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

Maxence R. Ouafik1, Laetitia Buret2, Jean-Luc Belche3, Beatrice Scholtes4

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

2 General Practice Department - Primary Care and Health Research Unit, MD - GP - PhD, research assistant, University of Liège, Liège, Belgium [laetitia.buret@uliege.be](mailto:laetitia.buret@uliege.be) OrcID <https://orcid.org/0000-0001-6039-9824>

3 General Practice Department - Primary Care and Health Research Unit, MD - GP - PhD, lecturer, University of Liège, Liège, Belgium [jlbelche@uliege.be](mailto:jlbelche@uliege.be) OrcID <https://orcid.org/0000-0001-8807-0473>

4 General Practice Department - Primary Care and Health Research Unit, Postdoctoral Researcher, University of Liège, Liège, Belgium [beatrice.scholtes@uliege.be](mailto:beatrice.scholtes@uliege.be) OrcID <https://orcid.org/0000-0001-5274-822X>

# Results

## Literature search

The electronic search identified 769 references and our handsearch of reference lists resulted in the addition of the seminal study by Stall and colleague[[1](#ref-Stall2003)] . After duplicates removal, 277 records were left to be screened for inclusion.

After screening the title and abstract, 109 records were excluded. The two main reasons for exclusion at this stage were that MSM were not the main study population (n=46) and that syndemic was not the main focus of the paper (n=34). 29 studies were excluded because the type of publication did not meet our inclusion criteria.

The full texts of the 168 remaining references were obtained and read; 59 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 was aggregated with data from another population (n=9), 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)

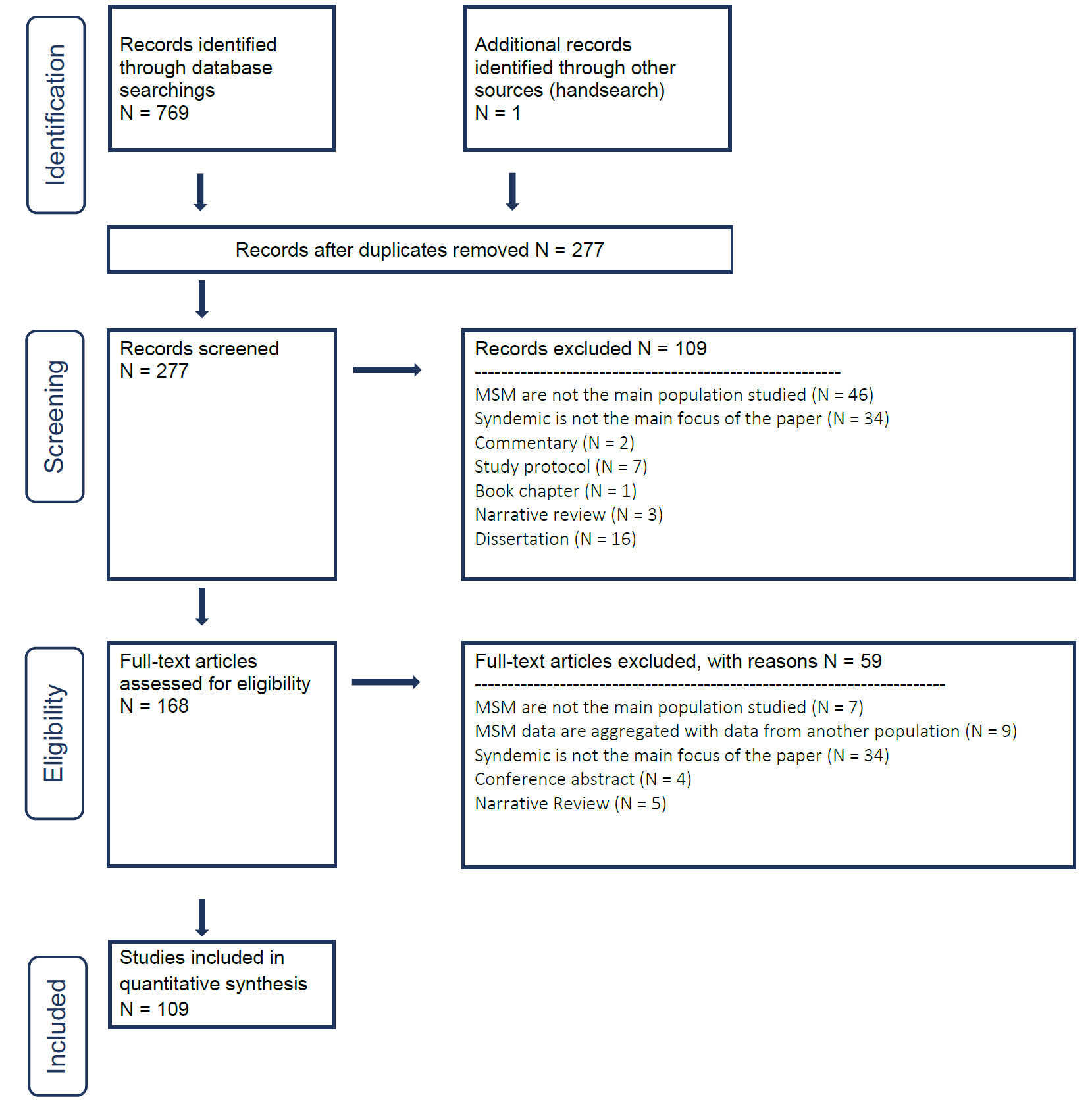


Figure 1: PRISMA flowchart of the search strategy

## 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 papers published annually from 2013 onward as illustrated in Figure [2](#PlotYear). There is also an increase in the diversity of the studies, both in the type of design used and the continents where the studies were conducted.

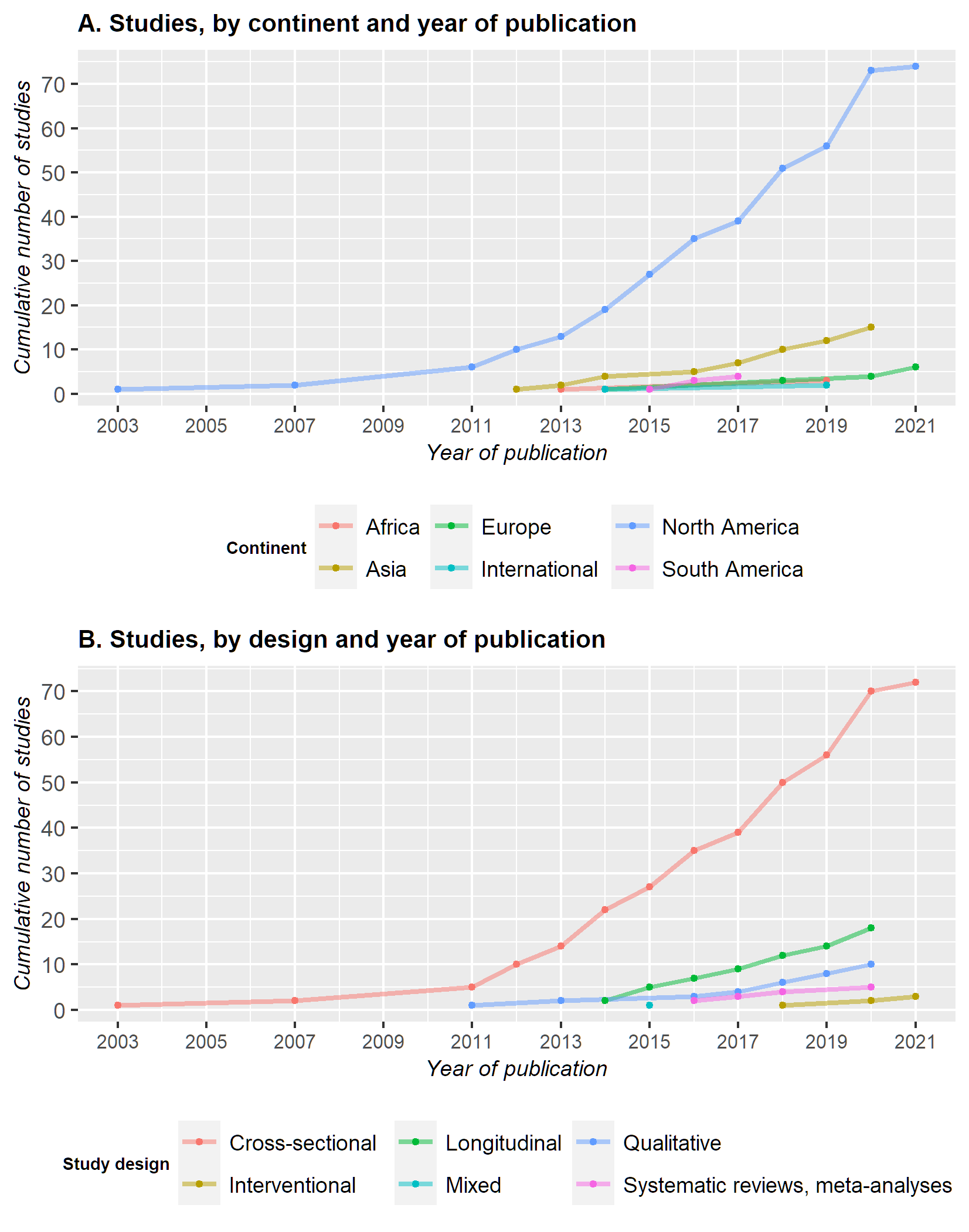


Figure 2: Plot of the cumulative number of studies published yearly

However, despite the emerging diversity, the vast majority of studies are conducted in North America (N = 74), with a large predominance of studies in the United States of America (N= 62). The majority of the remaining studies were then located in Asia (N = 15) or in Europe (N = 6). South America and Africa were the least represented continents, with only 4 and 3 studies respectively.

In terms of design, a similar pattern appears, with most of the studies employing a cross-sectional design (N = 72). The number of longitudinal studies grew steadily since 2014 and represents 0.1651376 papers to this day. Qualitative studies are under-represented, with only 10 papers. Of note, we only identified 1 mixed design[[2](#ref-buttram2015)] ; this study employed a cross-sectional design for the quantitative part and in-depth interviews analyzed through grounded theory for the qualitative part. The first systematic reviews and meta-analyses were published, in 2016, while the first interventional studies were published in 2018.

Finally, the median sample size of the studies was 450 (range : 15 - 24 274) and the mean age of the participants, when reported ranged from 16 to 58.

### Subpopulations studied

Fewer than half of the studies (N = 48 ) focus on a subpopulation of MSM. In this review, we identified 6 kind of MSM subpopulations studied in syndemic literature : (a) young MSM and older MSM ; (b) MSM from a racial/ethnic minority ; (c) MSM living with HIV ; (d) MSM engaged in sex work ; (e) Men who have Sex with Men and Women (MSMW) ; and (f) transgender MSM.

Among studies focusing on a specific age group, 12 studies focus on young adults, 2 studies focus on older MSM[[3](#ref-zepf2020),[4](#ref-Halkitis2012)] and 1 study focuses on adolescents[[5](#ref-Perry)]. Of note, the two studies on older MSM are both entirely composed of a sample of older MSM living with HIV.

Black MSM (BMSM) are the most studied MSM from a racial/ethnic minority (N= 14) but studies focusing on them still represent only 13% of our sample. Among these studies, 2 studies are composed of young BMSM[[6](#ref-Maiorana),[7](#ref-Reed2016)] and 1 study focuses on Black MSM engaged in sex work[[8](#ref-chandler2020)].  
7 studies focus on Latino MSM (LMSM) and 1 of these studies focus on Latino MSMW[[9](#ref-Munoz-Laboy2018)]. Furthermore, 1 study focus on both BMSM and LMSM[[10](#ref-cassels2020)].

Concerning the serologic status of MSM in syndemic literature, 13 studies are entirely comprised of a sample of MSM living with HIV. Apart from the aforementioned studies on older MSM living with HIV, 2 studies focus on young MSM living with HIV[[11](#ref-Lyons2013),[12](#ref-Bruce2011)] . Notably, we identified no studies conducted on racial minority MSM living with HIV.

Finally, the least represented subpopulation of MSM in this review are MSMW (N = 2), MSM engaged in sex work (N = 2) and transgender MSM (N = 1). Strikingly, transgender MSM, in addition to being the focus of only one study[[13](#ref-Reisner2016a)] are, by design, excluded from every other study whereas other MSM subpopulation are at least partially represented in most of the samples.

Figure [3](#PlotPop) gives a visual representation of MSM subpopulation’s representation in the studies included in this paper.

In order to have the most comprehensive knowledge of the representation of MSM subpopulations in syndemic literature, we also took into account studies who did not focus on any subpopulation in particular but who presented disaggregated data and analyses for one or more MSM subpopulation.  
8 studies presented such data : 1 for Black MSMW[[14](#ref-dyer2020)], 4 for MSMW[[15](#ref-branstrom)–[18](#ref-ferlatte2018)], 2 for MSM living with HIV[[19](#ref-Kurtz2012),[20](#ref-ng2020)] and 1 for Latino and Black MSM[[21](#ref-Mustanski2017)].

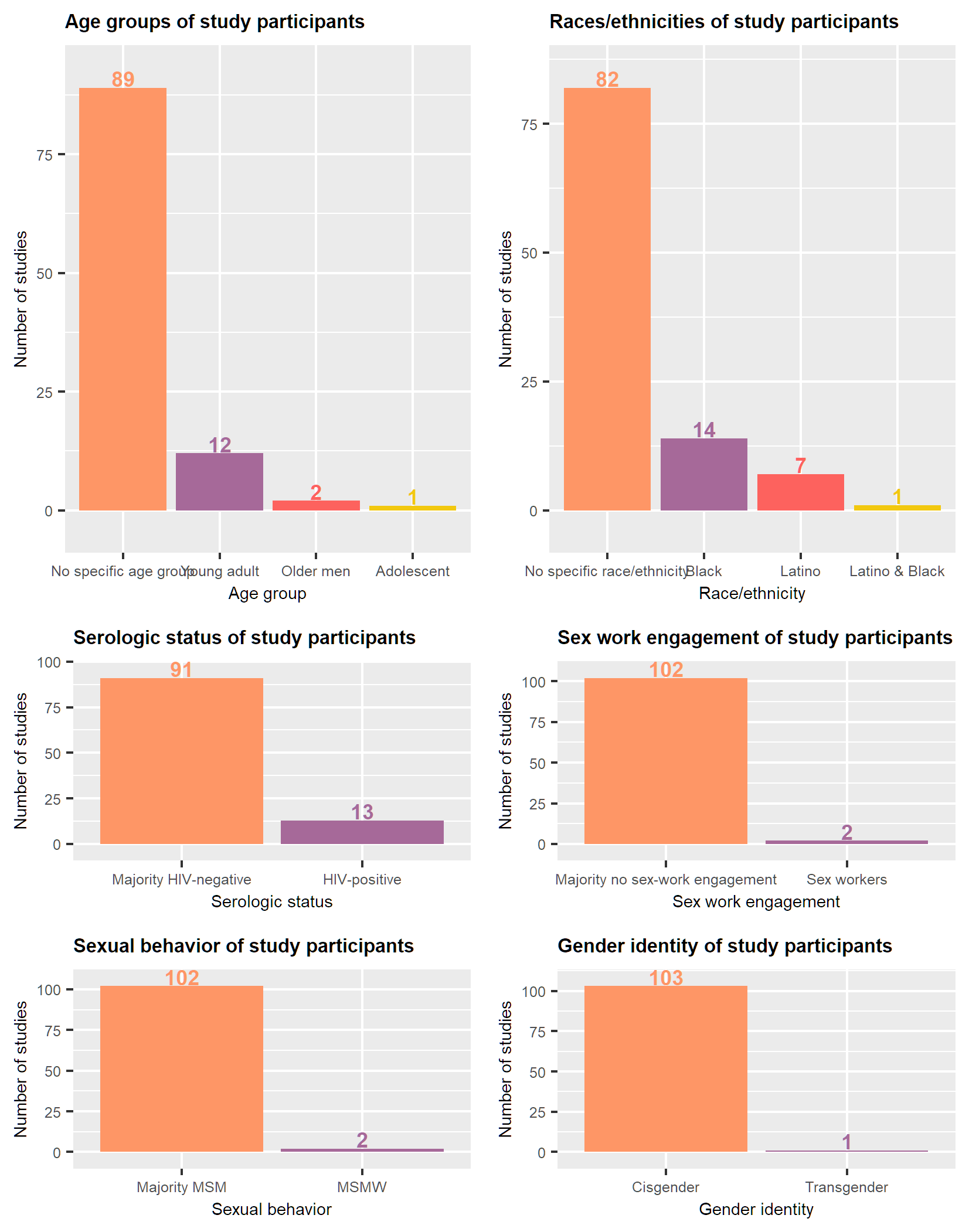


Figure 3: Number of studies focusing on a MSM subpopulation

### Syndemic conditions and their measurement

We identified 46 different syndemic conditions in the 94 quantitative studies we included : depression or depressive symptoms (N = 76), intimate partner violence [IPV] (N = 45), substance use (N = 43), childhood sexual abuse [CSA] (N = 34), polysubstance use (N = 26) , binge drinking (N = 22), sexual compulsivity (N = 19), alcohol use disorder [AUD] (N = 18), suicidal thoughts and/or attempts (N = 16), sexual risk behaviors (N = 15), experiences of violence (N = 15), anxiety (N = 14), substance use disorder [SUD] (N = 13), alcohol use (N = 12), discrimination (N = 10), post-traumatic stress disorder [PTSD] (N = 34), chemsex (N = 7), loneliness (N = 6), incarceration (N = 5), unstable housing (N = 5), tobacco use (N = 5), general mental distress (N = 5), low social support (N = 4), low self-esteem (N = 4), internalised homophobia (N = 3), exchange sex (N = 3), sexually transmitted infections [STI] (N = 3), childhood abuse (N = 3), intravenous drug use [IDU] (N = 2), poverty (N = 2), unemployment (N = 2), poor healthcare access (N = 2), involuntary subordination (N = 2), HIV diagnosis (N = 2), hostility (N = 2), stress (N = 2), experience of trauma (N = 2), school bullying (N = 1), sleep disturbance (N = 1), cognitive escape (N = 1), attention deficit hyperactivity disorder [ADHD] (N = 1), impulsivity (N = 1), hypersexuality (N = 1), alexithymia (N = 1), poor physical health (N = 1) and frequenting gay social venues (N = 1).

We chose to distinguish alcohol use disorder, binge drinking and alcohol use instead of merging them in a broad “alcohol-related syndemic condition”. Some authors also considered “heavy drinking”[[22](#ref-Martinez2016a),[23](#ref-martinez2020)] or “heavy alcohol use”[[24](#ref-Mimiaga2015b)] but we chose to aggregate these conditions under “binge drinking” for clarity. Similarly, we distinguished substance use, substance use disorder, intravenous drug use, polysubstance use, marijuana use, tobacco use and chemsex since they differ in potential harm and context of use.

Despite the important number of syndemic conditions studied in the literature, the impact of the seminal study by Stall et al.[[1](#ref-Stall2003)] is striking as the conditions in this paper (depression, IPV, CSA and polysubstance use) are among the five most studied conditions in the field. Furthermore, 91% 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.

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 are drawn between two nodes when two conditions are studied in the same research paper. Furthermore, edges between nodes are thicker as the two conditions are frequently studied together.

In this graph, we divided each conditions into 4 categories : mental health (e.g. depression, anxiety, PTSD), social conditions (e.g. substance use, loneliness), structural conditions (e.g. unemployment, healthcare access) and physical health (e.g. STI, HIV) . When viewing this graph, it is readily apparent that structural syndemic conditions and physical health-related syndemic conditions are way less central than social syndemic conditions and mental health-related syndemic conditions.

Regarding the edges of the network, we identified 337 pairs of syndemic conditions. However, nearly half of these pairs of conditions (N = 157) 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 = 33), depression and CSA (N = 29), depression and polysubstance use (N = 24) and IPV and CSA (N = 24).

We also computed centrality indices for this network, namely degree centrality, the sum of weight in the network, closeness centrality, the inverse of the total length of the paths from a node to all other nodes, and betweenness, the number of shortest path passing through a node[[25](#ref-opsahl2010)].  
Because the weight of the nodes in this network corresponds to the number of studies in which the syndemic conditions appear, degree centrality of each node does is nearly perfectly correlated to the number of studies in which the syndemic condition was studied (r(44) = 0.99, p<0.01).  
Closeness centrality and betweenness centrality are also strongly correlated to the number of studies (r(44) = 0.8, p<0.01 and r(44) = 0.76, p<0.01 respectively). Interestingly, the betweenness centrality of unstable housing is notably high given the low number of studies taking this syndemic condition into account (N = 5). Betweenness centrality can be seen as the extent of brokerage a node can exert on a network.[[26](#ref-zweig2016)] Moreover, the three structural syndemic conditions “unstable housing”, “incarceration” and “poverty” are mostly connected between each others. In other words, in syndemic literature, unstable housing acts as a bridge, notably between the two aforementioned structural syndemic conditions and the rest of the syndemic conditions. Indeed, unstable housing as been studied alongside 15 other syndemic conditions : depression, substance use, IPV, binge drinking, sexual compulsivity, IDU, CSA, polysubstance use, incarceration, poverty, unemployment, discrimination, poor healthcare access, alcohol use and violence.

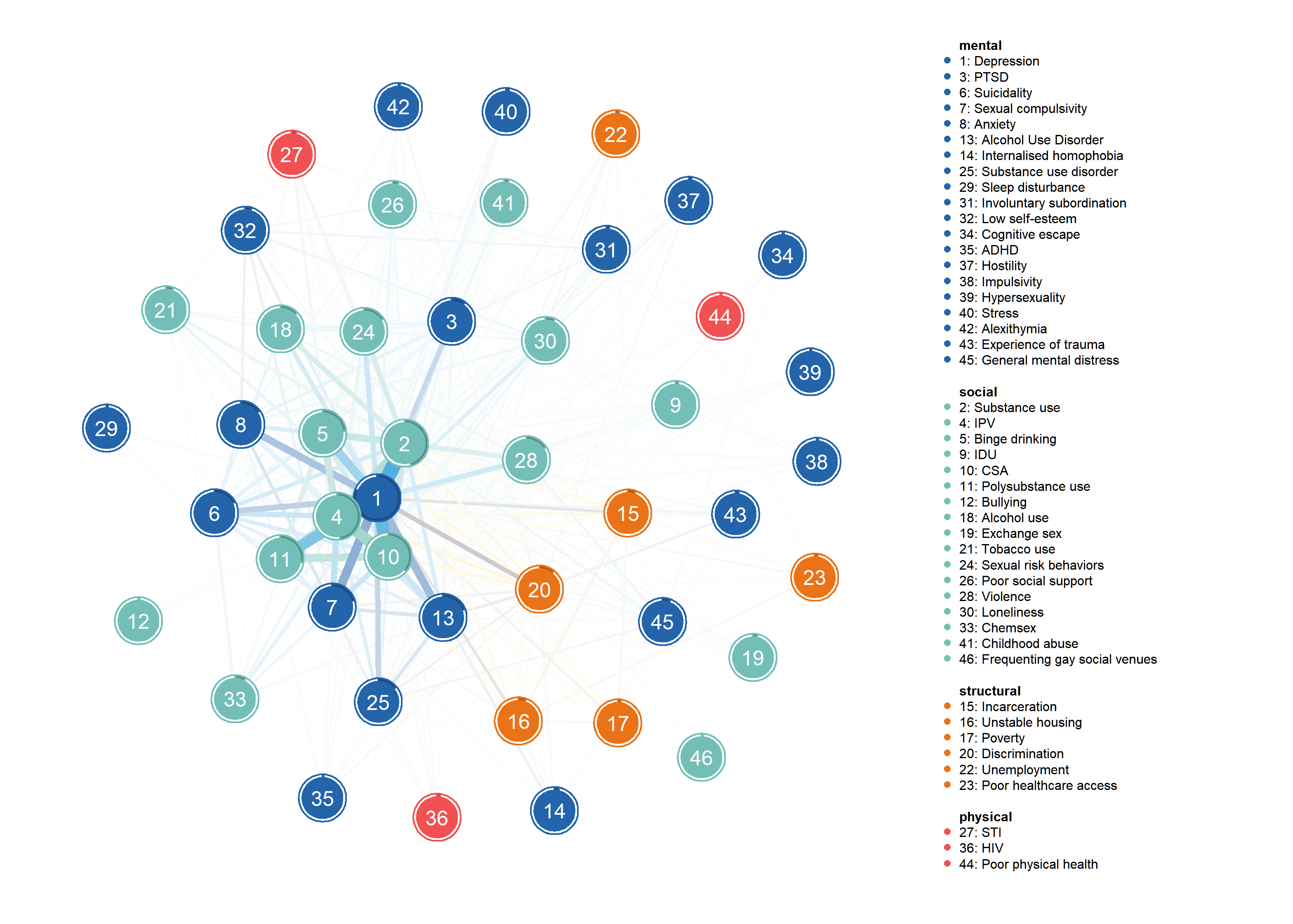


Figure 4: Network of the syndemic conditions studied in quantitative research. The centrality of the nodes gives an indication on the importance of the condition in the literature, the most studied conditions being the most central. Moreover, each node is circled by a pie chart of their frequency in the review. The thickness of the edges linking two nodes depends on the number of studies in which the two conditions were studied together.

The other part of our research question was to examine the way the syndemic conditions were studied in the literature. For the most often studied syndemic conditions, we found an important variability in their measurement. Different authors used different scales or criteria and, even when the same scale or criteria was used, the cutoff or reference period differed among studies. For the sake of brevity, we will not provide a detailed description of the measurement method of the syndemic conditions represented in less than 10% of our studies sample.

For depression, 20 different scales or criteria were used among the 76 studies in which this condition was studied.  
66 studies used scales while 10 studies used criteria to assess the presence of depression or depressive symptoms among the participants. The most used scales were the full Center for Epidemiologic Studies-Depression scale [CESD] (N = 24) and the 10-items version of this scale [CESD-10] (N=10), the 9-items version of the Patient Health Questionnaire [PHQ-9] (N=8) 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 was not used, the most frequent criteria to assess the presence of depression was the participant being on medication for depression in the past 12 months (N = 4).  
Table S1 summarizes every scales, criteria and cutoff used in the measurement of depression as well as the references of the studies.

For IPV, 5 types of intimate partner violence were identified : physical violence (N = 36), sexual violence (N = 21), psychological violence (N = 23), gay-related violence (e.g. threats of revealing the partner’s sexual orientation ; N = 3) and HIV-related violence (e.g. threats of disclosing the partner’s serologic status ; N = 1). Reference period varied from past month to lifetime.  
Furthermore, 7 studies used a scale to assess the presence of IPV : the HITS scale (N = 3) the Revised Conflict Tactics Scale [CTS2] (N= 3) and a scale developed by the authors of the study, assessing physical and psychological violence[[27](#ref-Yu2013)].  
Table S2 summarizes every combination of IPV, reference periods, scales and cutoff used as well as the references of the studies.

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 was stimulants (i.e. cocaine/crack, amphetamines ; N = 37), followed by depressants (i.e. GHB/GBL, benzodiazepines without prescriptions ; (N = 19), opioids (i.e. opioids misuse and ecstasy ; N = 19), marijuana (N = 17), ecstasy /MDMA (N = 17), hallucinogens (i.e. ketamine, psilocybine, phencyclidine ; N = 17), inhalants (nitrous oxyde, Popper ; N = 13) and new psychoactive substances (i.e. synthetic cannabinoids, cathinones ; N = 3).  
Reference period ranged from past month to lifetime.  
Table S3 summarizes every class of substances screened and reference period as well as the references of the studies.

For CSA, we identified 13 different definitions and 3 scales among the 34 studies. The various definitions differed on the age at which the sexual intercourse occurred to be qualified as childhood sexual abuse, the age gap between the victim and the perpetrator and the need for the sexual intercourse to be unwanted. The most frequent definition was Finkelhor’s definition[[28](#ref-finkelhor1994)] : any sexual experience before 13 years old with someone at least 5 years older or any sexual experience between 13 and 17 years old with someone at least 10 years older (N = 7).  
Table S4 summarizes every definition and scales as well as the references of the studies.

For polysubstance use, 17 studies considered there were polysubstance when 3 or more class of substance use were used while 9 studies defined polysubstance use as more than one class of substance use. Moreover, 4 studies excluded marijuana from the class of substances screened and 1 study excluded stimulants, because stimulants were already screened in another syndemic condition.  
Table S5 summarizes every definition of polysubstance use and the references of the studies.

For binge drinking, we identified 6 different thresholds for binge drinking, differing on the number and frequency of binge drinking episodes. The threshold ranged from one episode in the past 12 months to more than one episode per week, every week in the past 12 months.  
Table S6 summarizes every definition and reference period used as well as the references of the studies.

Measurement of sexual compulsivity was surprisingly standardized, compared to the rest of the most frequently studied syndemic conditions. Nearly every study used the Kalichman’s Sexual Compulsivity Scale, with cutoff ranging from 20 to 26, except for two studies using the Compulsive Sexual Behavior Inventory[[29](#ref-Herrick2013),[30](#ref-Dyer2012)] and one study using a scale devised by the authors[[31](#ref-Wang2017)].

For AUD, we identified 4 different definitions. 8 studies used the full Alcohol Use Disorder Identification Test (AUDIT-10),[[32](#ref-tomori2018)–[39](#ref-scheer2021)] 4 studies used the 3-items version of this screening test (AUDIT-C),[[5](#ref-Perry),[40](#ref-Chakrapania)–[42](#ref-sullivan2020)] 5 studies used the CAGE questionnaire[[43](#ref-Zhang2019)–[47](#ref-Safren2018)] and one study used clinical diagnosis based on the DSM-IV criteria[[21](#ref-Mustanski2017)].

Regarding suicide, 6 studies considered only suicidal thoughts[[21](#ref-Mustanski2017),[39](#ref-scheer2021),[44](#ref-Biello2016),[46](#ref-Mimiaga2015),[48](#ref-lee2020),[49](#ref-Halkitis2015)] , 5 studies considered both suicidal thoughts and suicide attempts[[18](#ref-ferlatte2018),[50](#ref-McDaid2019a)–[53](#ref-Halkitis2013)] and 3 studies considered only suicide attempts[[54](#ref-ocleirigh2018)–[56](#ref-Pantalone2018)] . Furthermore, one study used the Positive and Negative Suicide Ideation scale (PANSI)[[57](#ref-oginni2019)] and one study used the Suicide Behaviors Questionnaire-Revised (SBQ-R)[[20](#ref-ng2020)].

A number of behaviors have been used to define sexual risk behaviors as a syndemic condition. The most widely used of these criteria is condomless anal sex (N = 11)[[8](#ref-chandler2020),[16](#ref-Mustanski2014),[34](#ref-semple2017),[49](#ref-Halkitis2015),[58](#ref-Wu2018)–[64](#ref-blondeel2021)], followed by the number of partners (N = 7)[[8](#ref-chandler2020),[16](#ref-Mustanski2014),[34](#ref-semple2017),[58](#ref-Wu2018)–[60](#ref-Li2016),[64](#ref-blondeel2021)] . The condomless anal sex criteria has been refined in three studies, two of them taking into account the type of partner (regular versus casual)[[65](#ref-Friedman2015),[66](#ref-friedman2016)] and one, the serologic status of both partners[[67](#ref-Ferlatte2015)].  
Other criteria such as condomless oral sex[[49](#ref-Halkitis2015),[62](#ref-Halkitis2013a),[63](#ref-Storholm2011)] , condomless vaginal sex[[61](#ref-eaton2013)], STI diagnosis[[8](#ref-chandler2020)], engagement in sex work[[8](#ref-chandler2020)] and sexual intercourse with a HIV positive partner[[8](#ref-chandler2020)] have been used. Finally, one study used the Kalichman’s Sexual Sensation Seeking Scale to assess the propensity of participants to engage in novel or risky sexual stimulation.[[68](#ref-Wim2014a)]

For violence 11 studies looked at sexual violence, 10, at physical violence and 5 at psychological violence. One Indian study also took into account sexual and physical harassment by the police[[69](#ref-Chakrapani2017)].  
Table S7 summarizes every combination of violence studied, the reference period as well as the reference of the studies.

Several types of anxiety disorder were studied : generalized anxiety disorder (N = 7), social phobia (N = 5) and panic disorder (N = 3). The type of anxiety disorder screened was not specified in 5 studies.  
8 different criteria were used to assess the presence of an anxiety disorder among the 14 studies considering anxiety as a syndemic condition. The most frequent criteria was a score equal or greater than 10 on the 7-items version of the Generalized Anxiety Disorder screening test (GAD-7 ; N = 4).  
Table S8 summarizes every combination of anxiety disorder studied, the criteria or scale used and the cutoff or reference period, as appropriate, as well as the references of the studies.

SUD was screened through a clinical diagnosis based on the DSM-IV[[2](#ref-buttram2015),[19](#ref-Kurtz2012),[70](#ref-Batchelder2019),[71](#ref-carrico2018)], mention of substance abuse in the electronic medical record[[72](#ref-Byg2016)] or the participant thinking he should reduce his substance use[[73](#ref-Ferlatte2014)]. Several screening test were also used : the Drug Use Disorder Identification Test (DUDIT)[[33](#ref-Morrison2018a),[36](#ref-tan2016),[37](#ref-achterbergh2021)], the Texas Christian University Drug Screen (TCUDS)[[43](#ref-Zhang2019),[74](#ref-OLeary2014b)], the Mini International Neuropsychiatric Interview (MINI)[[47](#ref-Safren2018)] and the 10-items Drug Abuse Screening Test (DAST-10)[[75](#ref-chuang2018)].

Outside of binge drinking and alcohol use disorder, which represents two distinct syndemic conditions, we aggregated three aspects of alcohol use studied in syndemic literature to form a generic “alcohol use” syndemic condition : alcohol consumption[[27](#ref-Yu2013),[49](#ref-Halkitis2015),[53](#ref-Halkitis2013),[57](#ref-oginni2019)], alcohol use until intoxication[[4](#ref-Halkitis2012),[52](#ref-Guadamuz2014),[63](#ref-Storholm2011)] and early alcohol use[[76](#ref-Hirshfield2015)].

Finally, for discrimination, there were as many criteria as there were research papers studying this condition. Most of the studies only considered discrimination based on sexual orientation, except for two studies examining racist discrimination[[14](#ref-dyer2020),[77](#ref-turpin2020)], one study examining HIV-based discrimination[[75](#ref-chuang2018)] and one study who did not distinguish discrimination based on sexuality, race/ethnicity or any other factor[[22](#ref-Martinez2016a)].

### Outcomes and their measurement

### Interventions

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

### Statistics used to show an interaction

### Proposed mechanisms of interaction

## What were the key findings of these studies?

# Discussion

# Conclusion

# References

1 Stall R, Mills TC, Williamson J, *et al.* 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* 2003;**93**:939–42. doi:[10.2105/AJPH.93.6.939](https://doi.org/10.2105/AJPH.93.6.939)

2 Buttram ME, Kurtz SP. 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* 2015;**2**:1–0. doi:[10.1007/s40615-014-0042-2](https://doi.org/10.1007/s40615-014-0042-2)

3 Zepf R, Greene M, Hessol NA, *et al.* Syndemic conditions and medication adherence in older men living with HIV who have sex with men. *AIDS Care* 2020;**32**:1610–6. doi:[10.1080/09540121.2020.1772954](https://doi.org/10.1080/09540121.2020.1772954)

4 Halkitis PN, Kupprat SA, Hampton MB, *et al.* 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* 2012;**36**:365–86. doi:[10.1111/napa.12009](https://doi.org/10.1111/napa.12009)

5 Perry NS, Nelson KM, Carey MP. Diversity of psychosocial syndemic indicators and associations with sexual behavior with male and female partners among early adolescent sexual minority males. *LGBT Health* 2019;**6**:386–92. doi:[10.1089/lgbt.2019.0113](https://doi.org/10.1089/lgbt.2019.0113)

6 Maiorana A, Kegeles SM, Brown S, *et al.* 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* Published Online First: 2020. doi:[10.1080/13691058.2019.1688395](https://doi.org/10.1080/13691058.2019.1688395)

7 Reed SJ, Miller RL. Thriving and Adapting: Resilience, Sense of Community, and Syndemics among Young Black Gay and Bisexual Men. *American journal of community psychology* 2016;**57**:129–43. doi:[10.1002/ajcp.12028](https://doi.org/10.1002/ajcp.12028)

8 Chandler CJ, Meunier E, Eaton LA, *et al.* 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* Published Online First: 2020. doi:[10.1007/s10508-020-01828-2](https://doi.org/10.1007/s10508-020-01828-2)

9 Muñoz-Laboy M, Martinez O, Levine EC, *et al.* Syndemic Conditions Reinforcing Disparities in HIV and Other STIs in an Urban Sample of Behaviorally Bisexual Latino Men. *Journal of immigrant and minority health* 2018;**20**:497–501. doi:[10.1007/s10903-017-0568-6](https://doi.org/10.1007/s10903-017-0568-6)

10 Cassels S, Meltzer D, Loustalot C, *et al.* 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* 2020;**97**:609–22. doi:[10.1007/s11524-020-00481-3](https://doi.org/10.1007/s11524-020-00481-3)

11 Lyons T, Johnson AK, Garofalo R. "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* 2013;**12**:368–83. doi:[10.1080/15381501.2013.816211](https://doi.org/10.1080/15381501.2013.816211)

12 Bruce D, Harper GW, Interventions AMTN for H. 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* 2011;**38**:367–78. doi:[10.1177/1090198110375911](https://doi.org/10.1177/1090198110375911)

13 Reisner SL, White Hughto JM, Pardee D, *et al.* 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* 2016;**27**:955–66. doi:[10.1177/0956462415602418](https://doi.org/10.1177/0956462415602418)

14 Dyer TV, Turpin RE, Stall R, *et al.* 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* 2020;**47**:571–9. doi:[10.1097/OLQ.0000000000001208](https://doi.org/10.1097/OLQ.0000000000001208)

15 Branstrom R, Pachankis JE. 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*;403. doi:[10.1007/s00127-018-1491-4](https://doi.org/10.1007/s00127-018-1491-4)

16 Mustanski B, Andrews R, Herrick A, *et al.* A syndemic of psychosocial health disparities and associations with risk for attempting suicide among young sexual minority men. *American Journal of Public Health* 2014;**104**:287–94. doi:[10.2105/AJPH.2013.301744](https://doi.org/10.2105/AJPH.2013.301744)

17 Friedman MR, Kurtz SP, Buttram ME, *et al.* HIV risk among substance-using men who have sex with men and women (MSMW): Findings from south florida. *AIDS and Behavior* 2014;111–9. doi:[10.1007/s10461-013-0495-z](https://doi.org/10.1007/s10461-013-0495-z)

18 Ferlatte O, Salway T, Trussler T, *et al.* 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* 2018;**28**:509–21. doi:[10.1080/09581596.2017.1380298](https://doi.org/10.1080/09581596.2017.1380298)

19 Kurtz SP, Buttram ME, Surratt HL, *et al.* Resilience, syndemic factors, and serosorting behaviors among HIV-positive and HIV-negative substance-using MSM. *AIDS Education and Prevention* 2012;**24**:193–205. doi:[10.1521/aeap.2012.24.3.193](https://doi.org/10.1521/aeap.2012.24.3.193)

20 Ng RX, Guadamuz TE, Akbar M, *et al.* Association of co-occurring psychosocial health conditions and HIV infection among MSM in malaysia: Implication of a syndemic effect. *International Journal of STD & AIDS* 2020;**31**:568–78. doi:[10.1177/0956462420913444](https://doi.org/10.1177/0956462420913444)

21 Mustanski B, Phillips G, Ryan DT, *et al.* 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* 2017;**21**:845–57. doi:[10.1007/s10461-016-1607-3](https://doi.org/10.1007/s10461-016-1607-3)

22 Martinez O, Arreola S, Wu E, *et al.* 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* 2016;**166**:258–62. doi:[10.1016/j.drugalcdep.2016.06.033](https://doi.org/10.1016/j.drugalcdep.2016.06.033)

23 Martinez O, Brady KA, Levine E, *et al.* 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* 2020;**13**:217–36. doi:[10.15257/ehquidad.2020.0009](https://doi.org/10.15257/ehquidad.2020.0009)

24 Mimiaga MJ, O’Cleirigh C, Biello KB, *et al.* 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* 2015;**68**:329–36. doi:[10.1097/QAI.0000000000000475](https://doi.org/10.1097/QAI.0000000000000475)

25 Opsahl T, Agneessens F, Skvoretz J. Node centrality in weighted networks: Generalizing degree and shortest paths. *Social Networks* 2010;**32**:245–51. doi:[10.1016/j.socnet.2010.03.006](https://doi.org/10.1016/j.socnet.2010.03.006)

26 Zweig KA. Centrality Indices. Vienna: : Springer Vienna 2016. 243–76.<http://link.springer.com/10.1007/978-3-7091-0741-6_9>

27 Yu F, Nehl EJ, Zheng T, *et al.* A syndemic including cigarette smoking and sexual risk behaviors among a sample of MSM in Shanghai, China. *Drug and alcohol dependence* 2013;**132**:265–70. doi:[10.1016/j.drugalcdep.2013.02.016](https://doi.org/10.1016/j.drugalcdep.2013.02.016)

28 Finkelhor D. Current Information on the Scope and Nature of Child Sexual Abuse. *The Future of Children* 1994;**4**:31. doi:[10.2307/1602522](https://doi.org/10.2307/1602522)

29 Herrick AL, Lim SH, Plankey MW, *et al.* Adversity and syndemic production among men participating in the multicenter AIDS cohort study: a life-course approach. *American Journal of Public Health* 2013;**103**:79–85. doi:[10.2105/AJPH.2012.300810](https://doi.org/10.2105/AJPH.2012.300810)

30 Dyer TP, Shoptaw S, Guadamuz TE, *et al.* Application of syndemic theory to black men who have sex with men in the Multicenter AIDS Cohort Study. *Journal of Urban Health* 2012;**89**:697–708. doi:[10.1007/s11524-012-9674-x](https://doi.org/10.1007/s11524-012-9674-x)

31 Wang Y, Wang Z, Jia M, *et al.* Association between a syndemic of psychosocial problems and unprotected anal intercourse among men who have sex with men in Shanghai, China. *BMC infectious diseases* 2017;**17**:46. doi:[10.1186/s12879-016-2132-8](https://doi.org/10.1186/s12879-016-2132-8)

32 Tomori C, McFall AM, Solomon SS, *et al.* Is there synergy in syndemics? Psychosocial conditions and sexual risk among men who have sex with men in India. *Social Science & Medicine* 2018;**206**:110–6. doi:[10.1016/j.socscimed.2018.03.032](https://doi.org/10.1016/j.socscimed.2018.03.032)

33 Morrison SA, Yoong D, Hart TA, *et al.* High prevalence of syndemic health problems in patients seeking post-exposure prophylaxis for sexual exposures to HIV. *PLOS One* 2018;**13**:e0197998. doi:[10.1371/journal.pone.0197998](https://doi.org/10.1371/journal.pone.0197998)

34 Semple SJ, Stockman JK, Goodman-Meza D, *et al.* Correlates of sexual violence among men who have sex with men in tijuana, mexico. *Archives of Sexual Behavior* 2017;**46**:1011–23. doi:[10.1007/s10508-016-0747-x](https://doi.org/10.1007/s10508-016-0747-x)

35 Biello KB, Colby D, Closson E, *et al.* The syndemic condition of psychosocial problems and HIV risk among male sex workers in Ho Chi Minh City, Vietnam. *AIDS and Behavior* 2014;**18**:1264–71. doi:[10.1007/s10461-013-0632-8](https://doi.org/10.1007/s10461-013-0632-8)

36 Tan DHS, Leon-Carlyle M, Mills R, *et al.* Self-administered screening for syndemic mental health problems should be routinely implemented among MSM PrEP users. *Journal of Gay & Lesbian Mental Health* 2016;**20**:13–20. doi:[10.1080/19359705.2015.1105765](https://doi.org/10.1080/19359705.2015.1105765)

37 Achterbergh RCA, van Rooijen MS, van den Brink W, *et al.* 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* 2021;**97**:11–7. doi:[10.1136/sextrans-2020-054438](https://doi.org/10.1136/sextrans-2020-054438)

38 Shuper PA, Joharchi N, Bogoch II, *et al.* 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* 2020;**20**:1782. doi:[10.1186/s12889-020-09883-z](https://doi.org/10.1186/s12889-020-09883-z)

39 Scheer JR, Clark KA, Maiolatesi AJ, *et al.* Syndemic profiles and sexual minority men’s hiv-risk behavior: A latent class analysis. *Archives of Sexual Behavior* Published Online First: 2021. doi:[10.1007/s10508-020-01850-4](https://doi.org/10.1007/s10508-020-01850-4)

40 Chakrapani V, Kaur M, Tsai AC, *et al.* 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* Published Online First: 2020. doi:[10.1016/j.socscimed.2020.112817](https://doi.org/10.1016/j.socscimed.2020.112817)

41 Ogunbajo A, Oke T, Jin H, *et al.* A syndemic of psychosocial health problems is associated with increased HIV sexual risk among nigerian gay, bisexual, and other men who have sex with men (GBMSM). *AIDS Care* 2019;**32**:337–42. doi:[10.1080/09540121.2019.1678722](https://doi.org/10.1080/09540121.2019.1678722)

42 Sullivan MC, Eaton LA. Intersecting barriers to prep awareness and uptake in black men who have sex with men in atlanta, ga: A syndemic perspective. *International Journal of Behavioral Medicine* Published Online First: 2020. doi:[10.1007/s12529-020-09925-1](https://doi.org/10.1007/s12529-020-09925-1)

43 Zhang J, O’Leary A, Jemmott 3rd JB, *et al.* Syndemic conditions predict lower levels of physical activity among African American men who have sex with men: A prospective survey study. *PLOS One* 2019;**14**:e0213439–9. doi:[10.1371/journal.pone.0213439](https://doi.org/10.1371/journal.pone.0213439)

44 Biello KB, Oldenburg CE, Safren SA, *et al.* 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* 2016;**28 Suppl 1**:84–91. doi:[10.1080/09540121.2016.1146205](https://doi.org/10.1080/09540121.2016.1146205)

45 O’Leary D. The syndemic of AIDS and STDS among MSM. *The Linacre quarterly* 2014;**81**:12–37. doi:[10.1179/2050854913Y.0000000015](https://doi.org/10.1179/2050854913Y.0000000015)

46 Mimiaga MJ, Biello KB, Robertson AM, *et al.* High prevalence of multiple syndemic conditions associated with sexual risk behavior and HIV infection among a large sample of Spanish- and Portuguese-speaking men who have sex with men in Latin America. *Archives of Sexual Behavior* 2015;**44**:1869–78. doi:[10.1007/s10508-015-0488-2](https://doi.org/10.1007/s10508-015-0488-2)

47 Safren SA, Blashill AJ, Lee JS, *et al.* Condom-use self-efficacy as a mediator between syndemics and condomless sex in men who have sex with men (MSM). *Health Psychology* 2018;**37**:820–7. doi:[10.1037/hea0000617](https://doi.org/10.1037/hea0000617)

48 Lee JS, Bainter SA, Carrico AW, *et al.* 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* Published Online First: 2020. doi:[10.1007/s10865-020-00148-z](https://doi.org/10.1007/s10865-020-00148-z)

49 Halkitis PN, Kapadia F, Bub KL, *et al.* A Longitudinal Investigation of Syndemic Conditions Among Young Gay, Bisexual, and Other MSM: The P18 Cohort Study. *AIDS and Behavior* 2015;**19**:970–80. doi:[10.1007/s10461-014-0892-y](https://doi.org/10.1007/s10461-014-0892-y)

50 McDaid LM, Flowers P, Ferlatte O, *et al.* Informing theoretical development of salutogenic, asset-based health improvement to reduce syndemics among gay, bisexual and other men who have sex with men: Empirical evidence from secondary analysis of multi-national, online cross-sectional surveys. *SSM - Population Health* 2019;**10**:100519. doi:[10.1016/j.ssmph.2019.100519](https://doi.org/10.1016/j.ssmph.2019.100519)

51 Ferlatte O, Salway T, Samji H, *et al.* 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* 2018;**45**:163–8. doi:[10.1097/OLQ.0000000000000713](https://doi.org/10.1097/OLQ.0000000000000713)

52 Guadamuz TE, McCarthy K, Wimonsate W, *et al.* Psychosocial health conditions and HIV prevalence and incidence in a cohort of men who have sex with men in bangkok, thailand: Evidence of a syndemic effect. *AIDS and Behavior* 2014;**18**:2089–96. doi:[10.1007/s10461-014-0826-8](https://doi.org/10.1007/s10461-014-0826-8)

53 Halkitis PN, Wolitski RJ, Millett Ga. A holistic approach to addressing HIV infection disparities in gay, bisexual, and other men who have sex with men. *American Psychologist* 2013;**68**:261–73. doi:[10.1037/a0032746](https://doi.org/10.1037/a0032746)

54 O’Cleirigh C, Pantalone DW, Batchelder AW, *et al.* Co-occurring psychosocial problems predict HIV status and increased health care costs and utilization among sexual minority men. *Journal of Behavioral Medicine* 2018;**41**:450–7. doi:[10.1007/s10865-018-9913-z](https://doi.org/10.1007/s10865-018-9913-z)

55 Bränström R, Pachankis JE. 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* 2018;**78**:376–82. doi:[10.1097/QAI.0000000000001697](https://doi.org/10.1097/QAI.0000000000001697)

56 Pantalone DW, Valentine SE, Woodward EN, *et al.* Syndemic Indicators Predict Poor Medication Adherence and Increased Health Care Utilization for Urban HIV-Positive Men Who Have Sex with Men. *Journal of Gay & Lesbian Mental Health* 2018;**22**:71–87. doi:[10.1080/19359705.2017.1389794](https://doi.org/10.1080/19359705.2017.1389794)

57 Oginni OA, Mapayi BM, Afolabi OT, *et al.* Association between risky sexual behavior and a psychosocial syndemic among nigerian men who have sex with men. *Journal of Gay & Lesbian Mental Health* 2019;**23**:168–85. doi:[10.1080/19359705.2018.1552640](https://doi.org/10.1080/19359705.2018.1552640)

58 Wu E. Childhood sexual abuse among Black men who have sex with men: A cornerstone of a syndemic? *PLOS One* 2018;**13**:e0206746–6. doi:[10.1371/journal.pone.0206746](https://doi.org/10.1371/journal.pone.0206746)

59 Beymer MR, Weiss RE, Halkitis PN, *et al.* Disparities within the disparity-determining HIV risk factors among latino gay and bisexual men attending a community-based clinic in los angeles, CA. *Journal of Acquired Immune Deficiency Syndromes* 2016;**73**:237–44. doi:[10.1097/QAI.0000000000001072](https://doi.org/10.1097/QAI.0000000000001072)

60 Li R, Cai Y, Wang Y, *et al.* Psychosocial syndemic associated with increased suicidal ideation among men who have sex with men in Shanghai, China. *Health Psychology* 2016;**35**:148–56. doi:[10.1037/hea0000265](https://doi.org/10.1037/hea0000265)

61 Eaton LA, Pitpitan EV, Kalichman SC, *et al.* Men who report recent male and female sex partners in cape town, south africa: An understudied and underserved population. *Archives of Sexual Behavior* 2013;**42**:1299–308. doi:[10.1007/s10508-013-0077-1](https://doi.org/10.1007/s10508-013-0077-1)

62 Halkitis PN, Moeller RW, Siconolfi DE, *et al.* Measurement model exploring a syndemic in emerging adult gay and bisexual men. *AIDS and Behavior* 2013;**17**:662–73. doi:[10.1007/s10461-012-0273-3](https://doi.org/10.1007/s10461-012-0273-3)

63 Storholm ED, Halkitis PN, Siconolfi DE, *et al.* Cigarette smoking as part of a syndemic among young men who have sex with men ages 13-29 in New York City. *Journal of Urban Health* 2011;**88**:663–76. doi:[10.1007/s11524-011-9563-8](https://doi.org/10.1007/s11524-011-9563-8)

64 Blondeel K, Dias S, Furegato M, *et al.* Sexual behaviour patterns and STI risk: Results of a cluster analysis among men who have sex with men in portugal. *BMJ open* 2021;**11**:e033290. doi:[10.1136/bmjopen-2019-033290](https://doi.org/10.1136/bmjopen-2019-033290)

65 Friedman MR, Stall R, Silvestre AJ, *et al.* Effects of syndemics on HIV viral load and medication adherence in the multicentre AIDS cohort study. *AIDS (London, England)* 2015;**29**:1087–96. doi:[10.1097/QAD.0000000000000657](https://doi.org/10.1097/QAD.0000000000000657)

66 Friedman MR, Coulter RWS, Silvestre AJ, *et al.* Someone to count on: Social support as an effect modifier of viral load suppression in a prospective cohort study. *AIDS care* 2016;**29**:469–80. doi:[10.1080/09540121.2016.1211614](https://doi.org/10.1080/09540121.2016.1211614)

67 Ferlatte O, Dulai J, Hottes TS, *et al.* Suicide related ideation and behavior among Canadian gay and bisexual men: a syndemic analysis. *BMC public health* 2015;**15**:597. doi:[10.1186/s12889-015-1961-5](https://doi.org/10.1186/s12889-015-1961-5)

68 Van den Berghe W, Nöstlinger C, Laga M. Syndemic and other risk factors for unprotected anal intercourse among an online sample of belgian HIV negative men who have sex with men. *AIDS and Behavior* 2014;**18**:50–8. doi:[10.1007/s10461-013-0516-y](https://doi.org/10.1007/s10461-013-0516-y)

69 Chakrapani V, Newman PA, Shunmugam M, *et al.* 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* 2017;**12**:250–65. doi:[10.1080/17441692.2015.1091024](https://doi.org/10.1080/17441692.2015.1091024)

70 Batchelder AW, Choi K, Dale SK, *et al.* Effects of syndemic psychiatric diagnoses on health indicators in men who have sex with men. *Health Psychology* 2019;**38**:509–17. doi:[10.1037/hea0000724](https://doi.org/10.1037/hea0000724)

71 Carrico AW, Rodriguez VJ, Jones DL, *et al.* Short circuit: Disaggregation of adrenocorticotropic hormone and cortisol levels in HIV-positive, methamphetamine-using men who have sex with men. *Human psychopharmacology* 2018;**33**. doi:[10.1002/hup.2645](https://doi.org/10.1002/hup.2645)

72 Byg B, Bazzi AR, Funk D, *et al.* 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* 2016;**41**:1204–11. doi:[10.1007/s10900-016-0202-x](https://doi.org/10.1007/s10900-016-0202-x)

73 Ferlatte O, Hottes TS, Trussler T, *et al.* Evidence of a syndemic among young Canadian gay and bisexual men: uncovering the associations between anti-gay experiences, psychosocial issues, and HIV risk. *AIDS and Behavior* 2014;**18**:1256–63. doi:[10.1007/s10461-013-0639-1](https://doi.org/10.1007/s10461-013-0639-1)

74 O’Leary A, Jemmott 3rd JB, Stevens R, *et al.* Optimism and education buffer the effects of syndemic conditions on HIV status among African American men who have sex with men. *AIDS and Behavior* 2014;**18**:2080–8. doi:[10.1007/s10461-014-0708-0](https://doi.org/10.1007/s10461-014-0708-0)

75 Chuang D-M, Newman PA, Li AT-W. Syndemic factors and HIV infection among men who have sex with men in taiwan. *Journal of HIV/AIDS & Social Services* 2018;**17**:337–52. doi:[10.1080/15381501.2018.1454866](https://doi.org/10.1080/15381501.2018.1454866)

76 Hirshfield S, Schrimshaw EW, Stall RD, *et al.* Drug Use, Sexual Risk, and Syndemic Production Among Men Who Have Sex With Men Who Engage in Group Sexual Encounters. *American Journal of Public Health* 2015;**105**:1849–58. doi:[10.2105/AJPH.2014.302346](https://doi.org/10.2105/AJPH.2014.302346)

77 Turpin RE, Dyer TV, Dangerfield DT2nd, *et al.* Syndemic latent transition analysis in the HPTN 061 cohort: Prospective interactions between trauma, mental health, social support, and substance use. *Drug and alcohol dependence* 2020;**214**. doi:[10.1016/j.drugalcdep.2020.108106](https://doi.org/10.1016/j.drugalcdep.2020.108106)

# Supplementary Materials

Table S1: Summary of the studies including depression or depressive symptoms as a syndemic condition and the criteria used to screen this condition

| **Use of a scale or a criteria** | **Number of studies** | **Scale or criteria used** | **Number of studies** | **Cutoff used** | **References** |
| --- | --- | --- | --- | --- | --- |
| Scale | 66 | CESD | 24 | 16 | **Zhang et al. 2019** |
| **Morrison et al. 2018** |
| **Wang et al. 2017** |
| **Friedman et al. 2016** |
| **Tulloch et al. 2015** |
| **Friedman et al. 2015** |
| **Herrick et al. 2014** |
| **Herrick et al. 2013** |
| **Dyer et al. 2012** |
| **Tan et al. 2016** |
| **Ng et al. 2020** |
| 22 | **Vanden Berghe et al. 2014** |
| 23 | **Wang et al. 2018** |
| **Parsons et al. 2017** |
| **Hart et al. 2017** |
| **Li et al. 2016** |
| **Starks 2014** |
| **Jie et al. 2012** |
| **Parsons et al. 2012** |
| **Stall et al. 2003** |
| 27 | **Carrico et al. 2018** |
| Continuous | **Hugh Klein 2011** |
| **Turpin et al. 2020b** |
| **Dyer et al. 2020** |
| CESD-10 | 10 | 10 | **Chandler et al. 2020a** |
| **Ogunbajo et al. 2019** |
| **Chandler et al. 2020b** |
| **Martinez et al. 2016** |
| **Biello et al. 2016** |
| **Mimiaga et al. 2015a** |
| **Biello et al. 2014** |
| **Shuper et al. 2020** |
| **Chandler et al. 2020c** |
| **Sullivan and Eaton 2020** |
| PHQ-9 | 8 | 10 | **Zepf et al. 2020** |
| **Nostlinger et al. 2020** |
| **Harkness et al. 2019** |
| **Tomori et al. 2018** |
| 15 | **McDaid et al. 2019** |
| 5 | **Chakrapani et al. 2020** |
| **Safren et al. 2018** |
| Having at least 5 positive items in addition to the depressed mood and/or loss of interest items | **Harkness et al. 2018** |
| BDI-II | 5 | 16 | **Halkitis et al. 2012** |
| 17 | **Pitpitan et al. 2016** |
| Continuous | **Semple et al. 2017** |
| **Halkitis et al. 2015** |
| **Halkitis et al. 2013** |
| Depression subscale of the Brief Symptom Inventory | 4 | 0.5 (raw-score) | **Parsons et al. 2015** |
| 0.8 (raw score) | **Muñoz-Laboy et al. 2018** |
| 65 (T-score) | **Starks et al. 2016** |
| Not specified | **Moeller et al. 2011** |
| PHQ-2 | 3 | 3 | **Walters et al. 2020** |
| **Hirshfield et al. 2015** |
| **Santos et al. 2014** |
| PHQ-8 | 3 | 10 | **Blashill et al. 2020** |
| Continuous | **Lee et al. 2020a** |
| **Lee et al. 2020b** |
| HADS | 2 | 10 | **Card et al. 2018** |
| 8 | **Achterbergh et al. 2021** |
| Zung Self Rating Depression Scale | 2 | 0.5 | **Jiang et al. 2020** |
| 40 | **Oginni et al. 2019** |
| BDI-FS | 1 | 7 | **Chakrapani et al. 2017** |
| CESD-12 | 1 | 10 | **Yu et al. 2013** |
| CESD-5 | 1 | 1 | **O'Leary et al. 2014** |
| CESD-SF | 1 | 13 | **Mimiaga et al. 2015b** |
| The Depression Symptom Scale (DSS-9) | | | **Friedman et al. 2014** |
| Criteria | 10 | Being on medication for depression in the last 12 months | | | **Ferlatte et al. 2015** |
| **Brandstrom and Pachankis 2018** |
| **Ferlatte et al. 2018b** |
| Clinical diagnosis based on the DSM-IV | | | **Batchelder et al. 2019** |
| **Mustanski et al. 2017** |
| During the past 12 months having felt so sad or hopeless almost every day for 2 weeks in a row that the respondent stopped doing some usual activities | | | **Turpin et al. 2020a** |
| **Mustanski 2014** |
| Feeling snap and unable to snap out of it for most of the time or being in treatment for depression | | | **Ferlatte et al. 2014** |
| Medical diagnosis of depression in the EMR | | | **Byg et al. 2016** |
| Self-report of a medical diagnosis | | | **Reisner et al. 2016** |

Table S2: Summary of the studies including intimate partner violence as a syndemic condition and the criteria used to screen this condition

| **Use of a scale or a criteria** | **Number of studies** | **Type(s) of violence screened or scale used** | **Number of studies** | **Reference period or cutoff used** | **References** |
| --- | --- | --- | --- | --- | --- |
| Criteria | 38 | physical IPV, sexual IPV, psychological IPV | 12 | Past year | **Oginni et al. 2019** |
| Past 6 months | **Turpin et al. 2020b** |
| Past 5 years | **Biello et al. 2016** |
| **Starks et al. 2016** |
| **Mimiaga et al. 2015a** |
| **Parsons et al. 2015** |
| **Stall et al. 2003** |
| **Achterbergh et al. 2021** |
| Lifetime | **Lee et al. 2020a** |
| **Safren et al. 2018** |
| **Mustanski et al. 2007** |
| **Dyer et al. 2020** |
| physical IPV, psychological IPV | 8 | Past 5 years | **Starks 2014** |
| **Herrick et al. 2013** |
| **Dyer et al. 2012** |
| **Parsons et al. 2012** |
| Past 12 months | **McDaid et al. 2019** |
| **Ferlatte et al. 2018a** |
| Not specified | **Jie et al. 2012** |
| Lifetime | **Walters et al. 2020** |
| physical IPV | 7 | Past month | **Mustanski 2014** |
| Past 4 months | **Eaton et al. 2013** |
| Past 12 months | **Chandler et al. 2020a** |
| **Chandler et al. 2020b** |
| **Chandler et al. 2020c** |
| Lifetime | **Tomori et al. 2018** |
| **Tulloch et al. 2015** |
| physical IPV, sexual IPV | 6 | Past 6 months | **Mustanski et al. 2017** |
| Lifetime | **Turpin et al. 2020a** |
| **OCleirigh et al. 2018** |
| **O'Leary et al. 2014** |
| **Ng et al. 2020** |
| **Reisner et al. 2016** |
| physical IPV, sexual IPV, psychological IPV, gay-related IPV | 2 | Past 5 years | **Jiang et al. 2020** |
| Lifetime | **Chuang et al. 2018** |
| Not specified | 2 | Not specified | **Byg et al. 2016** |
| Lifetime | **Beymer et al. 2016** |
| physical IPV, sexual IPV, psychological IPV, gay-related IPV, HIV-related IPV | 1 | Past month | **Wu Elwin 2018** |
| Scale | 7 | HITS | 3 | Continuous | **Lee et al. 2020b** |
| 11 | **Zepf et al. 2020** |
| **Blashill et al. 2020** |
| CTS2 | 3 | Responding yes to at least one item | **Parsons et al. 2017** |
| Not specified | **Zhang et al. 2019** |
| Continuous | **Pantalone et al. 2018** |
| Authors' scale (physical and psychological) | 1 | continuous | **Yu et al. 2013** |
| Physical intimate partner violence: 36 studies ; 80% of studies with IPV as a syndemic condition | | | | | |
| Psychological intimate partner violence: 23 studies ; 51% of studies with IPV as a syndemic condition | | | | | |
| Sexual intimate partner violence: 21 studies ; 47% of studies with IPV as a syndemic condition | | | | | |
| Gay-related intimate partner violence: 3 studies ; 7% of studies with IPV as a syndemic condition | | | | | |
| HIV-related intimate partner violence: 1 studies ; 2% of studies with IPV as a syndemic condition | | | | | |

Table S3: Summary of the studies including substance use as a syndemic condition and the substances specifically screened in the studies

| **Type of substances screened** | **Number of studies** | **Reference period** | **References** |
| --- | --- | --- | --- |
| stimulants | 6 | Past month | **Zepf et al. 2020** |
| Past 6 months | **Mimiaga et al. 2015b** |
| **Herrick et al. 2013** |
| **Dyer et al. 2020** |
| Past 3 months | **Harkness et al. 2019** |
| **Harkness et al. 2018** |
| stimulants, ecstasy, hallucinogens, depressants | 4 | Past 4 months | **Moeller et al. 2011** |
| Past 12 months | **Ferlatte et al. 2015** |
| **Ferlatte et al. 2018a** |
| **Ferlatte et al. 2018b** |
| stimulants, marijuana, opioids | 3 | Past month | **Semple et al. 2017** |
| Past 3 months | **Wu Elwin 2018** |
| Lifetime | **Oginni et al. 2019** |
| stimulants, ecstasy, hallucinogens, marijuana, depressants, opioids, inhalants | 3 | Past month | **Halkitis et al. 2015** |
| **Halkitis et al. 2013** |
| Past 3 months | **Storholm et al. 2011** |
| stimulants, opioids | 2 | Past 6 months | **OCleirigh et al. 2018** |
| **Tomori et al. 2018** |
| not\_specified | 2 | Past month | **Biello et al. 2014** |
| Past 12 months | **Santos et al. 2014** |
| marijuana | 2 | Past month | **Blashill et al. 2020** |
| Lifetime | **Perry et al. 2019** |
| stimulants, marijuana, inhalants | 1 | Past 4 months | **Eaton et al. 2013** |
| stimulants, marijuana | 1 | Past month | **Mustanski 2014** |
| stimulants, inhalants | 1 | Past 3 months | **Sullivan and Eaton 2020** |
| stimulants, hallucinogens, marijuana, depressants, inhalants | 1 | Lifetime | **Shuper et al. 2020** |
| stimulants, hallucinogens, depressants, opioids, inhalants | 1 | Past 3 months | **Lee et al. 2020a** |
| stimulants, hallucinogens, depressants, opioids | 1 | Past month | **Lee et al. 2020b** |
| stimulants, hallucinogens, depressants, NPS, opioids | 1 | Lifetime | **Ogunbajo et al. 2019** |
| stimulants, hallucinogens, depressants, NPS | 1 | Past 3 months | **Nostlinger et al. 2020** |
| stimulants, ecstasy, opioids, inhalants | 1 | Past 6 months | **Dyer et al. 2012** |
| stimulants, ecstasy, NPS, opioids | 1 | Lifetime | **Turpin et al. 2020a** |
| stimulants, ecstasy, marijuana, depressants, opioids | 1 | **Yu et al. 2013** |
| stimulants, ecstasy, marijuana | 1 | **Li et al. 2016** |
| stimulants, ecstasy, inhalants | 1 | Past 12 months | **Beymer et al. 2016** |
| stimulants, ecstasy, hallucinogens, marijuana, depressants, opioids | 1 | Past month | **Hugh Klein 2011** |
| stimulants, ecstasy, hallucinogens, marijuana, depressants | 1 | Past 12 months | **Mustanski et al. 2007** |
| stimulants, ecstasy, hallucinogens, depressants, opioids, inhalants | 1 | Lifetime | **Pitpitan et al. 2016** |
| stimulants, ecstasy, hallucinogens, depressants, opioids | 1 | Past 3 months | **Herrick et al. 2014** |
| stimulants, ecstasy, hallucinogens, depressants, inhalants | 1 | Past 4 months | **Guadamuz et al. 2014** |
| stimulants, depressants, opioids, inhalants | 1 | Past 6 months | **Turpin et al. 2020b** |
| marijuana, opioids | 1 | Past 12 months | **Chakrapani et al. 2019b** |
| marijuana, inhalants | 1 | Past month | **Halkitis et al. 2012** |
| Stimulants : cocaine/crack, amphetamine (37 studies ; 86%) | | | |
| Ecstasy (17 studies ; 40%) | | | |
| Hallucinogens : ketamine, psilocybine, phencyclidine (17 studies ; 40%) | | | |
| Marijuana (17 studies ; 40%) | | | |
| Depressants : GHB/GBL, benzodiazebines (19 studies ; 44%) | | | |
| NPS : New Psychoactive Substances : synthetic cannabinoids, cathinones (3 studies ; 7%) | | | |
| Opioids : opioids misuse, heroin (19 studies ; 44%) | | | |
| Inhalants : nitrous oxyde, Popper : (13 studies ; 30%) | | | |

Table S4: Summary of the studies including childhood sexual abuse as a syndemic condition and the criteria used to screen this condition

| **Use of a scale or a criteria** | **Number of studies** | **Scale or criteria used1** | **Number of studies** | **Cutoff used** | **References** |
| --- | --- | --- | --- | --- | --- |
| Definition | 28 | Finkelhor definition | | | **Lee et al. 2020a** |
| **Blashill et al. 2020** |
| **Lee et al. 2020b** |
| **Harkness et al. 2019** |
| **Safren et al. 2018** |
| **Harkness et al. 2018** |
| **Mimiaga et al. 2015b** |
| Any unwanted sexual experience before 18 years old | | | **Semple et al. 2017** |
| **Biello et al. 2016** |
| **Starks et al. 2016** |
| **Mimiaga et al. 2015a** |
| **Biello et al. 2014** |
| **Ng et al. 2020** |
| Any unwanted sexual experience before 17 years old with someone at least 10 years older | | | **Parsons et al. 2015** |
| **Starks 2014** |
| **Parsons et al. 2012** |
| **Stall et al. 2003** |
| Any unwanted sexual experience before 15 years old | | | **OCleirigh et al. 2018** |
| **Reisner et al. 2016** |
| Having experienced unwanted sexual activity with someone older at 16 years old or younger | | | **Parsons et al. 2017** |
| Having experienced sexual abuse as a child | | | **Eaton et al. 2013** |
| Any unwanted sexual experience before 17 years old | | | **Martinez et al. 2016** |
| Any unwanted sexual experience before 16 years old with someone at least 5 years older | | | **Jie et al. 2012** |
| Any unwanted sexual experience before 16 years old | | | **Tomori et al. 2018** |
| Any unwanted sexual experience before 13 years old | | | **Mustanski et al. 2017** |
| Any sexual experience before 13 years old with someone at least 4 years older | | | **Muñoz-Laboy et al. 2018** |
| Any sexual experience before 12 years old, any unwanted sexual experience between 12 years old and 16 years old or any sexual experience with an adult or someone at least 5 years older before 16 years old | | | **Jiang et al. 2020** |
| Any sexual experience before 11 years old, any unwanted sexual experience between 11 years old and 17 years old or any sexual experience with someone at least 4 years older before 17 years old | | | **Wu Elwin 2018** |
| Scale | 6 | CTQ Sexual Abuse subscale | 3 | 5 | **Perry et al. 2019** |
| **Hart et al. 2017** |
| 13 | **Carrico et al. 2018** |
| WSHQ-CSA | 2 |  | **Zhang et al. 2019** |
| **O'Leary et al. 2014** |
| Sexual abuse subscale of the Childhood Maltreatment Interview Schedule - Short Form (CMIS-SF) | 1 | Endorsement of any one item | **Pantalone et al. 2018** |
| 1Finkelhor definition : any sexual experience before 13 years old with someone at least 5 years older or any sexual experience between 13 and 17 years old with someone at least 10 years older (Finkelhor 1994) | | | | | |

Table S5: Summary of the studies including polysubstance use as a syndemic condition and the criteria used to screen this condition

| **Number of substances to qualify as polysubstance use** | **Number of studies** | **Inclusion of marijuana in the substances count** | **Reference period** | **References** |
| --- | --- | --- | --- | --- |
| At least 3 categories of substance use | 16 | Marijuana not included | Past month | **Blashill et al. 2020** |
| Past 3 months | **Chandler et al. 2020a** |
| **Chandler et al. 2020b** |
| Past 12 months | **Pantalone et al. 2018** |
| Marijuana included | Past 6 weeks | **Parsons et al. 2015** |
| Past 6 months | **Card et al. 2018** |
| **Tulloch et al. 2015** |
| **Stall et al. 2003** |
| Past 4 months | **Muñoz-Laboy et al. 2018** |
| Past 3 months | **Harkness et al. 2019** |
| **Harkness et al. 2018** |
| **Parsons et al. 2017** |
| **Starks 2014** |
| **Parsons et al. 2012** |
| Past 2 months | **Hirshfield et al. 2015** |
| Past 12 months | **Reisner et al. 2016** |
| More than one category of substance use | 9 | Marijuana not included | Past 3 months | **Walters et al. 2020** |
| **Hart et al. 2017** |
| Marijuana included | Past 6 months | **Mustanski et al. 2017** |
| **Friedman et al. 2016** |
| **Friedman et al. 2015** |
| **Jie et al. 2012** |
| Past 3 months | **Starks et al. 2016** |
| **Scheer et al. 2021** |
| **Chandler et al. 2020c** |
| At least 3 categories of substance, excluding stimulants | 1 | Marijuana included | Past 6 months | **Mimiaga et al. 2015b** |

Table S6: Summary of the studies including binge drinking as a syndemic condition and the criteria used to screen this condition

| **Number of episodes to qualify as binge drinking** | **Number of studies** | **Reference period** | **References** |
| --- | --- | --- | --- |
| At least one episode | 12 | Past month | **Blashill et al. 2020** |
| **Martinez et al. 2020** |
| **Martinez et al. 2016** |
| **Herrick et al. 2014** |
| Past 6 months | **Mustanski et al. 2017** |
| **Jie et al. 2012** |
| **Dyer et al. 2012** |
| **Reisner et al. 2016** |
| **Dyer et al. 2020** |
| Past 3 months | **Lee et al. 2020a** |
| **Wu Elwin 2018** |
| Past 12 months | **Zepf et al. 2020** |
| At least one per week, every week | 4 | Past 3 months | **Harkness et al. 2019** |
| **Harkness et al. 2018** |
| Past 12 months | **Mustanski et al. 2007** |
| **Ferlatte et al. 2018b** |
| At least one per month | 2 | Past 12 months | **Chandler et al. 2020a** |
| **Chandler et al. 2020b** |
| More than one per week, every week | 2 | Past 12 months | **Brandstrom and Pachankis 2018** |
| **Ferlatte et al. 2018a** |
| At least 3 episodes | 1 | Past month | **Mustanski 2014** |
| Having at least 4 drinks everyday or at least 6 drinks on a typical drinking day | 1 | Not specified | **Mimiaga et al. 2015b** |

Table S7: Summary of the studies including violence as a syndemic condition and the criteria used to screen this condition

| **Type(s) of violence screened** | **Number of studies** | **violence\_period** | **References** |
| --- | --- | --- | --- |
| sexual | 5 | Past 4 months | **Eaton et al. 2013** |
| Lifetime | **Turpin et al. 2020a** |
| **Guadamuz et al. 2014** |
| **Biello et al. 2014** |
| **Mustanski et al. 2007** |
| physical, sexual, psychological | 4 | Past 12 months | **Friedman et al. 2014** |
| Lifetime | **Pitpitan et al. 2016** |
| **Buttram et al. 2015** |
| **Kurtz et al. 2012** |
| physical, sexual | 2 | Past 12 months | **Chakrapani et al. 2019b** |
| Lifetime | **Zepf et al. 2020** |
| physical | 2 | Past 12 months | **Chandler et al. 2020c** |
| Lifetime | **Brandstrom and Pachankis 2018** |
| physical, sexual harassment by police, physical harassment by police | 1 | Not specified | **Chakrapani et al. 2017** |
| physical, psychological | 1 | Past 12 months | **Santos et al. 2014** |
| Physical violence: 10 studies ; 22% of studies with violence as a syndemic condition | | | |
| Psychological violence: 5 studies ; 11% of studies with violence as a syndemic condition | | | |
| Sexual violence: 11 studies ; 24% of studies with violence as a syndemic condition | | | |
| Physical harassment by the Police: 1 studies ; 2% of studies with violence as a syndemic condition | | | |
| Sexual harassment by the Police: 1 studies ; 2% of studies with violence as a syndemic condition | | | |

Table S8: Summary of the studies including anxiety as a syndemic condition and the criteria used to screen this condition

| **Type of anxiety disorder screened, if specified** | **Number of studies** | **Criteria or scale used** | **Number of studies** | **Reference period or cutoff used** | **References** |
| --- | --- | --- | --- | --- | --- |
| not specified | 5 | Being on medication for anxiety | 2 | Past 12 months | **Ferlatte et al. 2015** |
| **Ferlatte et al. 2018b** |
| BSI | 1 | Not specified | **Moeller et al. 2011** |
| Self-report of having an anxiety disorder | 1 |  | **Reisner et al. 2016** |
| HADS | 1 | 8 | **Achterbergh et al. 2021** |
| generalized anxiety disorder | 4 | GAD-7 | 4 | 10 | **McDaid et al. 2019** |
| **Wang et al. 2018** |
| **Wang et al. 2017** |
| **Li et al. 2016** |
| social phobia, panic disorder, generalized anxiety disorder | 3 | MINI-SPIN, PHQ | 2 |  | **Harkness et al. 2019** |
| **Harkness et al. 2018** |
| Clinical diagnosis based on the DSM-IV | 1 | **Batchelder et al. 2019** |
| social phobia | 2 | SPIN | 2 | 19 | **Lee et al. 2020a** |
| **Safren et al. 2018** |