

Tobacco Use Among Gender-Varying and Gender-Stable Adolescents and Adults Living in the United States

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Abstract

Introduction: This study examines the proportion of the United States adolescents and adults who are variable (ie, at least one change in gender identity) versus stable in their gender identities over time, and whether they differ significantly in their nicotine/tobacco use after adjusting for key covariates.

Methods: We fit multivariable logistic regression models to data from Waves 2–4 (2014/15–2016/18) of the Population Assessment of Tobacco and Health (PATH), a nationally representative study ($n = 33\,197$ U.S. adolescents and adults aged ≥ 14 years). We examined associations of gender stability/variability over three waves with tobacco use at wave 4 (2016–2018). Differences in any past 30-day tobacco, cigarette, e-cigarette, other tobacco, and poly-tobacco use were assessed among cisgender-stable, transgender-stable, and gender-varying respondents.

Results: An estimated 1.0% of adolescents and adults were classified as gender-varying. Prevalence of any past 30-day tobacco use was higher among gender-varying individuals (42.7%) than among gender-stable individuals (transgender-stable, 37.8% and cisgender-stable, 26.7%). There were no significant differences in the odds of nicotine/tobacco use between the two gender-stable groups. However, gender-varying respondents had significant increased odds of any past 30-day tobacco use (adjusted odds ratio [AOR] = 2.0, 95% confidence interval [CI] = 1.3 to 3.0), cigarette use (AOR = 1.7, 95% CI = 1.1 to 2.5), e-cigarette use (AOR = 2.2, 95% CI = 1.4–3.5), other tobacco use (AOR = 2.2, 95% CI = 1.4 to 3.4), and poly-tobacco use (AOR = 2.0, 95% CI = 1.3 to 3.1) compared with cisgender-stable individuals.

Conclusions: Gender-varying individuals are at higher risk for nicotine/tobacco use, placing them at greater risk for tobacco-related health consequences.

Implications: Despite increased knowledge about transgender health in recent years, there remains a paucity of research about gender-varying individuals. This study is the first to examine the proportion of gender-varying individuals in the United States using a longitudinal, nationally representative sample and to explore differences in nicotine/tobacco use among gender-varying and gender-stable individuals. Our findings suggest that gender-varying people have an increased risk for nicotine/tobacco use, placing them at higher risk for tobacco-related health consequences. This study increases knowledge about nicotine/tobacco use among this under-represented population in research and underscores the importance of developing an awareness of gender diversity.

Introduction

Prior research suggests that nicotine/tobacco use (including e-cigarettes) is more prevalent among transgender populations (individuals whose gender identity differs from their assigned sex at birth¹) relative to cisgender populations,^{2–8} thus increasing their risk for smoking-related health consequences.^{9,10} Approximately 1.4 million adults¹¹ and 150 000 youth (ages 13–17 years)¹² in the United States identify as transgender, with youth and young adults being more likely to confirm a non-cisgender identity.^{11–13} With the

proportion of adults who identify as transgender growing over time,¹³ there is a need to further study this population that is vulnerable to nicotine/tobacco use.

The term transgender encompasses a multiplicity of identities that transcends culturally defined categories of gender.¹ Some transgender individuals cross the gender binary towards a stable endpoint, whereas others, for whom the experience of gender identity is more complex, ambiguous, and liminal,^{14,15} challenge a fixed and dichotomous model of gender. Despite burgeoning research on

transgender health disparities, there remains limited knowledge about gender-varying individuals (ie, individuals who experience changes in gender identity over time).^{14,15} Gender-varying individuals experience unique challenges because of conventional conceptualizations of gender as binary, static, and mutually exclusive.^{14,15} No U.S. studies have examined the proportion of individuals who are gender-varying using a nationally representative, probability-based sample. In extant studies of nicotine/tobacco use among transgender populations,^{2-8,16} gender identity was assessed as a static construct using cross-sectional data. No research has explored the association between gender variability and nicotine/tobacco use.

Our research questions were: 1. What proportion of the U.S. adolescents and adults are variable versus stable in their gender identity? 2. Do individuals who are gender-varying differ significantly from those who are gender-stable in their nicotine/tobacco use after adjusting for key covariates, including *sexual identity stability/variability*, psychological distress, and sociodemographic characteristics? Identifying the gender identity subgroups at greatest risk of nicotine/tobacco use can inform targeted prevention and intervention strategies.

Methods

Data Source

Data come from waves 2–4 of the Population Assessment of Tobacco and Health (PATH), collected from 2014–2018.¹⁷ The PATH study is a nationally representative survey of the United States noninstitutionalized adults (≥ 18 years) and youth (12–17 years) and used a four-state stratified address-based area probability sampling design. The sample was 45 971 with an overall response rate of 74.0% for adults and 78.4% for youth at wave 1. Response rates at waves 2–4 were: 83.2%, 78.4%, and 73.5% for adults, and 87.3%, 83.3%, and 79.5% for youth, respectively. Human subject approval was received from the first author's institution.

We restricted our sample to individuals aged ≥ 14 years at wave 2, as they were eligible to receive questions about sexual and gender identity. Wave 1 data were not used because gender identity was conflated with the item assessing sexual identity. We included panel respondents who responded at waves 2–4 with valid responses to items about sexual and gender identity; a complete case analysis was necessary to assess gender variability. The overall sample size for our study was 33 197 individuals aged ≥ 14 years at wave 2.

Measures

Outcome Variables at Wave 4 included

past 30-day cigarette use (smoking a cigarette, even a puff or two, within the past 30 days), *past 30-day e-cigarette use* (using any electronic cigarette product, even once or twice, in the past 30 days), *past 30-day other tobacco use* (using cigars, cigarillos, smokeless, hookah, pipes, or snus in the past 30 days), *past 30-day any tobacco use* (any of the following tobacco products in the past 30 days: Cigarettes, e-cigarettes, cigars, cigarillos, smokeless, hookah, pipes, and snus), and *past 30-day poly-tobacco use* (using two or more tobacco products in the past 30 days).

Gender Stability/Variability was determined as follows

Some people describe themselves as transgender when they experience a different gender identity from their sex at birth.

For example, a person born into a male body, but who feels female or lives as a woman would be transgender. Do you consider yourself to be transgender? (yes/no) Respondents aged ≥ 14 years who identified as transgender were subsequently asked, “Do you consider yourself to be male-to-female, female-to-male, or non-conforming?” Gender stability/variability consisted of three categories based upon respondents' self-reported transgender identity in waves 2–4: cisgender-stable, transgender-stable, and gender-varying. Individuals who answered “no” to the transgender item at all three waves were considered cisgender-stable. Individuals who answered “yes” to the transgender item and maintained a consistent transgender subgroup identity (eg, male-to-female) at all three waves were considered transgender-stable. Individuals were considered gender-varying if they responded differently to the transgender item across waves or changed transgender identity subgroups across waves.

Wave 4 Covariates used in multivariable analyses

Past year psychological stress was determined from the Global Appraisal of Individual Needs-Short Screener (GAIN-SS; none/low, moderate, and high severity).¹⁸ *Sexual identity stability/variability* was determined by sexual identity endorsement across waves 2–4, similar to prior work.¹⁹ Heterosexual-stable individuals were consistent in their heterosexual identity across waves. Individuals who identified as lesbian, gay, bisexual, or something else (LGBS) and were consistent across the three waves were categorized as LGBS-stable. Individuals were categorized as sexual identity-varying if they changed sexual identity across waves. Other covariates included *sex* (male, female), *age* (14–17, 18–25, 26–44, and 45+ years), *race/ethnicity* (White, Black, Asian, Hispanic, and Multiracial/Other), and *the United States Census region* (Northeast, Midwest, South, and West).

Statistical Analysis

All analyses accounted for the complex sampling design of the PATH. We used the time-varying longitudinal, all-wave survey weights for adult and youth cohorts as well as Fay's method of Balance Repeated Replication (BRR) for variance estimation.¹⁷ PATH provided the 100 replicate weights for BRR with an estimated weighting adjustment of 0.3 for weighting down half of the sample. All analyses were conducted using Stata version 16's “svy” commands to obtain design-based estimates, and unconditional subpopulation analysis commands were used throughout to ensure proper variance estimation.

Initial univariate analyses provided un-weighted sample size distributions and weighted percentage distributions. We then examined bivariate associations of gender stability/variability with past 30-day any tobacco use, cigarette use, e-cigarette use, other tobacco use, and poly-tobacco use, and reported prevalence estimates, unadjusted odds ratios, and 95% confidence intervals. Significant associations were determined using design-adjusted Rao-Scott F-Tests.²⁰ *P*-values smaller than 0.05 were considered significant. Multivariable logistic regression models then estimated the odds of past 30-day nicotine/tobacco use as a function of gender stability/variability, adjusting for sex, sexual identity stability/variability, psychological stress, and sociodemographic variables. We employed an Archer-Lemeshow goodness-of-fit test for each model.²¹

We also examined gender stability/variability by age in supplemental analyses. We then tested whether the relationship

Table 1. Prevalence and Unadjusted Odds Ratios of Past 30-day Nicotine/Tobacco Use Among Respondents Aged ≥14 Years in the PATH, Wave 4

Gender Stability/ Variability	Past 30-day					
	Any tobacco use N = 12 658	Cigarette use N = 9 513	E-cigarette use N = 3 324	Other tobacco use ^a N = 4 590	Poly-tobacco use N = 4 281	
	% (SE)	OR 95% CI	% (SE)	OR 95% CI	% (SE)	OR 95% CI
Cisgender-stable	26.7% (0.3)	REF	5.9% (0.1)	REF	9.2% (0.2)	8.2% (0.2)
Transgender-stable	37.8% (9.9)	1.7 (0.7-3.9)	8.5% (3.5)	1.5 (0.5-4.1)	15.1% (6.5)	14.3% (6.4)
Gender-varying	42.7% (4.3)	2.1 ^{†††} (1.5-2.9)	31.9% (3.8)	2.5 ^{†††} (1.8-3.5)	19.8% (2.8)	17.6% (2.5)

^aOther tobacco use includes: cigars, cigarillos, smokeless, hookah, pipes, and snus. Asterisks denote statistical significance based on the Rao-Scott adjusted F test (**p* < .05, ***p* < .01, ****p* < .001). Significance is by column. Crosses denote statistical significance for unadjusted odds ratios (†*p* < .05, ††*p* < .01, †††*p* < .001).

between nicotine/tobacco use and gender stability/variability was moderated by age and conducted sensitivity analyses by restricting the study sample to respondents aged ≥18 years.

Results

An estimated 1.0% (*n* = 377) of adolescents and adults were classified as gender-varying and 0.1% (*n* = 49) were transgender-stable. Overall, 26.2% reported past 30-day nicotine/tobacco product use at wave 4, with 19.9% reporting past 30-day cigarette smoking and 8.2% engaging in poly-tobacco use (Supplemental Table 1).

Table 1 presents past 30-day nicotine/tobacco use by gender stability/variability. Transgender-stable and gender-varying respondents reported a significantly higher prevalence of any nicotine/tobacco use (37.8% and 42.7%, respectively) compared to cisgender-stable individuals (26.7%; *p* < .001). Similar results were found for cigarette smoking, with 33% of transgender-stable respondents reporting cigarette smoking, followed by gender-varying individuals (31.9%) and cisgender-stable individuals (20.3%, *p* < .01). Gender-varying respondents had a significantly higher prevalence of any tobacco (*p* < .001), e-cigarette (*p* < .001), other tobacco (*p* < .001), and poly-tobacco (*p* < .001) use compared with individuals with stable gender identity. Gender-varying respondents had higher unadjusted odds for all nicotine/tobacco use outcomes compared with cisgender-stable respondents.

Though the associations above were slightly attenuated in the multivariable models, gender-varying respondents still had significantly increased odds for past 30-day any nicotine/tobacco use (AOR = 2.0, 95% CI 1.3, 3.0); cigarette smoking (AOR = 1.7, 95% CI 1.1, 2.5); e-cigarette use (AOR = 2.2, 95% CI 1.4, 3.5); other tobacco use (AOR = 2.2, 95% CI 1.4, 3.4); and poly-tobacco use (AOR=2.0, 95% CI 1.3, 3.1) compared with cisgender-stable individuals. Transgender-stable individuals were not at higher risk for any of the past 30-day tobacco use outcomes relative to cisgender-stable individuals (Table 2).

Gender variability was more prevalent among adolescents (1.6%) and young adults (1.2%) relative to other adult age groups (26-44, 1.0%; 45+, 1.0%; Supplemental Table 2). In our interaction tests, no significant interactions were found between age and gender stability/variability, suggesting that gender stability/variability has a similar association with nicotine/tobacco use, regardless of age.

Sensitivity analyses using an age-restricted sample (age ≥18 years) showed that gender-varying respondents had significantly increased odds for all nicotine/tobacco outcomes relative to cisgender-stable individuals, and tests for interactions between age and gender stability/variability in each of the models were not significant (results available upon request).

Discussion

Our study is the first to estimate the proportion of individuals in the United States who are gender-varying using a longitudinal, nationally representative sample. An estimated 1% of the sample experienced one or more changes in gender identity during the study period and the proportion of gender-varying people during the study period was greater than the proportion of transgender-stable individuals. This study brings an under-represented population into the foreground

Table 2. Past 30-day Nicotine/Tobacco Use As a Function of Gender Stability/Variability Among Respondents Aged ≥14 Years in the PATH, Wave 4

Variable	Past 30-Day				
	Any tobacco AOR (95% CI)	Cigarette AOR (95% CI)	E-cigarette AOR (95% CI)	Other tobacco ^a AOR (95% CI)	Poly-tobacco AOR (95% CI)
Gender Stability/Variability	N = 28,276	N = 28 247	N = 28 163	N = 28 173	N = 28 069
Cisgender-stable	REF	REF	REF	REF	REF
Transgender-stable	1.1 (0.4–2.7)	1.4 (0.5–3.6)	0.4 (0.1–1.3)	1.5 (0.5–4.2)	1.0 (0.3–3.0)
Gender-varying	2.0 (1.3–3.0)**	1.7 (1.1–2.5)*	2.2 (1.4–3.5)**	2.2 (1.4–3.4)**	2.0 (1.3–3.1)**
Sex					
Male	REF	REF	REF	REF	REF
Female	0.5 (0.5–0.6)***	0.7 (0.7–0.7)***	0.7 (0.6–0.8)***	0.3 (0.2–0.3)***	0.4 (0.4–0.4)***
Age					
14-17	REF	REF	REF	REF	REF
18-25	3.7 (3.3–4.3)***	4.6 (3.8–5.5)***	1.3 (1.1–1.5)**	4.7 (3.8–5.7)***	4.3 (3.5–5.3)***
26-44	3.8 (3.3–4.3)***	6.3 (5.2–7.6)***	0.9 (0.7–1.0)	2.9 (2.4–3.4)***	3.1 (2.5–3.8)***
45+	2.1 (1.8–2.4)***	3.7 (3.1–4.6)***	0.3 (0.3–0.4)***	1.3 (1.0–1.5)*	1.1 (0.9–1.4)
Race/Ethnicity					
White	REF	REF	REF	REF	REF
Black	1.2 (1.1–1.3)**	1.2 (1.1–1.4)***	0.6 (0.5–0.8)***	1.7 (1.5–1.9)***	1.4 (1.2–1.6)***
Asian	0.3 (0.3–0.4)***	0.4 (0.3–0.5)***	0.3 (0.2–0.6)***	0.4 (0.3–0.6)***	0.4 (0.3–0.6)***
Hispanic	0.8 (0.7–0.8)***	0.9 (0.8–0.9)**	0.6 (0.5–0.7)***	0.8 (0.7–0.9)***	0.8 (0.7–0.9)***
Multiracial/Other	1.4 (1.2–1.6)***	1.3 (1.2–1.5)***	1.3 (1.1–1.5)*	1.6 (1.3–1.9)***	1.5 (1.3–1.7)***
Region					
Northeast	REF	REF	REF	REF	REF
Midwest	1.2 (1.1–1.4)**	1.2 (1.0–1.4)*	1.1 (0.9–1.3)	1.2 (1.0–1.4)*	1.2 (1.0–1.4)
South	1.2 (1.1–1.4)**	1.2 (1.0–1.3)*	1.2 (1.0–1.4)*	1.2 (1.0–1.4)*	1.2 (1.0–1.3)*
West	0.9 (0.8–1.0)	0.9 (0.8–1.0)	1.1 (0.9–1.4)	0.9 (0.7–1.0)	0.9 (0.8–1.1)
Sexual Identity Stability/Variability					
Heterosexual-stable	REF	REF	REF	REF	REF
LGBS-stable	1.5 (1.3–1.8)***	1.6 (1.4–2.0)***	1.8 (1.4–2.6)***	1.2 (0.9–1.4)	1.5 (1.2–1.8)***
Sexually-varying	1.6 (1.4–1.9)***	1.6 (1.3–1.8)***	1.4 (1.2–1.6)***	1.4 (1.2–1.6)***	1.6 (1.4–1.9)***
Past Year Psychological Stress					
No/low (0-1 symptoms)	REF	REF	REF	REF	REF
Moderate (2-3 symptoms)	1.4 (1.3–1.6)***	1.5 (1.4–1.7)***	1.6 (1.4–1.8)***	1.2 (1.0–1.3)*	1.4 (1.2–1.6)***
High (4 symptoms)	2.4 (2.2–2.6)***	2.5 (2.3–2.7)***	2.4 (2.1–2.7)***	1.8 (1.6–2.0)***	2.5 (2.3–2.8)***
Goodness of Fit Test	<i>P</i> = 0.0322	<i>P</i> = .0015	<i>P</i> < .0001	<i>P</i> < .0001	<i>P</i> < .0001

Notes. AOR, adjusted odds ratio; CI, confidence interval; LGBS, lesbian, gay, bisexual, or something else. All models adjusted for sex, age, race/ethnicity, region, sexual identity stability/variability, and past year psychological distress. Asterisks denote statistical significance (**p* < .05, ***p* < .01, ****p* < .001). ^aOther tobacco use includes: cigars, cigarillos, smokeless, hookah, pipes, and snus.

and underscores the multiplicity and changing nature of gender identity.

Our study extends previous research on transgender individuals using PATH data.^{5,16} We found that a change in gender identity was significantly associated with past 30-day nicotine/tobacco use, whereas transgender-stable individuals were not at increased risk. Gender-varying individuals may

experience unique stress because of societal views of gender identity as a static and binary construct.^{14,15} Tobacco use is a stress-related behavior that gender-varying individuals may engage in to cope with their unique stress.⁸ Thus, those experiencing changes in gender identity may be at greater risk for smoking-related health consequences. Additionally, the odds of e-cigarette use are higher among gender-varying

individuals relative to cisgender-stable individuals. Future research should examine if gender-varying individuals are more likely to use e-cigarettes as a tobacco cessation method. Prevention and intervention efforts to decrease nicotine/tobacco use among transgender and gender-varying populations should include awareness promotion of gender diversity.

The strengths of this study include: 1. conceptualization of gender and sexual identities as non-exclusively stable constructs; 2. the use of a nationally representative, probability-based sample and 3. the inclusion of a wide range of ages. Other strengths include longitudinal data, valid measures, and enough transgender respondents to make meaningful conclusions.

The study is not without limitations. These include: 1. gender stability/variability was based on one transgender item or a change in transgender identity over three waves of data (from 2014 through 2018), limiting generalizability, and 2. the gender-varying subgroup included individuals who made their transition (eg, cisgender to transgender) only once during the data collection and may have subsequently remained stable in their gender identity. Additionally, our study did not capture changes in gender identity that may have occurred prior to Wave 2. Therefore, our study may underestimate the proportion of individuals who are gender-varying. Future research should include additional waves from the PATH dataset to provide estimates of gender stability/variability over a longer period. We used a complete case analysis in this study. However, our use of survey weights minimizes concerns about missing data. More in-depth comparisons of different approaches to missing data are an important topic for future research. We used information on nicotine/tobacco use from Wave 4 to examine the associations among gender stability/variability and past 30-day nicotine/tobacco use. Future work should examine multi-level factors influencing nicotine/tobacco use among gender-varying and gender-stable individuals over time.

In this study, we used the term *gender-varying* as an adjective, distinguishing it from the term *gender-variant*, which connotes stability. Furthermore, not all gender-varying individuals embrace the transgender identity label, and this posed a validity threat in this study.¹ Indeed, gender-varying can be considered an identity itself. Gender identity labels are dynamic and influenced by culture, social context, race/ethnicity, and cohort.¹ The transgender-stable and gender-varying categories may include individuals who identify beyond the response options available in the PATH study (ie, male-to-female, female-to-male, or non-conforming).

Given the intersectional nature of social identities, future work is needed to examine other identity dimensions (eg, sexual identity stability/variability or race/ethnicity) among gender-stable and gender-varying individuals, as they may complicate the relationship between nicotine/tobacco use and gender stability/variability.

Our study addressed a gap in the research literature about gender-varying individuals and the leading cause of preventable death in the United States. We examined the proportion of individuals, who are gender-varying using a probability-based sample and found that individuals who experienced changes in gender identity may have an increased risk of nicotine/tobacco use, thereby placing them at greater risk for tobacco-related death and diseases. Healthcare providers and tobacco cessation specialists should develop an awareness of gender

diversity and gender variability to create a welcoming, inclusive environment for individuals who do not subscribe to a fixed, binary conceptualization of gender.

Data Availability Statement

The data underlying this article will be shared on reasonable request to the corresponding author.

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Author Contributions

LK conceptualized and designed the study, conducted the literature review, and drafted the original manuscript. RJE-P assisted with the conceptualization of the study, critically reviewed, and edited the manuscript. CWE conducted the data analyses and drafted the original manuscript. CJB and PTV critically reviewed and edited the manuscript. BTW provided supervision for the data analyses, assisted with data interpretation, and critically reviewed and edited the manuscript. SEM assisted with the conceptualization of the study and interpretation of results, critically reviewed the manuscript, and provided supervision for the study. All authors approved the final manuscript as submitted and agree to be accountable for all aspects of the work.

Disclosures

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Declaration of Interests

The authors declare no conflicts of interest.

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