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Examining tobacco use at the intersection of gender, sexual orientation, race, and ethnicity using national U.S. data of sexual and gender diverse youth

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ABSTRACT

Objectives: To expand the literature documenting that tobacco use inequities persist and continue to increase for minoritized youth populations by exploring patterns of tobacco use across *multiple* intersections of sexual, gender, racial, and ethnic identities. Studies with this focus are needed to understand the degree to which tobacco use varies across groups who hold multiple minoritized identities. **Methods**: The current study used a novel analytical approach— Exhaustive Chi-square Automatic Interaction Detection – to examine lifetime cigarette use among a U.S.-based sample of sexual and gender diverse youth collected in 2022. Exhaustive Chi-square Automatic Interaction Detection is a data-driven, decision-tree approach that uses successive Chi-square tests to iteratively cycle through all interactions among categorical independent variables, splitting where categories differ significantly with respect to the dependent variable. Participants identified as sexual and/or gender diverse youth, resided in the U.S., and were between 13–18 years of age ($N = 9{,}504$). **Results**: Several important patterns emerged: The groups with the highest prevalence of cigarette experimentation included transgender boys, cisgender boys, and non-binary youth. These adolescents were likely to also hold minoritized racial and ethnic identities, and identify with plurisexual identities. Some age-related differences in patterns emerged; across grades, transgender boys and Multiracial sexually and gender diverse youth were a part of high prevalence cigarette experimentation groups. **Conclusions**: The results highlight the complex patterns of cigarette use differences in heterogenous sexual and gender diverse populations, particularly across gender, sexual, and ethnoracial identities.

1. Introduction

Tobacco use remains a persistent public health concern among youth (Gentzke et al., 2020) and is one of the leading causes of preventable deaths among adults in the U.S. (United States Surgeon General, 2014). Disparities in tobacco use have been documented among minoritized populations (Marshal et al., 2008) and, in some cases, have grown in magnitude (Fish et al., 2019; Watson et al., 2018). For example, youth who hold minoritized sexual (e.g., lesbian, gay, pansexual) and/or gender (e.g., nonbinary, transgender) identities are more likely to report lifetime cigarette use (Day et al., 2017; Watson et al., 2018) and to experiment with combustible tobacco products earlier in adolescence compared to their cisgender and heterosexual peers (Fish et al., 2021; Talley et al., 2019). Elevated use among minoritized youth is not surprising given the tobacco industry continues to intentionally target sexual, gender, racial, and ethnic minorities (Cruz et al., 2019). Considering that earlier experimentation with tobacco products can predispose youth to continue tobacco use into adulthood (Corliss et al., 2013), identifying disparities in experimental tobacco use across diverse adolescent populations is critical for current prevention efforts. However, extant research focused on tobacco use disparities has traditionally focused on one minoritized identity at a time, comparing socially privileged groups to minoritized groups (Toomey et al., 2017). This work has overlooked youth with multiple minoritized identities, yet there is

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reason to believe that there are meaningful and important differences in tobacco use by these identities (Wheldon et al., 2019). At the same time, previous scholarship has called for wider utilization of intersectional research (Evans, 2019), noting that intersectional scholarship has the potential to transform our understanding of health disparities. Intersectional analytical approaches for investigating intersectionality are needed. As such, the current study examined the intersections of lifetime tobacco use among a large, contemporary, U.S. based sample of sexual and gender diverse youth (SGDY).

Limited prior research has identified group differences in tobacco use patterns among SGDY at multiple intersections of social identities. From extant research that explores one social identity at a time, it has been documented that transgender and nonbinary youth consistently report higher lifetime use of tobacco relative to their non-transgender peers (Day et al., 2017; Harlow et al., 2023). Research consistently documents that bisexual girls/women share a greater burden of tobacco use (Coulter et al., 2019; Li et al., 2020; Schuler et al., 2020). Other research has found that compared to cisgender boys, cisgender girls report a lower likelihood of current tobacco use (Wheldon et al., 2019); in comparison, other work has documented a greater prevalence of tobacco use among sexual minority females relative to males (Fish et al., 2021), while other work does not document any differences (Gamarel et al., 2020). Additionally, one study found that among SGDY, Black (16.1%) and Asian American (21.4%) youth reported a lower prevalence of current smoking status relative to their White (30.6%) and multiracial peers (32.4%; Blosnich et al., 2011). It is important to note that studies vary considerably in how they assess tobacco use and risk (i.e., lifetime use or past 30-day use), which could contribute to mixed findings regarding disparities in tobacco use behaviors and susceptibility.

All individuals may hold *multiple* minoritized identities (e.g., Black pansexual youth who also identify as transgender boys). The intersectionality framework suggests the interconnected nature of systems of oppression influences health experiences (e.g., unique manifestations of heterosexism and racism among SGDY with racially minoritized identities; Crenshaw, 1990). Interlocking systems of oppression related to gender, sexual, racial, and ethnic identities oftentimes result in the experience of minority stressors (see Meyer, 2003). Minority stressors (e.g., internalized homophobia and SGD-related harassment) may differ across combinations of minoritized social positions. Accordingly, scholars have argued for the application of intersectional frameworks to examine tobacco-related disparities across various populations as a necessary avenue to better inform current and future tobacco control efforts (Sheffer et al., 2022). As such, it remains unclear which SGDY populations, or more specifically which intersections of social positions, experience the greatest burdens of tobacco use.

Despite current limitations, a growing body of research has used large-scale data to document disparities in tobacco use across intersections of two social positions (e.g., sexual, gender, racial, and ethnic identities). For instance, using an international sample of 90,941 adults in the 2015 Global Health Survey, female (relative to male) participants who also held a sexual or racial minoritized identity had greater odds of lifetime tobacco use compared to those with only one or no minoritized identity (Demant et al., 2018). Among adolescents, recent work has found SGDY (combined as a singular group in analyses) who also identified as Black, Hispanic/Latinx, or multiracial reported higher odds of lifetime tobacco use compared to their non-SGDY White peers, yet SGDY who identified as Asian were at lower odds of lifetime tobacco use (Blosnich et al., 2011; Donaldson et al., 2023). However, in the Youth Risk Behavior Survey, lesbian, gay, and bisexual youth who identified as Asian or Black showed some of the highest prevalence rates of tobacco use relative to other racial groups (Corliss et al., 2014). Other research using more comprehensive measures of gender and sexual identity has found that transgender boys who identified as pansexual reported some of the highest patterns of current tobacco use relative to other gender and sexuality subgroups (Wheldon et al., 2019).

Taken together, emerging evidence suggests that there may be meaningful differences in tobacco use at the intersections of sexual, gender, racial, and ethnic identities. At the same time, most research is limited in the measurement of social identities (e.g., collapsing sexual, gender, and racially minoritized identities into singular groups), has typically only assessed the unique contributions of intersecting identities in analytic models (e.g., multiple linear regression using various interaction terms), or has only focused on two social identities at a time (e.g., race and sexual identity or sexual identity and gender identity). Additionally, extant research often excludes adolescents with expansive sexual or gender identities (e.g., pansexual), has combined all SGDY into a single group to compare with cisgender/heterosexual or cisgender/sexual minority White adolescents (e.g., combining Native American youth with other groups), or has been unable to examine intersections beyond two identities. In the spirit of elucidating intersectional differences in tobacco use, the current study utilized within-group modeling via a novel intersectional analytic approach and leveraged a large contemporary national sample of SGDY to examine tobacco experimentation at the intersection of four identities: sexual, gender, racial. and ethnic identities. Given the dearth of previous scholarship focused on several intersecting positions simultaneously using intersectionality methodologies, this work is exploratory, and we made no a priori hypotheses.

2. Methods

2.1. Study Design

Data for the present analysis were from the *LGBTQ National Teen Survey*, conducted by researchers with the Human Rights Campaign (HRC) between February and October 2022. Data sampling relied on non-probability methodologies; thus, no weighting procedures were applied to analyses. Participant inclusion criteria required participants to identify as SGDY, reside in the U.S., and report being 13–18 years of age upon completing the survey. Gift cards of $5 to Amazon or Starbucks were offered to validated participants who finished the survey. Study protocols were approved by the Institutional Review Board at the University of Connecticut. All youth participants provided informed assent; parental consent was waived.

2.2. Participant Recruitment

Participants were recruited through paid social media advertisements (e.g., Instagram, Snapchat), posts by social media ambassadors and social media influencers, and word-of-mouth. Researchers and the HRC also advertised in-person and online to high school gender and sexuality alliances, university lesbian, gay, bisexual, transgender, and queer (LGBTQ+) centers, and youth pride events. The HRC leveraged their large networks of sexual and gender diverse stakeholders, youth ambassadors, and social media presence to drive traffic to the survey. In total, paid advertisements reached approximately one million individuals.

2.3. Data validation procedures

To ensure data integrity, a screener was used to prevent ineligible participants from taking the survey, rather than distributing the full survey on public channels. Next, IP addresses were obtained in the screener to prevent participants from completing the screener more than once. Additionally, the research team enacted a multistep verification process for participant remuneration to deter fraudulent responses. For example, participants who provided a K-12 or college school e-mail (.edu, .org) were provided automatic verification and remuneration. More detailed information on data validation procedures is provided elsewhere (see Watson et al., 2024).

2.4. Data screening procedures

In total, 37,221 individuals completed the study screener, and 24,570 (66%) met the inclusion criteria. Of those 24,570 youth, 25% exited the survey early before completing all demographics and were subsequently removed by the research team ($n = 6,200$), resulting in a sample of 18,370 participants. The research team then conducted post hoc data screening and removed 412 participants for not reporting a valid age and 380 participants for fraudulent and/or international e-mails. The cleaning procedure resulted in a final analytic sample of 17,578 SGDY. Characteristics of the sample are included in Table 1. See Supplementary Figure 1 for a flowchart that highlights the progress of participants from entering the screener through final analytic sample.

2.5. Measures

2.5.1. Gender identity

Participants reported their current gender identity in response to a select all that apply item; participants who selected more than one gender identity were then instructed to indicate which one identity best represented their current gender (see Table 1 for response options). Write-in responses were back-coded into matching existing options where applicable or were recoded as "something not listed." For the current analysis, participants who reported they were gender non-conforming, gender fluid, or nonbinary were categorized collectively as nonbinary+ (NB+). Likewise, "questioning" and "something not listed" responses were combined into one category due to small sample sizes. Participants who were missing on the gender identity item were retained in a "missing" category for analytic purposes.

Table 1
Demographic characteristics and cigarette smoking prevalence among analytic sample.

	Total (N = 9,504)	
	N	%
Demographic characteristics		
Gender identity		
Cisgender boy	1,553	16.3
Cisgender girl	1,454	15.3
Transgender boy	1,777	18.7
Transgender girl	754	7.9
NB+ [1]	2,947	31.0
Gender non-conforming	287	3.0
Gender queer	440	4.6
Gender fluid	663	7.0
Non-binary	1,557	16.4
Questioning or a gender identity not listed	991	10.4
Missing	28	0.3
Sexual identity		
Gay/lesbian	2,789	29.3
Bisexual	2,626	27.6
Queer	996	10.5
Pansexual	1,352	14.2
Asexual	898	9.4
Straight, questioning, or a sexual identity not listed	843	8.9
Straight	108	1.1
Questioning	294	3.1
Something else	441	4.6
Race and ethnicity		
Hispanic/Latina/e/x/o	1,568	16.5
Non-Hispanic/Latina/e/x/o (NL) American Indian, Alaska Native, Native Hawaiian/Pacific Islander[2]	60	0.6
NL Asian	393	4.1
NL Black or African American	418	4.4
NL White	6,271	66.0
NL Multiracial	719	7.6
NL Other race	67	0.7
Missing	8	0.1
Cigarette Smoking		
Never smoked a cigarette	8,312	87.5
Ever smoked a cigarette	1,192	12.5

[1] NB+ includes those who identified as gender non-conforming, genderqueer, gender fluid, and non-binary.

[2] American Indian, Alaska Native, and Native Hawaiian/Pacific Islander (AI/AN/HPI) participants were combined in the present analysis due to small cell sizes.

2.5.2. Sexual identity

Participants reported which one sexual identity label best described them (see Table 1 for response options). Participants who wrote in a sexual identity that matched existing options were back-coded into that option. For the current analysis, participants who responded "questioning," "straight," or "something not listed" were combined into one category due to small cell sizes so to not exclude participants from each category entirely from analyses, and based on previous best practices (see Ott et al., 2011).

2.5.3. Ethnicity

Participants responded to one item about their ethnicity: "Are you Hispanic or Latina/e/o/x?" (response options: yes/no).

2.5.4. Race

Participants were asked, "What is your race? (select all that apply)" (response options: "American Indian or Alaska Native," "Asian," "Black or African American," "Hawaiian Native/Pacific Islander," "White," and "None of these").

2.5.5. Ethnoracial identity

For the present analysis, responses were combined across the race and ethnicity items to create a six-level racial and ethnic (described as "ethnoracial" below) identity variable: Hispanic/Latina/e/o/x; non-Hispanic/Latina/e/o/x (NL) American Indian, Alaska Native, and Native Hawaiian/Pacific Islander; NL Asian; NL Black or African American; NL White; and NL Multiracial. Participants categorized as missing for race and ethnicity were retained in a "missing" category for ethnoracial identity. American Indian, Alaska Native, and Native Hawaiian/Pacific Islander (AI/AN/HPI) participants were combined in the present analysis due to small cell sizes, shared experiences of colonialism, and prior research (Martin et al., 2021; Trask, 1999) highlighting elevated rates of health risk behaviors among youth with Native/indigenous identities.

2.5.6. Cigarette smoking

To assess cigarette experimentation, participants were asked, "Have you ever smoked a cigarette?" Response options were "Yes" and "No.".

2.6. Statistical analysis

The present analysis utilized data from 9,504 participants in grades 9–12 or college (54% of the full sample) who responded to the survey item about cigarette smoking. Participants in the analytic sample, compared to those excluded, varied significantly with respect to sexual, gender, racial, and ethnic identities. Specifically, participants in the analytic sample were more likely to be transgender girls, transgender boys, or NB+ and less likely to be cisgender boys (X^2 (5, $N = 17,448$) = 302.81, $p < 0.001$); more likely to be lesbian/gay, queer, or asexual and less likely to be straight/questioning/else (X^2 (5, $N = 17,578$) = 147.85, $p < 0.001$); and more likely to be Asian, White, Multiracial, or Latina/e/x/o, and less likely to be AI/AN/HPI or Black/African American (X^2 (7, $N = 17,578$) = 1844.81, $p < 0.001$).

For our primary analysis, we used exhaustive Chi-square Automatic Interaction Detection (ECHAID) with a Bonferroni correction and ten-fold cross validation, as recommended for quantitative studies of multiple intersecting social positions with moderate to large sample sizes (Kass, 1980; Mahendran et al., 2022; Shaw et al., 2011). ECHAID is different than similar methods (e.g., Classification and regression trees; Multilevel analysis of individual heterogeneity and discriminatory

Table 2
Groups of youth who reported having ever smoked a cigarette at a prevalence at least 10 % higher or lower than the overall sample prevalence (N = 9,504; overall sample prevalence = 12.5%).

Prevalence (%)	Index (%)	Gender Identity	Sexual Identity	Race/ethnicity
High Prevalence Groups				
27.7 n = 47	220.5	Cis girl; Questioning/other; Trans girl; Missing	–	AI/AN/HPI; Other
19.4 n = 248	154.3	Cis boy; NB+	Bisexual; Lesbian/Gay; Queer; Straight/Questioning/ Other	Multiracial; Missing
17.9 n = 1,777	142.7	Trans boy	–	–
17.0 n = 647	135.6	Cis boy; NB+	Pansexual	–
Low Prevalence Groups				
9.2 n = 2,349	73.0	Cis girl; Questioning/other; Trans girl; Missing	–	Black/African American; White
6.1 n = 392	48.8	NB+	Asexual	–
5.1 n = 356	40.3	Cis boy; NB+	Bisexual; Lesbian/Gay; Queer; Straight/Questioning/ Other	Asian; AI/AN/HPI; Black/African American
4.5 n = 154	36.2	Cis girl; Questioning/other; Trans girl; Missing	–	Asian; Missing
0.0 n = 63	0.0	Cis boy	Asexual	–

Note. The overall prevalence of having ever smoked cigarettes was 12.5 %. Where cells have a "-", nodes did not split by that particular indicator (racial identity, ethnic identity) and, thus, that node implicitly includes participants across all categories for that indicator. An index score of 100 indicates that cigarette smoking prevalence in a particular subset of the sample was the same as the overall sample prevalence. Index scores above and below 100 indicate higher or lower prevalence of smoking relative to the overall sample prevalence, respectively. For example, an index score of 220.5 signifies that cigarette smoking prevalence for this group is 2.2 times (or 120.5 %) higher than the overall sample prevalence. AI/AN/HPI = American Indian, Alaska Native, or Native Hawaiian/Pacific Islander. Cis = cisgender. NB+ = gender nonconforming, gender fluid, or non-binary. Trans = transgender.

accuracy) in that it is based on a statistical method that uses Chi-squared tests to find the best splits, opposed to greedy, recursive partitioning methodologies (see Supplemental Material for more information). In ECHAID, ten-fold cross-validation was used to prevent overfitting to assess the generalizability of the decision tree model by splitting the data into ten subsets and training the model on each subset ("fold") while testing it on the remaining data. Prediction performance was assessed by classification accuracy, risk values for each class, and gain tables.

ECHAID is a data-driven, decision-tree approach which uses successive Chi-square tests to iteratively cycle through all interactions among categorical independent variables (i.e., gender identity, sexual identity, racial identity, ethnic identity), splitting where categories differ significantly (Bonferroni adjusted $p < 0.05$) with respect to the dependent variable (i.e., cigarette smoking). This process repeats until a "terminal node" is reached (i.e., the final groups in this decision tree which cannot be further split by independent variables). We set a minimum "parent node" size of 40 and "child node" size of 20 to avoid overfitting. ECHAID has several advantages, including 1) the ability to conduct numerous interaction tests concurrently (compared to regression models which may not be powered to do so) and 2) the retention of missing data for each independent variable in a "missing" category.

In addition to conducting an ECHAID with the overall sample, we also conducted an ECHAID stratified by grade given age-related differences in tobacco use (e.g., Wheldon et al., 2019). The terminal nodes with the highest and lowest prevalence of lifetime cigarette smoking are reported in Table 2. Specifically, the terminal nodes with a prevalence of at least 10 % above or below the mean are reported. Grade-stratified ECHAIDs are reported in Table 3. These nodes illustrate the intersections of social positions most and least likely to have reported tobacco use. Index scores were calculated to demonstrate the proportion of adolescents in a given node reporting cigarette smoking relative to the overall sample mean. An index score of 100 indicates that cigarette smoking prevalence in a particular subset of the sample was the same as the overall sample prevalence. Index scores above and below 100 indicate higher or lower prevalence of smoking relative to the overall sample prevalence, respectively. For example, an index score of 220.5 signifies that cigarette smoking prevalence for this group is 2.2 times (or 120.5%) higher than the overall sample prevalence. All analyses were conducted in SPSS version 29. Supplemental Materials are provided that provide the final decision trees for each model (see Supplemental Figures 2-5) along with information regarding the classification accuracy, risk values for each class, and gain tables for each ECHAID model.

3. Results

Participants were between 13 and 18 years old (Mean age = 16.05, Standard Deviation = 1.26). The largest gender group included several non-binary identities (31.0%); slightly more than half (56.9%) of the sample identified as either lesbian/gay or bisexual. Several patterns emerged with respect to sexual and gender diverse youth with the highest and lowest prevalence of lifetime cigarette use (see Table 2 for aggregated results across all grades). First, the highest prevalence of cigarette experimentation groups comprised predominantly transgender boys, cisgender boys, and NB+ youth. For instance, 17.9% of transgender boys—regardless of sexual or ethnoracial identity—reported having ever smoked cigarettes. However, notably, the small group of cisgender girls, transgender girls, and youth with other (or "missing") gender identities who were AI/AN/HPI or another race not listed in this sample (n = 47) had the highest prevalence of lifetime cigarette use (27.7%) – more than double the overall sample prevalence.

By comparison, cisgender girls, transgender girls, and adolescents who were questioning their gender identity or who identified as another gender identity not listed, and who were Asian, Black/African American, White, or missing ethnorcial identity, were part of two of the five lowest prevalence cigarette smoking groups, with 4.5–9.2% reporting cigarette experimentation depending on ethnoracial identity. While cisgender boys and/or NB+ youth appeared in three of the five lowest prevalence groups, they were often asexual. Cisgender boys and NB+ youth who were bisexual, gay/lesbian, queer, and straight, questioning, or had another sexual identity in the low prevalence groups differed from their counterparts in the high prevalence groups with respect to ethnoracial identity, with AI/AN/HPI, Asian, and Black/African American youth reporting a prevalence of cigarette smoking (5.1 %) nearly five times lower than their Multiracial (or "missing" for race) counterparts

Table 3
Sociodemographic characteristics of youth with high (≥10% above mean) or low (≥10% below mean) prevalence of lifetime cigarette smoking, stratified by grade.

Prevalence (%)	Index (%)	Gender Identity	Sexual Identity	Race/ethnicity
Grades 9–10 (n = 3,941; overall lifetime cigarette smoking prevalence = 10.8%)				
21.1 n = 152	195.2	Cis boy; NB+; missing	–	AI/AN/HPI; Multiracial
16.3 n = 882	151.4	Trans boy	–	–
9.6 n = 1,577	89.4	Cis boy; NB+; missing	–	Asian; Black/African American; Latina/e/x/o; White; Other
7.3 n = 1,330	67.6	Cis girl; Questioning/other; Trans girl	–	–
Grades 11–12 (n = 4,395; overall lifetime cigarette smoking prevalence = 13.5%)				
25.5 n = 94	188.9	–	Bisexual	Multiracial; Other
17.2 n = 1,083	127.1	–	Pansexual; Queer	–
15.8 n = 1,124	117.2	Cis boy; Questioning/other; Trans boy	Bisexual; Lesbian/Gay	AI/AN/HPI; Black/African American; Latina/e/x/o; White
11.0 n = 1,156	81.3	Cis girl; NB+; Trans girl; Missing	Bisexual; Lesbian/Gay	AI/AN/HPI; Black/African American; Latina/e/x/o; White
8.6 n = 745	63.6	–	Asexual; Straight/Questioning/ Other	–
2.9 n = 105	21.1	–	Bisexual; Lesbian/Gay	Asian
College (n = 1,168; overall lifetime cigarette smoking prevalence = 14.8%)				
28.0 n = 143	188.9	Trans boy	–	–
13.0 n = 1,025	87.6	Cis boy; Cis girl; NB+; Trans girl; Missing	–	–

Note. An index score of 100 indicates that cigarette smoking prevalence in a particular subset of the sample was the same as the overall sample prevalence. Index scores above and below 100 indicate higher or lower prevalence of smoking relative to the overall sample prevalence, respectively. For example, an index score of 220.5 signifies that cigarette smoking prevalence for this group is 2.2 times (or 120.5%) higher than the overall sample prevalence.

(19.4%).

Findings also underscore age-related differences in patterns of cigarette experimentation (see Table 3 for disaggregated results by grade). Transgender boys were part of the high prevalence groups across grades, with 16.3% of transgender boys in grades 9 or 10 and 28.0% of transgender boys in college – regardless of their sexual or ethnoracial identity – reporting having ever smoked a cigarette. Multiracial youth (in conjunction with other social positions) were also part of the highest prevalence groups in grades 9–10 and 11–12, with prevalence rates nearly double the overall sample prevalence. Among 9th and 10th graders, cisgender girls, transgender girls, and youth with another gender identity not listed had the lowest prevalence of lifetime cigarette smoking (7.3%), and ethnoracial identity was a significant differentiator of prevalence among cisgender boys, NB+ youth, and youth missing for gender identity. Indeed, among cisgender boys, NB+ youth, and youth missing for gender identity in grades 9–10, prevalence of lifetime cigarette smoking was 9.6 % for Asian, Black/African American, Latina/e/x/o, White, or youth with another race not listed, but more than double that (i.e., 21.1%) for AI/AN/HPI and Multiracial youth. Race/ethnicity was also a significant differentiator of prevalence of cigarette smoking among 11-12th graders. For example, whereas only 2.9% of Asian bisexual or lesbian/gay youth reported having ever smoked cigarettes, 25.5% of Multiracial youth or youth with another race not listed and who were bisexual had ever smoked cigarettes.

4. DISCUSSION

This study utilized a novel quantitative intersectional approach to determine the SGDY subgroups most at risk for tobacco experimentation. The results highlight the complex patterns of tobacco use differences in heterogenous SGDY populations, particularly across gender, sexual, and ethnoracial identities. Based on these exploratory findings, we highlight critical areas for future research.

Across youth in all grades, gender identity was highly relevant to group classification, intersecting with varied sexual and ethnoracial identities. Three groups with the highest prevalence of cigarette experimentation were among transgender boys. The other most prevalent groups included cisgender boys. These findings support previous research that found high prevalence of current cigarette use and younger age of first use among transgender boys (Wheldon et al., 2019). It may be that masculinity could be an important sociocultural context relevant to adolescent tobacco use (see Hamilton and Mahalik, 2009; Pachankis et al., 2011)—particularly among ethnoracially minoritized cisgender and transgender boys (Pachankis et al., 2011). Previous research provides some support to this proposition. Conformity to masculine gender norms was associated with greater substance use in a sample of cisgender gay identified men (Hamilton and Mahalik, 2009). Gender norms have long been used to promote smoking by the tobacco industry (Morrow and Barraclough, 2010), but more research that specifically focuses on SGDY is needed.

Youth who identified with multiple marginalized identities (e.g., transgender boys who are also multiracial or belong to other minority racial groups) had notably higher prevalence of tobacco use. This suggests that the intersectional stigma related to sexual, gender, racial, and ethnic identity may be related to tobacco use behaviors—particularly for transgender and gender diverse youth. Though we cannot test or explain mechanisms that may influence the disproportionate burden of tobacco use for multiply marginalized identities, previous scholarship helps to contextualize our findings. For example, Sheffer and colleagues (2022) explain that the marginalization of individuals with minoritized identities operates through stigma, prejudice, exclusion in practice and policy, aggression, and trauma—experiences that are linked to a host of negative psychological experiences such as feelings of powerlessness, despair, shame, and isolation. In turn, individuals with marginalized identities may experience greater tobacco use disparities, including more severe dependence, relapse, difficulty quitting, and lower motivation to quit. Undoubtedly, more severe tobacco use experiences are compounded when an individual has multiple minoritized social positions. Future research is needed to elucidate specific minority stressors (e.g., bias-based bullying) that may impact tobacco use behaviors among

LGBTQ+ youth—including multiply marginalized LGBTQ+ youth.

Both gender and ethnoracial identity patterns in the ECHAID that examined the overall sample were repeated when ECHAIDs were stratified by grade level. As expected, the prevalence of cigarette use increased in each grade-stratified ECHAID, with 10.8% for youth in grades 9–10 reporting lifetime tobacco use, 13.5% for youth in grades 11–12, and 14.8% of youth who were in college. Results from stratified ECHAID analyses revealed patterns: transgender multiracial youth were consistently part of nodes, across both groupings of youth in high school, defined by the highest prevalence of lifetime tobacco use. Among college students, gender identity was the only significant differentiator in lifetime tobacco use, showing once again transgender boys experienced a disproportionate burden of high lifetime tobacco use. These results also challenge the idea that sexual identity alone is a risk factor for tobacco use among adolescents. It is often found that lesbian and bisexual, cisgender women are at the highest risk for tobacco use (Fish et al., 2021; Wheldon et al., 2018), which was not reflected in the current study. It may be these youth experiment at later ages and rapidly progress to established use; however, the prevalence of cigarette experimentation for lesbian and bisexual cisgender girls was 10.1% in the current study. That is approximately equal to the 10.9% of current high school students who have ever smoked a cigarette in the U.S. according to the National Youth Tobacco Survey (NYTS; Delnevo and Villanti, 2023). Research that utilizes similar intersectional analytical approaches should consider age cohort as a factor, as the experience of minority stress and the impact of normative social pressures may be highly varied across generations.

An indigenous ethnoracial identity was characteristic of several of the nodes with more prevalent tobacco experimentation groups when examining both grade-aggregated and disaggregated ECHAIDs. On average, AI/AN/HPI people have the highest cigarette smoking rate of any other ethnoracial identity in the U.S. (United States Department of Health and Human Services, 2020). Higher rates are often attributed to differences in norms related to tobacco use among indigenous peoples and the historical significance of tobacco in ceremonial activities (Hodge, 2002). There are also significant socioeconomic challenges (e.g., unemployment) among indigenous communities in the U.S. that are related to tobacco use in the general population (De Vogli and Santinello, 2005). The effect of these social and cultural factors likely intersect in ways that promote tobacco use among SGDY living in these communities.

It is interesting to note that an asexual sexual identity is often associated with lower rates of tobacco use (Bauer et al., 2020; Wheldon et al., 2019). In this study, asexual identity was generally a characteristic of the groups with the lowest cigarette experimentation, with one exception (i.e., transgender multiracial or AI/AN/HPI youth). Differences in social motivations to engage in substance use behaviors, the composition of social networks, and/or differences in the venues in which socializing takes place are important areas for future research. More research focused on the seeming protective effect of asexual identity may advance a more general understanding of the mechanisms that mediate the relationships between sexuality and substance use (Bauer et al., 2020).

4.1. Limitations

Despite the strengths presented above, this study is not without limitations. First, these data are non-representative and do not reflect the most vulnerable youth that our study could not reach, such as youth experiencing homelessness without access to the Internet or resources to complete a survey. Additionally, there were differences between those included and excluded from the analytic sample across demographic variables, which may contribute to selection bias. This pattern may reflect some level of systematic missingness that could be driven by our inclusion criteria (i.e., grade level 9 and onward), early survey termination, and item functioning, such that some participants may be more or less likely to skip substance use related items (e.g., not comfortable reporting). These limitations may result in underestimating of tobacco prevalence or intersections that include the most marginalized social positions.

Next, the vast majority of the sample (i.e., 87.1%) had not tried tobacco products in their lifetime. Despite the large sample of SGDY, which provided the opportunity to detect patterns across intersecting social positions in tobacco use, more research is needed with diverse samples to continue to understand the groups most impacted by tobacco use across the lifespan and who use tobacco more frequently during adolescence (e.g., regular cigarette users). Another limitation is that this analysis only considers four social positions as they intersect and relate to tobacco use, without consideration of identity-based social experiences, such as stressors experienced that contribute to tobacco use as a coping response. Last, future research should 1) consider other mechanisms of tobacco consumption, such as vaping and e-cigarettes, and 2) consider reporting both lifetime and past-month cigarette use—despite past-month cigarette use frequency being extremely low in our sample of youth, the use of lifetime use may overestimate tobacco use prevalence in our sample.

4.2. Conclusion

We demonstrate the importance of within-group modeling to explicate differences in cigarette use among contemporary SGDY youth at the intersection of sexual, gender, and ethnoracial identity. Findings highlight elevated risk for cigarette use among transgender boys who also reported minoritized ethnoracial identities. Given longstanding efforts by tobacco companies to target tobacco products to SGD and racially minoritized communities, prevention and cessation strategies that specifically reach these communities are necessary.

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Contributors

Dr. Watson designed and conceptualized the data collection project, scope of paper, and contributed to writing. Dr. Lawrence performed secondary analysis of the existing dataset and contributed to writing. Drs. Wheldon, Fish, and Eaton, and Peter McCauley aided in conceptualization of the project, critically reviewed and edited the manuscript, and contributed writing.

Author Agreement

All authors have seen and approved the final version of the manuscript being submitted. They warrant that the article is the authors' original work, hasn't received prior publication and isn't under consideration for publication elsewhere.

Credit authorship contribution statement

Ryan J. Watson: Writing – original draft, Supervision, Resources, Project administration, Methodology, Investigation, Funding acquisition, Data curation, Conceptualization. **Samantha E. Lawrence:** Writing – original draft, Formal analysis, Conceptualization. **Peter S. McCauley:** Writing – original draft. **Christopher W. Wheldon:** Writing – original draft, Conceptualization. **Jessica N. Fish:** Writing – review & editing, Writing – original draft, Conceptualization. **Lisa A. Eaton:** Writing – review & editing, Writing – original draft.

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. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.addbeh.2025.108246.

Data availability

Data may be made available on request.

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