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Association Between Mental Health and Nicotine/Tobacco Use by Disaggregated Gender Identities Among U.S. Adolescents, 2020–2023

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Abstract

Purpose: Adolescents with internalizing mental health (IMH) symptoms are more likely to use nicotine/tobacco products; however, the association with gender identity remains unclear. We examined differences in the relationship between IMH symptoms and nicotine/tobacco use by gender identity.
Methods: Data came from the U.S. arm of the International Tobacco Control Youth Tobacco and Vaping Survey, an online cross-sectional survey of adolescents aged 16–19, conducted from 2020 to 2023 ($n = 28,959$). Current nicotine/tobacco use was categorized as: (1) no use, (2) exclusive combustible product use, (3) exclusive noncombustible product use, and (4) use of both product types. Current depression and anxiety symptoms were aggregated into an IMH symptoms variable (yes/no). Gender identity was determined based on responses to questions regarding current gender identity and sex assigned at birth. Analyses examined differences in IMH symptoms and nicotine/tobacco use by gender identity and the potential moderating role of gender identity in the relation between IMH symptoms and nicotine/tobacco use.
Results: Risk for nicotine/tobacco use and IMH symptoms varied across gender identities. Transgender women reported the highest prevalence of any product use (29%) followed by transgender men (24%), cisgender men (22%), cisgender women (19%), and gender nonconforming (GNC) adolescents (14%). GNC adolescents reported the highest prevalence of IMH symptoms (85%), followed by transgender men (80%), cisgender women (67%), transgender women (65%), and cisgender men (45%). We found significant interactions between IMH symptoms and gender identity ($p < 0.0001$).
Conclusion: This study revealed the importance of disaggregating GNC and transgender identities in research related to nicotine/tobacco use and mental health among adolescents.

Keywords: cross-sectional study, gender identity, mental health, nicotine, tobacco

Introduction

Use of nicotine/tobacco products (e.g., combustible cigarettes, e-cigarettes) among adolescents remains a public health concern, especially given the high prevalence of e-cigarette use, the growing array of nicotine-containing products, and adolescents' tendency to underestimate their potential harm.[1] Although all adolescents are at risk for nicotine/tobacco use, some groups are at greater risk, including males (compared with females)[2,3] and sexual and gender minority (SGM) individuals.[4–6] Researchers often group SGM subgroups together as one high-risk group for nicotine/tobacco use[7–9]; however, SGM identities are associated with unique stressors, as posited by an adaptation of the minority stress model focused on gender minority individuals.[10] Therefore, these identities should

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be disaggregated to evaluate potentially distinct patterns of nicotine/tobacco use.

There is a large body of literature demonstrating that sexual minority adolescents have higher rates of nicotine/tobacco use and report earlier initiation than their heterosexual peers.[11] Despite a relatively limited body of research focused on gender diverse adolescents, the available evidence suggests that disparities in tobacco use among gender-diverse adults begin early, particularly for transgender boys and nonbinary youth.[5,6]

Data from the 2015–2016 Population Assessment of Tobacco and Health study indicated that transgender youth were more likely than youth who did not identify as transgender to report both ever and current use of cigarettes, electronic nicotine products, and smokeless tobacco.[4] Across gender diverse identities, the 2022 LGBTQ National Teen Survey indicated that transgender boys and nonbinary youth (including those who identified as gender nonconforming [GNC] or gender fluid) were among the groups reporting the highest prevalence of experimentation with cigarettes.[5] A similar study using a national probability sample of SGM youth demonstrated that transgender boys reported higher odds of currently smoking cigarettes compared with both cisgender and transgender girls. Furthermore, transgender boys demonstrated a larger adjusted hazard ratio of smoking at a younger age than cisgender boys.[6]

In their study of tobacco use among high school students in California, Harlow et al. demonstrated that nonbinary youth had greater prevalence of ever use of both combustible and noncombustible tobacco use compared with their cisgender male peers. In that study, transgender youth reported greater susceptibility to nicotine/tobacco use than cisgender male students, but not greater tobacco use prevalence.[12] However, limited research has examined nicotine/tobacco use among gender minority adolescents.[13]

Failing to disaggregate tobacco use patterns across gender prevents a nuanced assessment of gender minority adolescents and the unique challenges they face.[14] Some gender minority adolescents experience more discrimination based on not conforming to gender norms in terms of physical appearance, particularly early in transition, whereas some cisgender sexual minority adolescents may "pass" as heterosexual and avoid such discrimination.[15] Furthermore, gender minority adolescents may face barriers regarding gender-affirming social supports and medical care.[4] Given the growing number of gender minority-identifying adolescents[8] and the negative impacts of discrimination on both mental and physical health,[16] it is critical for research to distinguish between SGM identities.

There is also a need to better understand specific gender identity subgroups due to unique experiences that may contribute to disparate substance use and health.[8] For example, one study of adults found similar smoking rates among transgender and nonbinary adults,[17] whereas another found lower smoking prevalence among GNC adults compared with transgender adults.[18] Cross-sectional research highlights the co-occurrence of depressive symptoms with recent cigarette smoking among gender diverse youth, but few studies have disaggregated gender identities.[19] There is limited evidence that gender minority youth, particularly those with nonbinary identities, are at a uniquely high risk for both depression and current cigarette smoking, although additional examination linking these outcomes is needed.[20]

Adolescence is a critical period for nicotine/tobacco use. Use can adversely affect brain development,[21] and adolescents may be particularly susceptible to addiction and subsequent long-term use of substances.[22–24] Adolescence also represents a sensitive period for the onset of internalizing mental health (IMH) symptoms (i.e., symptoms of anxiety and depression).[25] Unfortunately, IMH symptoms are rarely diagnosed or treated during adolescence,[26] and rates are increasing over time,[27] resulting in elevated risk for adverse health outcomes.[28] Individuals with IMH conditions have a shorter life expectancy compared with the general population, largely attributed to substance use.[29,30]

Gender minority adolescents are at particular risk for IMH symptoms due to their exposure to unique social stressors, including stigma, discrimination, and bias events.[31–33] Indeed, gender minority adolescents exhibit higher rates of IMH symptoms compared with their cisgender sexual minority peers.[20] There is abundant evidence that IMH symptoms and nicotine/tobacco use are positively associated,[34] and many studies have found that this association is stronger for females than for males.[35–42] However, to our knowledge, no studies have explicitly examined the relationship between mental health and nicotine/tobacco use among gender minority adolescents. Greater understanding of nicotine/tobacco use among gender minority adolescents, and its relation to IMH, is essential for appropriately targeting resources and interventions.

The present study examined associations among gender identities, IMH symptoms, and nicotine/tobacco use using a national sample of U.S. adolescents. Nicotine/tobacco products can generally be classified into noncombustible (e.g., e-cigarettes, nicotine pouches) and combustible (e.g., cigarettes, cigars), reflecting their relative harmfulness. Our previous work demonstrated that adolescents reporting IMH symptoms were more likely to report use of combustible and noncombustible products[43]; however, it is unclear how this may vary by gender identity. We hypothesize that compared with cisgender adolescents, gender minority adolescents will be more likely to report IMH symptoms and nicotine/tobacco product use. In addition, we aimed to explore differences in these associations among specific gender identities as well as the extent to which gender identity moderates relations between IMH symptoms and nicotine/tobacco use.

Methods

Data source

Data came from the International Tobacco Control (ITC) Policy Evaluation Project Youth Tobacco and Vaping Survey, a repeat cross-sectional survey of national samples of adolescents aged 16–19 from Canada, England, and the U.S. Recruitment information is reported elsewhere.[44] This study analyzed data from 2020–2023 (from February to March 2020; August 2020; February 2021; August 2021; August 2022; August 2023) in the United States ($n = 29{,}606$), excluding participants with invalid responses (e.g., refused or provided uninterpretable open-ended response) for gender ($n = 221$) or IMH symptoms ($n = 426$). The final analytic sample was 28,959.

Original data collection was completed in accordance with the Declaration of Helsinki as revised in 2013. Institutional review boards at the University of Waterloo and King's College London provided ethics approval for the ITC project, which was sufficient to allow the study to be undertaken at all sites. Informed participant consent was obtained before completing the survey. Where participants were minors, guardian/parental consent was obtained. Because the data in this analysis were de-identified, the University of South Carolina does not consider this to be human subjects research and was therefore not required to be reviewed beyond internal approval of the ITC Project. Participants' identifying information (i.e., names, addresses, and/or telephone numbers) were unavailable to the present research team. Data ascertained during the survey were kept anonymous and used exclusively in aggregate form during analyses.

Measures

Current nicotine/tobacco product use. Total days of past-month cigarette and e-cigarette use were used to derive dichotomous variables for each product (1 = 1–30 days; 0 = no days). Past-month use of other nicotine/tobacco products was measured with a checklist (responses: "yes" or "no"). Responses were aggregated to create a four-category variable: (1) no current use; (2) exclusive use of combustible products (cigarettes, little cigars or cigarillos, cigars, bidis, hookah); (3) exclusive use of noncombustible products (e-cigarette, smokeless tobacco, and nicotine pouches); or (4) use of both product types (at least one of each).

Gender identity. Gender identity was determined based on participant responses to two questions: current gender identity and sex assigned at birth. For current gender identity, participants were asked, "What is your current gender identity?": "Man," "Woman," "Trans male/trans man," "Trans female/trans woman," "Gender queer/Gender nonconforming," "Different identity," where an open response was provided, "Don't Know," or "Refused." For sex assigned at birth, participants could select "male," "female," "don't know," or "refused." If participants selected "don't know" or "refused," they were asked again for their sex at birth and were able to select "*x*- not specified on birth certificate." Participants who selected "don't know," "refused," or "*x*" were recoded as "male" if their gender identity was "man" and "female" if their gender identity was "woman" due to the necessity of including sex for developing survey weights.

Cisgender men were those who indicated "man" as their current gender identity and "male" as their sex assigned at birth (n = 8238). Transgender men were those who either directly indicated "trans male/trans man" (n = 371) or those who indicated a gender identity of "man" and "female" sex assigned at birth (n = 75). Cisgender women were those who indicated "woman" as their current gender identity and "female" as their sex assigned at birth (n = 19,101). Transgender women were those who either directly indicated "trans female/trans woman" (n = 117) or those who indicated a gender identity of "woman" and "male" sex assigned at birth (n = 59). In models investigating the interactions between IMH symptoms and gender identity on nicotine/tobacco use, we combined transgender men and transgender women into a single group (n = 623).

GNC youth were those who indicated "gender queer/gender nonconforming" (n = 819). In addition, the open-ended responses for those who indicated "Different identity" (n = 179) were coded as "cisgender man" (n = 2), "cisgender woman" (n = 7), "transgender man" (n = 1), "transgender woman" (n = 0), or "GNC" (n = 169). "Unknown" responses (i.e., open-ended responses that did not fit a category or included jokes/gibberish), "don't know," and "refused" were excluded from the analytic sample (n = 221).

IMH symptoms. IMH symptoms were measured using two items from the Screening Tool for Psychological Distress, which has been validated among adults[45] and has been validated with other mental health measures that have been validated among youth.[46–48] Depressive symptoms were measured with the following question, "In the last month, how much have you been bothered by feeling sad, down, or uninterested in life?" Anxiety symptoms were measured with the following question, "In the last month, how much have you been bothered by feeling anxious or nervous?" Both items were rated on a 10-point scale, from 0 = "not at all" to 9 = "severely."

Continuous depression and anxiety responses were highly correlated ($r = 0.75$, $p < 0.001$), and when categorized by cut points, of the 50% of the sample who reported either symptom type, 83% reported both symptoms of depression and anxiety, aligning with past research that symptoms of anxiety and depression are highly comorbid and are difficult for youth to differentiate.[49] Therefore, we aggregated these measures to create one dichotomous IMH symptoms variable indicating clinically significant levels of either depression (>4) or anxiety (>5),[45] where a value of 1 indicated depression, anxiety, or both. Continuous measures were retained for sensitivity analyses.

Covariates. Participants indicated their age and race/ethnicity (White, Black, Hispanic/Latino, Asian, Native Hawaiian or Pacific Islander, Native American Indian or Alaska Native, Other, and no response). We categorized race/ethnicity as "Non-Hispanic White," "Non-Hispanic Black," "Hispanic/Latino," "Alaska Native or American Indian," "Asian or Pacific Islander," "another race," and "no response." Socioeconomic status was assessed using a 4-level measure of perceived income adequacy where 0 = not meeting basic expenses and 4 = living comfortably.[44] State of residence was recoded into the U.S. census regions (Northeast, South, Midwest, West).

Analyses

Descriptive analysis included weighted percentages of all the variables by gender identity. Then, we assessed differences in IMH symptoms by gender identity using logistic regression models (no [reference] vs. yes), adjusting for nicotine/tobacco use, covariates, and survey wave. We assessed differences in nicotine/tobacco use by gender identity using multinomial logistic regression models, adjusting for wave, IMH symptoms, and all covariates. No current use served as

the reference group. Postestimation commands were used to generate predicted probabilities.

Relations between IMH symptoms and nicotine/tobacco use and the potential moderating role of gender identity were examined using multinomial logistic regression. The model included main effects of IMH symptoms, gender identity, and covariates. Interactions of IMH symptoms and gender identity on nicotine/tobacco use were examined by creating an interaction term: IMH symptoms × Gender identity and adding it into the adjusted model. Models with statistically significant interaction terms were re-estimated after stratifying by gender identity. For stratified models including transgender participants, transgender men and transgender women were combined into one group due to small sample size.

We also conducted sensitivity analyses to confirm whether there were differences between participants with closed-ended GNC responses and open-ended GNC responses (see Supplementary Table S1), differences in results when using the continuous IMH symptoms variable with the depression and anxiety variables averaged together (see Supplementary Tables S2 and S3), and differences when combining transgender participants into one group (see Supplementary Table S4). In all cases, results were similar. All analyses were conducted using poststratification sample weights[44] using Stata V.18 (StataCorp LLC, College Station, TX).

Results

Sample characteristics

The analytic sample (n = 28,959) comprised 49.7% of respondents identifying as cisgender men, 45.9% identifying as cisgender women, 2.9% identifying as GNC, 1.0% identifying as transgender men, and 0.6% identifying as transgender women (see Table 1).

IMH symptoms and gender identity

The associations between gender identity and IMH symptoms after adjusting for covariates are shown in Table 2. Overall, 44.6% of cisgender men, 67.1% of cisgender women, 65.1% of transgender women, 80.1% of transgender men, and 85.0% of GNC adolescents reported IMH symptoms. In adjusted models, individuals of all gender identities had significantly higher odds of reporting IMH symptoms compared with cisgender men, with the largest differences for GNC adolescents (adjusted odds ratio [aOR] = 7.79, 95% confidence interval [CI] = 5.92–10.25), followed by transgender men (aOR = 5.47, 95% CI = 3.93–7.61), cisgender women (aOR = 2.68, 95% CI = 2.51–2.87), and then transgender women (aOR = 2.44, 95% CI = 1.59–3.77).

Nicotine/tobacco use and gender identity

Transgender women reported the highest prevalence of any product use (29.3%), followed by transgender men (24.4%), cisgender men (21.8%), cisgender women (18.8%), and GNC adolescents (14.0%) (see Fig. 1). Associations between gender identity and current nicotine/tobacco use are shown in Table 3. For exclusive combustible use, cisgender women were less likely to report use compared with cisgender men (adjusted relative risk ratio [aRRR] = 0.60, 95% CI = 0.51–0.70), as were GNC adolescents (aRRR = 0.43, 95% CI = 0.29–0.64).

For exclusive noncombustible use, cisgender women were more likely to report use than cisgender men (aRRR = 1.24, 95% CI = 1.11–1.39), whereas GNC adolescents were less likely to report use compared with cisgender men (aRRR = 0.70, 95% CI = 0.51–0.97). For both product type use, cisgender women were less likely to report use (aRRR = 0.48, 95% CI = 0.43–0.55), as were GNC adolescents (aRRR = 0.52, 95% CI = 0.35–0.77) compared with cisgender men.

Interaction effects between IMH symptoms and gender identity on nicotine/tobacco use

We found significant interactions between IMH symptoms and gender identity (global F-test statistic = 75.47, $p < 0.0001$; see Supplementary Table S5). Stratified analyses (Table 4) showed differences in the strength of association between IMH symptoms and nicotine/tobacco product use by gender identity. Cisgender men with IMH symptoms had a greater likelihood of exclusive combustible use (aRRR = 1.58, 95% CI = 1.25–2.01), exclusive noncombustible use (aRRR = 1.41, 95% CI = 1.15–1.73), and use of both types (aRRR = 2.34, 95% CI = 1.93–2.83) compared with cisgender men without IMH symptoms.

Compared with cisgender women without IMH symptoms, there was no association between IMH symptoms and exclusive combustible use among cisgender women who reported IMH symptoms. However, cisgender women with IMH symptoms had a greater likelihood of exclusive noncombustible use (aRRR = 2.17, 95% CI = 1.89–2.49) and use of both types (aRRR = 1.38, 95% CI = 1.16–1.64) than cisgender women without IMH symptoms.

Due to small sample sizes for this analysis, transgender men and transgender women were combined into one transgender category. Among transgender participants, IMH symptoms were associated with lower odds of exclusive combustible use (aRRR = 0.33, 95% CI = 0.14–0.73) and use of both types (aRRR = 0.39, 95% CI = 0.20–0.77). Among GNC participants, there was no statistically significant association between IMH symptoms and exclusive combustible use or both types of use. GNC participants with IMH symptoms were significantly more likely to report exclusive noncombustible use than GNC participants without IMH symptoms (aRRR = 2.97, 95% CI = 1.04–8.55).

Discussion

We found that the risk for IMH symptoms, nicotine/tobacco use, and their relations varied across gender identity, suggesting that gender identities should be disaggregated when examining tobacco use and mental health among youth. In terms of nicotine/tobacco use, the prevalence of any current nicotine use was highest among transgender women, followed by transgender men, cisgender men, cisgender women, and then GNC adolescents. The findings for transgender women and transgender men align with previous research and surveillance data from 2022,[50] both finding higher rates of nicotine/tobacco use among gender minority adolescents compared with cisgender adolescents. However,

Table 1. Sample Characteristics by Gender Identity (N = 28,959)

	Cisgender men	*Cisgender women*	*Transgender men*	*Transgender women*	*GNC individuals*	*Analytic sample*
	n = *8240*	n = *19,108*	n = *447*	n = *176*	n = *988*	N = *28,959*
			Weighted %			
Wave						
Feb '20	17.8	18.1	12.0	6.6	6.8	17.5
Aug '20	20.4	20.8	20.3	18.6	11.2	20.3
Feb '21	17.6	17.9	18.5	19.6	15.9	17.7
Aug '21	16.3	15.6	22.5	21.1	27.8	16.4
Aug '22	13.6	13.5	15.1	22.2	24.6	14.0
Aug '23	14.3	14.2	11.8	11.9	13.8	14.2
Age						
16	23.7	21.2	22.1	16.8	20.0	22.4
17	26.1	28.4	26.2	20.5	29.1	27.2
18	30.6	29.2	31.0	40.1	30.0	30.0
19	19.6	21.2	20.8	22.6	21.1	20.4
Race/Ethnicity						
Non-Hispanic White	68.9	72.9	76.6	63.6	77.5	71.0
Hispanic/Latino	11.7	10.4	11.1	14.7	9.3	11.1
Non-Hispanic Black	9.7	10.0	6.6	15.1	5.4	9.7
Asian/Pacific Islander	6.9	4.4	3.1	1.9	4.7	5.6
Alaska Native/American Indian	1.6	1.4	1.8	3.5	2.1	1.5
Another race	0.4	0.4	0.3	0.1	0.6	0.4
No response	0.7	0.7	0.5	1.1	0.5	0.6
Perceived income adequacy						
Not meeting needs	4.1	4.9	6.6	10.1	5.0	4.6
Just meeting needs	22.4	24.9	31.5	27.2	25.7	23.8
Meeting needs	33.1	31.6	32.7	32.9	32.3	32.4
Living comfortably	36.1	34.3	26.0	24.8	34.1	35.0
No response	4.3	4.3	3.2	4.9	2.9	4.2
U.S. census region						
West	23.6	23.2	28.6	25.2	30.0	23.7
Midwest	21.1	21.1	21.9	19.1	22.7	21.1
Northeast	16.7	16.9	19.3	15.5	14.6	16.7
South	38.6	38.9	30.2	40.2	32.8	38.5
IMH symptoms[a]						
Yes	44.4	67.0	81.9	69.7	85.9	56.5
Current nicotine/tobacco use[b]						
None	79.6	80.1	72.8	67.5	84.4	79.8
Exclusive noncombustible	8.5	12.4	9.8	13.9	8.3	10.3
Exclusive combustible	4.7	3.1	7.3	8.8	2.2	4.0
Both	7.3	4.4	10.1	9.8	5.0	6.0

[a]Internalizing mental health symptoms included reporting either symptoms of depression or anxiety or both.
[b]Current nicotine/tobacco use included reporting use of a nicotine/tobacco product in the past 30 days. Exclusive combustible products included cigarettes, cigars, little cigars or cigarillos, bidis, and hookah. Exclusive noncombustible products included e-cigarettes, nicotine pouches, and smokeless tobacco. Both types included at least one combustible and noncombustible product. Prevalence rates are weighted.
GNC, gender nonconforming; IMH, internalizing mental health.

we found that GNC adolescents appeared to be at lower risk for nicotine/tobacco use than both transgender and cisgender adolescents, given their lowest prevalence of use. Qualitative research is needed to understand possible explanations for this novel finding.

When examining gender differences in IMH symptoms, we found that the adjusted prevalence of experiencing IMH symptoms was highest among GNC participants, followed by transgender men, cisgender women, transgender women, and cisgender men. Previous research has found that gender minority adolescents have a higher burden of poor mental health compared with cisgender adolescents.[32,33] Our findings align with the minority stress hypothesis as it relates to worse mental health among SGM individuals.[51,52]

In terms of worse mental health among GNC adolescents compared with transgender men and transgender women, this aligns with findings from a systematic review, which demonstrated worse general mental health among nonbinary youth compared with both transgender and cisgender adolescents.[53] This was attributed to higher likelihood of gender dysphoria,[54] limited visibility, and invalidation of their identities.[55] More research is needed to better understand the unique experiences of transgender and GNC adolescents as

Table 2. Association Between Gender Identity and Current Internalizing Mental Health Symptoms ($N = 28,959$)

		*Internalizing mental health symptoms (*n = *28,959)*[a]	
	%[b]	*OR (95% CI)*[c]	*aOR (95% CI)*[d]
Gender identity			
Cisgender man	44.6	Ref	Ref
Cisgender woman	67.1	2.55 (2.39–2.72)***	2.68 (2.51–2.87)***
Transgender man	80.1	5.68 (4.20–7.69)***	5.47 (3.93–7.61)***
Transgender woman	65.1	2.88 (1.88–4.42)***	2.44 (1.59–3.77)***
Gender nonconforming	85.0	7.63 (5.85–9.95)***	7.79 (5.92–10.25)***
Nicotine/tobacco use[e]			
None	54.4	Ref	Ref
Exclusive noncombustible	65.7	1.85 (1.65–2.08)***	1.70 (1.51–1.91)***
Exclusive combustible	59.6	1.25 (1.07–1.46)**	1.26 (1.07–1.50)**
Both	67.6	1.69 (1.48–1.92)***	1.86 (1.61–2.15)***
Age			
16	49.3	Ref	Ref
17	51.2	1.16 (1.06–1.26)**	1.09 (0.99–1.19)
18	61.1	1.77 (1.61–1.93)***	1.70 (1.55–1.87)***
19	65.1	2.19 (1.98–2.42)***	2.06 (1.85–2.29)***
Race/Ethnicity			
Non-Hispanic White	56.0	Ref	Ref
Hispanic/Latino	60.5	1.20 (1.10–1.32)***	1.20 (1.09–1.33)***
Non-Hispanic Black	54.0	0.92 (0.84–1.01)	0.91 (0.82–0.99)*
Asian/Pacific Islander	58.8	1.12 (0.99–1.28)	1.31 (1.14–1.51)***
Alaska Native/American Indian	62.6	1.32 (1.05–1.65)*	1.35 (1.06–1.72)*
Another race	63.6	1.38 (0.91–2.09)	1.56 (0.99–2.45)
No response	51.9	0.85 (0.60–1.20)	0.93 (0.64–1.33)
Perceived income adequacy			
Not meeting needs	63.1	Ref	Ref
Just meeting needs	64.1	1.04 (0.89–1.23)	1.13 (0.95–1.34)
Meeting needs	55.5	0.73 (0.62–0.86)***	0.82 (0.69–0.97)*
Living comfortably	51.9	0.63 (0.54–0.74)***	0.69 (0.58–0.82)***
No response	53.3	0.67 (0.54–0.82)***	0.77 (0.61–0.97)*
Wave			
Feb ‘20	50.7	Ref	Ref
Aug ‘20	56.6	1.25 (1.13–1.38)***	1.31 (1.18–1.45)***
Feb ‘21	64.1	1.73 (1.55–1.93)***	1.85 (1.65–2.07)***
Aug ‘21	62.2	1.61 (1.44–1.81)***	1.69 (1.50–1.91)***
Aug ‘22	56.8	1.34 (1.20–1.51)***	1.32 (1.17–1.49)***
Aug ‘23	47.5	0.89 (0.80–0.98)*	0.87 (0.77–0.97)*
U.S. census region			
West	57.9	Ref	Ref
Midwest	55.8	0.89 (0.81–0.99)*	0.91 (0.88–1.01)
Northeast	56.3	0.92 (0.83–1.02)	0.93 (0.83–1.03)
South	56.2	0.92 (0.84–1.01)	0.92 (0.83–1.02)

[a]Internalizing mental health symptoms included reporting either symptoms of depression or anxiety or both.
[b]% predicted probabilities of current IMH symptoms were calculated using postestimation commands adjusting for all covariates in the model.
[c]Odds ratios were estimated in logistic regression models with current internalizing mental health symptoms (Ref = no) as the outcome.
[d]Models adjusted for gender identity, nicotine/tobacco use, wave, age, race/ethnicity, U.S. census region, and perceived income adequacy. All models are weighted.
[e]Current nicotine/tobacco use included reporting use of a nicotine/tobacco product in the past 30 days. Exclusive combustible products included cigarettes, cigars, little cigars or cigarillos, bidis, and hookah. Exclusive noncombustible products included e-cigarettes, nicotine pouches, and smokeless tobacco. Both types included at least one combustible and noncombustible product.
*$p < 0.05$, **$p < 0.01$, ***$p < 0.001$.
aOR, adjusted odds ratio; CI, confidence interval; OR, odds ratio.

it relates to their mental health, which would aid in the development of targeted interventions adapted to their unique needs.

Surprisingly, there was no association between IMH symptoms and exclusive combustible nicotine/tobacco use or use of both product types among GNC adolescents. The relatively higher rates of IMH symptoms among GNC adolescents may have resulted in a “ceiling” effect due to the limited number of those without IMH symptoms. This was particularly evident when evaluating relatively lower rates of nicotine/tobacco use among GNC adolescents compared with transgender adolescents.

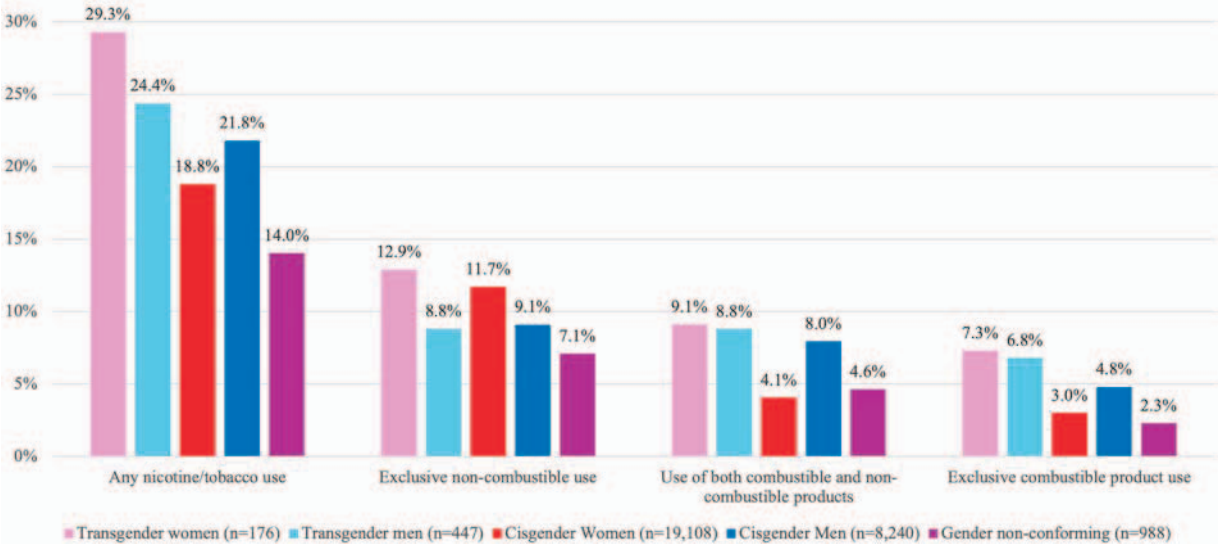

FIG. 1. Predicted probabilities of current use of nicotine/tobacco products by gender identity among U.S. adolescents, 2020–2023 (n = 28,959). All prevalence rates are weighted and adjust for internalizing mental health symptoms, wave, age, race/ethnicity, perceived income adequacy, and U.S. census region. Any nicotine/tobacco product use included any past 30-day use of cigarettes, e-cigarettes, little cigars or cigarillos, cigars, bidis, hookah, smokeless tobacco, and nicotine pouch. Exclusive combustible products included cigarettes, cigars, little cigars or cigarillos, bidis, and hookah. Exclusive noncombustible products included e-cigarettes, nicotine pouches, and smokeless tobacco. Both types included at least one combustible and noncombustible product. Prevalence rates are weighted.

Another surprising result was the finding that transgender adolescents with IMH symptoms were less likely to be exclusive users of combustible products or report using both types of tobacco products compared with those without IMH symptoms. These unexpected findings may be explained by differences in minority stressors, social factors, or experiences with gender-affirming care. For example, there is a possibility that transgender youth may experience less proximal stress related to identity concealment and validation than GNC youth,[54,55] resulting in less smoking to cope with stress.

Similarly, if transgender youth are receiving gender-affirming medical care, they may have more encounters with medical professionals who may regularly suggest tobacco cessation. Medical professionals could also potentially withhold specific gender-affirming interventions unless patients have confirmed their cessation. The general finding that GNC youth reported less overall nicotine/tobacco use than their transgender peers but exhibited an increased risk for non-combustible nicotine/tobacco use with IMH symptoms that was not exhibited by transgender youth should be prioritized for research moving forward.

Among cisgender men, IMH symptoms were associated with all types of use. Among cisgender women, IMH symptoms were associated with use of noncombustibles and of both product types. Many studies focusing on the relationship between IMH symptoms and cigarette smoking suggest that sex moderates this relationship, with most finding stronger associations for females.[35–41] Our study provides evidence that the relationship between IMH symptoms and nicotine/tobacco use differs by gender identity. Future studies should continue examining the nuances of how adolescents' gender identity relates to use of the growing array of nicotine products.

This study has several strengths. Use of a large, weighted data set allowed us to examine relatively low prevalence gender identity subgroups. Indeed, our sample of adolescents aged 16–19 included 1.6% identifying as transgender and 2.9% identifying as GNC. National estimates show that the prevalence rates of transgender (including nonbinary) individuals are 3.3% among 13–17-year olds and 2.7% among 18–24-year olds; however, gender identity was measured differently than in our study (e.g., aggregating transgender and GNC identities),[56] which may explain our finding of a higher prevalence, as some GNC individuals do not consider themselves transgender.[55] There are no current estimates of the population size of GNC adolescents, but our study had a sufficient sample to study this group.

Limitations. Our study has several limitations that should be noted. Whereas our convenience sample may have resulted in selection bias, the use of poststratification sample weights adjusted analyses to enhance population-level inferences. In terms of potential limitations, the cross-sectional nature of the data means that we cannot comment on directionality, which may be an important part of the relationship between IMH and nicotine use.

The depression and anxiety items we used to derive the IMH measure have only been validated among adults.[45] However, the prevalence of symptoms of depression and anxiety found by these measures in our study was similar to population-level prevalence rates found using other measures.[57] In addition, these items are highly correlated with the Beck inventories,[48] which have been validated among youth.[46,47] We chose to combine the depression and anxiety items into one measure to account for the comorbidity and lack of discriminability between these types of symptoms among youth compared with among adults.[49] Furthermore,

Table 3. Association Between Gender Identity and Current Nicotine/Tobacco Use ($N = 28,959$)

	Exclusive combustible use			*Exclusive noncombustible use*			*Both*		
	%[a]	*RRR (95% CI)*[b]	*aRRR (95% CI)*[c]	%	*RRR (95% CI)*[b]	*aRRR (95% CI)*[c]	%	*RRR (95% CI)*[b]	*aRRR (95% CI)*[c]
Gender identity									
Cisgender man	4.7	Ref	Ref	8.5	Ref	Ref	7.3	Ref	Ref
Cisgender woman	3.1	0.66 (0.57–0.77)***	0.60 (0.51–0.70)***	12.4	1.45 (1.29–1.62)***	1.24 (1.11–1.39)***	4.4	0.60 (0.53–0.67)***	0.48 (0.43–0.55)***
Transgender man	7.3	1.71 (1.10–2.63)*	1.48 (0.96–2.30)	9.8	1.27 (0.82–1.95)	1.00 (0.64–1.57)	10.1	1.51 (1.05–2.18)*	1.15 (0.77–1.71)
Transgender woman	8.8	2.21 (1.24–3.94)**	1.71 (0.96–3.05)	13.9	1.93 (1.04–3.60)*	1.60 (0.84–3.04)	9.8	1.59 (0.90–2.80)	1.29 (0.71–2.36)
GNC	2.2	0.45 (0.30–0.66)***	0.43 (0.29–0.64)***	8.3	0.93 (0.67–1.28)	0.70 (0.51–0.97)*	5.0	0.65 (0.44–0.96)*	0.52 (0.35–0.77)**
IMH symptoms[d]									
No	3.7	Ref	Ref	7.9	Ref	Ref	4.4	Ref	Ref
Yes	4.2	1.25 (1.07–1.46)**	1.26 (1.06–1.50)**	12.0	1.85 (1.65–2.08)***	1.69 (1.50–1.90)***	7.3	1.69 (1.48–1.92)***	1.86 (1.61–2.15)***
Age									
16	3.2	Ref	Ref	7.8	Ref	Ref	4.9	Ref	Ref
17	3.6	1.11 (0.89–1.37)	1.14 (0.92–1.42)	8.5	1.16 (0.99–1.36)	1.12 (0.95–1.31)	5.6	1.17 (0.98–1.39)	1.19 (1.00–1.42)*
18	4.5	1.60 (1.29–1.98)***	1.52 (1.22–1.88)***	12.3	1.87 (1.61–2.17)***	1.73 (1.49–2.01)***	6.1	1.51 (1.26–1.81)***	1.39 (1.16–1.67)***
19	4.5	1.68 (1.34–2.11)***	1.57 (1.24–1.97)***	12.3	1.96 (1.67–2.30)***	1.76 (1.50–2.07)***	7.2	1.87 (1.56–2.25)***	1.69 (1.40–2.04)***
Race/Ethnicity									
NH White	3.4	Ref	Ref	11.6	Ref	Ref	6.5	Ref	Ref
Hispanic/Latino	4.5	1.27 (1.03–1.57)*	1.13 (0.91–1.41)	8.4	0.69 (0.60–0.80)***	0.67 (0.58–0.78)***	5.5	0.81 (0.68–0.97)*	0.72 (0.60–0.86)***
NH Black	8.6	2.50 (2.08–3.01)***	2.32 (1.93–2.79)***	6.7	0.57 (0.48–0.68)***	0.53 (0.45–0.64)***	5.3	0.80 (0.66–0.97)*	0.71 (0.58–0.87)**
Asian/Pacific Islander	2.4	0.60 (0.43–0.84)**	0.56 (0.39–0.79)**	4.4	0.33 (0.25–0.43)***	0.35 (0.27–0.47)***	1.8	0.24 (0.17–0.33)***	0.23 (0.16–0.32)***
Alaska Native/American Indian	4.3	1.29 (0.71–2.33)	1.16 (0.64–2.10)	11.4	0.99 (0.69–1.43)	0.92 (0.64–1.34)	6.5	1.01 (0.66–1.55)	0.85 (0.54–1.34)
Another race	4.2	1.13 (0.31–4.03)	1.08 (0.30–3.80)	6.3	0.49 (0.23–1.04)	0.47 (0.22–1.02)	3.4	0.48 (0.26–0.87)*	0.44 (0.24–0.82)*
No response	2.3	0.60 (0.31–1.16)	0.57 (0.29–1.13)	3.8	0.29 (0.17–0.49)***	0.33 (0.19–0.56)***	4.2	0.57 (0.26–1.26)	0.61 (0.27–1.37)
Perceived income adequacy									
Not meeting needs	7.3	Ref	Ref	12.6	Ref	Ref	13.4	Ref	Ref
Just meeting needs	5.0	0.59 (0.44–0.78)***	0.59 (0.44–0.79)***	11.4	0.75 (0.59–0.94)*	0.78 (0.62–0.99)*	7.0	0.43 (0.34–0.55)***	0.45 (0.35–0.57)***
Meeting needs	3.5	0.36 (0.27–0.48)***	0.39 (0.29–0.52)***	9.7	0.56 (0.44–0.71)***	0.62 (0.49–0.78)***	5.2	0.29 (0.23–0.37)***	0.31 (0.24–0.40)***
Living comfortably	3.2	0.33 (0.25–0.44)***	0.36 (0.27–0.49)***	10.1	0.57 (0.45–0.71)***	0.65 (0.51–0.83)***	5.2	0.29 (0.23–0.37)***	0.31 (0.25–0.40)***
No response	3.7	0.37 (0.22–0.60)***	0.39 (0.23–0.64)***	8.1	0.41 (0.29–0.57)***	0.49 (0.35–0.69)***	2.9	0.14 (0.10–0.21)***	0.16 (0.11–0.24)***
Wave									
Feb '20	3.9	Ref	Ref	11.9	Ref	Ref	8.1	Ref	Ref
Aug '20	4.6	1.08 (0.87–1.35)	1.13 (0.90–1.42)	8.9	0.70 (0.59–0.82)***	0.71 (0.60–0.83)***	6.2	0.70 (0.59–0.84)***	0.74 (0.61–0.88)**
Feb '21	4.6	1.13 (0.90–1.43)	1.13 (0.89–1.43)	9.1	0.74 (0.62–0.87)***	0.72 (0.61–0.86)***	6.4	0.76 (0.63–0.92)**	0.76 (0.63–0.92)**
Aug '21	3.4	0.80 (0.62–1.03)	0.82 (0.64–1.07)	10.4	0.81 (0.68–0.97)*	0.81 (0.68–0.97)*	4.8	0.56 (0.45–0.70)***	0.56 (0.45–0.70)***
Aug '22	3.6	0.90 (0.67–1.21)	0.87 (0.65–1.18)	11.3	0.91 (0.77–1.09)	0.89 (0.75–1.70)	4.8	0.59 (0.47–0.73)***	0.56 (0.49–0.70)***
Aug '23	3.2	0.78 (0.60–1.01)	0.77 (0.59–0.99)*	10.9	0.84 (0.71–0.99)*	0.86 (0.72–1.01)	4.8	0.56 (0.45–0.70)***	0.55 (0.44–0.69)***
U.S. census region									
West	4.3	Ref	Ref	8.9	Ref	Ref	5.6	Ref	Ref
Midwest	3.7	0.96 (0.75–1.24)	0.87 (0.67–1.13)	11.3	1.33 (1.13–1.57)**	1.28 (1.08–1.52)**	5.1	0.98 (0.80–1.21)	0.91 (0.74–1.13)
Northeast	4.1	1.02 (0.80–1.31)	0.95 (0.73–1.23)	9.3	1.07 (0.90–1.25)	1.04 (0.88–1.23)	5.5	1.02 (0.84–1.25)	0.98 (0.80–1.20)
South	3.8	1.09 (0.87–1.36)	0.91 (0.73–1.15)	11.1	1.28 (1.10–1.49)**	1.28 (1.09–1.49)**	6.8	1.31 (1.09–1.58)**	1.25 (1.03–1.51)*

[a]% predicted probabilities of current nicotine/tobacco use were calculated using postestimation commands adjusting for all covariates in the model.

[b]RRRs were estimated in multinomial logistic regression model with current nicotine/tobacco use as the outcome (ref = no use).

[c]Models adjusted for all covariates. All models are weighted.

[d]Internalizing mental health symptoms included reporting either symptoms of depression or anxiety or both.

Current nicotine/tobacco use included reporting use of a nicotine/tobacco product in the past 30 days. Exclusive combustible products included cigarettes, cigars, little cigars or cigarillos, bidis, and hookah. Exclusive noncombustible products included e-cigarettes, nicotine pouches, and smokeless tobacco. Both types included at least one combustible and noncombustible product.

*$p < 0.05$, **$p < 0.01$, ***$p < 0.001$.

aRRR, adjusted relative risk ratio; RRR, relative risk ratio.

Table 4. Multinomial Logistic Regression Models of the Association Between Internalizing Mental Health Symptoms and Nicotine/Tobacco Use, Stratified by Gender Identity (N = 28,959)

Strata	IMH symptoms[a]	Exclusive combustible use		Exclusive noncombustible use		Use of both types	
		RRR (95% CI)[b]	aRRR (95% CI)[c]	RRR (95% CI)[b]	aRRR (95% CI)[c]	RRR (95% CI)[b]	aRRR (95% CI)[c]
Cisgender man	No	Ref	Ref	Ref	Ref	Ref	Ref
(n = 8240)	Yes	1.70 (1.35–2.15)***	1.58 (1.25–2.01)***	1.43 (1.18–1.74)***	1.41 (1.15–1.73)**	2.31 (1.92–2.78)***	2.34 (1.93–2.83)***
Cisgender woman	No	Ref	Ref	Ref	Ref	Ref	Ref
(n = 19,108)	Yes	1.07 (0.88–1.3)	0.96 (0.79–1.17)	2.35 (2.05–2.68)***	2.17 (1.89–2.49)***	1.60 (1.35–1.89)***	1.38 (1.16–1.64)***
Transgender	No	Ref	Ref	Ref	Ref	Ref	Ref
(n = 623)	Yes	0.38 (0.19–0.78)**	0.33 (0.14–0.73)**	0.51 (0.22–1.21)	0.48 (0.21–1.12)	0.37 (0.18–0.75)**	0.39 (0.20–0.77)**
GNC	No	Ref	Ref	Ref	Ref	Ref	Ref
(n = 988)	Yes	0.61 (0.25–1.47)	0.66 (0.27–1.61)	2.82 (1.04–7.67)*	2.97 (1.04–8.55)*	0.51 (0.19–1.40)	0.38 (0.14–1.04)

[a]Internalizing mental health symptoms included reporting either symptoms of depression or anxiety or both.
[b]RRRs found in separate multinomial regression models stratified by gender identity with current nicotine/tobacco use (ref = no current use) as the outcome and IMH symptoms as the independent variable.
[c]Models adjusted for wave, age, race/ethnicity, perceived income adequacy, and U.S. census region. All models are weighted.
Current nicotine/tobacco use included reporting use of a nicotine/tobacco product in the past 30 days. Exclusive combustible products included cigarettes, cigars, little cigars or cigarillos, bidis, and hookah. Exclusive noncombustible products included e-cigarettes, nicotine pouches, and smokeless tobacco. Both types included at least one combustible and noncombustible product.
$*p < 0.05$, $**p < 0.01$, $***p < 0.001$.

the continuous measures of depression and anxiety symptoms were highly correlated. Future work should continue to examine the validity of this measure in younger populations.

Although our measure of gender identity differentiated between transgender and GNC identities, it is important to note that gender identity is fluid. Some identities that fit under the GNC category may also fit under the transgender category. In other words, there are no concrete definitions of "transgender" or "GNC," and participants ascribing to these identity labels may have distinctly different risk for IMH and/or tobacco use.

However, in models investigating the interaction between IMH symptoms and gender identity on nicotine/tobacco use, the sample size of transgender men and transgender women was insufficient for adequately powered analyses disaggregated by specific transgender identity. As a result, estimates may obscure meaningful differences across subgroups. In addition, whereas participants could only endorse one response option in the present study, some adolescents may feel that their gender identity fits under both the transgender and GNC categories. Recognizing such differences is essential to fostering the well-being of adolescents with these identities,[14] and may be important to consider when developing interventions that are targeted toward gender minority adolescents.

The initial item measuring sex at birth only had response options of "male," "female," "don't know," "refused," or "*x*." Because sex was required to develop survey weights, participants who selected "don't know," "refused," or "*x*" could not be included in weighted analyses without recoding. We therefore recoded sex based on current gender identity for those participants to avoid systematic exclusion from population-level estimates. We acknowledge that this may have resulted in misclassification for individuals whose sex assigned at birth does not align with their current gender identity. Future research should also consider examining intersex identities as well. Finally, this study did not measure sexual orientation, which may add important nuances that future research on gender identity and health risk could consider.

Conclusion

The present research reveals the importance of disaggregating GNC and transgender identities in research related to nicotine/tobacco use and mental health among adolescents. A guide to best practices for ethical research with SGM adolescents exists and is being increasingly used.[58] Our findings lend further support to the calls for adolescent research incorporating these best practices to safely and accurately conduct research with this at-risk population. As the U.S. government becomes increasingly hostile toward protecting the rights of gender minority individuals, it is essential that we understand their unique health characteristics to best advocate for them.

Authors' Contributions

E.E.H.: Conceptualization, formal analysis, visualization, and writing—original draft. D.V.-P.: Writing—original draft. R.O'N.: Formal analysis and writing—review and editing. J.T.H.: Writing—review and editing.

A.R.T.: Writing—review and editing. M.K.: Writing—review and editing. J.F.: Writing—review and editing. D.H.: Funding acquisition, investigation, conceptualization, project administration, supervision, and writing—review and editing. J.F.T.: Supervision, conceptualization, and writing—review and editing.

Data Availability

Data are available upon reasonable request. Deidentified data will be made available to researchers who provide a methodologically sound proposal for use in achieving the goals of the approved proposal. Proposals should be submitted to D.H.

Disclaimer

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Supplementary Material

Supplementary Table S1
Supplementary Table S2
Supplementary Table S3
Supplementary Table S4
Supplementary Table S5

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