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A Socioecological Mixture Model of Asthma Prevalence Among Sexual Minority Adults in the United States

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Abstract

Purpose: Sexual minority (SM) identity as well as sociodemographic and socioeconomic factors are associated with asthma prevalence. A syndemics framework analyzes disease conditions in a population and the social, economic, and environmental contexts in which they are found. We used a syndemic model of individual-level socioecological factors to identify profiles of asthma prevalence among SM adults.
Methods: Latent class analysis (LCA) was conducted on a subpopulation of SM adults aged 18–59 years from the 2001 to 2016 National Health and Nutrition Examination Survey. Indicators in the LCA model included current asthma, gender, sexual identity, poverty-income ratio, education, and serum cotinine level. Multinomial logistic regression analyzed the effects of covariates (race/ethnicity, nativity, age, marital status, body mass index, lifetime smoking, and mental health care seeking) on identified profiles.
Results: Four classes were identified among our sample of $n = 1097$ SM adults. Classes 1 and 2 had 19% and 18% conditional probabilities of current asthma, respectively, and were primarily female and bisexual. Classes 3 and 4 had 5% and 2% conditional probabilities of asthma, respectively, and were primarily male and gay. Classes 1 and 3 also had conditional probabilities of high income and educational attainment. Black individuals had higher odds than White individuals of being in Class 1 (odds ratio [OR] = 4.46, 95% confidence interval [CI] = 1.43–13.93), Class 2 (OR = 21.66, 95% CI = 7.50–62.60), and Class 4 (OR = 7.41, 95% CI = 2.05–26.71), relative to Class 3.
Conclusion: Findings extend past literature that suggests within-group asthma disparities among SM adults. Informational campaigns on asthma management should target this community to avoid severe disease exacerbations.

Keywords: asthma, bisexual disparities, health disparities, minority stress, sexual minority, socioecological model

Introduction

Eight percent of adults in the United States (US) had asthma as of 2019, although the disease is more prevalent among women (9.8%) than men (6.1%).[1] Asthma causes inflammation of the airways and leads to coughing and wheezing. In the absence of proper management, asthma can lead to poor quality of life and enormous financial burden for those afflicted.[2] However, asthma does not affect everyone equally; it is more prevalent among low-socioeconomic status (SES), racial/ethnic minority, and sexual minority (SM) individuals.[3]

Disparities in asthma incidence and severity are driven by complex interactions of social, structural, behavioral, and, to a lesser degree, biological factors.[2] Although the mechanistic pathway is uncertain, current literature has found that in high-income countries, low SES, often assessed by education and income level, is associated with high asthma prevalence and severity as well as treatment failure.[4–6] In addition, racial/ethnic disparities in asthma outcomes, such as among

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Puerto Rican and non-Hispanic Black individuals, are driven by an unequal burden of socioenvironmental exposures, including pollution, tobacco smoke, and experiences of racism, in minority communities.[3,7,8]

SM people face widespread discrimination, violence, and homophobia. Little research has analyzed asthma prevalence among this community; however, numerous studies have documented greater asthma risk among SM individuals, particularly women, compared with their heterosexual peers.[9–11] Asthma risk factors, including smoking and obesity, are more prevalent among SM individuals and obesity among SM women may contribute to higher asthma prevalence among this group compared with heterosexual women.[12]

However, current knowledge of the effects of these risk factors on asthma prevalence among SM adults is limited.[12] In addition, bisexual individuals seem to have higher asthma prevalence than gay/lesbian individuals although current research is inconclusive.[12,13]

Asthma and other substantive mental and physical health disparities among SM individuals[14–16] may be partially explained by theories of minority stress that posit a causal relationship between stress endured as a result of discrimination and exacerbations of poor health.[17–19] Homophobia, discrimination, and internalized stigma lead to heightened levels of stress relative to the experiences of heterosexual individuals.[17] This so-called minority stress can worsen physiological health indirectly, through increasing health behaviors such as smoking and substance use,[20] and possibly directly, through allostatic load.[19,21]

Higher prevalence of tobacco use among SM individuals can worsen asthma severity leading to reduced lung function, altered lung inflammatory response, and increased use of emergency care.[22–25] Further, there is emerging evidence of a potential causal relationship between tobacco exposure and asthma in adults and children.[25,26] Despite these associations, asthma disparities persist even when controlling for higher smoking prevalence and obesity among SM individuals.[27]

A syndemics framework can be used to understand disease conditions in a population and the social, economic, and environmental contexts in which they are found.[28,29] The socioecological model of health recognizes that health is affected by complex and interacting influences from individual to community and societal factors. Individual-level socioecological factors are biological and personal characteristics such as income, education, health history, and substance use.[30]

Although associations between individual-level socioecological factors and asthma are established, the synergistic influence of these factors on asthma prevalence is not well understood. Latent class analysis (LCA) is a method used to identify unobserved and mutually exclusive subgroups of individuals in a population and allows researchers to evaluate, through a syndemic framework, how social conditions and disease factors cluster in populations.[31] Given this, our aim was to use LCA to identify subgroups of SM adults in the United States based on individual-level socioecological factors, including current asthma.

Methods

Study population

Our analyses used participant data from a subpopulation of SM adults from the 2001 to 2016 National Health and Nutrition Examination Survey (NHANES). The NHANES is a nationally representative, cross-sectional health and nutrition survey conducted each year by the National Center for Health Statistics (NCHS) at the Centers for Disease Control and Prevention (CDC). The survey uses a complex, four-stage probability sampling design to select a representative sample of the target, non-institutionalized US-resident civilian population. Further details on NHANES methodology can be found elsewhere.[32] The NHANES data analyzed in the present article are publicly available from the NCHS database.[33]

Between 2001 and 2016, NHANES interviewed 82,097 people. Per NHANES eligibility requirements for the sexual behavior questionnaire, the sexual identity survey item was administered to adults aged 18–59 years. After excluding ineligible participants ($n = 49{,}300$), 32,797 remained. As our target population was SM adults, we further excluded adults who were missing sexual identity information ($n = 6739$) and those who responded ''Straight, that is, not lesbian or gay,'' ''Something else,'' ''I don't know the answer,'' ''Refused'' or ''Don't know'' (males = 12,287, females = 12,674) to the sexual identity survey item. Our final sample consisted of $n = 1097$ individuals.

We conducted a 16-year pooled analysis of the 2001–2016 NHANES. Multi-year sampling weights were constructed using provided 2-year weights in accordance with NHANES analytic guidelines to adjust for survey non-response and sample selection probabilities for the 2001–2016 cycles.[34] Stratum and cluster variables were used to account for complex sampling design. All analyses were conducted using Mplus 8.5 (Muthén & Muthén).[35] Analytical files are available on request. As this research did not involve human subjects, it was exempt from review by the Institutional Review Board at the National Institutes of Health.

Latent class analysis

We conducted LCA to identify latent or hidden profiles of SM adults in the United States based on individual-level socioecological factors, including current asthma. Observed indicator variables were assessed as conditional probabilities, that is, the likelihood of an individual in a given class to have the characteristic defined by the indicator. We used an iterative comparison approach to determine the number of classes for our LCA model. Once the best-fit latent class model was selected, we conducted multinomial logistic regression to regress covariates onto the identified latent classes. Mplus uses maximum likelihood estimation to address missing data in the LCA and listwise deletion in the multinomial logistic regression.

Indicator variables

The binary outcome of current asthma was assessed by the questions, ''Has a doctor or other health professional ever told you that you have asthma? [yes; no]'' and if yes, ''Do you still have asthma? [yes; no].'' Participants who responded ''yes'' to both questions were considered to have current asthma, whereas those who responded ''no'' to either question were considered to not have current asthma. Participants' sexual identities were categorized as gay/lesbian or bisexual based on their self-described sexual orientation. Although the NHANES sexual identity survey item evolved between 2001 and 2016, the 2015 and 2016 item asked: ''Do you think of yourself as… [Lesbian or gay; Straight, that is,

not lesbian or gay; Bisexual; Something else; I don't know the answer; Refused; Don't know].''

The remaining model indicators included gender (male, female), poverty income ratio (PIR) (<1, 1–1.99, 2–3.49, ≥ 3.5), which is calculated by dividing the total family income by the respective poverty threshold for the given survey year, the highest educational attainment (less than high school, high school/general educational development (GED) certificate, some college/associate degree, college graduate or above), and serum cotinine level (≤1, >1 ng/mL). Poverty thresholds are issued annually by the Department of Health and Human Services and vary by family size and geography, with three separate guidelines for the 48 contiguous states and the District of Columbia, Alaska, and Hawaii.[36]

Cotinine is a metabolite of nicotine and is commonly used as a biomarker for tobacco exposure. Non-smokers exposed to average levels of second-hand smoke typically have serum cotinine levels of <1 ng/mL, whereas those exposed to heavy second-hand smoke can have levels between 1 and 10 ng/mL. The serum cotinine cutoff for active smoking is considered 10 ng/mL.[37] Serum cotinine level was reported by NHANES as a continuous variable. Serum specimens are processed, stored, and analyzed at the Division of Laboratory Sciences, National Center for Environmental Health, and CDC. A detailed description of NHANES laboratory methodology for serum cotinine collection and measurement can be found in the NHANES Laboratory Procedures Manual.[38]

Covariates for latent class regression

Sociodemographic covariates included race/ethnicity (Hispanic/Latino, non-Hispanic/Latino Black, non-Hispanic/Latino White, All other races), nativity (U.S. born [50 U.S. states or Washington, DC]; foreign born), age (<35, ≥35), and marital status (married/living with partner, widowed/divorced/separated/never married). The NHANES assessed participants' ethnic identities with the question, ''Do you consider yourself to be Hispanic, Latino or of Spanish origin? [yes; no],'' and racial identities with the question, ''What race or races do you consider yourself to be? Please select one or more. [American Indian or Alaskan Native (AIAN); Asian; Black or African American; Native Hawaiian or Pacific Islander (NHPI); White; Other].''

Participants who responded ''yes'' to the former were considered Hispanic/Latino, and participants who responded ''no'' to the former were categorized by their self-reported race. For the present analysis, the racial category, ''All other races'' included AIAN, Asian, NHPI, and multiracial individuals.

Health covariates were body mass index (normal weight/underweight (<25 kg/m^2), overweight (25–29.9 kg/m^2), obese (≥30 kg/m^2)), lifetime smoker (defined by smoking ≥100 cigarettes in lifetime) (non-smoker, smoker), and mental health care seeking (yes, no), assessed by the question, ''During the past 12 months, have you seen or talked to a mental health professional such as a psychologist, psychiatrist, psychiatric nurse or clinical social worker about your health? [yes; no].''

Model fit assessment

Multiple models, from one- to seven-class solutions, were compared using the following criteria: (1) entropy (2) Bayesian information criterion (BIC) and sample-size-adjusted BIC (ssa-BIC), and (3) theoretical implications.[31] Entropy is a measure of classification precision that takes values between zero and one where a value of one indicates perfect classification of individuals into classes. BIC and ssa-BIC are statistical measures used in model selection that favor models with high likelihoods but implement a penalty based on the number of parameters in the model. Lower values are generally preferred and indicate a more parsimonious model over a more complex one. Therefore, we selected our model for interpretation based on high entropy, parsimony, assessed by low BIC and ssa-BIC, and practical application.

Results

Sample characteristics

Weighted percentages are given. Our sample of 1097 SM adults was primarily female (57%) and bisexual (57%). Non-Hispanic/Latino White adults comprised 70% of the sample, whereas 11% of the sample were Hispanic/Latino, 13% were non-Hispanic/Latino Black, and 6% were All other races. Much of the sample was U.S. born (91%), <35 years old (50%), and not married (60%). Twenty percent of the sample had a PIR <1, 20% had a PIR of 1–1.99, 23% had a PIR of 2–3.49, and 36% had a PIR ≥3.5. Sixty-six percent attained some college education/associate degree or higher.

A serum cotinine level of ≤1 ng/mL was found in 55% of the sample. More than half of the sample (56%) were lifetime smokers, and 80% did not seek mental health care in the past year. Fourteen percent reported current asthma. See Table 1 for complete sample statistics.

Latent class analysis

The four-class solution was selected as the best-fit model. Complete model fit criteria are included as Supplementary Figure S1.

Class 1 represented 27% of the sample and had a 19% conditional probability of current asthma, the highest of any class. This class had high conditional probabilities of being female (79%) and bisexual (71%) as well as having a PIR of ≥3.5 (58%), being a college graduate (54%), and having serum cotinine levels of ≤1 ng/mL (80%).

Class 2 (40% of sample) had an 18% conditional probability of current asthma. Similar to Class 1 class, this class was majority female (78%) and bisexual (83%). The Low-SES Bisexual Female class had a 43% conditional probability of a PIR of <1 and a 0% probability of being a college graduate. In addition, this class had a high conditional probability of serum cotinine levels of >1 ng/mL (71%).

Class 3 (17% of sample) had a 5% conditional probability of current asthma and had high conditional probabilities of being male (100%) and gay/lesbian (95%). This class had the highest SES of any class with an 82% conditional probability of having a PIR of ≥3.5 and a 72% conditional probability of having graduated from college. Class 3 also had the lowest conditional probability of any class of serum cotinine levels of >1 ng/mL at 17%.

Class 4 (15% of sample) had a 2% conditional probability of current asthma. This class had high conditional probabilities of being male (73%) and gay/lesbian (72%). Most of Class 4 had a PIR between 2 and 3.49 (59%) and had

Table 1. Study Sample Characteristics for Model Indicators and Covariates ($n = 1097$)

	n	*Weighted %*
Age		
<35	616	50
≥35	481	50
Gender		
Male	429	43
Female	668	57
Sexual identity		
Gay/Lesbian	419	43
Bisexual	678	57
Race/ethnicity		
White	520	70
Hispanic/Latino	211	11
Black	262	13
Other	104	6
Nativity		
Foreign born	157	9
U.S. born	940	91
Marital status		
Married/living with partner	381	40
Not married[a]	647	60
Missing	69	
PIR		
<1	286	20
1–1.99	250	20
2–3.49	226	23
≥3.5	285	36
Missing	50	
Educational attainment		
Less than high school	185	12
High school/GED certificate	254	21
Some college/associate degree	393	36
College graduate or above	265	30
BMI (kg/m^2)		
<25	422	40
25–29.9	305	27
≥30	348	33
Missing	22	
Serum cotinine (ng/mL)		
≤1	544	55
>1	508	45
Missing	45	
Lifetime smoker		
Non-smoker	480	44
Smoker	585	56
Missing	32	
Sought mental health care in past year		
No	870	80
Yes	227	20
Current asthma		
No	938	86
Yes	158	14
Missing	1	

[a]Widowed/divorced/separated/never married.

BMI, body mass index; GED, general education development; PIR, poverty income ratio; US, United States.

received some college education or an associate degree (54%). Finally, this class had a 62% conditional probability of serum cotinine levels of >1 ng/mL. Complete conditional probabilities for all classes can be found in Table 2.

Latent class regression

The regression analysis included = 1007 individuals. Ninety observations were removed from the sample due to listwise deletion of missing data for the latent class regression. Class 3 was selected as the reference class as gay, male, and high-SES individuals have lower asthma prevalence than their bisexual, female, and lower-SES counterparts.[1,5,12]

Controlling for other factors, Black individuals, compared with White individuals, were at higher odds of being in Class 1 (odds ratio (OR) = 4.46, 95% confidence interval (CI) = 1.43–13.93), Class 2 (OR = 21.66, 95% CI = 7.50–62.60), and Class 4 (OR = 7.41, 95% CI = 2.05–26.71), relative to Class 3. Hispanic/Latino individuals also had greater odds than White individuals of being in Class 2 (OR = 3.34, 95% CI = 1.35–8.25) and Class 4 (OR = 3.12, 95% CI = 1.04–9.33).

Compared with adults ≥35 years of age, younger individuals had increased odds of being in Class 1 (OR = 1.91, 95% CI = 1.01–3.63) and Class 2 (OR = 5.14, 95% CI = 2.60–10.16), relative to Class 3. Lifetime smokers had higher odds of being in Class 2 (OR = 7.64, 95% CI = 3.74–15.63) and Class 4 (OR = 4.43, 95% CI = 1.64–11.96) compared with non-smokers. Lastly, those who sought mental health care in the past year had higher odds of being in Class 1

Table 2. Conditional Probabilities for the Four-Class Solution Model

	Class 1 (27%)	*Class 2 (40%)*	*Class 3 (17%)*	*Class 4 (15%)*
Current asthma				
No	0.81	0.82	0.95	0.98
Yes	0.19	0.18	0.05	0.02
Gender				
Male	0.21	0.22	1.00	0.73
Female	0.79	0.78	0.00	0.27
Sexual identity				
Gay/Lesbian	0.29	0.17	0.95	0.72
Bisexual	0.71	0.83	0.05	0.28
PIR				
<1	0.03	0.43	0.05	0.19
1–1.99	0.15	0.33	0.05	0.17
2–3.49	0.25	0.12	0.08	0.59
≥3.5	0.58	0.12	0.82	0.06
Educational attainment				
Less than high school	0.00	0.32	0.02	0.00
High school/GED	0.13	0.30	0.04	0.35
Some college/ associate degree	0.33	0.38	0.22	0.54
College graduate or above	0.54	0.00	0.72	0.12
Serum cotinine (ng/mL)				
≤1	0.80	0.29	0.83	0.39
>1	0.20	0.71	0.17	0.62

(OR = 3.37, 95% CI = 1.29–8.83) and Class 2 (OR = 3.41, 95% CI = 1.24–9.35), relative to Class 3. Latent class regression results can be found in Table 3.

Discussion

Our LCA on a nationally representative sample of US SM adults allowed for a holistic analysis of the individual-level socioecological factors that affect asthma morbidity and disparities. We identified four classes of SM adults at varying risk levels for asthma. Two profiles were found to have a high prevalence of asthma and were markedly female and bisexual. The remaining profiles were majority male and gay/lesbian and were found to have a very low prevalence of asthma. The multinomial logistic regression revealed that those who were younger, identified as racial/ethnic minority individuals, and sought mental health care had greater odds of being in the high-asthma-prevalence classes, relative to Class 3.

Classes 1 and 2 were characterized by high conditional probabilities of female gender and bisexuality. A high volume of literature has illustrated stark asthma disparities in SM populations, most consistently among SM women.[9–11,16] However, few studies have directly compared asthma prevalence in gay/lesbian and bisexual individuals. In one such study, Fredriksen-Goldsen et al.[13] compared the health of gay/lesbian and bisexual women separately and found that bisexual women were more likely to be diagnosed with asthma and to have poor physical health when compared with their heterosexual peers, while observing no such disparity among gay/lesbian women.

Despite this finding, many other studies have observed asthma disparities among both gay/lesbian and bisexual women.[9,16,39] Among SM men, asthma disparities have been observed most regularly, although not exclusively, among bisexual individuals.[9–11] Overall, physical and mental health disparities are more numerous among bisexual men and women than among gay/lesbian individuals, when compared with heterosexual individuals.[39,40] For instance, Dyar et al.[41] repeatedly found that bisexual individuals were at the highest risk for adverse physical health outcomes compared with gay/lesbian and heterosexual individuals, whether sexuality was defined by identity, attraction, or behavior.

Key among the causes for these disparities are stigma, discrimination, and experiences of SM stress unique to bisexual individuals.[42] These distinct stressors include anti-bisexual bias from both the heterosexual and gay/lesbian communities as well as microaggressions about their sexual promiscuity and the reality of their sexual identity.[41,43] Katz-Wise et al.[44] demonstrated that bisexual-specific minority stress is associated with poorer overall health and is a distinct form of prejudice uniquely experienced by bisexual people. The clustering between bisexual identity and asthma prevalence in the present analysis is consistent with past literature that has found unique and numerous health disparities among bisexual individuals, particularly bisexual women.

The potential confounding role of female gender in the relationship between bisexuality and asthma prevalence is important to consider. Adult women in the United States have a higher prevalence of asthma than adult men[1] and are more likely to identify as bisexual.[45] Although Classes 1 and 2 were majority female and Classes 3 and 4 were majority male, gender differences alone do not account for the significant asthma disparity between profiles. The conditional probabilities of asthma in Classes 1 and 2 (nearly 20% in each) were considerably greater than the prevalence of asthma among U.S. adult women overall (9.8%).[1]

Although our findings suggest greater prevalence of asthma among bisexual individuals, there is a profound lack of research on asthma disparities among the SM community. More research is needed to compare asthma risk among SM individuals with careful attention to the role of minority stress.

Minority stress also has detrimental effects on the mental health of those who experience it. Bisexual people have higher rates of mental health problems than both heterosexual and gay/lesbian individuals, including anxiety and depression.[42,46] Consistent with this literature, the present study revealed that mental health care recipients had higher

Table 3. Odds Ratios and 95% Confidence Intervals from Multivariate Logistic Regression, $n = 1007$

	Class 1			*Class 2*			*Class 4*		
		95% CI			*95% CI*			*95% CI*	
	OR	*Lower*	*Upper*	*OR*	*Lower*	*Upper*	*OR*	*Lower*	*Upper*
Hispanic/Latino[a]	1.72	0.57	5.19	**3.34**	1.35	8.25	**3.12**	1.04	9.33
Black[a]	**4.46**	1.43	13.93	**21.66**	7.50	62.60	**7.41**	2.05	26.71
Other race[a]	0.63	0.17	2.37	1.35	0.36	5.07	0.84	0.15	4.87
U.S. born	1.73	0.51	5.92	0.91	0.29	2.78	1.01	0.26	3.95
Age <35	**1.91**	1.01	3.63	**5.14**	2.60	10.16	1.65	0.64	4.21
Married/living with partner	0.58	0.28	1.20	0.77	0.38	1.53	2.33	0.90	6.01
Overweight BMI[b]	0.42	0.19	0.93	0.63	0.29	1.35	0.59	0.20	1.73
Obese BMI[b]	2.07	0.87	4.93	1.89	0.79	4.47	0.42	0.15	1.20
Lifetime smoker	0.80	0.35	1.83	**7.64**	3.74	15.63	**4.43**	1.64	11.96
Sought mental health care in past year	**3.37**	1.29	8.83	**3.41**	1.24	9.35	1.69	0.52	5.48

Reference is Class 3. Bold denotes significance at $p < 0.05$.
[a]Non-Hispanic/Latino White as reference.
[b]Normal weight/underweight as reference.
CI, confidence interval; OR, odds ratio.

odds of being in Classes 1 and 2 than in Class 3. Further, global studies have repeatedly found that people with asthma are more likely to be diagnosed with mental health disorders.[47–50]

Although the mechanisms behind this association are not well elucidated, a meta-analysis examining the temporal relationship between depression and asthma found an association between depression and incidence of adult-onset asthma.[51] Shared risk factors for depression and asthma, including obesity, smoking, and chronic inflammation, could explain the association between these two prevalent chronic illnesses.[48,51]

A notable finding from our study was that although education, income, and serum cotinine level did not seem to group with asthma prevalence, these indicators did cluster with each other in a noticeable pattern. Class 2 and Class 4 each had low conditional probabilities of high income and educational attainment and were found to have 71% and 62% conditional probabilities, respectively, of serum cotinine level >1 ng/mL. These probabilities could reflect direct tobacco exposure or indirect exposure through passive environmental or occupational contact.

There is a robust literature on the associations between SES and tobacco use and exposure. U.S. national data from 2019 revealed that regular tobacco use among adults (≥25) whose highest educational attainment was the GED was significantly more common (43.7%) than among adults who obtained a graduate degree (8.7%).[52] Income disparities were also apparent. Among adults ≥18 with an annual household income of less than $35,000, 27% used tobacco products regularly compared with 15.5% of adults in households with an annual income of ≥$100,000.[52]

Although smoking is often considered a behavioral choice, many social and structural factors drive tobacco use disparities, including the strategic and targeted marketing practices of the tobacco industry.[7] As smoking is a risk factor for severe exacerbations of asthma, targeted interventions to reduce tobacco use are needed in Class 2 due to its high conditional probabilities of both asthma and tobacco exposure.

Multipronged clinical interventions to improve asthma management should be implemented and not only involve patient education but also involve education for the professional in charge of providing care, the addition of a specialist to the care team, or a management system for ensuring continuity of care and patient follow-up.[53] In particular, interventions should be aimed at improving care for Black bisexual female patients to avoid severe disease exacerbations in this population. In addition, implicit bias trainings to improve health care provider knowledge of the needs of SM individuals could be implemented to improve quality of care and health care trust and utilization among this population.[54]

Given findings that indicate within-group asthma prevalence differences among SM adults, more research is needed on the etiology of these disparities. National health surveillance surveys should take care to oversample sexual and gender minority populations to increase sample size and should improve survey instruments to better data quality and representativeness of the SM population.[55] Some existing measures of sexual identity used in survey questionnaires mischaracterize the SM population, for instance, individuals with lower SES and those who identify as Hispanic/Latino are more likely to be misclassified in certain survey data meant to measure sexual identity.[55]

Limitations

The analysis was limited by a small sample population, as NHANES does not oversample SM adults and therefore includes a small proportion of SM individuals. To increase our sample size, we used pooled data from NHANES 2001–2016 survey cycles. A limitation of pooling data is inconsistent social contexts across survey years. For instance, there were significant transformations in federal and state policy and social sentiment toward LGB individuals in the United States between 2001 and 2016 that could have contributed to changes in feelings of discrimination and stigma and ''outness'' among SM adults during this time period.

County- and community-level social stigmas, which include local policies and cultural norms that restrict resources and opportunities to stigmatized individuals—such as low levels of local support for same-sex marriage—may not reflect the national context yet are associated with higher smoking prevalence and lower health care utilization among LGBT individuals.[56,57] These factors may have impacted survey responses in ways we were unable to control for in our analysis.

The self-reported nature of the mental health care seeking variable was limiting, as some may underreport mental health treatment and care seeking is not a proxy for diagnosed mental illness. However, our analytic approach sets the present article apart as it allowed the combined use of a nationally representative sample and a person-centered methodology.

Conclusion

Our analysis addresses an important gap in the literature on the socioecological profiles of SM adults with asthma. Our person-centered approach permits the investigation of syndemic factors affecting asthma risk in underserved populations. We identified bisexual female adults who are Black to be at the highest risk for current asthma. Future research, including longitudinal studies, must consider psychological and physiological factors in tandem to understand the mechanisms driving SM health disparities from a comprehensive socioecological perspective.

Authors' Contributions

C.J.T. conceptualized the analysis and drafted the article. C.J.T. and F.A.M.I. curated the data, designed the analytical strategy, performed the analysis, interpreted findings, and critically revised the article. F.W. acquired the data, supervised the analysis, interpreted findings, and significantly edited and revised the article. All authors reviewed and approved the article before submission.

Disclaimer

The content is solely the responsibility of the authors and does not necessarily reflect the views of the National Institutes of Health.

Author Disclosure Statement

No competing financial interests exist.

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Supplementary Material

Supplementary Figure S1

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