours among migrants and ethnic minority MSM in North America and Europe ([Lewis & Wilson, 2017](#ref-lewis2017)). They found high rates of HIV prevalence and associated risk factors and propose that transnational migration could be part of a syndemic.

In their meta-analysis, Rooney et al. studied the syndemic conditions associated with sexual compulsivity among MSM and computed the mean effect size as well as whether this effect varied depending on the type of syndemic conditions associated ([Rooney et al., 2018](#ref-Rooney2018a)). They included 36 papers and found that sexual compulsivity was significantly associated with seven syndemic conditions (anxiety, depression, CSA, alcohol use, substance use, IPV and sexual risk behaviours). The two strongest associations were with depression and anxiety.

Finally, Pantalone et al. sought to have a better understanding of the state of interventions co-targeting interconnected syndemic conditions and HIV-related health behaviours of MSM ([Pantalone et al., 2020](#ref-Pantalone2020)). They included 43 studies and found a small significant positive effect of combined behavioural interventions to improve mental health, substance use, alcohol use and sexual risk behaviours, with significant heterogeneity. Interestingly, a greater number of sessions (at least nine) and individual rather than group interventions showed greater efficacy.

### Additional frameworks used in the studies

Twenty studies use an additional framework alongside syndemic theory. The most widely used is resilience theory (N = 10), followed by minority stress model (N = 5), intersectionality (N=2), social-cognitive theory (N=2), salutogenesis (N=1) and ecological framework (N=1).

## How is the concept of interaction explored in syndemic research applied to MSM?

### Statistics used to show an interaction

It should be stated that, when we speak of an interaction between syndemic conditions, we do not necessarily mean “synergy”, though synergy is indeed one of the interactions we consider. Drawing from the works of authors such as Tsai and Chakrapani, we consider three types of interaction: synergistically interacting epidemics, serially causal epidemics, and mutually causal epidemics ([Chakrapani, Lakshmi, et al., 2019](#ref-Chakrapani2019); [Tsai, 2018](#ref-Tsai2018a)). As such, statistical methods such as mediation analysis, path analysis or structural equation modelling are also considered.

Our review reveals a high degree of variability in the statistical analyses. The most frequently used statistical method is regression analysis using a summation score of the syndemic conditions (N = 68). Among studies employing this method, 45 do not use any other method to determine the degree of interaction between syndemic conditions. In comparison, only 13 studies tried to evaluate departure from additivity on the additive and/or multiplicative scales, as recommended by Tsai ([Tsai & Burns, 2015](#ref-tsai2015)) to demonstrate synergy between syndemic conditions. Examples of measures for assessing departure from additivity are relative excess risk due to interaction (RERI), attributable proportion due to interaction (AP), and the synergy index (S). Furthermore, some studies sought to obtain a better understanding of the mechanism of interaction between the syndemic conditions and the outcome by using mediation analysis (N = 12), moderation analysis (N = 8), Structural Equation Modelling (N = 7) or path analysis (N = 1). Additionally, eight studies use latent variables modelling such as Exploratory/Confirmatory Factor Analysis, Latent Profile Analysis, Latent Class Analysis or Latent Transition Analysis. Using a different approach, two studies conducted by Lee and colleagues ([Lee, Bainter, et al., 2020](#ref-lee2020); [Lee, Safren, et al., 2020](#ref-Lee)) use network analysis, in which syndemic is conceptualised as a network and the syndemic conditions as interconnected nodes reinforcing each other. Finally, other statistic analyses used to assess interaction are observed/expected ratio (N = 2), cluster analysis (N = 1), point-biserial correlation matrix (N= 1) and synergy factor analysis (N=1).

### Proposed mechanisms of interaction

In our sample of quantitative studies, we found only one study offering a mechanism of biological interaction ([Carrico et al., 2018](#ref-carrico2018)) and two studies offering a mechanism of bio-social interaction ([Klein, 2011](#ref-Klein2011); [Tapia et al., 2021](#ref-tapia2021)).

Carrico et al. showed that the combined effects of HIV infection and methamphetamine use are detrimental for the functioning of the Hypothalamic-Pituitary-Adrenal axis which is thought to play an important role in the reinforcing effect of stimulants.

Klein proposed that attitudes toward condom use is one of the key factors contributing to condomless sex and, subsequently, HIV infection. In their study, attitudes toward condoms are predicted by low self-esteem, as condom use represents a self-protecting mechanism, as well as by sexual preferences, substance use, race, and education. Furthermore, childhood emotional neglect has a negative influence on self-esteem thus indirectly contributing to sexual risk taking.

Finally, Tapia et al. demonstrated that a higher number of syndemic conditions are associated with elevation in rectal cytokines/chemokines relevant to HIV/STI transmission. This finding presents a pathway through which depression, alcohol use disorder, substance use and PTSD may increase the biological susceptibility to HIV/STI. Unfortunately, using solely a summation score to conduct regression analysis, no synergy between the conditions is evaluated.

Qualitative studies propose mechanisms of bio-social interaction more often than quantitative studies. We identified five papers with such hypothesis of interaction ([Chakrapani, Kaur, et al., 2019](#ref-Chakrapani2019a); [Lyons et al., 2013](#ref-Lyons2013); [Maiorana et al., 2020](#ref-Maiorana); [Pollard et al., 2018](#ref-Pollard2018a); [Quinn, 2019](#ref-Quinn)). On the other hand, we did not find any qualitative paper exploring biological interaction.

Stigma and structural inequalities are indicated by the five papers as the root causes of syndemic conditions and HIV risk behaviours. Maionara et al. showed that economic dependency and fear of violence may maintain YBMSM in dysfunctional relationships plagued by IPV and substance abuse which increase their odds of incarceration and HIV infection ([Maiorana et al., 2020](#ref-Maiorana)). Furthermore, methamphetamine is used as a coping strategy while simultaneously representing a potential factor in acquiring or transmitting HIV to others, notably during sex parties.

This finding of substance use as a coping mechanism is supported by the study by Pollard et al. who found that maladaptive coping strategies to minority stress and the performative resistant space of the gay scene contributed to chemsex use ([Pollard et al., 2018](#ref-Pollard2018a)).

For Black MSM, other sources of structural violence such as racial neighbourhood segregation contribute, alongside poverty, unemployment, violence, unstable housing, incarceration, and poor healthcare access to expectations surrounding masculinity which may conflict with the sexual orientation of BMSM, leading to internalised homophobia ([Quinn, 2019](#ref-Quinn)). Internalised homophobia, in turn, may lead to poor mental health as well as to substance abuse and sexual risk taking as coping mechanisms. Moreover, the use of PrEP, perceived as a “gay pill” may negatively impact the use of PrEP in this community. Lyons et al. also showed that the marginalisation of YMSM within their school, communities of origin and families resulted in a lack of gay-specific HIV prevention, education, role model and productive goal-related activities ([Lyons et al., 2013](#ref-Lyons2013)). The HIV-positive MSM youth in this study linked these factors to their HIV acquisition. Finally ([Chakrapani, Kaur, et al., 2019](#ref-Chakrapani2019a)) showed the role of family support and communities of MSM to serve as resilience resources to counteract the negative effects of stigma and syndemic conditions.

## What were the key findings of these studies?

In nearly all of the quantitative studies, the syndemic conditions chosen by the authors are associated with the outcomes of interest.

However, some interesting discrepancies in the findings were found. On the topic of synergy, results are conflicting between studies. The findings of Chakrapani and colleagues support the three models of interacting epidemics (synergistically interacting epidemics, serially causal epidemics, and mutually causal epidemics) with the strongest support for the model of synergistically interacting epidemics ([Chakrapani, Lakshmi, et al., 2019](#ref-Chakrapani2019)). These findings are supported by other studies that found synergy through departure from additivity, by using measures such as RERI, AP or S, or through a departure from multiplicativity by using significant product terms in the multiplicative scale ([Bulled, 2021](#ref-bulled2021); [Chakrapani et al., 2020](#ref-Chakrapani); [Chandler, Meunier, et al., 2020](#ref-chandler2020); [Chandler, Bukowski, Matthews, Hawk, Markovic, Stall, et al., 2020](#ref-Chandler2019); [Chuang et al., 2021](#ref-chuang2021); [Tomori et al., 2018](#ref-tomori2018)). However, other studies found no synergy between the syndemic conditions using the same statistical approach ([Batchelder et al., 2019](#ref-Batchelder2019); [Ferlatte, Salway, Samji, et al., 2018](#ref-Ferlatte2018a); [Shuper et al., 2020](#ref-shuper2020)).

Conflicting results are also present for MSMW. Brandstrom and Pachankis found no clustering of syndemic conditions for MSMW ([Bränström & Pachankis, 2018](#ref-Branstrom2018)) while Mustanski et al. found a stronger clustering of syndemic conditions in YMSMW compared to YMSM ([Mustanski et al., 2014](#ref-Mustanski2014)). Furthermore, Black MSM in the study by Dyer et al. suffered from a higher burden of STI than Black MSMW ([Dyer et al., 2020](#ref-dyer2020)). Ferlatte et al. found more syndemic conditions in the MSM compared to the MSMW ([Ferlatte, Salway, Trussler, et al., 2018](#ref-ferlatte2018)), mainly driven by party drug use and treatment for depression or anxiety. Finally, in a sample of Latino MSMW, having two syndemic conditions predicted receptive condomless anal sex and STI diagnosis but not insertive nor vaginal condomless sex ([Muñoz-Laboy et al., 2018](#ref-Munoz-Laboy2018)).

In a longitudinal study ([Mustanski et al., 2017](#ref-Mustanski2017)) Black MSM were found to have the highest HIV incidence while having a lower burden of syndemic condition than White MSM, raising the question of the need to focus on syndemic conditions specific to Black MSM. Interestingly, Bulled observed a synergy only for White MSM in their reanalysis of Stall’s data ([Bulled, 2021](#ref-bulled2021)). The authors proposed that, for racial minority MSM, structural disadvantage limiting access to healthcare may be more important than substance use and violence.

While condomless anal sex is often used as a proxy for the risk of acquiring HIV or another STI, the findings of some studies tend to show some limitation of this proxy. For example, Moeller et al. found an association between syndemic conditions and condomless anal sex but not with HIV diagnosis ([Moeller et al., n.d.](#ref-moeller)). A similar pattern appears in a longitudinal study that found an association between syndemic conditions and sexual risk behaviours but not with HIV or STI incidence ([Mustanski et al., 2017](#ref-Mustanski2017)). On the other hand, some authors found an association between syndemic conditions and HIV but not with condom use ([Chuang et al., 2018](#ref-chuang2018)).

Alcohol misuse is inconsistently linked to risk taking. Card et al. found no association between the AUDIT score and sexual risk behaviours ([Card et al., 2018](#ref-Card2018)) while another study using latent class analysis found that the class with alcohol misuse has a lower level of risk behaviour ([Scheer et al., 2021](#ref-scheer2021)). Nonetheless, alcohol misuse is associated with PrEP non-adherence ([Shuper et al., 2020](#ref-shuper2020)).

# Discussion

The objective of this scoping review was to map the current knowledge on syndemic research applied to MSM. To this end, we analysed 115 articles and found that the literature was both too homogeneous in some aspects while being not focused enough in other aspects. As we will discuss in more depth below, the location, design, subpopulations, and outcomes lacked diversity. On the other hand, the syndemic conditions and ways of measurement were not standardised enough to ensure the robustness, reproducibility, and comparability of the findings. Furthermore, a substantial part of the literature does not provide empirical data to support one of the core tenets of syndemic theory—namely disease interaction—as has been pointed out in a previous review ([Tsai & Burns, 2015](#ref-tsai2015)).

## Location

The location of the study is an aspect of syndemic literature suffering from too much homogeneity. Indeed 72% of studies are conducted in North America alone while all studies conducted in the Global South represent only 21% of our sample.

Three issues arise from this. First, under-representation of the Global South compromises our understanding of the health of MSM living in these countries. Furthermore, as pointed out by ([Weaver & Kaiser, 2020](#ref-weaver2020)), the screening tool used to assess the presence of a syndemic condition in the Western context may not be efficient in another sociocultural setting, especially regarding mental health. As syndemics are driven by the sociocultural forces of a given place at a given time, these potential biases need to be addressed in order to conduct meaningful research outside Europe and North America.

Moreover, even for studies conducted in Europe and North America, a large portion of the studies conflate data from different cities, counties, states or even countries in order to obtain a sample big enough to conduct statistical analyses. However, geographical variations in syndemic burdens are likely to be missed. Migration of MSM to larger cities is a well-known phenomenon and thought to be an important part of syndemic production among MSM as well as a source of resilience ([Bruce et al., 2011](#ref-Bruce2011); [Stall et al., 2007](#ref-stall2007)). Differences in the density of gay social venues and peer organisations as well as exposure to discrimination and violence or an easier access to substances need to be taken into account when studying a syndemic. As Shresta et al. suggested, syndemic research needs to incorporate data from spatial epidemiology to better understand the interactions of socioeconomic forces in the physical space and how these forces can influence health ([Shrestha et al., 2020](#ref-shrestha2020)). In their paper, they illustrate their framework with a “syringe-based syndemic” of HCV, HIV, and opioid-related deaths in West Virginia and describe how variables related to unique physical space such as local drug availability drove this syndemic.

## Design

The design of syndemic studies is another element suffering from a lack of diversity. The field is dominated by quantitative studies as qualitative papers represent only 9% of our sample. Moreover 75% of the quantitative studies were cross-sectional. As vulnerability to syndemic conditions is suspected to arise from early adverse experience ([Stall et al., 2007](#ref-stall2007)) longitudinal studies running over a long period of time are probably needed to study syndemic production among MSM.

Moreover, as shown in our result, qualitative papers are more prone to discuss the potential interactions between syndemic conditions. Some concepts and experiences needed to understand syndemic production in MSM can only be studied through a qualitative approach. For example, the complex narratives surrounding drug use and its link to loneliness, marginalisation, personal affirmation, resistance, and lack of meaningful emotional connections ([Pollard et al., 2018](#ref-Pollard2018a)) would be hard to measure and model using quantitative data. As Tsai previously pointed out, the inevitable simplification needed to estimate statistical models may lead to an oversimplification of disease dynamics ([Tsai, 2018](#ref-Tsai2018a)). Mixed methods studies are needed to complement robust statistical estimation with insights on sociocultural mechanisms and on the lived experiences of people facing this clustering of adverse conditions. Our review only identified two studies employing such mixed methodology. Future research would benefit from generating and analysing qualitative data to support and enrich their quantitative findings.

Finally, we identified two interventional studies with mixed results. The efficacy of interventions that target interconnected syndemic conditions is supported by a meta-analysis ([Pantalone et al., 2020](#ref-Pantalone2020)), indicating that syndemic-based interventions hold promise for improving the health of marginalised populations. Nonetheless, the mixed results presented in our review probably reflect the current shallowness of our understanding of how syndemics operate in different populations across the globe. Therefore, we should strive to close this knowledge gap in order to improve the design of future interventions. However, we do not recommend researchers wait before designing and testing syndemic-based interventions as such interventions may also contribute to our understanding of disease interactions. In this regard, we share the view of Stall et al. in their response to Tsai’s review ([Stall et al., 2015](#ref-Stall2015a)). Given the harms caused to marginalised populations by a syndemic, we also agree with them when they state that “[w]e cannot wait until the methodological question of interaction is settled to develop interventions to address these co-morbidities within high risk populations.’ Nonetheless only two interventions were conducted since this commentary was written seven years ago and we have made little progress in our understanding of disease interaction. This indicates an urgent need to move the field forward, both toward the comprehension of disease interaction and toward intervention development and implementation.

## Subpopulations

Studying the health of MSM poses a challenge regarding the diversity of this population. While nearly half of the studies included in our sample studied a subpopulation of MSM, the number of MSM subpopulations is such that most MSM subpopulations remain underserved. For example, Young Black MSM are specifically studied in two studies while representing 52% of the new HIV diagnosis among MSM aged 13–24 years in 2018 ([Center for Disease Control and Prevention, 2020](#X4cf13d81533c7b267d16e8ce422f52a6b94e857)).

This discrepancy between the number of studies focusing on a subpopulation and the very high prevalence of some syndemic conditions such as HIV infection is even more concerning when considering that dual-minority identity may expose a person to different stressors and outcomes. For example, some studies found that Black MSM had a higher rate of HIV seroconversion than White MSM while being exposed to fewer syndemic conditions ([Mustanski et al., 2017](#ref-Mustanski2017)). These findings are supported by qualitative data suggesting that intersectional theory offers the context needed to understand syndemics among Black MSM which differ from syndemics among White MSM ([Quinn, 2019](#ref-Quinn)). Furthermore, the findings from Bulled suggest that structural disadvantage may have more weight on the lives of Black MSM than individual factors such as substance use ([Bulled, 2021](#ref-bulled2021)). We agree with the views of these authors and believe that more attention should be given to structural disadvantages such as institutional racism and how it impacts the emergence of different syndemic conditions.

MSMW are another example of an underserved population with conflicting results. In a cross-sectional study using syndemic sum count, Latino MSMW with two or more syndemic conditions had a 7.09 Odds Ratio to engage in receptive condomless anal sex but no statistically significant difference was found for insertive condomless anal sex or condomless vaginal sex ([Muñoz-Laboy et al., 2018](#ref-Munoz-Laboy2018)). On the other hand, in another study the number of syndemic conditions was associated with HIV diagnosis for MSM but not for MSW or MSMW ([Bränström & Pachankis, 2018](#ref-Branstrom2018)). Among young MSM and MSMW, one study found more syndemic conditions and a greater association between them for MSMW compared to MSM ([Mustanski et al., 2014](#ref-Mustanski2014)). On the contrary, Ferlatte et al. found that MSM were more likely than MSMW to suffer from two or more syndemic conditions ([Ferlatte, Salway, Trussler, et al., 2018](#ref-ferlatte2018)). These conflicting findings may be partly due to the difficulty to define and operate bisexuality in research ([Swan, 2018](#ref-swan2018)), differences between age groups or differences in syndemic mechanism for MSMW compared to MSM. Outside the field of syndemic literature, studies suggest that bisexual men suffer from a similar or higher burden of mental health conditions compared to gay men ([Chaudhry & Reisner, 2019](#ref-Chaudhry2019); [Ross et al., 2018](#ref-ross2018); [Salway et al., 2019](#ref-salway2019)) and literature specific to bisexual men remains scarce. In the future, syndemic theory should thus seek to study the specificity of this population. First, there is a need to better conceptualise and define bisexuality in the field—should we still use solely a behaviour-based definition (as in MSMW), or should we incorporate a self-definition of one’s sexual orientation? Then, researchers should aim to disaggregate data concerning MSMW/bisexual men from data concerning MSM/gay men whenever possible. Lastly, more research focusing on MSMW/bisexual men is needed.

Finally, transgender MSM were included in only one study in our sample. This is concerning, especially when most study excludes transgender men by design. As such, this population of MSM is the one we know the least about. It is striking that the number of studies we had to exclude due to merging transgender women and MSM was higher than the number of eligible studies found focusing on transgender men. This conflation of sex and gender has already been decried ([Poteat et al., 2016](#ref-poteat2016)) and contributed to our decision to exclude studies that reproduced this unfortunate practice. Linking transgender women and MSM on the assumption of shared biology and practices reduces transgender women to their birth assignation rather than their social identities. Conversely, excluding transgender MSM although they seem exposed to similar risk patterns as cisgender MSM ([Reisner et al., 2016](#ref-Reisner2016a)) because of their biological sex is, at best, revealing of a lack of knowledge about this population. Indeed, it seems counterproductive to give such precedent to the biological sex of participants over their social identifies while using a framework that considers diseases as socially caused. We believe that this practice is due to cissexist bias that should be avoided in future research.  
The health of transgender men remains greatly understudied and the few available studies suggest high rates of adverse conditions such as violence, notably sexual violence ([Testa et al., 2012](#ref-Testa2012)), suicide attempts ([Haas et al., 2014](#ref-Haas2014)), chlamydia and gonococcal infections ([Pitasi et al., 2019](#ref-Pitasi2019)), intimate partner violence ([Peitzmeier et al., 2020](#ref-peitzmeier2020)) and HIV infection ([Becasen et al., 2019](#ref-Becasen2019)). Syndemic theory represents a promising framework for research on transgender men as its premises of social adversities producing and concentrating diseases in a population allows us to explore the health of transgender men without pathologising them.

## Syndemic Conditions

There is a lack of consensus concerning the choice of syndemic conditions and the way they should be measured. We identified 46 different conditions in our quantitative sample and nine of them were only studied once. Despite this diversity of syndemic conditions, the impact of the study by Stall et al. ([Stall et al., 2003](#ref-Stall2003)) is striking. The conditions studied in that paper (depression, IPV, CSA and polysubstance use) are among the five most studied conditions in the field. Furthermore, 92% of the quantitative studies included in our review consider at least one of the four conditions studied by Stall and colleagues as part of a syndemic.

Some of these conditions are past events (e.g. history of trauma or childhood sexual abuse) while most were current conditions. Given the cross-sectional nature of 75% of the quantitative papers, we cannot disentangle how past experiences may influence the emergence of a syndemic.

Furthermore, studies diverge on what represents a syndemic condition and what may lead to the emergence of a syndemic. For example, childhood sexual abuse is mostly seen as a syndemic condition per se but may very well be a risk factor to the emergence of a syndemic, as hypothesised by some authors ([Herrick et al., 2013](#ref-Herrick2013); [Leblanc et al., 2021](#ref-leblanc2021)). The same question may be asked for other conditions, including discrimination, trauma, impulsivity, bullying, poor social support, loneliness, childhood abuse, or poor access to healthcare.  
Qualitative studies may help to distinguish between syndemic conditions and pathways to the emergence of a syndemic by drawing insights from the narratives of MSM with more depths than quantitative studies. Life-story interviews, for example, offer the opportunity to explore how early challenges shaped the narratives and lives of individuals. One example of insights gained through such design is the study of Adam et al ([Adam et al., 2018](#ref-adam2018)). They found one major pathway of syndemic production characterised by childhood adversity leading to depression, substance abuse and risk taking and two minor pathways characterised by migration stress, or transition stress from home to college/work. These findings are in line with Stall’s theory of syndemic production in which early socially produced harms, beginning in childhood, continue through adolescence and adult life and are aggravated by the stresses associated with migration to large urban centres ([Stall et al., 2007](#ref-stall2007)). Given that the childhood damages are socially produced, the experiences that produce a syndemic may differ across generations or subpopulations of MSM ([Stall et al., 2007](#ref-stall2007)). As such, it may be possible that one condition, such as poor social support, participates in the emergence of a syndemic in a subpopulation of MSM while being part of a syndemic in another. As this theory is a developmental theory of syndemic production, longitudinal studies may also help to disentangle pathways and syndemic conditions by surveying participants over an extended period of time.

Furthermore, even when the same condition was studied in multiple papers, the differences in measurement methods impede the reproducibility of the results. For example, let’s imagine a survivor of sexual intimate partner violence with a CESD score of 16, who uses marijuana on a regular basis and cocaine occasionally. This man would have been classified as depressed in 46% of studies using the CESD, a polysubstance user in 26% of studies considering polysubstance use and as a survivor of intimate partner violence in 49% of studies considering IPV. In other words, the same person could have been classified as having zero, one, two or even three syndemic conditions, depending on the study design. Considering that most studies use a summation score of the number of syndemic conditions to conduct regression analysis, it seems evident that the results would vary greatly according to the way the syndemic conditions are measured.

It is beyond the scope of this paper to provide an exhaustive list of syndemic conditions researchers should use from now on or to determine the best scale or set of criteria to use to measure these conditions. An absolute answer to these questions is likely unrealistic due to variations across subpopulations and geographical settings.  
However, we advise researchers to pay more attention to the local context and the lived experience of the population they seek to study when selecting syndemic conditions to investigate. Focus groups or Delphi studies interrogating peer navigators of grassroots organisation serving MSM may help to select more pertinent variables. Indeed, by drawing on their own experiences and knowledge of the public they work with on a daily basis, peer navigators may help researchers ground their research more effectively.  
Additionally, exploratory qualitative studies may also serve as a first step in describing a syndemic arrangement before selecting syndemic conditions for a quantitative study. As Singer et al. stated in their 2020 paper: “[t]he syndemic relationship first needs to be observed then measured, not theorised, and used to predict diseases outcomes” […] ([Singer et al., 2020](#ref-Singer2020)).

## Outcomes

Taken together, 97% of the quantitative studies in our sample had an HIV-related outcome, whether in the form of sexual risk behaviours, HIV diagnosis, HIV screening, adherence to antiretroviral therapy, PrEP use, viral load, or engagement in HIV care.

This omnipresence of HIV in syndemic literature applied to MSM is understandable. The first description of a syndemic, the SAVA syndemic, included AIDS as part of a syndemic ([Singer, 1996](#ref-singer1996)). Then, a few years later, the first paper on syndemic in the MSM population had HIV-related outcomes, in the form of HIV serostatus and CAS ([Stall et al., 2003](#ref-Stall2003)). Furthermore, MSM were the first and most severely affected population when the AIDS epidemic started ([De Cock et al., 2012](#ref-decock2012)). Nowadays, male-to-male sexual contact still represents nearly 70% of the new HIV cases in the USA ([Center for Disease Control and Prevention, 2020](#X4cf13d81533c7b267d16e8ce422f52a6b94e857)). While we can’t deny the importance of the HIV pandemic, notably for MSM, and especially in the Global South, where more research on syndemics and HIV is needed, we would argue that HIV is not the only issue in need of attention.

Indeed, MSM are also disproportionately affected by, among others, suicide, anxiety, depression and substance use ([Luo et al., 2017](#ref-luo2017); [Medley et al., 2016](#ref-Medley2016); [Ross et al., 2018](#ref-ross2018)). Moreover, with the advances in antiretroviral therapy and the subsequent decline in HIV-related mortality, a Canadian study showed that gay men were more likely to die from suicide than from HIV in 2011 ([Hottes et al., 2015](#ref-hottes2015)). Even if the estimates presented in Hottes’ paper overestimate the mortality due to suicide among MSM, suicide would still be a leading cause of death in this population while being studied as an outcome in only three papers in our sample.

Furthermore, when studying HIV as an outcome, we would argue that using condomless anal sex as a proxy should be reviewed, and better proxies sought. Indeed, condomless anal sex was one of the criteria in 57 studies out of the 60 with sexual risk behaviours as an outcome and 32 studies considered all forms of condomless anal sex as a risk behaviour. However, without refinement, this outcome fails to capture the changes in HIV prevention strategies such as PrEP or Treatment as Prevention (TasP). Only three studies in our sample took PrEP use and/or an undetectable viral load into account when considering condomless anal sex as a risk factor for HIV acquisition. Moreover, of these papers the oldest was published in 2019 ([Batchelder et al., 2019](#ref-Batchelder2019)) although the FDA has approved PrEP for HIV prevention in 2012.  
When the first paper on syndemic theory applied to MSM was published, engaging in condomless anal sex would have led to a high risk of acquiring HIV. Nowadays, people could be on PrEP, forego the use of a condom and still be at a very low risk of acquiring HIV ([Calabrese et al., 2017](#ref-calabrese2017)). Our methodologies in syndemic research should reflect this evolution. In addition, qualitative research gives an insight into risk behaviours and offers a more nuanced view on this topic than a binary variable of consistent condom use for anal intercourse. One such paper published in 2017 showed that risk practices fell into different subjectivities such as active and consistent pursuit of condomless sex, lack of assertiveness to a partner’s initiative of condomless anal sex and combination of episodic risk practices and reduction strategies ([Adam et al., 2017](#ref-Adam2017)). Besides, some studies showed that participants with a greater number of syndemic conditions would engage more frequently in condomless anal sex while not being more likely to test positive for HIV ([Mustanski et al., 2017](#ref-Mustanski2017); [Pitpitan et al., 2016](#ref-Pitpitan2016)). On the other hand, a paper from 2018 found that having a greater number of syndemic conditions was associated with self-reported HIV but not to condomless anal sex ([Chuang et al., 2018](#ref-chuang2018)). Taken together, we thus postulate that condomless anal sex should at least be replaced by “condomless anal sex without consistent PrEP use or with a detectable viral load” when an investigator seeks to use sexual risk behaviours as an outcome.

## Statistics and interaction

One of the tenets of syndemic theory is that there exists some form of biological, social and/or psychological interaction between the diseases ([Mendenhall & Singer, 2020](#ref-mendenhall2020)). As others have already pointed out, the extent to which syndemic literature had proved this core principle remains very limited ([Tsai & Burns, 2015](#ref-tsai2015)). Indeed, 45% of our quantitative sample of studies used solely a summation score of the syndemic conditions to conduct regression analysis. Two issues arise from this statistical approach. First, summation scores are additive by essence, thus unsuitable to demonstrate an interaction ([Tsai & Burns, 2015](#ref-tsai2015)). Second, two psychometric assumptions are made by such a model: (1) the unidimensionality of the construct and (2) equal factor weighting ([Halkitis et al., 2013](#ref-Halkitis2013a)). Put simply, using a summation score would imply that (1) every condition forms a single construct and that (2) every condition contributes equally to said construct (which would mean for example that feeling depressed during the past 14 days and having a history of childhood sexual abuse would contribute equally to a syndemic). The unidimensionality aspect of the construct has received some empirical support by Mustanski et al. as well as by Starks et al. using respectively Structural Equation Modelling and Latent Class Analysis ([Mustanski et al., 2014](#ref-Mustanski2014); [Starks et al., 2014](#ref-Starks2014)). On the contrary, Leblanc et al. failed to construct a single latent syndemic variable in their analysis ([Leblanc et al., 2021](#ref-leblanc2021)). Moreover, constraining factor loadings to be equal resulted in worse fit in the studies by Mustanski and Starks.

In short, the result of our review suggests that as much as 45% of the quantitative literature on syndemic theory applied to MSM doesn’t empirically support the presence of a syndemic and employs questionable statistical assumptions. Those studies are more an exploration of psychosocial risk factors associated with HIV acquisition or progression than the holistic framework syndemic is supposed to be.

As mentioned in the results, two statistically distinct models may be envisioned apart from synergistically interacting epidemics: mutually causal epidemics and serially causal epidemics ([Tsai, 2018](#ref-Tsai2018a)). As such, mediation analysis, path analysis or structural equation modelling may prove useful to assess an interaction.

More recently, a new statistical approach inspired from research in psychopathology has been used to model syndemics: network analysis ([Lee, Safren, et al., 2020](#ref-Lee); [Lee, Bainter, et al., 2020](#ref-lee2020)). The core principle of this approach is that mental disorders arise from causal interactions between symptoms in a network ([Borsboom, 2017](#ref-borsboom2017)). Applied to syndemic theory, a syndemic would then be the network and the various conditions would then be the nodes of the network. Furthermore, one of the benefits of this approach resides in the theoretical possibility to identify influential nodes in a network: nodes that play a significant part in the activation of the network and that could be the prime target of an intervention in order to deactivate the network ([Robinaugh et al., 2016](#ref-robinaugh2016)). In short, in addition to being statistically sound and coherent with the model of mutually causal epidemics, network analysis could offer actionable data to improve the health of MSM by identifying which conditions should be prioritised for interventions ([Tsai, 2018](#ref-Tsai2018a)).

We recommend that future research should abandon the summation score approach and attempt to clarify which model of interaction receives the most empirical support in order to implement effective public health interventions. Indeed, as reminded by Chakrapani et al., the three models have different programmatic implications ([Chakrapani, Lakshmi, et al., 2019](#ref-Chakrapani2019)). In the case of synergistically interacting epidemics, a single intervention may yield greater health improvement than if no interaction was present. For mutually causal epidemics, multicomponent interventions addressing the various epidemics should be implemented in order to produce an improvement. Finally, for serially causal epidemics, intervening at the root cause of a syndemic may prevent the development of a syndemic cascade.

## Additional frameworks

Resilience theory was the most frequently used framework to compliment syndemic theory.

Social support was shown to moderate the effect of syndemic conditions on viral load, providing a significant protective effect ([Friedman et al., 2016](#ref-friedman2016)). Moreover, a paper using Latent Transition Analysis to evaluate the impact of syndemic conditions on substance use showed that Black MSM with more social support were more likely to stay in the low-risk class or transitioning from the high-risk class to the low-risk class ([Turpin et al., 2020](#ref-turpin2020)). However, Chakrapani et al. found no moderation of social support on the relationship between syndemic conditions and risk taking ([Chakrapani et al., 2017](#ref-Chakrapani2017)).

On the topic of resilience resources, Zhang et al. did not find evidence of a moderating effect of resilience on the relationship between syndemic conditions and physical activity ([Zhang et al., 2019](#ref-Zhang2019)). O’Leary et al. did not find a buffering effect of resilience factors on the relationship between syndemic conditions and sexual risk behaviours, though optimism and education buffered the relationship between syndemic conditions and self-reported HIV status ([O’Leary et al., 2014](#ref-OLeary2014a)). On the other hand, Kurtz et al. found that, among MSM living with HIV, serosorting was positively associated with higher levels of two resilience factors: coping self-efficacy and positive coping skills ([Kurtz et al., 2012](#ref-Kurtz2012)). Similarly, Hart et al. found that psychosocial strengths were associated with lower likelihood of engaging in condomless anal sex, despite the presence of syndemic conditions ([Hart et al., 2017](#ref-Hart2017)).

In qualitative studies, resilience was also found to exert a protective effect against syndemic conditions ([Adam et al., 2018](#ref-adam2018); [Chakrapani, Kaur, et al., 2019](#ref-Chakrapani2019a); [Reed & Miller, 2016](#ref-Reed2016)). Furthermore, the review by Woodwards et al. found a protective effect of most resilience resources identified against HIV ([Woodward et al., 2017](#ref-woodward2017)). Additionally, as pointed out by Namer and Razum, focusing on risk rather than resilience and survivorship poses the threat of alienating minority groups rather than prioritising them ([Namer & Razum, 2021](#ref-namer2021)).

Minority stress represents another important framework as it explains how social stigma can get under the skin of minorised populations ([Meyer, 2003](#ref-Meyer2003)). Indeed, minority stress is fully integrated into theories of syndemic production among MSM ([Singer et al., 2017](#ref-singer2017); [Stall et al., 2007](#ref-stall2007)). In these theories, the minority stress experienced by MSM leads to maladaptive coping strategies such as substance abuse, development of psychopathological conditions such as anxiety disorders and depression, hereby increasing sexual risk behaviours. Therefore, minority stress theory offers a mechanistic explanation of the second tenet of syndemic theory: the formation and clustering of diseases due to adverse social conditions.  
As we recommend that future research better incorporate mental health issues, we believe that minority stress theory could be more often integrated into future analysis.  
Additionally, another advantage of minority stress theory is that it avoids pathologising MSM by placing the focus on the social roots of mental health issues.

Finally, although intersectionality was only used by two studies ([Ferlatte, Salway, Trussler, et al., 2018](#ref-ferlatte2018); [Quinn, 2019](#ref-Quinn)), we believe the field would benefit from this framework. Indeed, as shown in our results, there is some discrepancy in the results for subpopulations of MSM, especially for MSMW/bisexual men, Black MSM and Latino MSM. We believe that the inattention to systemic inequalities and structural disadvantage in the field may partly explain these discrepancies. In fact, only 16% of the quantitative studies examine a structural condition such as discrimination, poverty, or access to healthcare. However, as Bulled et al. reminds us, one of the goals of the syndemic framework is to “identify the role of power and structural injustices in creating pathology and recognising how pathology can intensify inequalities and multiple forms of oppression” ([Bulled et al., 2022](#ref-bulled2022)).

Some scholars are sceptical of the usefulness of syndemic theory to intersectionality and question the possibility of a conversation between the two fields ([Sangaramoorthy & Benton, 2021](#ref-sangaramoorthy2021)). As pertinent as the authors’ commentary is, we do believe in the possibility of bringing the two fields together. As Quinn pointed out in her response, incorporating an intersectional framework into syndemic research may address issues of power, oppression, and structural violence, neglected thus far in the field ([Quinn, 2021](#ref-quinn2021)). Doing so, we may address some gaps in the literature and disentangle the complex web of stigma and structural violence faced by sexual minority men, especially MSM situated at the intersection of multiple form of systemic discrimination such as racism, homophobia, biphobia, transphobia, classism, ableism or stigma against sex workers or people living with HIV. Furthermore, we agree with Bulled et al. when they argue that we need a syndemic analysis to understand clustering of diseases in marginalised populations ([Bulled et al., 2022](#ref-bulled2022)). Moreover, given the results of this review, we share the opinion that most of the criticism from Sangaramoorthy and Benton stems from flaws in the way research in the field was conducted rather than flaws in the framework itself.

## Recommendations

In light of these results, we propose the following suggestions to improve the quality of research on syndemic theory applied to MSM:

1. The local context should be taken into consideration more effectively by scholars. Analysis of the physical space through spatial epidemiology should be encouraged while merging data from different states and countries should be avoided as it blurs our understanding of the socioeconomic and cultural contexts in which MSM evolve.
2. More research should be conducted in the Global South, taking into account the difficulties involved when transposing some measures to different sociocultural contexts.
3. Researchers should carefully select syndemic conditions to avoid unnecessary dispersion and to select the most relevant variables to MSM in a given place at a given time. Exploratory qualitative research, focus groups or Delphi survey should be used before trying to quantify a syndemic. Furthermore, more attention should be paid to the selection of scales or sets of criteria when attempting to measure a syndemic condition to improve the reproducibility of the results.
4. A better understanding of how diseases interact is urgently needed. First, future research should abandon the summation score approach and aim to determine the model of interaction with the most empirical support. Second, future research should elucidate the mechanisms of bio-social and bio-bio interactions. Qualitative and mixed method studies should be employed more often to achieve this.
5. More attention should be given to structural disadvantage and systemic inequalities such as racism, biphobia, and transphobia in order to gain a better insight into racial disparities in syndemic production. Furthermore, the impact of monosexism and cissexism on the health of MSM should become a topic of investigation.
6. Transgender men should be included in the population of MSM in future studies, rather than conflating sex and gender by excluding them while often including transgender women alongside MSM.
7. Whenever possible, data from MSMW should be disaggregated to allow in-depth analysis.
8. Researchers should seek to study other aspects of MSM’s health than HIV infection. Mental health should no longer be neglected anymore. Moreover, when studying HIV infection, the outcome condomless anal sex should be replaced or refined.
9. Future work should continue to explore the impact of resilience in partially counteracting syndemics to develop public health interventions that aim to foster resilience resources among MSM.

# Strengths and Limitations

This review is the first scoping review to map the current knowledge in syndemic theory applied to MSM. We charted and presented detailed data regarding the existing literature. As such, we offer insight and actionable recommendations for the future of the field. Our search strategy of electronic databases was comprehensive and developed with the help of the director of health sciences library of our institution. We combined this database search with a subsequent hand search of reference lists of the included studies. Moreover, we conducted a fully transparent and reproducible review. Other researchers may freely reuse our data and scripts to conduct their own work or use our online visualisations to identify papers pertinent to their research projects.

Nevertheless, though we took several steps to ensure the comprehensiveness of our search strategy, we may still have missed some relevant literature. Furthermore, one of our inclusion criteria was the centrality of syndemic theory to the screened paper. Although two reviewers screened a part of the studies independently, this criterion may be somewhat arbitrary and other researchers may have chosen to include papers we rejected or the contrary. Finally, the usual limitations of a scoping review apply such as the lack of risk of bias and strength of evidence assessment.

# Conclusion

Despite our critical stance on the current literature, we remain convinced that syndemic theory is a useful framework to study the health of marginalised populations in a holistic way and the current research still offers valuable insights on the health of MSM. It is vital that research continue to evolve in order to deepen our understanding and, by consequence, improve the health of marginalised populations worldwide.

# Funding

We did not receive any specific grant for this research from any funding agency in the public, commercial or not-for-profit sectors.

# References

Achterbergh, R. C. A., van Rooijen, M. S., van den Brink, W., Boyd, A., & e Vries, H. J. C. (2021). Enhancing help-seeking behaviour among men who have sex with men at risk for sexually transmitted infections: The syn.bas.in randomised controlled trial. *Sexually Transmitted Infections*, *97*, 11–17. <https://doi.org/10.1136/sextrans-2020-054438>

Adam, B. D., Hart, T. A., Mohr, J., Coleman, T., & Vernon, J. (2017). HIV-related syndemic pathways and risk subjectivities among gay and bisexual men: a qualitative investigation. *Culture, health & sexuality*, *19*(11), 1254–1267. <https://doi.org/10.1080/13691058.2017.1309461>

Adam, B. D., Hart, T. A., Mohr, J., Coleman, T., & Vernon, J. (2018). Resilience pathways, childhood escape routes, and mentors reported by gay and bisexual men affected by syndemic conditions. *Sexualities*, *22*(4), 642. <https://doi.org/10.1177/1363460718758663>

Arksey, H., & O’Malley, L. (2005). Scoping studies: towards a methodological framework. *International Journal of Social Research Methodology*, *8*(1), 19–32. <https://doi.org/10.1080/1364557032000119616>

Ayhan, C. H. B., Bilgin, H., Uluman, O. T., Sukut, O., Yilmaz, S., & Buzlu, S. (2020). A Systematic Review of the Discrimination Against Sexual and Gender Minority in Health Care Settings. *International Journal of Health Services*, *50*(1), 44–61. <https://doi.org/10.1177/0020731419885093>

Batchelder, A. W., Choi, K., Dale, S. K., Pierre-Louis, C., Sweek, E. W., Ironson, G., Safren, S. A., & O’Cleirigh, C. (2019). Effects of syndemic psychiatric diagnoses on health indicators in men who have sex with men. *Health Psychology*, *38*(6), 509–517. <https://doi.org/10.1037/hea0000724>

Becasen, J. S., Denard, C. L., Mullins, M. M., Higa, D. H., & Sipe, T. A. (2019). Estimating the prevalence of HIV and sexual behaviors among the US transgender population: A systematic review and meta-analysis, 20062017. *American Journal of Public Health*, *109*. <https://doi.org/10.2105/AJPH.2018.304727>

Biello, K. B., Oldenburg, C. E., Safren, S. A., Rosenberger, J. G., Novak, D. S., Mayer, K. H., & Mimiaga, M. J. (2016). Multiple syndemic psychosocial factors are associated with reduced engagement in HIV care among a multinational, online sample of HIV-infected MSM in Latin America. *AIDS Care*, *28 Suppl 1*(sup1), 84–91. <https://doi.org/10.1080/09540121.2016.1146205>

Borsboom, D. (2017). A network theory of mental disorders. *World Psychiatry*, *16*(1), 5–13. <https://doi.org/10.1002/wps.20375>

Branstrom, R., & Pachankis, J. E. (n.d.). Sexual orientation disparities in the co-occurrence of substance use and psychological distress: A national population-based study (2008-2015). *Social Psychiatry and Psychiatric Epidemiology*, *4*, 403. <https://doi.org/10.1007/s00127-018-1491-4>

Bränström, R., & Pachankis, J. E. (2018). Validating the Syndemic Threat Surrounding Sexual Minority Men’s Health in a Population-Based Study With National Registry Linkage and a Heterosexual Comparison. *Journal of Acquired Immune Deficiency Syndromes*, *78*(4), 376–382. <https://doi.org/10.1097/QAI.0000000000001697>

Bruce, D., Harper, G. W., & Interventions, A. M. T. N. for H. (2011). Operating without a safety net: gay male adolescents and emerging adults’ experiences of marginalization and migration, and implications for theory of syndemic production of health disparities. *Health Education & Behavior*, *38*(4), 367–378. <https://doi.org/10.1177/1090198110375911>

Bulled, N. (2021). A new approach to measuring the synergy in a syndemic: Revisiting the SAVA syndemic among urban MSM in the united states. *Global Public Health*, *101256323*, 1–11. <https://doi.org/10.1080/17441692.2021.1974513>

Bulled, N., Singer, M., & Ostrach, B. (2022). Syndemics and intersectionality: A response commentary. *Social Science & Medicine*, *295*, 114743. <https://doi.org/10.1016/j.socscimed.2022.114743>

Buttram, M. E., & Kurtz, S. P. (2015). A mixed methods study of health and social disparities among substance-using african american/black men who have sex with men. *Journal of Racial and Ethnic Health Disparities*, *2*, 1–10. <https://doi.org/10.1007/s40615-014-0042-2>

Byg, B., Bazzi, A. R., Funk, D., James, B., & Potter, J. (2016). The Utility of a Syndemic Framework in Understanding Chronic Disease Management Among HIV-Infected and Type 2 Diabetic Men Who Have Sex with Men. *Journal of Community Health*, *41*, 1204–1211. <https://doi.org/10.1007/s10900-016-0202-x>

Calabrese, S. K., Underhill, K., & Mayer, K. H. (2017). HIV Preexposure Prophylaxis and Condomless Sex: Disentangling Personal Values From Public Health Priorities. *American Journal of Public Health*, *107*(10), 1572–1576. <https://doi.org/10.2105/AJPH.2017.303966>

Card, K. G., Lachowsky, N. J., Armstrong, H. L., Cui, Z., Wang, L., Sereda, P., Jollimore, J., Patterson, T. L., Corneil, T., Hogg, R. S., Roth, E. A., & Moore, D. M. (2018). The additive effects of depressive symptoms and polysubstance use on HIV risk among gay, bisexual, and other men who have sex with men. *Addictive Behaviors*, *82*(12), 158–165. <https://doi.org/10.1016/j.addbeh.2018.03.005>

Carrico, A. W., Rodriguez, V. J., Jones, D. L., & Kumar, M. (2018). Short circuit: Disaggregation of adrenocorticotropic hormone and cortisol levels in HIV-positive, methamphetamine-using men who have sex with men. *Human Psychopharmacology*, *33*(1). <https://doi.org/10.1002/hup.2645>

Cassels, S., Meltzer, D., Loustalot, C., Ragsdale, A., Shoptaw, S., & Gorbach, P. M. (2020). Geographic mobility, place attachment, and the changing geography of sex among african american and latinx MSM who use substances in los angeles. *Journal of Urban Health : Bulletin of the New York Academy of Medicine*, *97*, 609–622. <https://doi.org/10.1007/s11524-020-00481-3>

Center for Disease Control and Prevention. (2020). *HIV Surveillance Report 2018 (updated)* (p. 119). <https://www.cdc.gov/hiv/library/reports/hiv-surveillance.html>

Centers for Disease Control and Prevention. (2019). *Sexually transmitted disease surveillance 2018*. <https://doi.org/10.15620/cdc.79370>

Chakrapani, V., Kaur, M., Newman, P. A., Mittal, S., & Kumar, R. (2019). Syndemics and HIV-related sexual risk among men who have sex with men in India: influences of stigma and resilience. *Culture, health & sexuality*, *21*(4), 416–431. <https://doi.org/10.1080/13691058.2018.1486458>

Chakrapani, V., Kaur, M., Tsai, A. C., Newman, P. A., & Kumar, R. (2020). The impact of a syndemic theory-based intervention on HIV transmission risk behaviour among men who have sex with men in india: Findings from a pretest-posttest non-equivalent comparison group trial. *Social Science & Medicine*. <https://doi.org/10.1016/j.socscimed.2020.112817>

Chakrapani, V., Lakshmi, P. V. M., Tsai, A. C., Vijin, P. P., Kumar, P., & Srinivas, V. (2019). The syndemic of violence victimisation, drug use, frequent alcohol use, and HIV transmission risk behaviour among men who have sex with men: Cross-sectional, population-based study in India. *SSM - Population Health*, *7*, 100348. <https://doi.org/10.1016/j.ssmph.2018.100348>

Chakrapani, V., Newman, P. A., Shunmugam, M., Logie, C. H., & Samuel, M. (2017). Syndemics of depression, alcohol use, and victimisation, and their association with HIV-related sexual risk among men who have sex with men and transgender women in India. *Global Public Health*, *12*(2), 250–265. <https://doi.org/10.1080/17441692.2015.1091024>

Chandler, C. J., Bukowski, L. A., Matthews, D. D., Hawk, M. E., Markovic, N., Egan, J. E., & Stall, R. D. (2020). Examining the impact of a psychosocial syndemic on past six-month HIV screening behavior of black men who have sex with men in the united states: Results from the POWER study. *AIDS and Behavior*, *28*, 428–436. <https://doi.org/10.1007/s10461-019-02458-z>

Chandler, C. J., Bukowski, L. A., Matthews, D. D., Hawk, M. E., Markovic, N., Stall, R. D., & Egan, J. E. (2020). Understanding the impact of a syndemic on the use of pre-exposure prophylaxis in a community-based sample of behaviorally PrEP-eligible BMSM in the united states. *AIDS Care*, *32*(5), 551–556. <https://doi.org/10.1080/09540121.2019.1659921>

Chandler, C. J., Meunier, E., Eaton, L. A., Andrade, E., Bukowski, L. A., Matthews, D. D., Raymond, H. F., Stall, R. D., & Friedman, M. R. (2020). Syndemic health disparities and sexually transmitted infection burden among black men who have sex with men engaged in sex work in the u.s. *Archives of Sexual Behavior*. <https://doi.org/10.1007/s10508-020-01828-2>

Chaudhry, A. B., & Reisner, S. L. (2019). Disparities by sexual orientation persist for major depressive episode and substance abuse or dependence: Findings from a national probability study of adults in the united states. *LGBT Health*, *6*(5). <https://doi.org/10.1089/lgbt.2018.0207>

Chuang, D.-M., Newman, P. A., Fang, L., & Lai, M.-C. (2021). Syndemic conditions, sexual risk behavior, and HIV infection among men who have sex with men in taiwan. *AIDS and Behavior*, *25*(11), 3503–3518. <https://doi.org/10.1007/s10461-021-03269-x>

Chuang, D.-M., Newman, P. A., & Li, A. T.-W. (2018). Syndemic factors and HIV infection among men who have sex with men in taiwan. *Journal of HIV/AIDS & Social Services*, *17*(4), 337–352. <https://doi.org/10.1080/15381501.2018.1454866>

Closson, K., Smith, R. V., Olarewaju, G., & Crosby, R. (2018). Associations between economic dependence, sexual behaviours, and sexually transmitted infections among young, Black, gay, bisexual and other men who have sex with men living with and without HIV in Jackson, Mississippi, USA. *Sexual Health*, *15*(5), 473. <https://doi.org/10.1071/SH17218>

Collier, K. L., van Beusekom, G., Bos, H. M. W., & Sandfort, T. G. M. (2013). Sexual orientation and gender identity/expression related peer victimization in adolescence: A systematic review of associated psychosocial and health outcomes. *Journal of Sex Research*, *50*(3-4), 299–317. <https://doi.org/10.1080/00224499.2012.750639>

Colquhoun, H. L., Levac, D., O’Brien, K. K., Straus, S., Tricco, A. C., Perrier, L., Kastner, M., & Moher, D. (2014). Scoping reviews: Time for clarity in definition, methods, and reporting. *Journal of Clinical Epidemiology*, *67*(12), 1291–1294. <https://doi.org/10.1016/j.jclinepi.2014.03.013>

De Cock, K. M., Jaffe, H. W., & Curran, J. W. (2012). The evolving epidemiology of HIV/AIDS. *AIDS*, *26*(10), 1205–1213. <https://doi.org/10.1097/QAD.0b013e328354622a>

Dyer, T. V., Turpin, R. E., Stall, R., Khan, M. R., Nelson, L. E., Brewer, R., Friedman, M. R., Mimiaga, M. J., Cook, R. L., O’Cleirigh, C., & Mayer, K. H. (2020). Latent profile analysis of a syndemic of vulnerability factors on incident sexually transmitted infection in a cohort of black men who have sex with men only and black men who have sex with men and women in the HIV prevention trials network 061 study. *Sexually Transmitted Diseases*, *47*(9), 571–579. <https://doi.org/10.1097/OLQ.0000000000001208>

Eaton, L. A., Pitpitan, E. V., Kalichman, S. C., Sikkema, K. J., Skinner, D., Watt, M. H., & Pieterse, D. (2013). Men who report recent male and female sex partners in cape town, south africa: An understudied and underserved population. *Archives of Sexual Behavior*, *42*, 1299–1308. <https://doi.org/10.1007/s10508-013-0077-1>

European Centre for Disease Prevention and Control, & WHO Regional Office for Europe. (2019). *HIV/AIDS surveillance in Europe 2019. 2018 data* (p. 126).

Ferlatte, O., Salway, T., Samji, H., Dove, N., Gesink, D., Gilbert, M., Oliffe, J. L., Grennan, T., & Wong, J. (2018). An application of syndemic theory to identify drivers of the syphilis epidemic among gay, bisexual, and other men who have sex with men. *Sexually Transmitted Diseases*, *45*(3), 163–168. <https://doi.org/10.1097/OLQ.0000000000000713>

Ferlatte, O., Salway, T., Trussler, T., Oliffe, J. L., & Gilbert, M. (2018). Combining intersectionality and syndemic theory to advance understandings of health inequities among canadian gay, bisexual and other men who have sex with men. *Critical Public Health*, *28*(5), 509–521. <https://doi.org/10.1080/09581596.2017.1380298>

Finkelhor, D. (1994). Current Information on the Scope and Nature of Child Sexual Abuse. *The Future of Children*, *4*(2), 31. <https://doi.org/10.2307/1602522>

Friedman, M. R., Coulter, R. W. S., Silvestre, A. J., Stall, R., Teplin, L., Shoptaw, S., Surkan, P. J., & Plankey, M. W. (2016). Someone to count on: Social support as an effect modifier of viral load suppression in a prospective cohort study. *AIDS Care*, *29*(4), 469–480. <https://doi.org/10.1080/09540121.2016.1211614>

Friedman, M. R., Kurtz, S. P., Buttram, M. E., Wei, C., Silvestre, A. J., & Stall, R. (2014). HIV risk among substance-using men who have sex with men and women (MSMW): Findings from south florida. *AIDS and Behavior*, 111–119. <https://doi.org/10.1007/s10461-013-0495-z>

Haas, A. P., Rodgers, P. L., & Herman, J. L. (2014). *Suicide attempts among transgender and gender non-conforming adults : Findings of the national transgender discrimination survey*.

Halkitis, P. N., Kupprat, S. A., Hampton, M. B., Perez-Figueroa, R., Kingdon, M., Eddy, J. A., & Ompad, D. C. (2012). Evidence for a Syndemic in Aging HIV-positive Gay, Bisexual, and Other MSM: Implications for a Holistic Approach to Prevention and Healthcare. *Annals of anthropological practice*, *36*, 365–386. <https://doi.org/10.1111/napa.12009>

Halkitis, P. N., Moeller, R. W., Siconolfi, D. E., Storholm, E. D., Solomon, T. M., & Bub, K. L. (2013). Measurement model exploring a syndemic in emerging adult gay and bisexual men. *AIDS and Behavior*, *17*, 662–673. <https://doi.org/10.1007/s10461-012-0273-3>

Hart, T. A., Noor, S. W., Adam, B. D., Vernon, J. R. G., Brennan, D. J., Gardner, S., Husbands, W., & Myers, T. (2017). Number of Psychosocial Strengths Predicts Reduced HIV Sexual Risk Behaviors Above and Beyond Syndemic Problems Among Gay and Bisexual Men. *AIDS and Behavior*, *21*(10), 3035–3046. <https://doi.org/10.1007/s10461-016-1669-2>

Herrick, A. L., Lim, S. H., Plankey, M. W., Chmiel, J. S., Guadamuz, T. E., Kao, U., Shoptaw, S., Carrico, A., Ostrow, D., & Stall, R. (2013). Adversity and syndemic production among men participating in the multicenter AIDS cohort study: a life-course approach. *American Journal of Public Health*, *103*, 79–85. <https://doi.org/10.2105/AJPH.2012.300810>

Hottes, T. S., Ferlatte, O., & Gesink, D. (2015). Suicide and HIV as leading causes of death among gay and bisexual men: a comparison of estimated mortality and published research. *Critical Public Health*, *25*(5), 513–526. <https://doi.org/10.1080/09581596.2014.946887>

Klein, H. (2011). Using a syndemics theory approach to study HIV risk taking in a population of men who use the internet to find partners for unprotected sex. *American Journal of Men’s Health*, *5*(6), 466–476. <https://doi.org/10.1177/1557988311398472>

Kurtz, S. P., Buttram, M. E., Surratt, H. L., & Stall, R. D. (2012). Resilience, syndemic factors, and serosorting behaviors among HIV-positive and HIV-negative substance-using MSM. *AIDS Education and Prevention*, *24*(3), 193–205. <https://doi.org/10.1521/aeap.2012.24.3.193>

Lassiter, J. M., & Parsons, J. T. (2016). Religion and Spirituality’s Influences on HIV Syndemics Among MSM: A Systematic Review and Conceptual Model. *AIDS and Behavior*, *20*, 461–472. <https://doi.org/10.1007/s10461-015-1173-0>

Lea, T., de Wit, J., & Reynolds, R. (2014). Minority stress in lesbian, gay, and bisexual young adults in australia: Associations with psychological distress, suicidality, and substance use. *Archives of Sexual Behavior*, *43*(8), 1571–1578. <https://doi.org/10.1007/s10508-014-0266-6>

Leblanc, N. M., Crean, H. F., Dyer, T. P., Zhang, C., Turpin, R., Zhang, N., Smith, M. D. R., McMahon, J., & Nelson, L. (2021). Ecological and syndemic predictors of drug use during sex and transactional sex among u.s. Black men who have sex with men: A secondary data analysis from the HPTN 061 study. *Archives of Sexual Behavior*, *50*(5), 2031–2047. <https://doi.org/10.1007/s10508-020-01871-z>

Lee, J. H., Gamarel, K. E., Bryant, K. J., Zaller, N. D., & Operario, D. (2016). Discrimination, mental health, and substance use disorders among sexual minority populations. *LGBT Health*, *3*(4), 258–265. <https://doi.org/10.1089/lgbt.2015.0135>

Lee, J. S., Bainter, S. A., Carrico, A. W., Glynn, T. R., Rogers, B. G., Albright, C., O’Cleirigh, C., Mayer, K. H., & Safren, S. A. (2020). Connecting the dots: A comparison of network analysis and exploratory factor analysis to examine psychosocial syndemic indicators among HIV-negative sexual minority men. *Journal of Behavioral Medicine*. <https://doi.org/10.1007/s10865-020-00148-z>

Lee, J. S., Safren, S. A., Bainter, S. A., Rodríguez-Díaz, C. E., Horvath, K. J., & Blashill, A. J. (2020). Examining a syndemics network among young latino men who have sex with men. *International Journal of Behavioral Medicine*, *27*, 39–51. <https://doi.org/10.1007/s12529-019-09831-1>

Levac, D., Colquhoun, H., & O’Brien, K. K. (2010). Scoping studies: Advancing the methodology. *Implementation Science : IS*, *5*(69). <https://doi.org/10.1186/1748-5908-5-69>

Lewis, N. M., & Wilson, K. (2017). HIV risk behaviours among immigrant and ethnic minority gay and bisexual men in north america and europe: A systematic review. *Social Science & Medicine*, *179*, 115–128. <https://doi.org/10.1016/j.socscimed.2017.02.033>

Liu, R. T., Sheehan, A. E., Walsh, R. F. L., Sanzari, C. M., Cheek, S. M., & Hernandez, E. M. (2019). Prevalence and correlates of non-suicidal self-injury among lesbian, gay, bisexual, and transgender individuals: A systematic review and meta-analysis. *Clinical Psychology Review*, *74*, 101783. <https://doi.org/10.1016/j.cpr.2019.101783>

Luo, Z., Feng, T., Fu, H., & Yang, T. (2017). Lifetime prevalence of suicidal ideation among men who have sex with men: A meta-analysis. *BMC Psychiatry*, *17*. <https://doi.org/10.1186/s12888-017-1575-9>

Lyons, T., Johnson, A. K., & Garofalo, R. (2013). "What Could Have Been Different": A Qualitative Study of Syndemic Theory and HIV Prevention among Young Men Who Have Sex with Men. *Journal of HIV/AIDS & Social Services*, *12*(3-4), 368–383. <https://doi.org/10.1080/15381501.2013.816211>

Maiorana, A., Kegeles, S. M., Brown, S., Williams, R., & Arnold, E. A. (2020). Substance use, intimate partner violence, history of incarceration and vulnerability to HIV among young black men who have sex with men in a southern US city. *Culture, Health & Sexuality*. <https://doi.org/10.1080/13691058.2019.1688395>

Martinez, O., Arreola, S., Wu, E., Muñoz-Laboy, M., Levine, E. C., Rutledge, S. E., Hausmann-Stabile, C., Icard, L., Rhodes, S. D., Carballo-Diéguez, A., Rodríguez-Díaz, C. E., Fernandez, M. I., & Sandfort, T. (2016). Syndemic factors associated with adult sexual HIV risk behaviors in a sample of Latino men who have sex with men in New York City. *Drug and alcohol dependence*, *166*, 258–262. <https://doi.org/10.1016/j.drugalcdep.2016.06.033>

Martinez, O., Brady, K. A., Levine, E., Page, K. R., Zea, M. C., Yamanis, T. J., Grieb, S., Shinefeld, J., Ortiz, K., Davis, W. W., Mattera, B., Martinez-Donate, A., Chavez-Baray, S., & Moya, E. M. (2020). Using syndemics theory to examine HIV sexual risk among latinx men who have sex with men in philadelphia, PA: Findings from the national HIV behavioral surveillance. *EHQUIDAD. Revista Internacional De Políticas De Bienestar Y Trabajo Social*, *13*(101643738), 217–236. <https://doi.org/10.15257/ehquidad.2020.0009>

Medley, G., Lipari, R. N., Bose, J., Rti;., Cribb, D. S., Kroutil, L. A., & Mchenry, G. (2016). *Sexual orientation and estimates of adult substance use and mental health: Results from the 2015 national survey on drug use and health*. <https://www.samhsa.gov/data/>

Mendenhall, E., & Singer, M. (2020). What constitutes a syndemic? Methods, contexts, and framing from 2019. *Current Opinion in HIV and AIDS*, *Publish Ahead of Print*. <https://doi.org/10.1097/COH.0000000000000628>

Meyer, I. H. (2003). Prejudice, social stress, and mental health in lesbian, gay, and bisexual populations: Conceptual issues and research evidence. *Psychological Bulletin*, *129*(5), 674–697. <https://doi.org/10.1037/0033-2909.129.5.674>

Mimiaga, M. J., O’Cleirigh, C., Biello, K. B., Robertson, A. M., Safren, S. A., Coates, T. J., Koblin, B. A., Chesney, M. A., Donnell, D. J., Stall, R. D., & Mayer, K. H. (2015). The effect of psychosocial syndemic production on 4-year HIV incidence and risk behavior in a large cohort of sexually active men who have sex with men. *Journal of Acquired Immune Deficiency Syndromes*, *68*(3), 329–336. <https://doi.org/10.1097/QAI.0000000000000475>

Moeller, R. W., Halkitis, P. N., & Surrence, K. (n.d.). The interplay of syndemic production and serosorting in drug-using gay and bisexual men. *Journal of Gay & Lesbian Social Services*, *23*(1), 89–106. <https://doi.org/10.1080/10538720.2010.538007>

Muñoz-Laboy, M., Martinez, O., Levine, E. C., Mattera, B. T., & Isabel Fernandez, M. (2018). Syndemic Conditions Reinforcing Disparities in HIV and Other STIs in an Urban Sample of Behaviorally Bisexual Latino Men. *Journal of immigrant and minority health*, *20*(2), 497–501. <https://doi.org/10.1007/s10903-017-0568-6>

Mustanski, B., Andrews, R., Herrick, A., Stall, R., & Schnarrs, P. W. (2014). A syndemic of psychosocial health disparities and associations with risk for attempting suicide among young sexual minority men. *American Journal of Public Health*, *104*, 287–294. <https://doi.org/10.2105/AJPH.2013.301744>

Mustanski, B., Phillips, G., Ryan, D. T., Swann, G., Kuhns, L., & Garofalo, R. (2017). Prospective effects of a syndemic on HIV and STI incidence and risk behaviors in a cohort of young men who have sex with men. *AIDS and Behavior*, *21*(3), 845–857. <https://doi.org/10.1007/s10461-016-1607-3>

Namer, Y., & Razum, O. (2021). Surviving syndemics. *The Lancet*, *398*(10295), 118–119. <https://doi.org/10.1016/S0140-6736(21)01328-3>

Ng, R. X., Guadamuz, T. E., Akbar, M., Kamarulzaman, A., & Lim, S. H. (2020). Association of co-occurring psychosocial health conditions and HIV infection among MSM in malaysia: Implication of a syndemic effect. *International Journal of STD & AIDS*, *31*(6), 568–578. <https://doi.org/10.1177/0956462420913444>

O’Leary, A., Jemmott 3rd, J. B., Stevens, R., Rutledge, S. E., & Icard, L. D. (2014). Optimism and education buffer the effects of syndemic conditions on HIV status among African American men who have sex with men. *AIDS and Behavior*, *18*, 2080–2088. <https://doi.org/10.1007/s10461-014-0708-0>

Pantalone, D. W., Nelson, K. M., Batchelder, A. W., Chiu, C., Gunn, H. A., & Horvath, K. J. (2020). A systematic review and meta-analysis of combination behavioral interventions co-targeting psychosocial syndemics and HIV-related health behaviors for sexual minority men. *The Journal of Sex Research*, *57*, 681–708. <https://doi.org/10.1080/00224499.2020.1728514>

Peitzmeier, S. M., Malik, M., Kattari, S. K., Marrow, E., Stephenson, R., Agénor, M., & Reisner, S. L. (2020). Intimate Partner Violence in Transgender Populations: Systematic Review and Meta-analysis of Prevalence and Correlates. *American Journal of Public Health*, *110*(9), e1–e14. <https://doi.org/10.2105/AJPH.2020.305774>

Perry, N. S., Nelson, K. M., & Carey, M. P. (2019). Diversity of psychosocial syndemic indicators and associations with sexual behavior with male and female partners among early adolescent sexual minority males. *LGBT Health*, *6*(8), 386–392. <https://doi.org/10.1089/lgbt.2019.0113>

Peters, M. D. J., Marnie, C., Tricco, A. C., Pollock, D., Munn, Z., Alexander, L., McInerney, P., Godfrey, C. M., & Khalil, H. (2020). Updated methodological guidance for the conduct of scoping reviews. *JBI evidence synthesis*, *18*(10), 2119–2126. <https://doi.org/10.11124/JBIES-20-00167>

Pitasi, M. A., Kerani, R. P., Kohn, R., Murphy, R. D., Pathela, P., Schumacher, C. M., Tabidze, I., & Llata, E. (2019). Chlamydia, gonorrhea, and human immunodeficiency virus infection among transgender women and transgender men attending clinics that provide sexually transmitted disease services in six US cities. *Sexually Transmitted Diseases*, *46*(2), 112–117. <https://doi.org/10.1097/OLQ.0000000000000917>

Pitpitan, E. V., Smith, L. R., Goodman-Meza, D., Torres, K., Semple, S. J., Strathdee, S. A., & Patterson, T. L. (2016). "Outness" as a Moderator of the Association Between Syndemic Conditions and HIV Risk-Taking Behavior Among Men Who Have Sex with Men in Tijuana, Mexico. *AIDS and Behavior*, *20*, 431–438. <https://doi.org/10.1007/s10461-015-1172-1>

Pollard, A., Nadarzynski, T., & Llewellyn, C. (2018). Syndemics of stigma, minority-stress, maladaptive coping, risk environments and littoral spaces among men who have sex with men using chemsex. *Culture, Health & Sexuality*, *20*(4), 411–427. <https://doi.org/10.1080/13691058.2017.1350751>

Poteat, T., German, D., & Flynn, C. (2016). The conflation of gender and sex: Gaps and opportunities in HIV data among transgender women and MSM. *Global Public Health*, *7-8*, 835. <https://doi.org/10.1080/17441692.2015.1134615>

Quinn, K. G. (2021). The relationship between syndemics and intersectionality: A response to the commentary by Sangaramoorthy and Benton. *Social Science & Medicine*, 113784. <https://doi.org/10.1016/j.socscimed.2021.113784>

Quinn, K. G. (2019). Applying an intersectional framework to understand syndemic conditions among young black gay, bisexual, and other men who have sex with men. *Social Science & Medicine*. <https://doi.org/10.1016/j.socscimed.2019.112779>

R Core Team. (2020). *R: A language and environment for statistical computing.* R Foundation for Statistical Computing. <https://www.R-project.org/>

Reed, S. J., & Miller, R. L. (2016). Thriving and Adapting: Resilience, Sense of Community, and Syndemics among Young Black Gay and Bisexual Men. *American journal of community psychology*, *57*(1-2), 129–143. <https://doi.org/10.1002/ajcp.12028>

Reisner, S. L., White Hughto, J. M., Pardee, D., & Sevelius, J. (2016). Syndemics and gender affirmation: HIV sexual risk in female-to-male trans masculine adults reporting sexual contact with cisgender males. *International Journal of STD & AIDS*, *27*(11), 955–966. <https://doi.org/10.1177/0956462415602418>

Robinaugh, D. J., Millner, A. J., & McNally, R. J. (2016). Identifying highly influential nodes in the complicated grief network. *Journal of Abnormal Psychology*, *125*(6), 747–757. <https://doi.org/10.1037/abn0000181>

Rooney, B. M., Tulloch, T. G., & Blashill, A. J. (2018). Psychosocial syndemic correlates of sexual compulsivity among men who have sex with men: A meta-analysis. *Archives of Sexual Behavior*, *47*(1), 75–93. <https://doi.org/10.1007/s10508-017-1032-3>

Ross, L. E., Salway, T., Tarasoff, L. A., MacKay, J. M., Hawkins, B. W., & Fehr, C. P. (2018). Prevalence of depression and anxiety among bisexual people compared to gay, lesbian, and heterosexual individuals:a systematic review and meta-analysis. *Journal of Sex Research*, *55*(4-5), 435–456. <https://doi.org/10.1080/00224499.2017.1387755>

RStudio Team. (2020). *RStudio : Integrated development for r*. RStudio, Inc. <http://www.rstudio.com/>

Salway, T., Ross, L. E., Fehr, C. P., Burley, J., Asadi, S., Hawkins, B., & Tarasoff, L. A. (2019). A Systematic Review and Meta-Analysis of Disparities in the Prevalence of Suicide Ideation and Attempt Among Bisexual Populations. *Archives of Sexual Behavior*, *48*(1), 89–111. <https://doi.org/10.1007/s10508-018-1150-6>

Sangaramoorthy, T., & Benton, A. (2021). Intersectionality and syndemics: A commentary. *Social Science & Medicine*, 113783. <https://doi.org/10.1016/j.socscimed.2021.113783>

Satyanarayana, S., Safren, S. A., Rogers, B. G., Bainter, S. A., Christopoulos, K. A., Fredericksen, R. J., Mathews, W. C., Moore, R. D., Mugavero, M. J., Napravnik, S., Carrico, A. W., Mimiaga, M. J., Mayer, K. H., & Crane, H. M. (2021). Estimating HIV transmissions in a large u.s. Clinic-based sample: Effects of time and syndemic conditions. *Journal of the International AIDS Society*, *24*(3), e25679. <https://doi.org/10.1002/jia2.25679>

Scheer, J. R., Clark, K. A., Maiolatesi, A. J., & Pachankis, J. E. (2021). Syndemic profiles and sexual minority men’s hiv-risk behavior: A latent class analysis. *Archives of Sexual Behavior*. <https://doi.org/10.1007/s10508-020-01850-4>

Semple, S. J., Stockman, J. K., Goodman-Meza, D., Pitpitan, E. V., Strathdee, S. A., Chavarin, C. V., Rangel, G., Torres, K., & Patterson, T. L. (2017). Correlates of sexual violence among men who have sex with men in tijuana, mexico. *Archives of Sexual Behavior*, *46*, 1011–1023. <https://doi.org/10.1007/s10508-016-0747-x>

Shrestha, S., Bauer, C. X. C., Hendricks, B., & Stopka, T. J. (2020). Spatial epidemiology: An empirical framework for syndemics research. *Social Science and Medicine*. <https://doi.org/10.1016/j.socscimed.2020.113352>

Shuper, P. A., Joharchi, N., Bogoch, I. I., Loutfy, M., Crouzat, F., El-Helou, P., Knox, D. C., Woodward, K., & Rehm, J. (2020). Alcohol consumption, substance use, and depression in relation to HIV pre-exposure prophylaxis (PrEP) nonadherence among gay, bisexual, and other men-who-have-sex-with-men. *BMC Public Health*, *20*, 1782. <https://doi.org/10.1186/s12889-020-09883-z>

Singer, M. (1996). A dose of drugs, a touch of violence, a case of AIDS: conceptualizing the SAVA syndemic. *Free Inquiry in Creative Sociology*, *24*(2), 99–110.

Singer, M., Bulled, N., & Ostrach, B. (2020). Whither syndemics?: Trends in syndemics research, a review 20152019. *Global Public Health*, 1–13. <https://doi.org/10.1080/17441692.2020.1724317>

Singer, M., Bulled, N., Ostrach, B., & Lerman Ginzburg, S. (2021). Syndemics: A Cross-Disciplinary Approach to Complex Epidemic Events Like COVID-19. *Annual Review of Anthropology*, *50*(1), 41–58. <https://doi.org/10.1146/annurev-anthro-100919-121009>

Singer, M., Bulled, N., Ostrach, B., & Mendenhall, E. (2017). Syndemics and the biosocial conception of health. *The Lancet*, *389*, 941–950. <https://doi.org/10.1016/S0140-6736(17)30003-X>

Singer, M., & Clair, S. (2003). Syndemics and Public Health: Reconceptualizing Disease in Bio-Social Context. *Medical Anthropology Quarterly*, *17*(4), 423–441. <https://doi.org/10.1525/maq.2003.17.4.423>

Stall, R., Coulter, R. W. S., Friedman, M. R., & Plankey, M. W. (2015). Commentary on “syndemics of psychosocial problems and HIV risk: A systematic review of empirical tests of the disease interaction concept” by a. Tsai and b. burns. *Social Science & Medicine*, *145*, 129–131. <https://doi.org/10.1016/j.socscimed.2015.07.016>

Stall, R., Friedman, M., & Catania, J. A. (2007). Interacting Epidemics and Gay Men’s Health: A Theory of Syndemic Production among Urban Gay Men. In *Unequal Opportunity: Health Disparities Affecting Gay and Bisexual Men in the United States*. Oxford University Press.

Stall, R., Mills, T. C., Williamson, J., Hart, T., Greenwood, G., Paul, J., Pollack, L., Binson, D., Osmond, D., & Catania, J. A. (2003). Association of co-occurring psychosocial health problems and increased vulnerability to HIV/AIDS among urban men who have sex with men. *American Journal of Public Health*, *93*(6), 939–942. <https://doi.org/10.2105/AJPH.93.6.939>

Starks, T. J., Millar, B. M., Eggleston, J. J., & Parsons, J. T. (2014). Syndemic factors associated with HIV risk for gay and bisexual men: comparing latent class and latent factor modeling. *AIDS and Behavior*, *18*, 2075–2079. <https://doi.org/10.1007/s10461-014-0841-9>

Swan, D. J. (2018). *3 Defining Bisexuality: Challenges and Importance of and Toward a Unifying Definition* (D. J. Swan & S. Habibi, Eds.; pp. 37–60). Springer International Publishing. <https://doi.org/10.1007/978-3-319-71535-3_3>

Tapia, G. R., Glynn, T. R., Miller, C., Manuzak, J. A., Broedlow, C. A., Mcgaugh, A., Cherenack, E. M., Bauermeister, J. A., Grov, C., Dilworth, S. E., Parisi, R., Martinez, D., Klatt, N. R., & Carrico, A. W. (2021). Syndemics and preexposure prophylaxis are independently associated with rectal immune dysregulation in sexual minority men. *AIDS (London, England)*, *35*(8), 1295–1300. <https://doi.org/10.1097/QAD.0000000000002866>

Testa, R. J., Sciacca, L. M., Wang, F., Hendricks, M. L., Goldblum, P., Bradford, J., & Bongar, B. (2012). Effects of violence on transgender people. *Professional Psychology: Research and Practice*, *43*(5), 452–459. <https://doi.org/10.1037/a0029604>

Tomori, C., McFall, A. M., Solomon, S. S., Srikrishnan, A. K., Anand, S., Balakrishnan, P., Mehta, S. H., & Celentano, D. D. (2018). Is there synergy in syndemics? Psychosocial conditions and sexual risk among men who have sex with men in India. *Social Science & Medicine*, *206*, 110–116. <https://doi.org/10.1016/j.socscimed.2018.03.032>

Tricco, A. C., Lillie, E., Zarin, W., O’Brien, K. K., Colquhoun, H., Levac, D., Moher, D., Peters, M. D. J., Horsley, T., Weeks, L., Hempel, S., Akl, E. A., Chang, C., McGowan, J., Stewart, L., Hartling, L., Aldcroft, A., Wilson, M. G., Garritty, C., … Straus, S. E. (2018). PRISMA extension for scoping reviews (PRISMA-ScR): Checklist and explanation. *Annals of Internal Medicine*, *169*(7), 467–473. <https://doi.org/10.7326/M18-0850>

Tsai, A. C. (2018). Syndemics: A theory in search of data or data in search of a theory? *Social Science and Medicine*, *206*, 117–122. <https://doi.org/10.1016/j.socscimed.2018.03.040>

Tsai, A. C., & Burns, B. (2015). Syndemics of psychosocial problems and HIV risk: A systematic review of empirical tests of the disease interaction concept. *Social Science and Medicine*, *139*, 26–35. <https://doi.org/10.1016/j.socscimed.2015.06.024>

Turpin, R. E., Dyer, T. V., Dangerfield, D. T. 2nd., Liu, H., & Mayer, K. H. (2020). Syndemic latent transition analysis in the HPTN 061 cohort: Prospective interactions between trauma, mental health, social support, and substance use. *Drug and Alcohol Dependence*, *214*. <https://doi.org/10.1016/j.drugalcdep.2020.108106>

Weaver, L. J., & Kaiser, B. N. (2020). Syndemics theory must take local context seriously: An example of measures for poverty, mental health, and food insecurity. *Social Science and Medicine*. <https://doi.org/10.1016/j.socscimed.2020.113304>

Woodward, E. N., Banks, R. J., Marks, A. K., & Pantalone, D. W. (2017). Identifying resilience resources for HIV prevention among sexual minority men: A systematic review. *AIDS and Behavior*, *21*, 28602873. <https://doi.org/10.1007/s10461-016-1608-2>

Zepf, R., Greene, M., Hessol, N. A., Johnson, M. O., Santos, G. M., John, M. D., & Dawson-Rose, C. (2020). Syndemic conditions and medication adherence in older men living with HIV who have sex with men. *AIDS Care*, *32*(12), 1610–1616. <https://doi.org/10.1080/09540121.2020.1772954>

Zhang, J., O’Leary, A., Jemmott 3rd, J. B., Icard, L. D., & Rutledge, S. E. (2019). Syndemic conditions predict lower levels of physical activity among African American men who have sex with men: A prospective survey study. *PLOS One*, *14*(3), e0213439–e0213439. <https://doi.org/10.1371/journal.pone.0213439>