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Review

Minority stress and stimulant use among US adult sexual minority men: A systematic review

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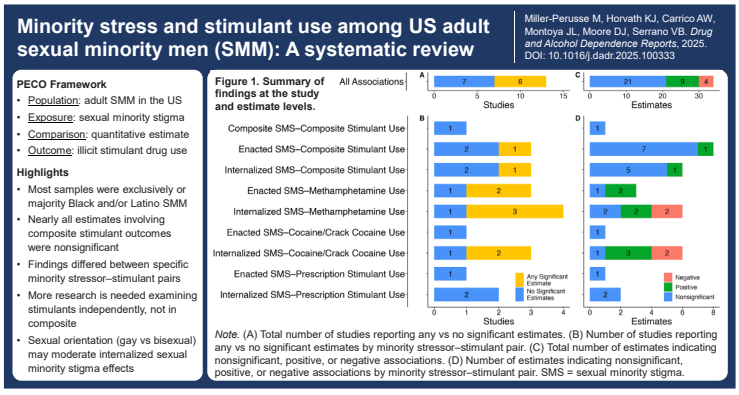
HIGHLIGHTS

- Most studies included exclusively or majority Black and/or Latino SMM.
- Nearly all estimates involving composite stimulant outcomes were nonsignificant.
- Findings differed between specific minority stressor–stimulant pairings.
- More research is needed examining stimulants independently, not in composite.
- Sexual orientation (gay vs bisexual) may moderate internalized SMS effects.

GRAPHICAL ABSTRACT



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ABSTRACT

Purpose: Minority stress theory posits health disparities among sexual minority men (SMM; i.e., non-heterosexual) result from experiences of sexual minority stigma (SMS). This systematic review synthesizes quantitative findings on the association between minority stress and stimulant use among US adult SMM.

Methods: PubMed, PsycInfo, CINAHL, and Scopus searches between November 2022 and October 2023 identified 991 studies, with 13 meeting selection criteria: English, peer-reviewed publication reporting an estimated minority stressor–stimulant use association among US adult SMM. Minority stressors included enacted, internalized, or anticipated SMS or identity concealment. Stimulants included methamphetamine, cocaine/crack cocaine, and diverted prescriptions. Proportions of studies and estimates indicating statistically significant associations were examined in total and for each minority stressor–stimulant pair.

Results: Many studies included primarily Black/Latino (69.2 %), urban (76.9 %), young adult samples (38.5 %). Significant associations were reported in 42.9 % (6/13) of studies but represented only 38.2 % (13/34) of unique estimates. Most estimates involving composite stimulant outcomes were nonsignificant (86.7 %, 13/15). Most

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estimates of enacted SMS–methamphetamine (66.7 %, 2/3), internalized SMS–methamphetamine (66.7 %, 4/6), and internalized SMS–cocaine/crack cocaine (83.3 %, 5/6) associations were significant. Findings suggest sexual orientation (i.e., gay vs bisexual) may moderate internalized SMS effects. Few studies examined prescription stimulants and none examined anticipated SMS or identity concealment.
Conclusions: Further research is needed examining the use of various stimulants independently, not in composite, and testing for moderation by sexual orientation. Findings suggest multi-level approaches targeting enacted SMS and individual-level approaches targeting internalized SMS may benefit SMM who use methamphetamine or cocaine/crack cocaine, respectively.

1 Introduction

The growing US illicit stimulant drug use (henceforth, stimulant use) epidemic (Fischer et al., 2021) disproportionately affects *sexual minority men* (SMM; i.e., gay, bisexual, and other non-heterosexual men). Data from the 2021–2022 National Survey on Drug Use and Health indicate, compared to heterosexual men, rates of past-year methamphetamine, cocaine, and prescription stimulant misuse 4.4, 1.6, and 2.2 times greater among gay men and 3.1, 2.6, and 1.6 times greater among bisexual men, respectively (Substance Abuse and Mental Health Services Administration, 2023). The dominant theory used to explain health disparities among SMM, including substance use disparities, is minority stress theory. However, no known systematic review to date has examined the extant literature on the quantitative association between minority stress and stimulant use among US adult SMM.

1.1. Minority stress theory and extant reviews

Minority stress theory posits that health disparities among minoritized populations are the result of *minority stressors*—chronic stressors rooted in oppressive norms and stigmatization—which members of such populations face in addition to general life stressors (Brooks, 1981; Meyer, 1995, 2003). Although applicable to any minoritized identity, minority stress theory was originally articulated with reference to sexual minority individuals and implicating *sexual minority stigma* (SMS; also referred to as homophobia, homonegativity, or heterosexism). Minority stressors among sexual minorities are often categorized as either distal or proximal, with distal stressors encompassing manifestations of enacted SMS (e.g., discrimination, victimization) and proximal stressors encompassing internalized SMS (i.e., directing negative social attitudes about sexual minorities towards the self or the community), anticipated SMS (e.g., expectations of rejection), and identity concealment (Meyer, 2003).

Minority stress theory has garnered much empirical support over the past two decades. Building on the work of Brooks (1981) with sexual minority women, Meyer (2003) reviewed the available literature on the prevalence of minority stressors and mental health disorders among sexual minorities and articulated an expanded version of the theory. In the years since, numerous research studies have examined the associations between minority stressors and indicators of well-being among sexual minorities, including mental health (Collier et al., 2013; de Lange et al., 2022; Dürrbaum and Sattler, 2020; Eaton, 2014; Goldbach et al., 2014; Huynh et al., 2022; Lee et al., 2016; Newcomb and Mustanski, 2010; Pachankis et al., 2020; Schmitt et al., 2014) and physical health (Christian et al., 2021; Flentje et al., 2020) outcomes.

Extant systematic reviews and meta-analyses have found substance use and substance use disorders, in aggregate, to be positively associated with enacted SMS (Collier et al., 2013; Evans-Polce et al., 2020; Goldbach et al., 2014; Lee et al., 2016) and internalized SMS (Huynh et al., 2022) but negatively associated with identity concealment (Pachankis et al., 2020). However, we know of only one review article synthesizing findings on minority stress and stimulant use specifically. Huynh et al. (2022) conducted a meta-analysis of studies examining internalized SMS and the use of various substances, finding internalized SMS to be positively associated with cocaine use but not associated with methamphetamine use. But, given that the scope was limited to internalized SMS, Huynh et al. (2022) examined no other minority stressors. All other systematic reviews and meta-analyses cited above included stimulant use in aggregate with other substances.

1.2. The present review

Given the increasing prevalence of stimulant use in the United States (Fischer et al., 2021), an understanding of the specific factors driving stimulant use disparities among SMM is critical to health improvement efforts for this population. Thus, we aimed to summarize and synthesize original research to answer the question, "to what extent is minority stress related to sexual orientation quantitatively associated with stimulant use among cisgender, adult SMM in the United States?" We conducted a systematic review to achieve this aim, as this is the review approach best suited to answering a clearly formulated review question (Moosapour et al., 2021). Other notable benefits of systematic reviews include their rigor and reproducibility, supported by a prespecified protocol and comprehensive search strategy as well as the use of multiple reviewers and critical appraisal of included studies. Furthermore, to investigate possible sources of heterogeneity with regards to our review question, we aimed to characterize the state of the evidence for each minority stressor–stimulant pair identified among included studies.

2. Methods

This systematic review adhered to the Conducting Systematic Reviews and Meta-Analyses of Observational Studies of Etiology (COSMOS-E; Dekkers et al., 2019) and Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA; Page et al., 2021) guidelines for conduct and reporting, respectively. A prespecified protocol including search strategies, selection criteria, data extraction, and quality assessment practices was developed, though was not pre-registered.

2.1. Search and selection criteria

We searched PubMed, CINAHL, PsychInfo, and SCOPUS to find relevant records. The search strategies for each database (Appendix A) were developed in collaboration with two health sciences librarians (see Acknowledgements) based on the population, exposure, comparator, and outcomes framework (Morgan et al., 2018).

Inclusion criteria were (a) peer-reviewed publication reporting original empirical data; (b) US sample or sub-sample composed of majority cisgender SMM with average age 18 years or older; (c) examination of at least one minority stressor (i.e., enacted, internalized, or anticipated SMS or identity concealment); (d) examination of at least one stimulant use variable (e.g., self-report measures of stimulant use, urinalysis screening for stimulant use, diagnosis of a stimulant use disorder) where stimulants were considered to include methamphetamine, cocaine, crack cocaine, naturally occurring or synthetic cathinone (i.e., khat or "bath salts"), and diverted prescription stimulants (e.g., amphetamine, methylphenidate); (e) reporting of results for at least one estimated minority stressor–stimulant association derived from quantitative analysis; and (f) available in English. Records were excluded if

they did not report original empirical data (wrong publication type; e.g., review article), were not peer-reviewed (wrong publication type; e.g., dissertation), or did not present quantitative results on the topic of this review (wrong study design; e.g., qualitative study). Further, given the reliance of frequentist statistics on the central limit theorem (Kwak and Kim, 2017), reports meeting inclusion criteria but having fewer than 30 participants were to be excluded; however, no such cases were identified.

The initial search was conducted on November 1, 2022 and the final search was conducted on October 19, 2023. No date limits were used. Identified records were uploaded into Rayann (Ouzzani et al., 2016), a free web application designed to facilitate the screening process for systematic reviews. Duplicate records were removed prior to independent screening of titles and abstracts by two authors (MMP, VBS) using the stated inclusion criteria. We marked each record as either "include", "exclude", or "maybe" and were blinded to one another's responses until screening of titles and abstracts was complete. Interrater reliability for title/abstract screening was excellent (κ =.94). For records with conflicting decisions or that were marked "maybe," titles and abstracts were discussed and consensus was reached between the two screening authors regarding whether to proceed with full-text screening. We then completed an independent full-text screening of each identified report using the stated inclusion criteria. Interrater reliability for full-text screening was excellent (κ =.89). Any conflicting decisions were discussed and consensus was reached between the two screening authors regarding inclusion in the review. Reports selected for inclusion were then uploaded into the Systematic Review Data Repository (Ip et al., 2012), a free resource for data extraction, management, and archival for systematic reviews.

2.2. Data extraction

Two authors (MMP, VBS) independently extracted data, including sample source (e.g., recruitment venue, geographic area), study design, and participant characteristics (i.e., gender, sexual orientation, age, race). For examinations conducted in the context of larger experimental studies and controlled trials, we described study arms and procedures. The duration of time between assessments was recorded for longitudinal studies. We extracted exposure and outcome data for all available timepoints, including operationalizations of minority stress and stimulant use, whether the included measures were established in prior research, the scale of measurement, and descriptive statistics (i.e., means and standard deviations for continuous variables, counts and proportions for categorical variables).

The types of analyses conducted in each study were recorded, as were as any covariates included in each analysis, effect size estimates for each association, and indicators of statistical significance (e.g., 95 % confidence intervals, *p*-values). Effect estimates are presented here as they are presented in the original report. For reports that did not provide an effect estimate but did provide a significance test, we calculated mean differences or rate ratios for the tested association when feasible based on reported data.

Data extraction concluded with an independent risk of bias assessment using the Quality Assessment Tool for Observational Cohort and Cross-Sectional Studies from the National Heart, Lung, and Blood Institute (2013). Each study was evaluated on fourteen quality criteria as well as given a holistic overall quality rating of "good" (least risk of bias, results considered valid), "fair" (risk of bias deemed insufficient to invalidate results), or "poor" (significant risk of bias raising concern for result validity). For studies assigned a quality rating of poor, the source of the significant risk of bias was described. We then compared and discussed our data extraction and quality assessment results, reaching consensus on any discrepancies.

2.3. Study characteristics

A total of 1743 records were identified from PubMed ($n = 410$), PsycInfo ($n = 385$), CINAHL ($n = 423$), and Scopus ($n = 525$; Supplementary Fig. S1; Haddaway et al., 2022). Upon removal of 752 duplicate records, 991 unique records were identified from our preliminary search for title/abstract screening. Based on title/abstract screening, we identified 63 reports for which to conduct full-text screening. Of these, 13 reports met all criteria for inclusion in the final review and underwent data extraction (Table 1). Reasons for exclusion during screening process included no analyses relevant to the topic of this review (title/abstract, $n = 242$; full-text, $n = 44$), examination of a population other than US adult SMM (title/abstract, $n = 396$; full-text, $n = 2$), wrong publication type (title/abstract, $n = 181$; full-text, $n = 2$), or wrong study design (title/abstract, $n = 108$; full-text, $n = 1$). In addition, one report otherwise appearing to meet inclusion criteria did not provide results from a quantitative analysis described to include minority stressors as predictors of a stimulant use outcome (Herrick et al., 2013). The authors were contacted but were unable to confirm whether the estimates of interest were omitted on account of perfect prediction or for another reason (R. Stall, personal communication, December 2, 2022). As such, this report was also excluded from the final review.

Of the 13 reports included, two analyzed data from the MSM and Substances Cohort at UCLA Linking Infections Noting Effects (mSTUDY; Li et al., 2018; Takada et al., 2021). However, given that each used data collected at different timepoints and analyzed different stimulant use outcomes, these were not considered to be duplicate studies. Additionally, two analyzed data from the PrEP and Substance Use National Survey (Kalinowski et al., 2022; Watson et al., 2023). Similarly, as each used data collected at different timepoints and analyzed different minority stress exposures, these were not considered to be duplicate studies.

Most studies utilized cross-sectional data exclusively (10, 76.9 %), employed voluntary response sampling (7, 53.8 %), recruited participants from community settings (12, 92.3 %), were restricted to urban areas (10, 76.9 %), and included exclusively or majority Black and/or Latino samples (9, 69.2 %). Five studies (38.5 %) were restricted to SMM ages 30 years or younger. Analytic sample sizes at baseline ranged from 191 to 1817 participants ($Mdn = 401$, IQR [379,614]).

2.4. Measures

2.4.1. Minority stress

A total of 24 minority stress variables were analyzed across all 13 included studies, though three of these represented subscales for which a total scale score was also analyzed (Shoptaw et al., 2009). Of the 21 independent minority stress variables, 57.1 % (12/21) across seven studies represented enacted SMS, 38.1 % (8/21) across eight studies represented internalized SMS, and 4.8 % (1/21) in one study (Storholm et al., 2019) represented a latent variable with indicators of both enacted and internalized SMS as well as racism. No studies reported assessment of anticipated SMS or identity concealment.

Most minority stress variables were analyzed as continuous, 71.4 % (15/21) across 11 studies, rather than categorical, 28.6 % (6/21) across three studies. All were assessed using self-report. Measurement references were cited for 71.4 % (15/21) across nine studies, of which 26.7 % (4/15) across three studies were described as adapted. Few measurement references were cited by more than one study. Regarding enacted SMS, three studies reported adapting items from Díaz et al. (2001) and two studies reported utilizing the lifetime victimization scale from Fredriksen-Goldsen and Kim (2017). Regarding internalized SMS, three studies reported utilizing a version of the internalized homophobia (IHP) scale—two utilizing the full 9-item IHP (see Herek et al., 1997; Martin and Dean, 1987; Meyer, 1995) and one utilizing the revised 5-item IHP-R (Herek, 2009)—and two studies reported adapting items from the Nungesser homosexual attitudes inventory (Nungesser, 1983).

Table 1
Characteristics, analyses, and findings for each included study ($N = 13$).

Design and Sampling	Sample Characteristics	Measurement of Minority Stress	Measurement of Stimulant Use	Analysis and Findings
Batchelder et al. (2020)				
Cross-sectional survey; voluntary response sample of adult (≥ 18) SMM in the Boston Metropolitan area recruited from community settings July to December, 2014	$N = 382$ Age: $M = 35.5$, $SD = 12.3$ Sexual orientation: Gay (88 %) Bisexual (10 %) Straight (1 %) Race: White (73 %) Black (17 %) Other (9 %) Hispanic/Latino: Yes (18 %) No (82 %)	Enacted SMS, assessed using adapted single-item measures of verbal abuse, physical assault, and work and healthcare discrimination with dichotomous response scales (Huebner et al., 2011; Preston et al., 2004; Raymond et al., 2011); analyzed as four dichotomous predictors	Past-year stimulant use, including any self-reported cocaine, CC, or amphetamine use; analyzed as a composite dichotomous outcome	Cramer's V calculated for each predictor-outcome pair; positive association observed for physical assault ($\Phi = .21$, $p = .046$), all others nonsignificant Bivariate logistic regression of predictors with significant V at $p < .05$ on stimulant use; no association observed for physical assault
Bruce et al. (2014)				
Cross-sectional survey; voluntary response sample of young adult (16–24) sexually active (past year) SMM in Chicago, IL recruited from community settings, online, and peer referral in 2012	$N = 200$ Age: $M = 20.8$, $SD = 2.1$ Sexual orientation: Gay (65 %) Bisexual (29 %) Other (7 %) Race/Ethnicity: Black (38 %) Hispanic/Latino (27 %) White (24 %) Other (12 %)	Enacted SMS, assessed using an adapted eight-item measure with a 4-point response scale of frequency (α =.93; Díaz et al., 2001; Bruce et al., 2008); analyzed as a composite continuous predictor Internalized SMS, assessed using an adapted nine-item measure with a 4-point response scale of agreement (α =.87; Bruce et al., 2008; Wagner, 1998); analyzed as a composite continuous predictor	Past-3-month stimulant use, including any self-reported cocaine, METH, or ecstasy use; analyzed as a composite dichotomous outcome	Multivariate path analysis; "Preliminary models failed to produce any significant paths to daily alcohol use and [stimulant] use from the minority stress or homelessness variables" (p. 574)
Jeffries and Johnson (2018)				
Pooled cross-sectional survey data; SMM subsample of those participating in the 2002, 2006–2010, and 2011–2013 cycles of the National Survey of Family Growth (NSFG), which recruits a probability-based sample of US persons ages 15–44 who are not institutionalized	$N = 614$ Age: $M = 30.4$, $SD = 7.4$ Sexual orientation: Gay (68 %) Bisexual (32 %) Race/Ethnicity: White (61 %) Hispanic/Latino (19 %) Black (13 %) Other (7 %)	Internalized SMS, assessed using one item with a 5-point response scale of agreement: "sexual relations between two adults of the same sex are all right" (p. 560); dichotomized as any level of disagreement	Past-year self-reported use of cocaine, CC, or METH; analyzed as three dichotomous outcomes	Rao-Scott chi-square test for each predictor-outcome pair stratified by sexual orientation and controlling for NSFG design; among gay men, positive associations observed for cocaine (RR = 3.54, $p = .011$) and METH (RR = 5.98, $p = .032$) but no CC use reported in internalized SMS group; among bisexual men, negative associations observed for cocaine (RR = 0.25, $p < .001$), CC (RR = 0.18, $p = .026$), and METH (RR = 0.25, $p = .009$) Bivariate logistic regression for each predictor-outcome pair stratified by sexual orientation; among gay men, positive association observed for cocaine (OR = 4.61, 95 % CI [1.25, 16.96]) but no association observed for METH; among bisexual men, negative associations observed for cocaine (OR = 0.19, 95 % CI [0.09, 0.40]), CC (OR = 0.16, 95 % CI [0.02, 0.93]), and METH (OR = 0.25, 95 % CI [0.08, 0.80]) Multivariable logistic regression stratified by sexual orientation with NSFG cycle, race/ ethnicity, age, education level, condom use, and sexual partners as covariates; among gay men, positive associations observed for cocaine (AOR = 6.52, 95 % CI [1.40, 30.33]) and METH (AOR = 18.89, 95 % CI [2.28, 156.74]); among bisexual men, negative associations observed for cocaine (AOR = 0.17, 95 % CI [0.07, 0.39]), CC (AOR = 0.05, 95 % CI [0.01, 0.05]), and METH (AOR = 0.17, 95 % CI [0.03, 0.91])
Johnson et al. (2008)				
Cross-sectional survey; SMM subsample of those participating in	$N = 465$ Age: $M = 41.5$, SD	Internalized SMS, assessed using an adapted four-item measure with a 6-	Regular stimulant use, defined as self-reported use of cocaine, CC, or	Point-biserial correlation for each predictor-outcome pair; positive

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Table 1 (*continued*)

Design and Sampling	Sample Characteristics	Measurement of Minority Stress	Measurement of Stimulant Use	Analysis and Findings
the Healthy Living Project, which recruited a convenience sample of adult (≥ 18) individuals living with HIV in the San Francisco Bay Area, CA from clinic and community settings April, 2000 to January, 2002	= 8.3 Sexual orientation: Gay (100 %) Race/Ethnicity: White (62 %) Black (18 %) Hispanic/Latino (10 %) Other (10 %)	point response scale of agreement (α =.77; Nungesser, 1983; Shidlo, 1994): "(1) 'I am glad to be gay' (reverse scored), (2) 'I wish I were heterosexual', (3) 'Whenever I think a lot about being gay, I feel critical about myself', (4) 'Homosexuality is not as satisfying as heterosexuality'" (p. 833); analyzed as four continuous predictors	METH 2–3 times weekly or more frequently; analyzed as a composite dichotomous outcome	association observed for question three ($r = .12$, $p < .01$) but not for questions one, two, or four
Kalinowski et al. (2022)				
Cross-sectional survey; Black subsample of those participating in the PrEP and Substance Use National Survey, which recruited a voluntary response sample of young adult (18–29), sexually active (past year), English- or Spanish-speaking Black and/or Latino SMM in the US from mailing lists and online March, 2020 to August, 2020	N = 390 Age: $M = 25.3$, $SD = 2.8$ Gender: Cisgender (94 %) Other (6 %) Sexual orientation: Gay (74 %) Bisexual (19 %) Other (7 %) Race/Ethnicity: Black (57 %) Mixed (43 %)	Enacted SMS microaggressions, assessed using the six-item Heterosexism in Racial/Ethnic Minority Communities subscale of the LGBT People of Color Microaggressions Scale with a 5-point response scale of intensity (α =.76; Balsam et al., 2011); analyzed as a composite continuous predictor	Cocaine and METH involvement, assessed using the six-item NIDA-modified Alcohol, Smoking, and Substance Involvement Screening Test (αs ≥ .82; National Institute on Drug Abuse, 2013); analyzed as two continuous outcomes	Pearson correlations for each predictor-outcome pair; no association observed for cocaine or METH involvement Multivariable zero-inflated negative binomial regressions of SMS microaggressions on each outcome with age, sexual orientation, gender, income, housing stability, ethnic identity, and SMS microaggressions by ethnic identity interaction; no association observed for cocaine or METH involvement
Kecojevic et al. (2015)				
Cross-sectional survey; age-stratified (18–21, 22–25, 26–29) voluntary response sample of young adult, sexually active (past 6 months) SMM reporting recent prescription drug misuse (past 6 months) in Philadelphia, PA recruited from community settings, online, and chain referral November, 2012 to July, 2013	N = 191 Age: $M = 23.7$, $SD = 3.3$ Sexual orientation: Gay (57 %) Bisexual (43 %) Race/Ethnicity: Black (37 %) White (34 %) Other (29 %)	Enacted SMS, assessed using a four-item measure with a 4-point response scale of frequency (α =.77; Díaz et al., 2001); analyzed as a composite continuous predictor Internalized SMS, assessed using an adapted four-item measure with a 4-point response scale of agreement (α =.92; Ross and Rosser, 1996; Wong et al., 2014); analyzed as a composite continuous predictor	Stimulant use severity, defined as self-reported number of prescription stimulant (e.g., Ritalin, Adderall, Desoxyn) pills misused in the past 6 months; analyzed as a continuous outcome (range [0850])	Multivariable negative binomial regression, with robust error estimators, of enacted and internalized SMS on stimulant use severity with age, racial/ethnic minority status, sexual orientation, childhood abuse, racism, sexual racism, depression, anxiety, somatization, and general stress appraisal as covariates; no association observed for enacted or internalized SMS
Li et al. (2018)				
Observational cohort data (semiannual visits over two years); participants in the MSM and Substances Cohort at UCLA Linking Infections Noting Effects (mSTUDY), which recruited a purposive (prioritized Black and/or Latino) stratified (50 % living with HIV, 50 % reported past-6-month substance use) voluntary response sample of adult (18–45) SMM in Los Angeles, LA recruited from clinic and community settings and online beginning in July, 2014	N = 401 1342 total person-visits Age: $M = 31.7$ Sexual orientation: Not reported Race/Ethnicity: Hispanic/Latino (48 %) Black (40 %) White (8 %) Other (5 %)	Enacted SMS, assessed using five items from the Lifetime Victimization Scale of the National Health, Aging, and Sexuality/Gender Study (Fredriksen-Goldsen and Kim, 2017) with a dichotomous response scale; analyzed as a composite continuous predictor, lagged by one observation (i.e., 6 months)	Past-6-month frequency of METH use, assessed using one item adapted from the Alcohol, Smoking, and Substance Involvement Screening Test (WHO ASSIST Working Group, 2002) with the following response scale: "(0) 'None,' (1) 'Once,' (2) 'Less often,' (3) 'Monthly,' (4) 'Weekly,' and (5) "Daily'" (p. 180); analyzed as an ordinal outcome	Spearman's rank correlation; positive association observed (ρ =.13, $p < .001$) Multivariable random-intercept ordered logistic regression with HIV status, age, race/ethnicity, education, employment status, incarceration, and days enrolled as covariates; positive association observed (AOR = 1.40, 95 % CI [1.15, 1.71]) Multilevel mediation model with unstable housing as partial mediator and HIV status, age, race/ethnicity, education, employment status, incarceration, and days since enrollment as covariates; positive total (AOR = 1.42, 95 % CI[1.17, 1.72])), direct (AOR = 1.34, 95 % CI [1.10, 1.62]), and indirect (AOR = 1.06, 95 % CI[1.01, 1.11]) effects observed
Nyamathi et al. (2017)				
Observational cohort data (baseline, 4 months, 8 months); participants in a RCT of nurse case management as adjunct to contingency management, which recruited a convenience sample of adult (18–46) homeless SMM who reported past-3-month stimulant use in Los Angeles, CA from community settings (dates not reported)	N = 422 1112 total person-visits Age: $M = 34.4$, $SD = 8.1$ Sexual orientation: Not reported Race/Ethnicity: Black (36 %) White (36 %) Hispanic/Latino (15 %) Other (13 %)	Internalized SMS, assessed using the five-item Revised Internalized Homophobia Scale with a 5-point response scale of agreement (A. Nyamathi, personal communication, June 15, 2023; Herek et al., 2009); dichotomized as sum score > 15	Stimulant-positive urinalysis at follow-up, defined as any positive urine test for cocaine, METH, or amphetamines at 4- or 8-month follow-up using the Phamatech QuickScreen™ test kit (San Diego, CA); analyzed as a composite dichotomous outcome	Preliminary, multivariable logistic regression of internalized SMS on stimulant-positive urinalysis at follow-up with randomization status as covariate (others covariates unclear); no association observed
Paul et al. (2014)				

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Table 1 (*continued*)

Design and Sampling	Sample Characteristics	Measurement of Minority Stress	Measurement of Stimulant Use	Analysis and Findings
Cross-sectional survey; race/ethnicity-stratified chain-referral sample of Black, Asian/PI, and Hispanic/Latino sexually active (past 6 months) adult (≥ 18) SMM in Los Angeles, CA recruited May, 2008 to October, 2009	$N = 1196$ Black, $n = 403$ Age: $M = 41$ Sexual orientation: Gay (60 %) Other (40 %) Hispanic/Latino, $n = 400$ Age: $M = 35$ Sexual orientation: Gay (77 %) Other (23 %) Asian/PI, $n = 393$ Age: $M = 33$ Sexual orientation: Gay (86 %) Other (14 %)	Enacted SMS in the general community, assessed using a five-item measure with a 4-point response scale of agreement; analyzed as a composite continuous predictor Enacted SMS among straight friends, assessed using a three-item measure with a 4-point response scale of agreement (α =.87); analyzed as a composite continuous predictor Enacted SMS among family, assessed using a three-item measure with a 4-point response scale of agreement (α =.82); analyzed as a composite continuous predictor	Past-6-month stimulant use, including any self-reported cocaine, CC, METH, ecstasy, or amphetamine use; analyzed as a composite dichotomous outcome	Bivariate generalized estimating equation logistic regression of each predictor on outcome; no association observed for any SMS variable Multivariable generalized estimating equation logistic regression of enacted SMS among straight friends on outcome with nativity, race/ethnicity, education, sexual orientation, and racism in general community as covariates; no association observed
Shoptaw et al. (2009)[a]				
Cross-sectional survey; SMM and transfeminine subsample from 2005–2006 and 2006–2008 waves of the Sexual Acquisition and Transmission of HIV–Cooperative Agreement Program, which recruited a respondent-driven sample of adults (≥ 18) reporting past-6-month anal sex and assigned male at birth or substance use regardless of sex assigned at birth and their sexual partners in Los Angeles, CA	$N = 722$ Age: <30 (12 %) 30–39 (2 %) 40–49 (50 %) 50–59 (18 %) ≥60 (3 %) Gender/sexual orientation: Transfeminine (4 %) Gay men (46 %) Bisexual men (27 %) Other (21 %) Race/Ethnicity: Black (43 %) Hispanic/Latino (27 %) White (21 %) Other (6 %)	Internalized SMS, assessed using the 23-item Internalized Homonegativity Inventory with a 6-point response scale of agreement (Mayfield, 2001) and four scores: total (α =.91), personal homonegativity (α = 90), gay affirmation (α =.83), and morality of homosexuality (α =.76); analyzed as four continuous predictors	Urinalysis positive for cocaine and/or METH; analyzed as two dichotomous predictors Past-6-month self-reported use of cocaine/CC or METH; analyzed as two dichotomous predictors	ANOVA of urinalysis result for cocaine on each internalized SMS score; positive association observed for total and two subscale scores (MDs [2.0, 7.6]; $ps < .05$), excepting personal homonegativity ANOVA of urinalysis result for METH on each internalized SMS score; negative association observed for total and all three subscale scores (MDs [–10.9, –2.3]; $ps < .05$) ANOVA of past-6-month cocaine/CC use on each internalized SMS variable; positive association observed for total and two subscale scores (MDs [0.9, 4.9]; $ps < .05$), excepting personal homonegativity ANOVA of past-6-month METH use on each internalized SMS variable; no association observed for total or any subscale score
Storholm et al. (2019)				
Cross-sectional survey; venue-based time-location sample of young adult (18–29), sexually active (past-year) Black SMM in Dallas, TX and Houston, TX recruited from community settings Spring–Fall of 2013, 2014, and 2015	$N = 1817$ Age: $M = 24.9$, $SD = 2.9$ Sexual orientation: Gay (58 %) Bisexual (20 %) Other (2 %) Race/Ethnicity: Not reported, all participants self-identified as Black	Enacted SMS, assessed using an adapted seven-item measure with a 5-point response scale of frequency (α =.86; Díaz et al., 2001); analyzed as a composite continuous indicator of latent intersectional minority stress Internalized SMS, assessed using an adapted three-item measure with a 5-point response scale of intensity (α =.72; Nungesser, 1983); analyzed as a composite continuous indicator of latent intersectional minority stress	Past-2-month stimulant use, including any self-reported cocaine, CC, METH, and ecstasy use; analyzed as four dichotomous indicators of latent stimulant use	Multivariate structural equation model with direct and indirect paths from latent intersectional minority stress (enacted SMS, λ = 0.71; internalized SMS, λ = 0.70; racism, λ = 0.64) to latent stimulant use (cocaine, λ = 0.67; CC, λ = 0.87; METH, λ = 0.59; ecstasy, λ = 0.52) directly and indirectly via latent resiliency, and paths from all latent variables to latent sexual risk behavior; no direct effect observed, indirect and total effects not reported
Takada et al. (2021)				
Cross-sectional survey; participants attending visits from May, 2017 to February, 2018 for the MSM and Substances Cohort at UCLA Linking Infections Noting Effects (mSTUDY), which recruited a purposive (prioritized Black and/or Latino) stratified (50 % living with HIV, 50 % reported past-6-month substance use) voluntary response sample of adult (18–45) SMM in Los Angeles, LA from community and clinic settings and online beginning in July, 2014	$N = 379$ Age: 18–20 (1 %) 21–30 (39 %) 31–40 (43 %) 41–50 (17 %) Sexual orientation: Not reported Race/Ethnicity: Black (41 %) Hispanic/Latino (36 %) White (14 %) Other (9 %)	Enacted SMS, assessed using five items from the Lifetime Victimization Scale of the National Health, Aging, and Sexuality/Gender Study (Fredriksen-Goldsen and Kim, 2017) with a dichotomous response scale; analyzed as a composite continuous predictor Internalized SMS, assessed using the nine-item Internalized Homophobia Scale with a 5-point response scale of agreement (α =.94; Martin and Dean, 1987; Meyer, 1995; Herek et al., 1997); analyzed as a composite continuous predictor	Sexualized METH use, defined as any self-reported METH use during or just before sex in the past 6 months; analyzed as a composite dichotomous outcome	Bivariate logistic regressions for each predictor-outcome pair; positive associations observed for enacted (AME = 0.10, 95 % CI [0.07, 0.14]) and internalized (AME = 0.04, 95 % CI [0.00, 0.08], $p < .05$) SMS Multivariable logistic regressions of enacted and internalized SMS on sexualized METH use with age, race/ethnicity, education, HIV status, income, past-6-month drug use, and social capital as covariates; positive association observed for enacted (AME = 0.09, 95 % CI [0.05, 0.12]) but not internalized SMS
Watson et al. (2023)				
Observational cohort data (five surveys administered every 4 months); longitudinal subsample	$N = 300$ Age: $M = 25.5$, $SD = 2.7$	Internalized SMS, assessed using the nine-item Internalized Homophobia Scale with a 4-point response scale of	Past-3-month frequency of cocaine, METH, or prescription stimulant use, assessed using a	Pearson correlations of internalized SMS with each outcome at baseline; no association observed for any

(*continued on next page*)

Table 1 (*continued*)

Design and Sampling	Sample Characteristics	Measurement of Minority Stress	Measurement of Stimulant Use	Analysis and Findings
of those participating in the PrEP and Substance Use National Survey, which recruited a voluntary response sample of young adult (18–29), sexually active (past year), English- or Spanish-speaking Black and/or Latino SMM in the US from mailing lists and online March, 2020 to August, 2020	Gender: Cisgender (96 %) Other (4 %) Sexual orientation: Gay (82 %) Bisexual (11 %) Other (7 %) Race/Ethnicity: Hispanic/Latino (66 %) Black (34 %) Other (< 1 %)	frequency (Martin and Dean, 1987; Meyer, 1995; Herek et al., 1997); analyzed as a composite continuous predictor	single item with the following response scale: "0 (never), 2 (once or twice), 3 (monthly), 4 (weekly), and 6 (daily or almost daily)" (p. 988); analyzed as three continuous outcomes	stimulant type Random-intercept mixed-effects linear regressions of internalized SMS on each outcome with psychological distress, age, gender, race/ethnicity, sexual orientation, and time point as covariates; no association observed for any stimulant type

Note. SMM = sexual minority men; SMS = sexual minority stigma; CC = crack cocaine; METH = methamphetamine; OR = odds ratio; CI = confidence interval; ARR = adjusted rate ratio; RR = rate ratio; AOR = adjusted odds ratio; PI = Pacific Islander; MD = mean difference; AME = average marginal effect.
[a] All data retrieved from Table 2 of the original publication.
[b] Incorrect citation provided in original report omitted.

2.4.2. Stimulant use

A total of 21 stimulant use variables were analyzed across all 14 included studies. Of these, 28.6 % (6/21) across seven studies were composite variables representing several stimulants (e.g., past-year use of any stimulants, latent variable indicated by several stimulants), 33.3 % (7/21) across seven studies were specific to methamphetamine, 28.6 % (6/21) across five studies were specific to cocaine/crack cocaine, and 9.5 % (2/21) across two studies were specific to diverted prescription stimulants. No studies reported assessment of naturally occurring or synthetic cathinone (i.e., khat or "bath salts").

Most stimulant use variables were analyzed as categorical, 61.9 % (13/21) across eight studies, rather than continuous, 38.1 % (8/21) across five studies. Urinalysis testing was used to derive 11.5 % (3/21) of stimulant use variables across two studies (Nyamathi et al., 2017; Shoptaw et al., 2009), including one composite variable, one specific to cocaine/crack cocaine, and one specific to methamphetamine. The remaining 85.7 % (18/21) were assessed using self-report, 16.7 % (3/18) of which were assessed using cited measurement tools with 33.3 % (1/3) also described as adapted. Both studies reporting measurement references for stimulant use variables cited the alcohol, smoking, and substance involvement screening test (ASSIST): one study cited the original WHO ASSIST Working Group (2002) version and one study cited the National Institute on Drug Abuse (2009) modified version.

2.5. Quality assessment

Quality assessment data for each study are presented in Supplementary Table S1. Notably, quality ratings assigned here are intended to apply only to evidence regarding the association under review and do not account for practical limitations that may have impacted study design decisions (e.g., limitations on the number of items that can be included in large, population-representative surveys). All studies included clearly stated objectives and clearly specified populations of interest. No studies provided a sample size justification, power description, or expected effect sizes or variances.

No studies included rejection sensitivity or neuroticism as covariates, which were identified a priori as potential confounders of interest for the purpose of this review. Rejection sensitivity was considered on the basis that it may contribute to increased likelihood of perceiving and endorsing enacted SMS in addition to being a theorized risk factor for addiction and recurrence of use (Leach and Kranzler, 2013). However, Feinstein (2020) has extended minority stress theory to include rejection sensitivity as a potentially influential mechanism rather than a confounder of its relationships. Regarding trait neuroticism, Bailey (2020, 2021) has called for the investigation of potential confounding by this construct in the minority stress literature broadly. However, this possibility remains debated among minority stress experts (Meyer et al., 2021). Thus, omission of rejection sensitivity or trait neuroticism as covariates were not considered known sources of bias for the purposes of quality assessment.

Only two studies (Li et al., 2018; Nyamathi et al., 2017) measured minority stress prior to measuring stimulant use, for both of which loss to follow-up was reported as less then 20 %. Both studies were assigned a quality rating of "good" on account of these characteristics in addition to utilizing measures deemed adequately valid and reliable to assess minority stress and stimulant use over multiple timepoints in an appropriate timeframe. One additional study (Watson et al., 2023) utilized longitudinal data but was instead assigned a quality rating of "fair" because we could not determine whether the timeframe between exposure and outcome was sufficient in longitudinal analyses because no methods were used to establish temporal precedence (e.g., using a lagged exposure variable).

Three studies were assigned a quality rating of "poor": (a) Jeffries and Johnson (2018), as the single-item measure of internalized SMS was not considered to represent the construct with adequate validity; (b) Johnson et al. (2008), as the single-item measures of internalized SMS were not considered to represent the construct with adequate validity and the level of susceptibility to interview bias was unclear; and (c) Kecojevic et al. (2015), on account of high susceptibility to recall bias inherent to the measurement of prescription stimulant use as well as to interviewer and social desirability bias inherent to the study design (i.e., data collected via unblinded interviews conducted in public settings). The remaining seven studies, in addition to Watson et al. (2023), were assigned quality ratings of "fair."

2.6. Data presentation

Results were summarized as counts and proportions of studies and estimates indicating a significant association between minority stress and stimulant use in a given direction (i.e., positive or negative) or a nonsignificant (i.e., null) association. To account for studies that included more than one analysis of the same association, counts and proportions at the estimate level include findings from initial analyses only with attention paid to finding sensitivity in subsequent analyses. Similarly, for studies including analyses of total scale as well as subscale scores derived from the same measure, counts and proportions at the estimate level include findings from analyses of total scale scores only with attention paid to finding sensitivity in subscale analyses. Findings were synthesized in total and, to explore heterogeneity, for each minority stressor–stimulant pair.

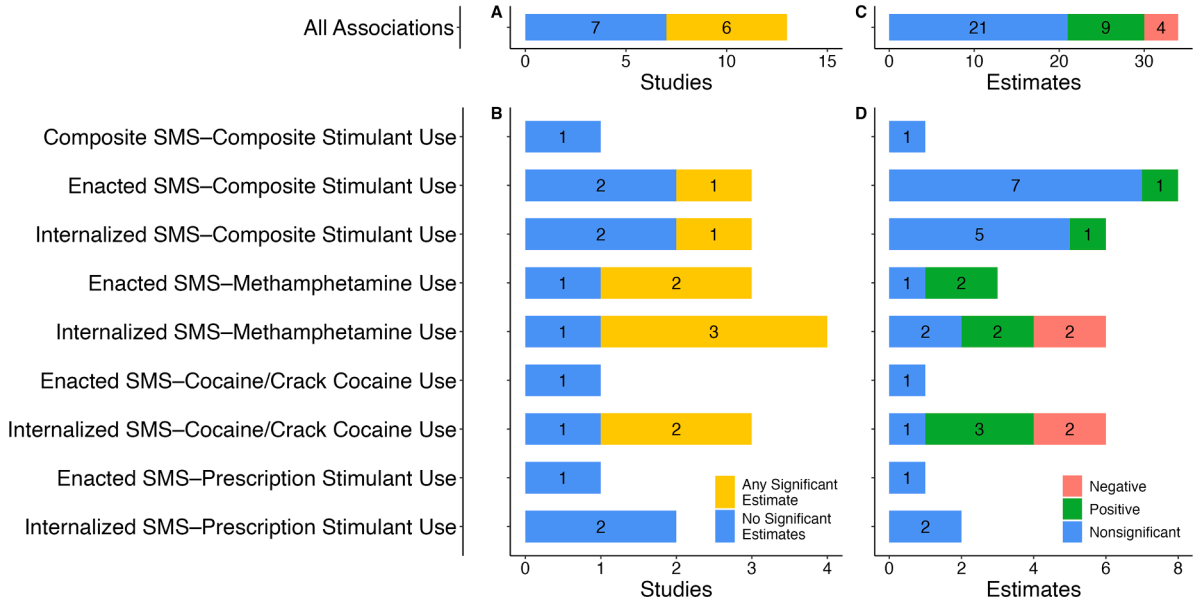

Fig. 1. Reported findings at the study and estimate levels. (A) Total number of studies reporting any vs no significant estimates. (B) Number of studies reporting any vs no significant estimates by minority stressor–stimulant pair. (C) Total number of estimates indicating nonsignificant, positive, or negative associations. (D) Number of estimates indicating nonsignificant, positive, or negative associations by minority stressor–stimulant pair.

3. Results

Thirty-four unique estimates of minority stressor–stimulant associations were tested across 13 included studies. Significant associations were reported in 42.9 % of studies (6/13) but represented only 38.2 % of unique estimates (13/34). Of the unique estimates, 26.5 % (9/34) reported in six studies indicated that greater level of or exposure to minority stress was associated with a greater level or likelihood of stimulant use (i.e., positive association), 11.8 % (4/34) reported in two studies indicated that greater level of or exposure to minority stress was associated with a lower level or likelihood stimulant use (i.e., negative association), and 61.8 % (21/34) reported in 11 studies indicated that level of or exposure to minority stress was not associated with level or likelihood of stimulant use (i.e., nonsignificant association; Fig. 1).

3.1. Composite stimulant use

3.1.1. Composite SMS

One estimate of a contemporaneous association between composite measures of SMS and stimulant use was reported by Storholm et al. (2019; fair quality rating) among Black SMM. This estimate, which was found to be nonsignificant, corresponded to a direct effect derived from mediation analysis of latent minority stress (indicated by enacted and internalized SMS as well as racism) on latent stimulant use (indicated by self-reported cocaine, crack cocaine, methamphetamine, and ecstasy in the past two months) independent of latent resiliency (indicated by gay pride/collective self-esteem, SMM social support, and general resilience). However, estimates were not reported for the indirect or total effects.

3.1.2. Enacted SMS

Eight estimates of enacted SMS–composite simulant use associations were reported in three studies: 12.5 % (1/8) indicated a positive enacted SMS–composite stimulant use association (Batchelder et al., 2020) while 87.5 % (7/8) indicated a nonsignificant association (Batchelder et al., 2020; Bruce et al., 2014; Paul et al., 2014).

Among a predominantly White sample, Batchelder et al. (2020; fair quality rating) observed a positive association between contemporaneous reports of past-year stimulant use and physical assault (Φ =.21, p = .046) but not verbal abuse or work or healthcare discrimination; however, this association was estimated to be nonsignificant in a subsequent bivariate analysis. Among Black, Latino, and Asian/Pacific Islander SMM, Paul et al. (2014; fair quality rating) did not observe significant associations between contemporaneous reports of past-6-month stimulant use and enacted SMS in the general community, among straight friends, or among family. Lastly, among a majority Black and Latino sample, Bruce et al. (2014; fair quality rating) did not observe a significant association between enacted SMS and contemporaneous reports of past-3-month stimulant use.

3.1.3. Internalized SMS

Six estimates of internalized SMS–composite stimulant use associations were reported in three studies: 16.7 % (1/6) indicated a positive association between internalized SMS and composite stimulant use (Johnson et al., 2008) while 83.3 % (5/6) indicated a nonsignificant association (Bruce et al., 2014; Johnson et al., 2008; Nyamathi et al., 2017).

Johnson et al. (2008; poor quality rating) observed a positive association between responses to a single-item measure of internalized SMS ("Whenever I think a lot about being gay, I feel critical about myself", p. 833) and contemporaneous reports of regular stimulant use (defined as twice weekly or more; r = .12, p < .01) among a predominantly White sample. However, significant correlations with regular stimulant use were not observed for responses to the other three internalized SMS items examined: "I am glad to be gay" (reverse scored), "I wish I were heterosexual," and "Homosexuality is not as satisfying as heterosexuality" (p. 833).

Among a predominantly Black and Latino sample, Bruce et al. (2014; fair quality rating) did not observe a significant association between internalized SMS and contemporaneous reports of past-3-month stimulant use. Similarly, Nyamathi et al. (2017; good quality rating) did not observe a significant association between baseline internalized SMS and prospective stimulant-positive urinalysis results, pooled from 4- and 8-month follow-up, among a majority Black and Latino sample.

3.2. Methamphetamine use

3.2.1. Enacted SMS

Three estimates of enacted SMS–methamphetamine use associations were reported in three studies: 66.7 % (2/3) indicated a positive association between enacted SMS and methamphetamine use (Li et al., 2018; Takada et al., 2021) while 33.3 % (1/3) indicated a nonsignificant association (Kalinowski et al., 2022).

Li et al. (2018; good quality rating) observed a positive association between enacted SMS, lagged by 6 months, and self-reported past-6--month methamphetamine use (ρ =.13, p < .001) among a majority Black and Latino sample; analogous positive estimates were observed in two subsequent analyses, including with unstable housing as a partial mediator. Among a majority Black and Latino sample also derived from the same longitudinal cohort (mSTUDY), but utilizing different timepoints, Takada et al. (2021; fair quality rating) observed a positive association between enacted SMS and contemporaneous reports of past-6-month sexualized methamphetamine use (AME = 0.10, 95 % CI [0.07, 0.14]); this association was also estimated to be positive in a subsequent multivariable analysis. Contrastingly, Kalinowski et al. (2022; fair quality rating) did not observe a significant association between enacted SMS microaggressions and contemporaneous methamphetamine involvement scores among an exclusively Black sample.

3.2.2. Internalized SMS

Six estimates of internalized SMS–methamphetamine use associations were reported in four studies: 33.3 % (2/6) indicated a positive association between internalized SMS and methamphetamine use (Jeffries and Johnson, 2018; Takada et al., 2021), 33.3 % (2/6) indicated a negative association (Jeffries and Johnson, 2018; Shoptaw et al., 2009), and 33.3 % (2/6) indicated a non-significant association (Shoptaw et al., 2009; Watson et al., 2023).

Jeffries and Johnson (2018; poor quality rating) observed a positive association between internalized SMS and contemporaneous reports of past-year methamphetamine use among gay men in their predominantly White sample (RR = 5.98, p = .032); however, among bisexual men in their sample, an inverse relationship was observed such that those with greater levels of internalized SMS were less likely to report past-year methamphetamine use (RR = 0.25, p = .009). Positive estimates of this association among gay men were observed in one of two subsequent analyses, while negative estimates of the association among bisexual men were observed in both subsequent analyses. Similarly, Shoptaw et al. (2009; fair quality rating) also observed a negative association between internalized SMS, assessed by Internalized Homonegativity Inventory (Mayfield, 2001) total scale score, and methamphetamine use contemporaneously confirmed by urinalysis (MD = –10.9, p < .001) among a majority Black and Latino sample. Notably, though, this sample included a greater proportion of gay men than bisexual men. Contrarily, no association was observed between contemporaneously reported past-6-month use and internalized SMS total scores. This pattern of findings was replicated when examining each of three subscale scores.

Among a majority Black and Latino sample derived from the mSTUDY cohort, Takada et al. (2021; fair quality rating) observed a positive association between internalized SMS and contemporaneous reports of past-6-month sexualized methamphetamine use (AME = 0.04, 95 % CI [0.00, 0.08], p < .05); however, this association was estimated to be nonsignificant in a subsequent multivariable analysis. Among

Black and Latino SMM, Watson et al. (2023; fair quality rating) did not observe an association between internalized SMS and contemporaneous reports of past-3-month methamphetamine use at baseline or when examining contemporaneous effects using longitudinal data.

3.3. Cocaine/crack cocaine use

3.3.1. Enacted SMS

One estimate of an enacted SMS–cocaine/crack cocaine use association was reported by Kalinowski et al. (2022; fair quality rating) among Black SMM. The authors did not observe a significant association between enacted SMS microaggressions and contemporaneous cocaine involvement scores.

3.3.2. Internalized SMS

Six estimates of internalized SMS–cocaine/crack cocaine use associations were reported in four studies: 50 % (3/6) indicated a positive association between internalized SMS and cocaine/crack cocaine use (Jeffries and Johnson, 2018; Shoptaw et al., 2009), 33.3 % (2/6) indicated a negative association (Jeffries and Johnson, 2018), and 16.7 % (1/6) indicated a nonsignificant association (Watson et al., 2023).

Jeffries and Johnson (2018; poor quality rating) observed a positive association between internalized SMS and contemporaneous reports of past-year cocaine use among gay men in their predominantly White sample (RR = 3.54, $p = .011$); however, among bisexual men in their sample, an inverse relationship was observed such that those with greater levels of internalized SMS were less likely to report past-year use of cocaine (RR = 0.25, $p < .001$) or crack cocaine (RR = 0.18, $p = .026$). Analogous estimates were observed for each group in both of two subsequent analyses. Of note, crack cocaine use among gay men could not be analyzed in this study because none of the gay-identified participants in the internalized SMS exposure group reported past-year crack cocaine use.

Shoptaw et al. (2009; fair quality rating) observed contemporaneous, positive associations between internalized SMS, assessed by Internalized Homonegativity Inventory (Mayfield, 2001) total scale score, and cocaine/crack cocaine use, confirmed by urinalysis (MD = 7.6, $p < .001$) as well as self-reported in the past 6 months (MD = 4.9, $p = .005$), among a majority Black and Latino sample. This pattern of findings was replicated when examining two of three subscale scores (i.e., gay affirmation and morality of homosexuality but not personal homonegativity). Conversely, Watson et al. (2023; fair quality rating) did not observe an association between internalized SMS and contemporaneous reports of past-3-month cocaine use at baseline or when examining contemporaneous effects using longitudinal data among Black and Latino SMM.

3.4. Prescription stimulant use

3.4.1. Enacted SMS

One estimate of an enacted SMS–prescription stimulant use association was reported by Kecojevic et al. (2015; poor quality rating) among a racially/ethnically diverse sample. The authors did not observe a significant association between enacted SMS and contemporaneously reported number of prescription stimulant pills misused in the past 6 months.

3.4.2. Internalized SMS

Two estimates of internalized SMS–prescription stimulant use associations were reported in two studies (Kecojevic et al., 2015; Watson et al., 2023), both of which were nonsignificant. Kecojevic et al. (2015; poor quality rating) did not observe a significant association between internalized SMS and contemporaneously reported number of prescription stimulant pills misused in the past 6 months among a racially/ethnically diverse sample. Among Black and Latino SMM, Watson et al. (2023; fair quality rating) did not observe a significant association between internalized SMS and contemporaneous reports of past-3-month prescription stimulant misuse in bivariate analysis at baseline or when examining contemporaneous effects using longitudinal data.

4. Discussion

The goal of this review was to explore the extant empirical literature on the quantitative associations between minority stressors and stimulant use among US adult SMM. Our results highlight that substantial heterogeneity characterizes the existing evidence. Significant minority stressor–stimulant use associations were reported in nearly half of the included studies but the majority of reported estimates indicated no association and, surprisingly, four estimates indicated a negative association. To gain an understanding of factors that may be driving this heterogeneity, we synthesized findings separately for each pairing of a minority stressor (i.e., enacted SMS, internalized SMS) with a stimulant use outcome (i.e., composite, methamphetamine, cocaine/crack cocaine, prescription stimulants).

Regarding composite stimulant use outcomes, we found very little support for an association with either enacted or internalized SMS alongside several nonsignificant estimates. The only observed positive estimates corresponded to a measure of SMS-related physical assault estimated to be nonsignificant in a subsequent analysis (Batchelder et al., 2020) and a single-item measure of internalized SMS (Johnson et al., 2008). While such results may indicate a lack of association between internalized or enacted SMS and stimulant use broadly, they may also be a product of the composite operationalizations used. It is possible that, by creating a single variable to encompass the use of several stimulants, differential relationships between minority stressors and the constitutive stimulants may be obscured. Indeed, findings pertaining to methamphetamine and cocaine/crack cocaine use suggest this to be the case.

Findings on methamphetamine use and enacted SMS suggest a positive association exists, particularly among Black and Latino SMM. The strongest evidence for an association of enacted SMS with methamphetamine use was a positive prospective estimate reported across three analyses (Li et al., 2018), supported by a positive contemporaneous estimate pertaining to sexualized use reported across two analyses (Takada et al., 2021). The only null estimate of this association corresponded to a measure of SMS-related microaggressions (Kalinowski et al., 2022), suggesting that the relationship between enacted SMS with methamphetamine use may be driven by experiences more intense than microaggressions.

Findings on methamphetamine use and internalized SMS were mixed in terms of both significance and direction of association. Positive and negative estimates reported among gay and bisexual men, respectively, suggest sexual orientation may play a moderating role (Jeffries and Johnson, 2018). One possible explanation for these findings is that internalized SMS may impact gay and bisexual men's community participation differently. For example, bisexual men with greater levels of internalized SMS may be more likely to avoid interacting with other SMM compared to gay men, thereby decreasing their exposure to triggers for social or sexualized use. The only other inverse association observed between internalized SMS and methamphetamine use was reported among a sample in which those with methamphetamine urinalysis data were majority gay men (Shoptaw et al., 2009) and, thus, does not appear to be explained by sexual orientation.

Findings on cocaine/crack cocaine use suggest an association with internalized SMS exists. Evidence for a positive association included two positive estimates among a predominantly Black and Latino sample in Los Angeles (Shoptaw et al., 2009), although this finding was not replicated by Watson et al. (2023) among a Black and Latino US national sample. An additional positive association between internalized SMS and cocaine/crack cocaine use was observed among gay-identified SMM recruited as part of a probability-based US national sample (Jeffries and

Johnson, 2018), suggesting this relationship may generalize to other racial/ethnic groups. Jeffries and Johnson (2018) also observed inverse associations between internalized SMS and cocaine as well as crack cocaine use among bisexual men, again suggesting moderation by sexual orientation.

We found a paucity of research examining the relationship between cocaine/crack cocaine use and enacted SMS as well as between prescription stimulant misuse and enacted or internalized SMS. Only three studies examined any of these relationships, none finding a significant association. However, this may be attributable to the operationalizations used in two such cases. Firstly, Kalinowski et al. (2022) examined SMS-related microaggressions, which may not be of sufficient intensity to drive cocaine/crack cocaine use (as appears to be the case with methamphetamine). Secondly, Kecojevic et al. (2015) assessed self-reported number of prescription stimulants pills misused in the past six months, which is highly susceptible to recall bias (Wilson et al., 2009).

No studies examined the use of naturally occurring or synthetic cathinone (i.e., khat or "bath salts"). However, this likely reflects a low prevalence of use in the United States. Indeed, the US prevalence of synthetic cathinone use among people aged 12 or older in 2021 was less than 0.1 % (Substance Abuse and Mental Health Services Administration, 2022). While research on khat use in the United States is limited, it is believed to be primarily restricted to individuals who have immigrated from countries where use is common (e.g., Ethiopia, Somalia, Yemen; Nakajima et al., 2017).

While measurement and psychometrics were not the focus of this review, we did observe substantial heterogeneity in the measurement of minority stressors across included studies. All minority stress variables were assessed via self-report measures, but only about half were assessed using a cited measurement tool that was not reported as being adapted. Thus, differences in measurement and susceptibility to measurement error across the various operationalizations of minority stress examined in this review may have also contributed to the heterogeneity of evidence observed.

4.1. Limitations of this review

This review is not without limitations. First, as with any review, our findings rely on the rigor of research presented in primary studies. Although we made efforts though quality assessment to identify and consider the impact of bias in primary studies, quality assessment is also reliant on accurate and full reporting. It is possible that important aspects of primary studies were not reported. For example, although some studies reported nonsignificant associations derived from preliminary analyses, others may have omitted such results. Second, this review may be biased towards studies finding significant associations, as we did not capture unpublished results or assess reporting bias. Third, included studies varied widely in terms of measurement and analytic methods, producing a variety of different estimates that preclude meta-analysis and necessitate caution in making direct comparisons across studies.

Fourth, we selected for samples of majority cisgender SMM, thereby precluding generalizability of findings to transgender men. Fifth, while resilience factors were considered to be outside the scope of our review, these have been identified as important aspects of the minority stress model for their hypothesized ability to buffer against negative effects (Meyer, 2015). As such, resilience factors may warrant consideration by future reviews on this topic. Finally, this review was limited to the examination of minority stress and stimulant use and, thus, did not examine other mental health conditions. Though extant research has established other mental health conditions (e.g., depression) as both associated with minority stress exposure (Meyer, 2003) and common comorbidities of substance use disorders (Schuckit, 2006), the role of such conditions in the relationship between minority stress and stimulant use among SMM was not examined in this review. As such, we are unable to disentangle the effects of mental health comorbidities that may be independent of minority stress.

4.2. Implications

4.2.1. Future research

Overall, only five or fewer studies examined any one minority stressor–stimulant pair described here, indicating that more research on these relationships among US adult SMM is necessary. Such future research will be critical to replicate preliminarily-supported associations, provide clarification on associations with mixed extant evidence, and build an evidence base for associations that remain understudied. Furthermore, nearly all studies included in this review were cross-sectional in nature, highlighting the need for prospective examinations. Most studies included majority or exclusively Black and Latino SMM as well as recruited only from urban areas, and many studies included only SMM aged 30 years or younger. As such, additional studies covering the breadth of demographic diversity among SMM will be necessary to ensure that findings generalize across the population or are accurately identified to differ by these demographic factors.

We recommend that those conducting future research on minority stress and stimulant use among US adult SMM examine the use of various stimulants independently, rather than in composite, to avoid the possibility of obscuring unique relationships between specific minority stressors and stimulants. Given the heterogeneity of tools used to measure SMS across studies included in this review, we also recommend researchers consult existing psychometric reviews (e.g., Aggarwal et al., 2024) to inform their operationalizations of minority stress. In addition, we recommend that researchers explore the possibility of moderation by sexual orientation whenever feasible, as nearly all negative effect estimates retrieved for this review were observed among bisexual subsamples.

Notably, no studies reviewed here examined anticipated SMS or identity concealment. Future examination of these constructs is necessary to cover the breadth of SMM-specific stressors posited by minority stress theory (Meyer, 2003). Additionally, no studies reviewed here included rejection sensitivity or trait neuroticism in their analyses. Given Feinstein's (2020) extension of minority stress theory to include reaction sensitivity, examination of this construct in the context of minority stress is warranted. And, if trait neuroticism is indeed determined to be a potential confounder of minority stress effects, control for such confounding would also be warranted in future research.

4.2.2. Clinical practice

Substantial heterogeneity in the evidence base identified by this review precludes us from making sweeping clinical practice recommendations across the domains of minority stress and stimulant use. Nevertheless, findings pertaining to specific minority stressor–stimulant pairs may have implications for clinical practice. Regarding enacted SMS, multi-level approaches that decrease exposure while also supporting adaptive coping skills may prove beneficial for SMM who use methamphetamine. Regarding internalized SMS, cognitive behavioral approaches to restructure self-stigmatizing beliefs or promote cognitive defusion from associated thoughts may prove beneficial for SMM who use cocaine/crack cocaine. However, findings suggest that care should be taken to monitor for and mitigate potential downstream increases in stimulant use risk among bisexual-identified SMM when addressing internalized SMS.

4.3. Summary

This systematic review synthesizes existing evidence on the quantitative association between minority stress and stimulant use among cisgender, adult SMM in the United States. Findings from thirteen reports, selected for inclusion based on a comprehensive search and screening strategy, differed on the basis of minority stressors and stimulants assessed. We found very little support for an association between

composite stimulant use outcomes and enacted or internalized SMS. Findings specific to methamphetamine use suggest a positive association with enacted SMS, particularly among Black and Latino SMM, though were mixed with regard to internalized SMS. Those specific to cocaine/crack cocaine use suggest a positive association with internalized SMS. Some evidence, though limited, suggests sexual orientation may moderate internalized SMS effects on stimulant use; however, this has not been tested with regards to enacted SMS. Finally, there was a paucity of research examining cocaine/crack cocaine use and enacted SMS as well as prescription stimulant misuse and minority stress generally, and no studies examined anticipated SMS or identity concealment.

Implications for future research and clinical practice were identified. Additional research will be critical to replicate associations supported in our review, provide clarification on those with mixed extant evidence, and build an evidence base for those that remain understudied. Further, studies covering the breadth of racial/ethnic and geographic diversity among SMM will be necessary to ensure that findings generalize across the population or are accurately identified to differ among these demographics. For those conducting such research, we recommend examining the use of various stimulants as independent outcomes, rather than in composite, as well as testing for moderation by sexual orientation. Regarding clinical practice, findings suggest that multi-level approaches to decrease exposure to enacted SMS and support adaptive coping skills may prove beneficial for SMM who use methamphetamine whereas individual-level approaches to address internalized SMS may prove beneficial for SMM who use cocaine/crack cocaine.

CRediT authorship contribution statement

Michael Miller-Perusse: Writing – original draft, Visualization, Methodology, Investigation, Funding acquisition, Formal analysis, Conceptualization.**Keith J. Horvath:** Writing – review & editing, Supervision. **Jessica L. Montoya:** Writing – review & editing, Supervision. **David J. Moore:** Writing – review & editing, Supervision. **Adam W. Carrico:** Writing – review & editing, Supervision. **Vanessa B. Serrano:** Writing – original draft, Methodology, Investigation, Funding acquisition.

Disclaimer

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Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. Search strategy for each database

PubMed search strategy

((("sexual"[TIAB] AND "minority"[TIAB]) OR "sexual minority"[TIAB] OR ("sexual"[TIAB] AND "minorities"[TIAB]) OR "sexual minorities"[TIAB] OR "gay"[TIAB] OR "gays"[TIAB] OR "bisexual*"[TIAB] OR "homosexual*"[TIAB] OR "non heterosexual*"[TIAB] OR "non-heterosexual*"[TIAB] OR "nonheterosexual*"[TIAB] OR ("men"[TIAB] AND "who"[TIAB] AND "sex"[TIAB] AND "men"[TIAB]) OR "men who have sex with men"[TIAB] OR "msm"[TIAB] OR "LGB"[TIAB] OR "sexual and gender minorities"[MH:noexp] OR "homosexuality"[MH:noexp] OR "homosexuality, male"[MH] OR "bisexuality"[MH]) AND ("minority stress"[TIAB] OR "stigma*"[TIAB] OR "homophob*"[TIAB] OR "homonegativ*"[TIAB] OR "heterosexis*"[TIAB] OR "discriminat*"[TIAB] OR "victim*"[TIAB] OR "reject*"[TIAB] OR "conceal*"[TIAB] OR "outness"[TIAB] OR "disclos*"[TIAB] OR "non disclos*"[TIAB] OR "non-disclos*"[TIAB] OR "nondisclos*"[TIAB] OR "microaggress*"[TIAB] OR "homophobia"[MH] OR "perceived discrimination"[MH] OR "social stigma"[MH] OR "rejection, psychology"[MH] OR "crime victims"[MH] OR "prejudice" [MH] OR "microaggression"[MH]) AND (("illicit"[TIAB] AND "drug*"[TIAB]) OR "illicit drug*"[TIAB] OR ("illicit"[TIAB] AND "substance*"[TIAB]) OR "illicit substance*"[TIAB] OR "stimulant"[TIAB] OR "stimulants"[TIAB] OR "methamphetamine"[TIAB] OR "meth"[TIAB] OR "cocaine"[TIAB] OR ("crack"[TIAB] AND "cocaine"[TIAB]) OR "crack cocaine"[TIAB] OR "crack"[TIAB] OR "amphetamine*"[TIAB] OR "dextroamphetamine"[TIAB] OR "methylphenidate"[TIAB] OR "cathinone*"[TIAB] OR "khat"[TIAB] OR ("bath"[TIAB] AND "salt*"[TIAB]) OR "bath salt*"[TIAB] OR "crystal"[TIAB] OR "other drug*"[TIAB] OR "other substance*"[TIAB] OR "methamphetamine"[NM] OR "cocaine"[NM] OR "amphetamine*"[NM] OR "dextroamphetamine"[NM] "methylphenidate"[NM] OR "cathinone*"[NM] OR "amphetamines"[MH] OR "methylphenidate"[MH] OR "methamphetamine"[MH] OR "cocaine"[MH] OR "crack cocaine"[MH] OR "amphetamine related disorders"[MH] OR "cocaine related disorders"[MH] OR "cocaine smoking"[MH] OR "illicit drugs"[MH] OR "substance abuse, oral"[MH] OR "substance abuse, intravenous"[MH] OR "central nervous system stimulants"[MH] OR "central nervous system stimulants"[PA]))

PsycInfo search strategy

(((TI (("sexual" AND "minority") OR "sexual minority" OR ("sexual" AND "minorities") OR "sexual minorities" OR "gay" OR "gays" OR "bisexual*" OR "homosexual*" OR "non heterosexual*" OR "non-heterosexual*" OR "nonheterosexual*" OR ("men" AND "who" AND "sex" AND "men") OR "men who have sex with men" OR "MSM" OR "LGB")) OR (AB (("sexual" AND "minority") OR "sexual minority" OR ("sexual" AND "minorities") OR "sexual minorities" OR "gay" OR "gays" OR "bisexual*" OR "homosexual*" OR "non heterosexual*" OR "non-heterosexual*" OR "nonheterosexual*" OR ("men" AND "who" AND "sex" AND "men") OR "men who have sex with men" OR "MSM" OR "LGB")) OR (TM (("sexual" AND "minority") OR "sexual minority" OR ("sexual" AND "minorities") OR "sexual minorities" OR "gay" OR "gays" OR "bisexual*" OR "homosexual*" OR "non heterosexual*" OR "non-heterosexual*" OR "nonheterosexual*" OR ("men" AND "who" AND "sex" AND "men") OR "men who have sex with men" OR "MSM" OR "LGB")) OR (DE ("LGBTQ" OR "Sexual Minority Groups" OR "Sexual Orientation" OR "Sexual Identity" OR "Bisexuality" OR "Homosexuality" OR "Male Homosexuality")) OR (MA ("sexual and gender minorities" OR "homosexuality" OR "homosexuality, male" OR "bisexuality"))) AND ((TI ("minority stress" OR "stigma*" OR "homophob*" OR "homonegativ*" OR ‘‘heterosexis*’’ OR "discriminat*" OR "victim*" OR "reject*" OR "conceal*" OR "outness" OR "disclos*" OR "non disclos*" OR "non-disclos*" OR "nondisclos*" OR "microaggress*")) OR (AB ("minority stress" OR "stigma*" OR "homophob*" OR "homonegativ*" OR "heterosexis*" OR "discriminat*" OR "victim*" OR "reject*" OR "conceal*" OR "outness" OR "disclos*" OR "non disclos*" OR "non-disclos*" OR "nondisclos*" OR "microaggress*")) OR (TM ("minority stress" OR "stigma*" OR "homophob*" OR

"homonegativ*" OR "discriminat*" OR "victim*" OR "reject*" OR "conceal*" OR "outness" OR "disclos*" OR "non disclos*" OR "non-disclos*" OR "nondisclos*" OR "microaggress*")) OR (DE ("Minority Stress" OR "Homosexuality (Attitudes Toward)" OR "Social Discrimination" OR "Stigma" OR "Prejudice" OR "Victimization" OR "Hate Crimes" OR "Crime Victims" OR "Microaggression" OR "Self-Stigma" OR "Self-Acceptance" OR "Social Acceptance" OR "Social Connectedness" OR "Belonging" OR "Self-Disclosure" OR "Coming Out")) OR (MA ("homophobia" OR "perceived discrimination" OR "social stigma" OR "rejection, psychology" OR "crime victims" OR "prejudice" or "microaggression"))) AND ((TI (("illicit" AND "drug*") OR "illicit drug*" OR ("illicit" AND "substance*") OR "illicit substance*" OR "stimulant" OR "stimulants" OR "methamphetamine" OR "meth" OR "cocaine" OR ("crack" AND "cocaine") OR "crack cocaine" OR "crack" OR "amphetamine*" OR "dextroamphetamine" OR "methylphenidate" OR "cathinone*" OR "khat" OR ("bath" AND "salt*") OR "bath salt*" OR "crystal" OR "other drug*" OR "other substance*")) OR (AB (("illicit" AND "drug*") OR "illicit drug*" OR ("illicit" AND "substance*") OR "illicit substance*" OR "stimulant" OR "stimulants" OR "methamphetamine" OR "meth" OR "cocaine" OR ("crack" AND "cocaine") OR "crack cocaine" OR "crack" OR "amphetamine*" OR "dextroamphetamine" OR "methylphenidate" OR "cathinone*" OR "khat" OR ("bath" AND "salt*") OR "bath salt*" OR "crystal" OR "other drug*" OR "other substance*")) OR (TM (("illicit" AND "drug*") OR "illicit drug*" OR ("illicit" AND "substance*") OR "illicit substance*" OR "stimulant" OR "stimulants" OR "methamphetamine" OR "meth" OR "cocaine" OR ("crack" AND "cocaine") OR "crack cocaine" OR "crack" OR "amphetamine*" OR "dextroamphetamine" OR "methylphenidate" OR "cathinone*" OR "khat" OR ("bath" AND "salt*") OR "bath salt*" OR "crystal" OR "other drug*" OR "other substance*")) OR (DE ("Amphetamines" OR "Methamphetamine" OR "Cocaine" OR "Crack Cocaine" OR "Dextroamphetamine" OR "Methylphenidate" OR "CNS Stimulating Drugs" OR "Intravenous Drug Usage" OR "Substance Use Disorder")) OR (MA ("amphetamines" OR "methylphenidate" OR "methamphetamine" OR "cocaine" OR "crack cocaine" OR "amphetamine related disorders" OR "cocaine related disorders" OR "cocaine smoking" OR "illicit drugs" OR "substance abuse, oral" OR "substance abuse, intravenous" OR "central nervous system stimulants"))))

CINAHL search strategy

((TI (("sexual" AND "minority") OR "sexual minority" OR ("sexual" AND "minorities") OR "sexual minorities" OR "gay" OR "gays" OR "bisexual*" OR "homosexual*" OR "non heterosexual*" OR "non-heterosexual*" OR "nonheterosexual*" OR ("men" AND "who" AND "sex" AND "men") OR "men who have sex with men" OR "MSM" OR "LGB")) OR (AB (("sexual" AND "minority") OR "sexual minority" OR ("sexual" AND "minorities") OR "sexual minorities" OR "gay" OR "gays" OR "bisexual*" OR "homosexual*" OR "non heterosexual*" OR "non-heterosexual*" OR "nonheterosexual*" OR ("men" AND "who" AND "sex" AND "men") OR "men who have sex with men" OR "MSM" OR "LGB")) OR (MH ("LGBTQ+ Persons" OR "Bisexuals" OR "Gay Persons" OR "Gay Men" OR "Sexual and Gender Minorities" OR "Sexual Orientation" OR "Bisexuality" OR "Sexual Identity" OR "Homosexuality"))) AND ((TI ("minority stress" OR "stigma*" OR "homophob*" OR "homonegativ*" OR "heterosexis*" OR "discriminat*" OR "victim*" OR "reject*" OR "conceal*" OR "outness" OR "disclos*" OR "non disclos*" OR "non-disclos*" OR "nondisclos*" OR "microaggress*")) OR (AB ("minority stress" OR "stigma*" OR "homophob*" OR "homonegativ*" OR "heterosexis*" OR "discriminat*" OR "victim*" OR "reject*" OR "conceal*" OR "outness" OR "disclos*" OR "non disclos*" OR "non-disclos*" OR "nondisclos*" OR "microaggress*")) OR (MH ("Minority Stress" OR "Homophobia" OR "Attitude to Sexuality" OR "Stigma" OR "Social Status" OR "Prejudice" OR "Discrimination" OR "Perceived Discrimination" OR "Microaggressions" OR "Crime Victims" OR "Coming Out Sexual Orientation"))) AND ((TI (("illicit" AND "drug*") OR "illicit drug*" OR ("illicit" AND "substance*") OR "illicit substance*" OR "stimulant" OR "stimulants" OR "methamphetamine" OR "meth" OR "cocaine" OR ("crack" AND "cocaine") OR "crack cocaine" OR "crack" OR "amphetamine*" OR "dextroamphetamine" OR "methylphenidate" OR "cathinone*" OR "khat" OR ("bath" AND "salt*") OR "bath salt*" OR "crystal" OR "other drug*" OR "other substance*")) OR (AB (("illicit" AND "drug*") OR "illicit drug* " OR ("illicit" AND "substance*") OR "illicit substance*" OR "stimulant" OR "stimulants" OR "methamphetamine" OR "meth" OR "cocaine" OR ("crack" AND "cocaine") OR "crack cocaine" OR "crack" OR "amphetamine*" OR "dextroamphetamine" OR "methylphenidate" OR "cathinone*" OR "khat" OR ("bath" AND "salt*") OR "bath salt*" OR "crystal" OR "other drug*" OR "other substance*")) OR (MH ("Street Drugs" OR "Crack Cocaine" OR "Cocaine" OR "Methylphenidate" OR "Amphetamine" OR "Dextroamphetamine" OR "Central Nervous System Stimulants" OR "Methamphetamine" OR "Substance Abuse, Intravenous" OR "Substance Use Disorders")))

Scopus search strategy

TITLE-ABS-KEY((("sexual" AND "minority") OR "sexual minority" OR ("sexual" AND "minorities") OR "sexual minorities" OR "gay" OR "gays" OR "bisexual*" OR "homosexual*" OR "non heterosexual*" OR "non-heterosexual*" OR "nonheterosexual*" OR ("men" AND "who" AND "sex" AND "men") OR "men who have sex with men" OR "MSM" OR "LGB") AND ("minority stress" OR "stigma*" OR "homophob*" OR "homonegativ*" OR "heterosexis*" OR "discriminat*" OR "victim*" OR "reject*" OR "conceal*" OR "outness" OR "disclos*" OR "non disclos*" OR "non-disclos*" OR "nondisclos*" OR "microaggress*") AND (("illicit" AND "drug*") OR "illicit drug*" OR ("illicit" AND "substance*") OR "illicit substance*" OR "stimulant" OR "stimulants" OR "methamphetamine" OR "meth" OR "cocaine" OR ("crack" AND "cocaine") OR "crack cocaine" OR "crack" OR "amphetamine*" OR "dextroamphetamine" OR "methylphenidate" OR "cathinone*" OR "khat" OR ("bath" AND "salt*") OR "bath salt*" OR "crystal" OR "other drug*" OR "other substance*"))

Appendix B. Supporting information

Supplementary data associated with this article can be found in the online version at doi:10.1016/j.dadr.2025.100333.

Data availability

This review was not registered prior to being conducted. For access to materials related to the conduct of this review—including protocol documentation, data extraction forms, data obtained through extraction, and analytic code—please contact the authors.

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