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## Mental Health Problems and Onset of Tobacco Use Among 12- to 24-Year-Olds in the PATH Study

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# Mental Health Problems and Onset of Tobacco Use Among 12- to 24-Year-Olds in the PATH Study

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**Objective:** To examine whether mental health problems predict incident use of 12 different tobacco products in a nationally representative sample of youth and young adults.

**Method:** This study analyzed Wave (W) 1 and W2 data from 10,533 12- to 24-year-old W1 never tobacco users in the Population Assessment of Tobacco and Health (PATH) Study. Self-reported lifetime internalizing and externalizing symptoms were assessed at W1. Past 12-month use of cigarettes, electronic nicotine delivery systems (ENDS), traditional cigars, cigarillos, filtered cigars, pipe, hookah, snus pouches, other smokeless tobacco, bidis and kreteks (youth only), and dissolvable tobacco was assessed at W2.

**Results:** In multivariable regression analyses, high-severity W1 internalizing (adjusted odds ratio [AOR] = 1.5, 95% CI = 1.3–1.8) and externalizing (AOR = 1.3, 95% CI = 1.1–1.5) problems predicted W2 onset of any tobacco use compared to no/low/moderate severity. High-severity W1 internalizing problems predicted W2 use onset across most tobacco products. High-severity W1 externalizing problems predicted onset of any tobacco (AOR = 1.6, 95% CI = 1.3–1.8), cigarettes (AOR = 1.4, 95% CI = 1.0–2.0), ENDS (AOR = 1.8, 95% CI = 1.5–2.1), and cigarillos (AOR = 1.5, 95% CI = 1.0–2.1) among youth only.

**Conclusion:** Internalizing and externalizing problems predicted onset of any tobacco use. However, findings differed for internalizing and externalizing problems across tobacco products, and by age, gender, and race/ethnicity. In addition to screening for tobacco product use, health care providers should screen for a range of mental health problems as a predictor of tobacco use. Interventions addressing mental health problems may prevent youth from initiating tobacco use.

**Key words:** young adult, tobacco, mental health, epidemiologic studies

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**A**lthough decreases in the overall prevalence of cigarette use among youth and young adults in the US have been observed over the past decade, cigarette use among those with mental illness has remained static since 2005.<sup>1–3</sup> Furthermore, it has been reported that individuals with serious mental illnesses have a life expectancy 25 years shorter when compared to that of the general population,<sup>4</sup> with a bulk of the disparity attributed to tobacco-related illnesses.<sup>5</sup> The literature thus far has been limited to examination of associations between mental illness and cigarette use,<sup>5</sup> despite increases in use of non-cigarette products, such as e-cigarettes, hookah, and cigars (eg, cigarillos), especially among US youth and young adults.<sup>6</sup> Therefore, it is critical to examine whether mental illness predicts the onset of tobacco use across

products during adolescence and young adulthood, when the risk of the onset of mental illness and substance use is greatest.<sup>7,8</sup>

Few longitudinal studies have examined how internalizing problems (depression, anxiety) and externalizing problems (conduct disorder, attention-deficit/hyperactivity disorder [ADHD], oppositional defiant disorder) predict tobacco use across products among youth and young adults. Those studies that have examined the onset of tobacco use among individuals with mental health problems are generally limited to cigarette use among youth.<sup>8–13</sup> Although studies of internalizing problems have shown that depression predicts the onset of cigarette use among youth,<sup>8–10</sup> others have found mixed results for anxiety.<sup>11,12</sup> Two studies found that ADHD predicts the onset of cigarette use

among youth,<sup>8,13</sup> and one study among youth and young adults found that ADHD plus co-existing conduct disorder or oppositional defiant disorder predicted overall tobacco use in the past year.<sup>14</sup> In addition, higher depressive symptoms among college students predicted e-cigarette use in the past 30 days.<sup>15</sup> However, to our knowledge, no prospective study has explored whether mental health problems predict the onset of specific tobacco product use beyond cigarettes and e-cigarettes among youth and young adults. As any use of a tobacco product in this vulnerable age group has been shown to predict future nicotine dependence,<sup>16</sup> examining whether mental health problems predict onset of tobacco use across products is important for future tobacco prevention efforts.

Using data from Waves 1 and 2 of the Population Assessment of Tobacco and Health (PATH) Study, the present study investigated whether internalizing and externalizing problems at Wave 1 predicted the onset of use for multiple types of tobacco products (ie, 12 products for youth; 10 products for young adults) at Wave 2 in a nationally representative sample of youth and young adult never tobacco users. Based on the negative reinforcement model of drug addiction,<sup>17</sup> we hypothesized that those individuals with higher severity of internalizing and externalizing problems would be more likely to begin using tobacco, regardless of product type. Furthermore, because early onset of psychopathology may be a marker for future tobacco use behaviors,<sup>18</sup> we also examined whether the association between mental health problems and tobacco use varied by age group.

## METHOD

### Study Design and Participants

The PATH Study is a national longitudinal cohort study of 45,971 adults and youth 12 years and older. The PATH Study recruitment used a stratified address-based, area-probability sampling design at Wave 1 that oversampled adult tobacco users, young adults (18–24 years), and African American adults. Details on sampling, weighting, survey interview procedures, questionnaires, and information on accessing the data are available at <http://doi.org/10.3886/Series606>. An in-person screener was used at Wave 1 to select participants 12 years and over from households. The study uses audio computer-assisted self-Interviews (ACASI) available in English and Spanish to collect self-report information on tobacco use patterns and associated health behaviors. All participants 18 years of age and older provided informed consent. Youth participants 12 to 17 years of age provided assent, whereas their parent/legal guardian provided consent. The study was conducted by Westat and approved by the Westat institutional review board. Further details regarding the PATH Study design and methods are published elsewhere.<sup>19</sup>

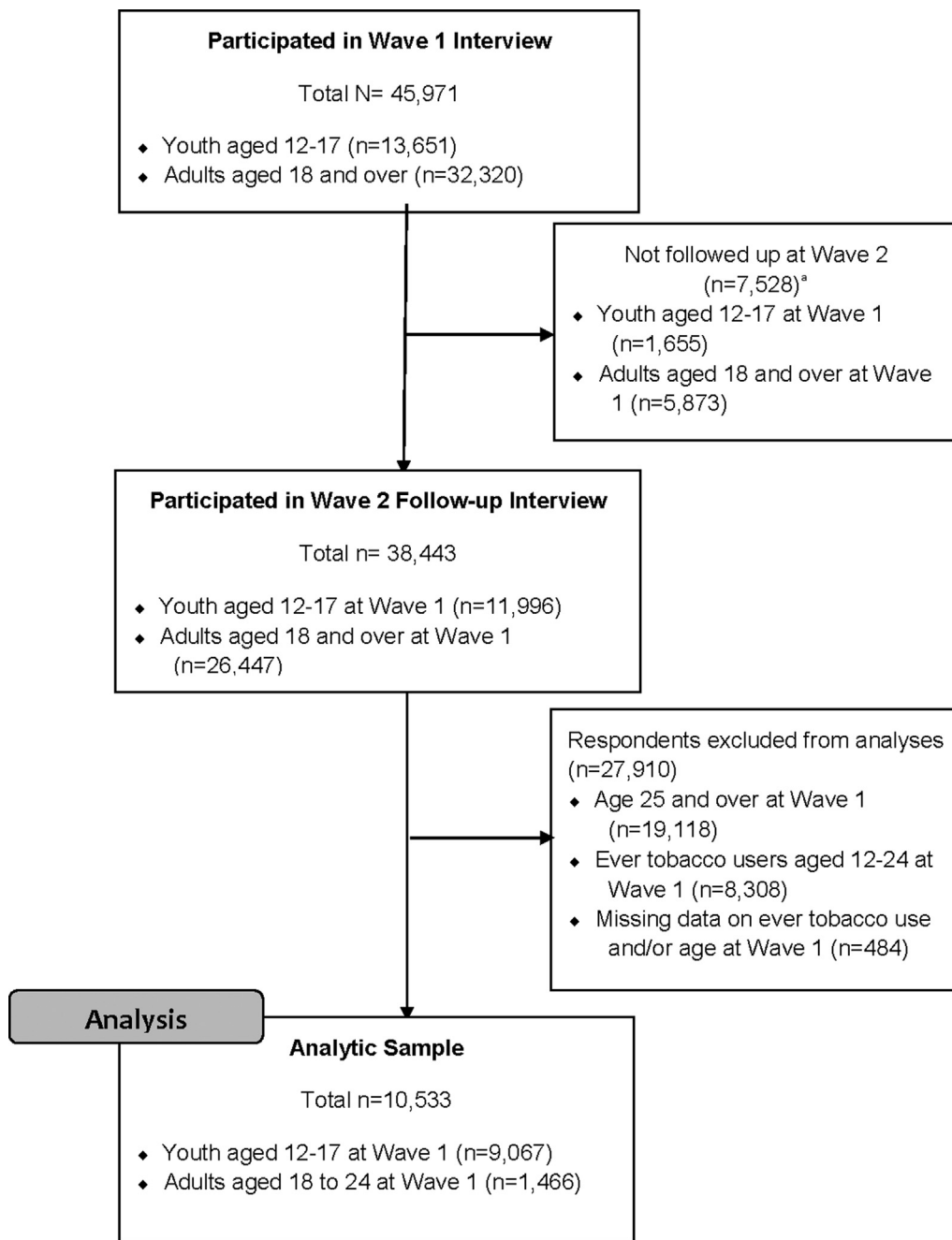
Population and replicate weights were created that adjusted for the complex study design characteristics (eg, oversampling at Wave 1) and nonresponse at Waves 1 and 2. Combined with the use of a probability sample, the weights allow analyses of the PATH Study data to compute estimates that are representative of the noninstitutionalized, civilian US population aged 12 years and older. At Wave 1, the weighted response rate for the household screener was 54.0%. Among households that were screened, the overall weighted response rate at Wave 1 was 74.0% for the Adult Interview and 78.4% for the Youth Interview. At Wave 2, the overall weighted response rate was 83.2% for the Adult Interview and 87.3% for the Youth Interview.

This article reports data from youth (aged 12–17 years) and young adults (18–24 years) recruited at Wave 1 (September 2013 to December 2014) and followed up approximately 1 year later (average period of follow-up, 52 weeks) at Wave 2 (October 2014 to October 2015) of the PATH Study. The time between the interviews varied as a function of respondents' schedules, time needed to contact respondents, and grouping of multiple respondents within a household. As shown in Figure 1, the present analyses were restricted to 10,533 Wave 1 youth ( $n = 9,067$ ) and young adult ( $n = 1,466$ ) never tobacco users with data on tobacco use, internalizing and externalizing problems, and covariates for the specific associations examined.

### Measures

**Mental Health Problems.** Mental health problems were assessed via the Global Appraisal of Individual Needs—Short Screener (GAIN-SS), modified for the PATH Study.<sup>20,21</sup> The GAIN-SS is a 3- to 5-minute screener that identifies individuals at risk for mental health or substance use disorders using a continuous measure of severity, based on the number of items endorsed. Items for the GAIN-SS were derived from the full GAIN instrument, a validated, standardized biopsychosocial assessment for individuals entering treatment for substance use or mental health disorders<sup>22</sup> and recommended for use in epidemiological samples by the PhenX Toolkit.<sup>23</sup> The PATH Study included four internalizing items, five externalizing items, five substance use problem items, and two hyperactivity items.<sup>22</sup> Given this study's focus on internalizing and externalizing problems, the substance use problem subscale was excluded from the analyses. In addition, as the externalizing and hyperactivity items were found to be collinear, these seven items were collapsed into one externalizing subscale.

The internalizing (youth Cronbach's  $\alpha = 0.81$ ; adult Cronbach's  $\alpha = 0.84$ ) and externalizing (youth Cronbach's  $\alpha = 0.77$ ; adult Cronbach's  $\alpha = 0.79$ ) subscales were found to be internally consistent in the PATH Study.<sup>20,21</sup> The internalizing ( $r = 0.31, p < .001$ ) and externalizing problems

**FIGURE 1** Flow Chart for Participants Selected Into the Analytic Sample

Note: <sup>a</sup>Wave 1 participants were lost to follow-up at Wave 2 for various standard reasons such as refusal, death, and other factors.

( $r = 0.42$ ,  $p < .001$ ) subscales were also correlated with the sum of three PROMIS (Patient-Reported Outcomes Measurement Information System) items on self-rated physical health, mental health, and overall health assessed among adults only in the PATH Study. PROMIS measures have been validated among the general US population<sup>24-26</sup> and are recommended for use by the PhenX Toolkit<sup>23</sup> for scoring of generic health-related quality of life.<sup>27</sup>

The number of responses endorsed for lifetime mental health problems were summed for each subscale, and complete data for subscale components were required (range, 0–4 for internalizing problems and 0–7 for externalizing problems). Based on the number of symptoms endorsed for each of the 2 subscales, respectively, participants were categorized into no/low/moderate (0–3 symptoms) or high (4 symptoms for internalizing problems or  $\geq 4$  symptoms for externalizing

problems) severity levels. These cutpoints were determined based on previous analyses,<sup>20,21</sup> with the goal of examining those participants deemed to be at highest risk for a mental health problem (ie, high-severity). Although the GAIN-SS is not a diagnostic tool, no/low severity indicates a low likelihood of diagnosis with need for services, moderate-severity indicates a potential diagnosis with need for services, and high-severity indicates a high likelihood of a diagnosis with need for services.<sup>28</sup>

**Tobacco Use.** Participants were asked about ever use of each tobacco product within the past 12 months at Wave 2, including cigarettes, electronic nicotine delivery systems (ENDS), traditional cigars, cigarillos, filtered cigars, pipe, hookah, smokeless tobacco (ie, loose snus, moist snuff, dip, spit, or chewing tobacco), snus pouches, bidis, kreteks, and dissolvable tobacco. Only youth were asked about use of bidis and kreteks, thus resulting in 12 tobacco products assessed for youth and 10 tobacco products assessed for young adults. A brief description and pictures of each product (except cigarettes) were shown to participants when asked about the products. Those who reported never using any of the above listed 12 tobacco products for youth and never using any of the above listed 10 tobacco products for young adults at Wave 1 were defined as never tobacco users. Wave 1 never users who reported ever use of a tobacco product in the past 12 months at Wave 2 were classified as “new users.” Due to assessment of e-cigarettes in Wave 1 and ENDS in Wave 2, new ENDS users were defined as Wave 1 never e-cigarette users who reported ever use of ENDS in the past 12 months at Wave 2. In Wave 2, summary variables were created for use of the following tobacco products: any tobacco (ie, any of the 12 [youth]/10 [young adults] tobacco products), any cigar (ie, traditional cigars, cigarillos, or filtered cigars), and any smokeless form of tobacco (ie, smokeless tobacco excluding snus pouches, snus pouches, or dissolvable tobacco). Complete data were required when defining nonuse for the summary variables.

Among Wave 2 new tobacco users, “new poly-users” of tobacco product were defined as ever using 2 or more of the following 10 tobacco products: cigarettes, ENDS, traditional cigars, cigarillos, filtered cigars, pipe, hookah, snus pouches, smokeless tobacco excluding snus pouches, and dissolvable tobacco at Wave 2. “New exclusive users” of any tobacco product were defined as ever using only one of these 10 tobacco products at Wave 2. Complete data were required to categorize participants as new exclusive users but were not required to categorize participants as new poly-users.

**Covariates.** Ever use of alcohol or any drug was assessed via participants’ responses to questions on ever use of each of the following at Wave 1: alcohol, marijuana (including blunts),

misuse of prescription drugs (ie, Ritalin or Adderall; painkillers, sedatives, or tranquilizers), cocaine or crack, stimulants (ie, methamphetamine or speed), heroin, inhalants, solvents, and hallucinogens. Alcohol and drug use items in the PATH Study were adapted from the National Epidemiologic Survey on Alcohol and Related Conditions<sup>29</sup> and the National Health and Nutrition Examination Survey.<sup>30</sup> Information was also collected on socio-demographics, including age (12–17 years, 18–24 years), gender (male, female), race (white, black, Asian, other including multi-racial), and ethnicity (Hispanic, not Hispanic).

### Statistical Analyses

Distributions of new use for each tobacco product at Wave 2, according to severity of internalizing problems and externalizing problems, respectively, at Wave 1 were examined. Multivariable logistic regression analyses were used to evaluate the associations between high-severity lifetime internalizing and externalizing problems, respectively, and new tobacco use, adjusting for socio-demographics, and ever any alcohol or drug use at Wave 1. To address the high comorbidity of these problems among youth and young adults,<sup>31</sup> lifetime internalizing problems and externalizing problems were included in the same model for each tobacco product. In addition, analyses were repeated using 3-category variables: no/low (0–1 symptom), moderate (2–3 symptoms), and high (4 symptoms for internalizing problems or  $\geq 4$  symptoms for externalizing problems) severity levels,<sup>28</sup> as well as a 4-category variable (no/low/moderate-severity internalizing/externalizing (referent), high-severity internalizing only, high-severity externalizing only, and high-severity internalizing/externalizing), and continuous scores.

Age group (ie, youth/young adult) by lifetime internalizing problem interactions were tested (adjusted for socio-demographics, ever any alcohol or drug use, and lifetime externalizing problems), and age group by lifetime externalizing problem interactions were tested (adjusted for socio-demographics, ever any alcohol or drug use, and lifetime internalizing problems). Post hoc exploratory analyses were conducted to examine whether gender and race/ethnicity moderated the associations between internalizing and externalizing problems and new tobacco use.

Estimates were weighted to represent the US youth and young adult populations; variances and CIs were estimated using the balanced repeated replication (BRR) method<sup>32</sup> with the Fay adjustment set to 0.3 to increase estimate stability.<sup>33</sup> Adjusted odds ratios (AORs) and 95% CIs were calculated for all regression analyses. Two-sided *p* values of  $<.05$  were considered statistically significant. When statistically significant interactions were identified for any

**TABLE 1** New Tobacco Product Use at Wave (W) 2 by Lifetime Severity of Internalizing Problems at W1 Among 9,067 Youth (Aged 12–17 Years) and 1,466 Young Adult (Aged 18–24 Years) Never Tobacco Users in the Population Assessment of Tobacco and Health (PATH) Study

New Tobacco Use Between W1 and W2 (Never-P12 Month Use)	New Tobacco Use Among W1 Never Users <sup>a</sup>		W1 Internalizing Problems					
			No/Low/Moderate Severity (Referent) 71.4% <sup>b</sup>		High Severity 28.6% <sup>b</sup>			
	Unweighted n	Weighted % (SE) <sup>c</sup>	Unweighted n	Weighted % (SE) <sup>c</sup>	Unweighted n	Weighted % (SE) <sup>c</sup>	AOR <sup>d</sup>	95% CI <sup>d</sup>
Any tobacco	1321	13.4 (.5)	764	11.4 (.5)	557	18.3 (1.0)	1.5	1.3–1.8
Cigarettes	393	4.1 (0.2)	206	3.2 (0.2)	187	6.4 (0.6)	2.2	1.7–3.0
ENDS	1147	10.4 (0.4)	653	8.7 (0.4)	494	14.6 (0.8)	1.4 <sup>e</sup>	1.2–1.7
Any cigar	300	3.4 (0.3)	165	2.5 (0.3)	135	5.5 (0.6)	2.2	1.5–3.0
Traditional cigars	135	1.8 (0.2)	73	1.4 (0.2)	62	2.7 (0.4)	2.1	1.3–3.2
Cigarillos	217	2.2 (0.2)	126	1.7 (0.2)	91	3.5 (0.4)	2.0	1.3–3.2
Filtered cigars	56	0.5 (0.1)	25	0.3 (0.1)	31	1.0 (0.2)	2.6	1.5–4.7
Pipe	32	0.3 (0.1)	22	0.3 (0.1)	† <sup>f</sup>	† <sup>f</sup>	† <sup>f</sup>	† <sup>f</sup>
Hookah	405	4.7 (0.3)	229	4.1 (0.4)	176	6.4 (0.5)	1.5	1.1–2.1
Any smokeless tobacco <sup>g</sup>	120	1.1 (0.1)	83	1.1 (0.1)	37	1.1 (0.2)	1.2	0.8–1.8
Smokeless tobacco (excluding snus pouches)	93	0.9 (0.1)	66	0.9 (0.1)	27	0.8 (0.1)	1.1	0.7–1.6
Snus pouches	40	0.4 (0.1)	25	0.3 (0.1)	15	0.5 (0.1)	# <sup>h</sup>	

**Note:** Statistically significant associations at  $p < .05$  indicated in boldface type. Estimates weighted using W2 longitudinal weights. † = suppressed estimate; AOR = adjusted odds ratio; ENDS = electronic nicotine delivery systems; P12 = past 12; SE = standard error.

<sup>a</sup>Restricted to those with W1 internalizing problem data.

<sup>b</sup>Percentages (%s) represent the prevalence of W1 lifetime internalizing problems.

<sup>c</sup>Percentages (%s) and SEs represent the prevalence of new tobacco use between W1 and W2 by W1 lifetime internalizing problems.

<sup>d</sup>AORs and 95% CIs indicate the odds of new tobacco use between W1 and W2 as a function of lifetime internalizing problems; adjusted for age group (12–17 vs. 18–24), gender, race, ethnicity, ever any alcohol or drug use at W1, and other externalizing problems at W1.

<sup>e</sup>Indicates significant race/ethnicity interaction at  $p < .05$ .

<sup>f</sup>Estimate has been suppressed because it is statistically unreliable. It is based on a (denominator) sample size of  $< 50$ , or the coefficient of variation of the estimate (or its complement) is  $> 30\%$ . Estimates for bidis, kreteks, and dissolvable tobacco have been suppressed based on these criteria.

<sup>g</sup>Includes snus pouches, smokeless tobacco excluding snus pouches, and dissolvables.

<sup>h</sup>Model did not run.

specific contrast, stratified analyses were evaluated. Estimates based on  $< 50$  observations in the denominator or with a relative standard error  $> 0.30$  were suppressed.<sup>34</sup>

Based on these criteria, individual estimates for pipe, bidis, kreteks, and dissolvable were suppressed in the tables and figure. All analyses were conducted using Stata software, version 14.<sup>35</sup>

## RESULTS

Demographic characteristics of the sample have been reported elsewhere.<sup>6,20,21</sup> At Wave 1, 29% of youth and young adults had high-severity internalizing problems in their lifetime, whereas 39% had lifetime high-severity externalizing problems. At Wave 2, about 13% of youth and young adult never tobacco users at Wave 1 started using any tobacco products. The most commonly used product was ENDS

(10%), followed by hookah use (5%), and cigarettes (4%) (Table 1 and Table 2).

### Wave 2 New Tobacco Product Use by Lifetime Severity of Internalizing and Externalizing Problems at Wave 1 Among Youth and Young Adult Never Tobacco Users

Table 1 presents the unadjusted distributions of new tobacco product use at Wave 2 by lifetime severity of internalizing problems at Wave 1. In models adjusting for socio-demographics, alcohol or drug use, and externalizing problems, youth and young adults with high-severity internalizing problems were 1.5 times more likely to begin using any tobacco product (95% CI = 1.3–1.8) compared to those with no/low/moderate severity internalizing problems. Associations were significant across all tobacco products, except any smokeless tobacco and

**TABLE 2** New Tobacco Product Use at Wave (W) 2 by Lifetime Severity of Externalizing Problems at W1 Among 9,067 Youth (Aged 12–17 Years) and 1,466 Young Adult (Aged 18–24 Years) Never Tobacco Users in the Population Assessment of Tobacco and Health (PATH) Study

New Tobacco Use Between W1 and W2 (Never-P12 Month Use)	W1 Externalizing Problems						
	New Tobacco Use Among W1 Never Users <sup>a</sup>		No/Low/Moderate Severity (Referent) 60.8% <sup>b</sup>		High Severity 39.2% <sup>b</sup>		
	Unweighted n	Weighted % (SE) <sup>c</sup>	Unweighted n	Weighted % (SE) <sup>c</sup>	Unweighted n	Weighted % (SE) <sup>c</sup>	AOR <sup>d</sup> 95% CI <sup>d</sup>
Any tobacco	1297	13.3 (0.5)	580	11.0 (0.5)	717	16.9 (0.9)	<b>1.3<sup>e,f,g</sup></b> 1.1–1.5
Cigarettes	389	4.1 (0.2)	174	3.6 (0.3)	215	4.8 (0.4)	0.9 <sup>e</sup> 0.7–1.2
ENDS	1130	10.4 (0.4)	477	8.0 (0.5)	653	14.0 (0.8)	<b>1.4<sup>e,f,g</sup></b> 1.1–1.7
Any cigar	298	3.4 (0.3)	131	2.8 (0.3)	167	4.3 (0.4)	1.0 0.7–1.4
Traditional cigars	132	1.8 (0.2)	64	1.6 (0.2)	68	2.0 (0.3)	0.9 0.5–1.3
Cigarillos	218	2.3 (0.2)	98	2.0 (0.2)	120	2.8 (0.3)	0.9 <sup>e</sup> 0.6–1.4
Filtered cigars	55	0.5 (0.1)	23	0.4 (0.1)	32	0.7 (0.1)	0.9 0.5–1.7
Pipe	31	0.3 (0.1)	† <sup>h</sup>	† <sup>h</sup>	17	0.3 (0.1)	† <sup>h</sup> † <sup>h</sup>
Hookah	395	4.7 (0.3)	187	4.2 (0.3)	208	5.5 (0.5)	1.1 <sup>f</sup> 0.8–1.5
Any smokeless tobacco <sup>i</sup>	120	1.2 (0.1)	63	1.1 (0.2)	57	1.2 (0.2)	0.9 <sup>g</sup> 0.5–1.4
Smokeless tobacco (excluding snus pouches)	92	0.9 (0.1)	53	1.0 (0.2)	39	0.8 (0.1)	0.7 <sup>g</sup> 0.4–1.1
Snus pouches	39	0.4 (0.1)	17	0.3 (0.1)	22	0.5 (0.1)	† <sup>j</sup>

**Note:** Statistically significant associations at  $p < .05$  indicated in boldface type. Estimates weighted using W2 longitudinal weights. † = suppressed estimate; AOR = adjusted odds ratio; ENDS = electronic nicotine delivery systems; P12 = past 12; SE = standard error.

<sup>a</sup>Restricted to those with W1 externalizing problem data.

<sup>b</sup>Percentages (%)s represent the prevalence of W1 lifetime externalizing problems.

<sup>c</sup>Percentages (%)s and SEs represent the prevalence of new tobacco use between W1 and W2 by W1 lifetime externalizing problems.

<sup>d</sup>AORs and 95% CIs indicate the odds of new tobacco use between W1 and W2 as a function of lifetime externalizing problems; adjusted for age group (12–17 vs. 18–24), gender, race, ethnicity, ever any alcohol or drug use at W1, and internalizing problems at W1.

<sup>e</sup>Indicates significant age interaction at  $p < .05$ .

<sup>f</sup>Indicates significant gender interaction at  $p < .05$ .

<sup>g</sup>Indicates significant race/ethnicity interaction at  $p < .05$ .

<sup>h</sup>Estimate has been suppressed because it is statistically unreliable. It is based on a (denominator) sample size of  $< 50$ , or the coefficient of variation of the estimate (or its complement) is  $> 30\%$ . Estimates for bidis, kreteks, and dissolvable tobacco have been suppressed based on these criteria.

<sup>i</sup>Includes snus pouches, smokeless tobacco excluding snus pouches, and dissolvables.

<sup>j</sup>Model did not run.

smokeless tobacco excluding snus pouches. The strongest associations were observed for new filtered cigar use (AOR = 2.6, 95% CI = 1.5–4.7) and new cigarette use (AOR = 2.2, 95% CI = 1.7–3.0). The results for pipe and kreteks were statistically unreliable, and models did not converge for snus pouches, bidis, and dissolvables.

Table 2 presents the unadjusted distributions of new tobacco product use at Wave 2 by lifetime severity of externalizing problems at Wave 1. In adjusted models, youth and young adults with high-severity externalizing problems were more likely to begin using any tobacco product (AOR = 1.3, 95% CI = 1.1–1.5). Regarding specific tobacco products, high-severity externalizing problems at Wave 1 predicted only new ENDS use (AOR = 1.4, 95% CI = 1.1–1.7) at Wave 2, whereas other products did

not reach statistical significance when examined individually.

Examination of the GAIN-SS as a three-category variable (no/low severity [referent], moderate severity, and high severity) for internalizing and externalizing problems (Tables S1 and S2, available online), as well as a four-category variable (no/low/moderate severity internalizing/externalizing [referent], high-severity internalizing only, high-severity externalizing only, and high-severity internalizing/externalizing) (Table S3, available online) yielded results similar to those in Tables 1 and 2. Internalizing and externalizing problems were also analyzed as continuous scores with similar results for new any tobacco use and new tobacco product-specific use to Tables 1 and 2 (results not shown). Each one symptom increase on the internalizing



(AOR = 1.1, 95% CI = 1.0–1.1) and externalizing (AOR = 1.1, 95% CI = 1.0–1.1) scale, respectively, was significantly associated with new any tobacco product use.

### Wave 2 New Exclusive and Poly–Tobacco Product Use by Lifetime Severity of Internalizing and Externalizing Problems at Wave 1 Among Youth and Young Adult Never Tobacco Users

Table 3 presents the unadjusted distributions of new exclusive and poly–tobacco product use at Wave 2 by lifetime severity of internalizing and externalizing problems, respectively, at Wave 1. In multinomial models adjusting for socio-demographics, alcohol or drug use, and externalizing problems, youth and young adults with high-severity internalizing problems were about 1.3 times more likely (95% CI = 1.0–1.5) to report new exclusive use of any tobacco product and about 1.8 times more likely (95% CI = 1.4–2.3) to report new poly-use of any tobacco product. Similarly, youth and young adults with high-severity externalizing problems were more likely to report new exclusive use of any tobacco product (AOR = 1.6, 95% CI = 1.3–2.0); however, findings were not significant for new poly-tobacco use.

### Age, Gender, and Race/Ethnicity Interactions Between Lifetime Severity of Internalizing and Externalizing Problems at Wave 1 and New Tobacco Product Use at Wave 2

There were no significant age or gender interactions across products for internalizing problems (Table 1). However, there was a significant race/ethnicity interaction for new ENDS use ( $p = .034$ ), such that white youth and young adults with high-severity internalizing problems were significantly more likely to report new ENDS use (AOR = 1.6; 95% CI = 1.2–2.1); this association was not significant among black youth and young adults.

Age significantly moderated the association between externalizing problems for any tobacco product ( $p = .002$ ), cigarettes ( $p = .002$ ), ENDS ( $p = .001$ ), and cigarillos ( $p = .046$ ); stratified results are presented in Figure 2. New use of any tobacco, cigarettes, ENDS, and cigarillos was more likely among youth with high-severity externalizing problems than youth with no/low/moderate-severity externalizing problems. In adjusted models, the strongest association across products was observed for onset of ENDS among youth with high-severity externalizing problems (AOR = 1.8, 95% CI = 1.5–2.1) compared to youth with no/low/moderate-severity externalizing problems, followed by cigarillos (AOR = 1.5, 95% CI = 1.0–2.1) and cigarettes (AOR = 1.4, 95% CI = 1.0–2.0).

In addition, gender significantly moderated the association between high-severity externalizing problems at Wave 1 and

new tobacco product use at Wave 2. Specifically, female youth and young adults with high-severity externalizing problems were more likely to report new use of any tobacco product (AOR = 1.4, 95% CI = 1.1–1.9) and ENDS (AOR = 1.5, 95% CI = 1.2–2.0), respectively, in comparison to male youth and young adults with high-severity externalizing problems. Associations with new hookah use were also stronger for female youth and young adults with high-severity externalizing problems in comparison to male youth and young adults with high-severity externalizing problems, but stratified results were not significant.

Significant race/ethnicity interactions were also observed for new any tobacco use, ENDS use, any smokeless tobacco use, and smokeless tobacco use excluding snus pouches. Specifically, white youth and young adults with high-severity externalizing problems were significantly more likely to report new any tobacco (AOR = 1.4; 95% CI = 1.1–1.7) and ENDS use (AOR = 1.4; 95% CI = 1.1–1.8); however, no significant associations were observed for Hispanic and black youth and young adults, respectively. In contrast, youth and young adults with high-severity externalizing problems belonging to other racial/ethnic groups were significantly less likely to report new any smokeless tobacco use (AOR = 0.1; 95% CI = 0.0–0.7) and new smokeless tobacco use excluding snus pouches (AOR = 0.1; 95% CI = 0.0–0.7); however, no significant associations were observed for white and black youth and young adults.

## DISCUSSION

In this nationally representative sample of youth and young adult never tobacco users, internalizing and externalizing problems each independently predicted onset of any tobacco use. Associations were robust to important confounders,<sup>16,20,21</sup> including alcohol or any drug use and comorbid mental health problems. Across tobacco products, however, findings differed for internalizing and externalizing problems, as well as by age, gender, and race/ethnicity.

Internalizing problems predicted the onset of nearly all tobacco product use assessed among youth and young adults, thereby extending findings of prior research focused on cigarettes among youth.<sup>8–10</sup> Although our findings linking internalizing problems to tobacco use are consistent across products, prior studies have generated mixed results for internalizing problems and tobacco use associations.<sup>8–12</sup> These differences could be due to definitional approaches used, including our assessment of mental health symptoms versus diagnoses,<sup>8,10,12</sup> and collapsing depression and anxiety rather than separating as has been done in other studies. In addition, differences in samples (eg, clinical versus population-based) may be a factor in accounting for divergent findings. Nonetheless, our results suggest that internalizing problems are a strong signal for the onset of tobacco use

**TABLE 3** New Exclusive and Poly-Tobacco Product Use at Wave (W) 2 by Lifetime Severity of Internalizing and Externalizing Problems at W1 Among 9,067 Youth (12–17 years) and 1,466 Young Adult (18–24 years) Never Tobacco Users in the Population Assessment of Tobacco and Health (PATH) Study

New Tobacco Use Between W1 and 2 (Never-P12 Month Use)	W1 Internalizing Problems			W1 Externalizing Problems		
	No/Low/Moderate Severity (referent) 71.4% <sup>a</sup>			No/Low/Moderate Severity (Referent) 60.8% <sup>a</sup>		
	Unweighted n	Weighted % (SE) <sup>b</sup>	AOR <sup>c</sup> 95% CI <sup>c</sup>	Unweighted n	Weighted % (SE) <sup>b</sup>	AOR <sup>c</sup> 95% CI <sup>c</sup>
Exclusive Use	430	6.4 (0.4)	1.3 (1.0–1.5)	313	5.6 (0.4)	1.6 (1.3–2.0)
Poly-use	332	5.1 (0.34)	1.8 (1.4–2.3)	265	5.4 (0.4)	1.0 (0.8–1.3)
					High Severity 28.6% <sup>a</sup>	High Severity 39.2% <sup>a</sup>
					Unweighted n	Unweighted n
					292	396
					263	321

Note: Estimates weighted using W2 longitudinal weights. No new tobacco use between W1 and 2 is the referent group. AOR = adjusted odds ratios; P12 = past 12; SE = standard error. Statistically significant associations at  $p < .05$  indicated in boldface type.

<sup>a</sup>Percentages (%)s represent the prevalence of W1 lifetime mental health problems.

<sup>b</sup>Percentages (%)s and SEs represent the prevalence of new tobacco use between W1 and W2 by W1 lifetime mental health problems.

<sup>c</sup>AORs and 95% CIs indicate the odds of new tobacco use between W1 and W2 as a function of lifetime mental health problems; adjusted for age group (12–17 vs. 18–24 years), gender, race, ethnicity, ever any alcohol or drug use at W1, and other mental health problems at W1 (ie, internalizing problems analyses adjusted for externalizing problems, and externalizing problems analyses adjusted for internalizing problems).

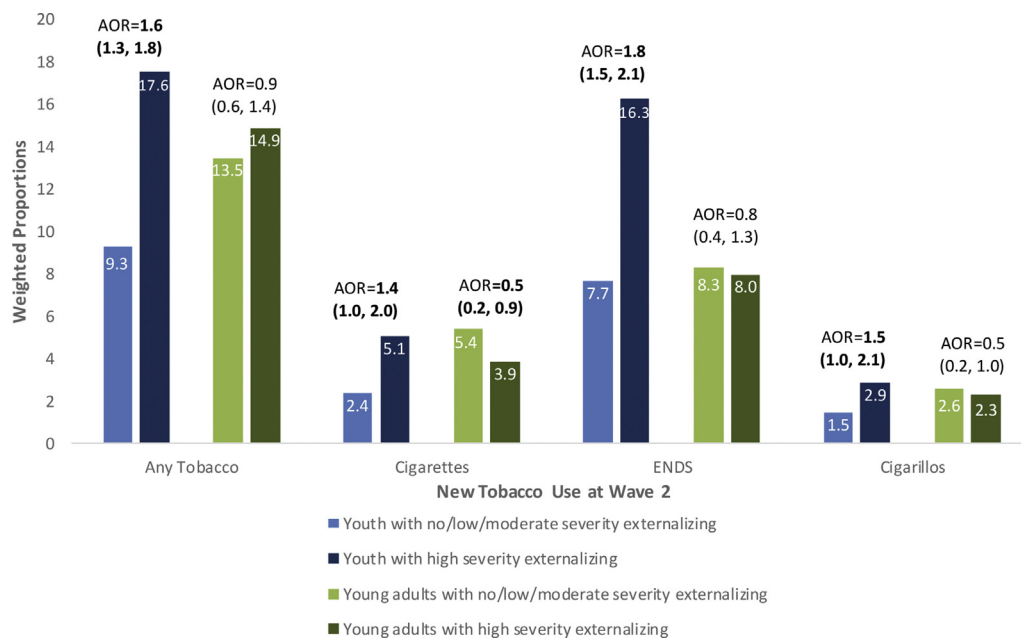
across a wide range of products. Furthermore, findings of a dose–response relationship between internalizing problems and onset of exclusive and poly-tobacco use, respectively, suggest that youth and young adults with internalizing problems were not only more likely to begin using tobacco products compared to those without internalizing problems, but were also more likely to begin using multiple tobacco products.

Externalizing problems similarly predicted the onset of any tobacco use among youth and young adults. However, across products, the only significant association was observed for the onset of ENDS use, likely driving the “any tobacco use” association. ENDS use also appeared to drive the significant association between externalizing problems and new exclusive use of any tobacco product, but not poly-tobacco use. One plausible interpretation is that youth and young adults with behavioral problems may be attracted to new products such as ENDS, as these individuals may be intrigued by novel stimuli and experiences. From an environmental exposure perspective, individuals with behavioral issues may be introduced to ENDS through peers or friends who use ENDS, which are often consumed in social contexts.<sup>36</sup> Future studies can examine whether youth and young adults with externalizing problems are more likely to start use of ENDS in comparison to other tobacco products.

In addition, age interactions were observed for externalizing psychopathology in which youth with high-severity problems were more likely to begin using cigarettes, ENDS, and cigarillos than youth classified as no/low/moderate severity. One study found that while externalizing psychopathology robustly predicted early onset of cigarette use by age 14 years, internalizing was a weaker predictor, perhaps because the internalizing–substance pathway emerges later in adolescence.<sup>37</sup> Our findings that externalizing problems predicted the onset of cigarette, ENDS, and cigarillo use among youth further implicates externalizing problems among youth as risk factors for use of these tobacco products.

The results from this study should also be interpreted within the context of the significant gender and race/ethnicity interactions observed, although findings were not consistent across mental health problems or tobacco products. The stronger associations for any tobacco, ENDS, and hookah use among female compared to male youth and young adults with externalizing problems support and extend previous cross-sectional findings from the PATH Study.<sup>20,21</sup> In addition, white youth and young adults with internalizing and externalizing problems, respectively, were more likely to report new ENDS use in comparison to other racial/ethnic groups with internalizing and externalizing problems, respectively. Taken together, the age, gender, and race/ethnicity interactions suggest that white female youth with externalizing problems may be particularly drawn to

**FIGURE 2** New Tobacco Product Use at Wave 2 by Lifetime Severity of Externalizing Problems at Wave 1 Stratified by Age (ie, 9,067 youth versus 1,466 young adults) in the Population Assessment of Tobacco and Health (PATH) Study



**Note:** Estimates weighted using W2 longitudinal weights. Age (ie youth [12–17 years] versus adult [18–24 years]) by lifetime severity externalizing problems interactions significant at  $p < .05$ . Age-stratified data shown for proportions of new tobacco product use at Wave 2 by lifetime severity externalizing problems. Adjusted odds ratios (AORs) and 95% CIs from multivariable logistic regression models adjusting for gender, race/ethnicity, ever substance use, and lifetime internalizing problems at Wave 1. Statistically significant associations at  $p < 0.05$  indicated in boldface type. Please note color figures are available online.

new use of ENDS, suggesting that targeted interventions for this group may be most efficacious for reducing mental health problems<sup>38</sup> and tobacco use.

Neither internalizing nor externalizing problems were associated with any smokeless tobacco use, suggesting that youth and young adults with mental health problems are not disproportionately drawn to this class of tobacco products. The few studies that have examined the profiles of smokeless tobacco users have focused on demographic indicators. Although prior studies found the most common smokeless tobacco users to be white middle-aged or older males generally of lower socioeconomic status,<sup>39,40</sup> a recent study found that smokeless tobacco use was most common among males, younger adults, non-Hispanic whites, and individuals residing in nonurban areas.<sup>41</sup> Interestingly, we observed racial/ethnic differences in the association between externalizing problems and smokeless tobacco, suggesting a protective association for other racial/ethnic groups. It is therefore important to consider interactions between demographic and psychosocial factors that may be unique to this class of products to better understand risk and protective factors for smokeless tobacco use.

This study has several important strengths, as well as some limitations. First, it is one of the first to assess the onset of tobacco use among youth and young adults as a function of

internalizing and externalizing problems in a nationally representative sample. Second, this study provides a comprehensive assessment of tobacco product use, which is rapidly evolving as new products gain favor in the marketplace. Although examination of specific tobacco products in this study advances prior research, small cell sizes for some tobacco products may have limited statistical power to detect associations. Third, the study included important covariates that allow for adjustment of potential confounding, such as demographics, alcohol or any drug use, and comorbid mental health problems. All of these covariates were predictors of onset of tobacco product use, with alcohol or any drug use strongly predicting new tobacco use. Future studies can examine how alcohol or drug use is associated with onset and continued tobacco product use.

Some potential confounders that could have an impact on the association between mental health problems and tobacco use were excluded, such as sensation seeking (assessed among youth but not adults), peer influence (not assessed in Waves 1 and 2), and socioeconomic status (not assessed directly in Wave 1). However, including education as a covariate (ie, parent's highest level of education for youth and the highest level of education reported by young adults as proxies for socioeconomic status) had no substantial effect on

the observed estimates. It should also be noted that statistical correction for multiple tests was not applied to the models, as applying such a correction would require adjusting  $p$  values for significance to a level that would be too conservative. Therefore, it remains a possibility that multiple testing may have resulted in obtaining significant results by chance alone. The PATH Study included a noninstitutionalized population, and thus our results may not be generalized to individuals in an institutional setting. Furthermore, as the PATH Study did not collect information about prior institutionalization, we were unable to assess its effect on our findings.

Fourth, although this study did not include diagnoses for internalizing and externalizing disorders, the high sensitivity and specificity between GAIN-SS items and psychiatric diagnoses supports the use of this measure as a strong indicator of significant mental health problems.<sup>22</sup> Fifth, to the extent that externalizing problems are a predictor of early tobacco use,<sup>37,42</sup> our exclusion of Wave 1 tobacco users may have contributed to the inconsistent associations that we found between externalizing and tobacco use; that is, it is possible that individuals with externalizing problems who had already initiated tobacco use were excluded.<sup>20,21</sup> When stratified by age, externalizing problems predicted the onset of cigarette, ENDS, and cigarillo use among youth, further supporting this hypothesis. Finally, although longitudinal associations were identified between mental health and tobacco use, causality cannot be determined by this epidemiologic study. Future assessments of mental health and tobacco use with additional waves of data collection in the PATH Study could help to inform our understanding of the progression of tobacco use (ie, frequency and intensity of tobacco use, dual use, ability to stop using tobacco) among individuals with and without mental health problems over time. Although this study examined how mental health problems are associated with the onset of tobacco use, future studies can examine the reverse direction, that is, how tobacco use may be associated with the onset of mental health problems among youth and young adults.<sup>5</sup>

In summary, this study demonstrates that mental health problems predict the onset of tobacco use among youth and young adults in a nationally representative sample, and across a wide range of tobacco products beyond cigarettes. A negative reinforcement model of drug addiction would suggest that tobacco use is initiated to ameliorate mental distress, but we cannot rule out the possibility that these associations are potentially driven by a common underlying factor of environmental, familial, or genetic risk for both mental illness and tobacco use.<sup>5,20</sup> Researchers can continue to investigate internalizing and externalizing problems as potential etiologic

factors for the onset of tobacco use, including examination of mediators and moderators of tobacco use made possible by the PATH Study's longitudinal data. In addition, reporting on initiatives to expand mental health and substance use screening in health care settings is often voluntary.<sup>43</sup> Recommended measures also do not comprehensively screen across tobacco products used by youth and young adults, or focus on monitoring severe mental health and substance use disorders that have already been diagnosed.<sup>44,45</sup> Thus, the need for early and specific tobacco product use screening, as well as screening across the spectrum of mental health problems, as tools to prevent tobacco product use onset is apparent. Providing incentives to providers to link these two screening mechanisms could increase the overall intergration of these services in clinical practice.

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**TABLE S1** New Tobacco Product Use at Wave (W) 2 by Lifetime Severity (No/Low, Moderate, and High) of Internalizing Problems at Wave 1 Among 9,067 Youth (12–17 Years) and 1,466 Young Adult (18–24 years) Never Tobacco Users in the Population Assessment of Tobacco and Health (PATH) Study

New Tobacco Use Between W1 and W2 (Never-P12 Month Use)	Wave 1 Internalizing Problems											
	New Tobacco Use Among W1 Never Users <sup>a</sup>		No/Low Severity (Referent) 41.1% <sup>b</sup>		Moderate Severity 30.2% <sup>b</sup>				High Severity 28.6% <sup>b</sup>			
	Unweighted n	Weighted % (SE)	Unweighted n	Weighted % (SE) <sup>c</sup>	Unweighted n	Weighted % (SE) <sup>c</sup>	AOR <sup>d</sup>	95% CI <sup>d</sup>	Unweighted n	Weighted % (SE) <sup>c</sup>	AOR <sup>d</sup>	95% CI <sup>d</sup>
Any tobacco	1321	13.4 (.5)	370	10.2 (.6)	394	12.9 (.9)	1.1	(0.9, 1.4)	557	18.3 (1.0)	1.6	(1.2, 2.0)
Cigarettes	393	4.1 (.2)	110	3.3 (.3)	96	3.0 (.4)	1.0	(0.7, 1.5)	187	6.4 (.6)	2.2	(1.5, 3.3)
ENDS	1147	10.4 (.4)	308	7.5 (.5)	345	10.2 (.8)	1.1	(0.9, 1.4)	494	14.6 (.8)	1.4	(1.1, 1.8)
Any cigar	300	3.4 (.3)	86	2.4 (.3)	79	2.8 (.4)	1.1	(0.7, 1.7)	135	5.3 (.6)	2.1	(1.3, 3.5)
Traditional cigars	135	1.8 (.2)	44	1.3 (.2)	29	1.3 (.2)	0.8	(0.4, 1.5)	62	2.7 (.4)	1.8	(0.9, 3.6)
Cigarillos	217	2.2 (.2)	63	1.5 (.2)	63	2.0 (.3)	1.4	(0.9, 2.2)	91	3.5 (.4)	2.5	(1.5, 4.3)
Filtered cigars	56	0.5 (.1)	14	0.3 (.1)	† <sup>e</sup>	† <sup>e</sup>	1.4	(0.5, 4.2)	31	1.0 (.2)	3.3	(1.4, 8.1)
Pipe	32	0.3 (.1)	† <sup>e</sup>	† <sup>e</sup>	† <sup>e</sup>	† <sup>e</sup>	1.0	(0.3, 3.2)	† <sup>e</sup>	† <sup>e</sup>	0.7	(0.2, 2.2)
Hookah	405	4.7 (.3)	106	3.5 (.4)	123	4.8 (.6)	1.3	(0.9, 1.9)	176	6.4 (.5)	1.8	(1.2, 2.7)
Any smokeless tobacco <sup>f</sup>	120	1.1 (.1)	43	1.2 (.2)	40	1.1 (.2)	0.9	(0.5, 1.4)	37	1.1 (.2)	1.1	(0.6, 1.8)
Smokeless tobacco (excluding snus pouches)	93	0.9 (.1)	38	1.1 (.2)	28	0.7 (.1)	0.6	(0.4, 1.2)	27	0.8 (.1)	0.8	(0.5, 1.4)
Snus pouches	40	0.4 (.1)	13	0.4 (.1)	† <sup>e</sup>	† <sup>e</sup>	# <sup>g</sup>		15	0.5 (.1)	# <sup>g</sup>	

**Note:** Statistically significant associations at  $p < .05$  indicated in boldface type. Estimates weighted using W2 longitudinal weights. † = suppressed estimate; AOR = adjusted odds ratio; ENDS = electronic nicotine delivery systems; P12 = past 12; SE = standard error.

<sup>a</sup>Restricted to those with Wave 1 internalizing problem data.

<sup>b</sup>Percentages (%) represent the prevalence of Wave 1 lifetime internalizing problems.

<sup>c</sup>Percentages (%) and standard errors (SE) represent the prevalence of new tobacco use between W1 and W2 by W1 lifetime internalizing problems.

<sup>d</sup>Adjusted odds ratios (AOR) and 95% CI indicate the odds of new tobacco use between W1 and W2 as a function of lifetime internalizing problems; adjusted for age group (12–17 vs 18–24 years), gender, race, ethnicity, ever any substance use at W1, and other externalizing problems at W1.

<sup>e</sup>Estimate has been suppressed because it is statistically unreliable. It is based on a (denominator) sample size of less than 50, or the coefficient of variation of the estimate (or its complement) is larger than 30%.

<sup>f</sup>Includes snus pouches, smokeless tobacco excluding snus pouches, and dissolvables.

<sup>g</sup>Model did not run. Estimates for bidis, kreteks, and dissolvable tobacco have been suppressed based on these criteria.

**TABLE S2** New Tobacco Product Use at Wave (W) 2 by Lifetime Severity (No/Low, Moderate, and High) of Externalizing Problems at Wave 1 Among 9,067 Youth (12–17 Years) and 1,466 Young Adult (18–24 years) Never Tobacco Users in the Population Assessment of Tobacco and Health (PATH) Study

New Tobacco Use Between W1 and W2 (Never-P12 Month Use)	Wave 1 Externalizing Problems											
	New Tobacco Use Among W1 Never Users <sup>a</sup>		No/Low Severity (Referent) 32.1% <sup>b</sup>		Moderate Severity 28.8% <sup>b</sup>				High Severity 39.2% <sup>b</sup>			
	Unweighted n	Weighted % (SE) <sup>c</sup>	Unweighted n	Weighted % (SE) <sup>c</sup>	Unweighted n	Weighted % (SE) <sup>c</sup>	AOR <sup>d</sup>	95% CI <sup>d</sup>	Unweighted n	Weighted % (SE) <sup>c</sup>	AOR <sup>d</sup>	95% CI <sup>d</sup>
Any tobacco	1297	13.3 (.5)	245	9.6 (.7)	335	12.6 (.9)	1.1	(0.9, 1.4)	717	16.9 (.9)	1.3	(1.1, 1.7)
Cigarettes	389	4.1 (.2)	77	3.3 (.4)	97	4.1 (.5)	0.9	(0.7, 1.4)	215	4.8 (.4)	0.9	(0.6, 1.3)
ENDS	1130	10.4 (.4)	180	6.4 (.6)	297	9.7 (.7)	1.3	(1.0, 1.7)	653	14.0 (.8)	1.6	(1.2, 2.1)
Any cigar	298	3.4 (.3)	57	2.2 (.3)	74	3.5 (.5)	1.3	(0.8, 2.0)	167	4.3 (.4)	1.1	(0.7, 1.8)
Traditional cigars	132	1.8 (.2)	28	1.3 (.3)	36	1.9 (.3)	1.1	(0.6, 2.2)	68	2.0 (.3)	1.0	(0.5, 2.0)
Cigarillos	218	2.3 (.2)	47	1.8 (.3)	51	2.1 (.4)	0.9	(0.6, 1.4)	120	2.8 (.3)	0.8	(0.5, 1.3)
Filtered cigars	55	0.5 (.1)	† <sup>g</sup>	† <sup>g</sup>	† <sup>g</sup>	† <sup>g</sup>	0.8	(0.2, 2.4)	32	0.7 (.1)	0.7	(0.3, 1.9)
Pipe	31	0.3 (.1)	† <sup>g</sup>	† <sup>g</sup>	† <sup>g</sup>	† <sup>g</sup>	1.6	(0.5, 5.2)	17	0.3 (.1)	1.1	(0.4, 3.5)
Hookah	395	4.7 (.3)	90	3.9 (.5)	97	4.5 (.5)	0.9	(0.6, 1.4)	208	5.5 (.5)	1.0	(0.7, 1.5)
Any smokeless tobacco <sup>e</sup>	120	1.2 (.1)	26	1.0 (.2)	37	1.2 (.3)	1.1	(0.7, 1.8)	57	1.2 (.2)	0.9	(0.6, 1.5)
Smokeless tobacco (excluding snus pouches)	92	0.9 (.1)	22	0.9 (.2)	31	1.0 (.2)	1.1	(0.6, 2.0)	39	0.8 (.1)	0.8	(0.5, 1.4)
Snus pouches	39	0.4 (.1)	† <sup>g</sup>	† <sup>g</sup>	† <sup>g</sup>	† <sup>g</sup>	# <sup>f</sup>		22	0.5 (.1)	# <sup>f</sup>	

**Note:** Statistically significant associations at  $p < .05$  indicated in boldface type. Estimates weighted using W2 longitudinal weights. † = suppressed estimate; AOR = adjusted odds ratio; ENDS = electronic nicotine delivery systems; P12 = past 12; SE = standard error.

<sup>a</sup>Restricted to those with W1 externalizing problem data.

<sup>b</sup>Percentages (%) represent the prevalence of Wave 1 lifetime externalizing problems.

<sup>c</sup>Percentages (%) and standard errors (SE) represent the prevalence of new tobacco use between W1 and W2 by W1 lifetime externalizing problems.

<sup>d</sup>Adjusted odds ratios (AOR) and 95% CI indicate the odds of new tobacco use between W1 and W2 as a function of lifetime externalizing problems; adjusted for age group (12–17 vs 18–24 years), gender, race, ethnicity, ever any substance use at W1, and internalizing problems at W1.

<sup>e</sup>Includes snus pouches, smokeless tobacco excluding snus pouches, and dissolvables.

<sup>f</sup>Model did not run.

<sup>g</sup>Estimate has been suppressed because it is statistically unreliable. It is based on a (denominator) sample size of less than 50, or the coefficient of variation of the estimate (or its complement) is larger than 30%. Estimates for bidis, kreteks, and dissolvable tobacco have been suppressed based on these criteria.

**TABLE S3** New Tobacco Product Use at Wave 2 by Lifetime Severity of Combined Internalizing and Externalizing Problems at Wave 1 Among 9,067 Youth (Aged 12–17 Years) and 1,466 Young Adult (Aged 18–24 Years) Never Tobacco Users in the Population Assessment of Tobacco and Health (PATH) Study (continued below)

New Tobacco Use Between Waves 1 and 2 (Never-P12 Month Use)	Wave 1 Mental Health Problems							
	New Tobacco Use Among W1 Never Users <sup>a</sup>		No/Low/Moderate Internalizing/ No/Low/Moderate Externalizing Severity (Referent) 52.8% <sup>b</sup>		High Internalizing Severity 7.9% <sup>b</sup>			
	Unweighted n	Weighted % (SE)	Unweighted n	Weighted % (SE) <sup>c</sup>	Unweighted n	Weighted % (SE) <sup>c</sup>	AOR <sup>d</sup>	95% CI <sup>d</sup>
Any tobacco	1285	13.3 (.5)	460	10.3 (.6)	110	15.6 (1.9)	1.6	(1.1, 2.1)
Cigarettes	384	4.1 (.2)	126	3.1 (.3)	44	7.4 (1.3)	2.4	(1.5, 3.9)
ENDS	1120	10.4 (.4)	386	7.6 (.5)	86	10.7 (1.4)	1.4	(1.0, 1.9)
Any cigar	294	3.4 (.3)	98	2.4 (.3)	30	5.7 (1.1)	2.5	(1.6, 4.0)
Traditional cigars	131	1.8 (.2)	50	1.5 (.2)	† <sup>e</sup>	† <sup>e</sup>	† <sup>e</sup>	† <sup>e</sup>
Cigarillos	214	2.3 (.2)	74	1.6 (.2)	21	4.3 (1.0)	3.0	(1.8, 5.0)
Filtered cigars	55	0.5 (.1)	18	0.4 (.1)	† <sup>e</sup>	† <sup>e</sup>	† <sup>e</sup>	† <sup>e</sup>
Hookah	391	4.7 (.3)	149	3.9 (.4)	36	6.3 (1.1)	1.5	(0.9, 2.5)
Any smokeless tobacco <sup>f</sup>	117	1.1 (.1)	54	1.1 (.2)	† <sup>e</sup>	† <sup>e</sup>	† <sup>e</sup>	† <sup>e</sup>
Smokeless tobacco (excluding snus pouches)	90	0.9 (.1)	46	1.0 (.2)	† <sup>e</sup>	† <sup>e</sup>	† <sup>e</sup>	† <sup>e</sup>
Snus pouches	39	0.4 (.1)	14	0.3 (.1)	† <sup>e</sup>	† <sup>e</sup>	# <sup>g</sup>	

**Note:** Population of interest: Wave 1 youth (aged 12–17 years,  $n = 8,873$ ) and young adults (aged 18–24 years,  $n = 1,455$ ) who never used any tobacco at Wave 1; estimates weighted using W2 longitudinal weights. Estimates for pipe, bidis, kreteks, and dissolvable tobacco have been suppressed based on these criteria. Statistically significant associations at  $p < 0.05$  indicated in boldface type. † = suppressed estimate; AOR = adjusted odds ratio; P12 = past 12; SE = standard error.

<sup>a</sup>Restricted to those with Wave (W) 1 internalizing problem and externalizing problem data.

<sup>b</sup>Percentages (%) represent the prevalence of Wave 1 lifetime mental health problems.

<sup>c</sup>Percentages (%) and standard errors (SE) represent the prevalence of new tobacco use between W1 and W2 by W1 lifetime mental health problems.

<sup>d</sup>Adjusted odds ratios (AOR) and 95% CI indicate the odds of new tobacco use between W1 and W2 as a function of lifetime mental health problems; adjusted for age group (12–17 vs 18–24 years), gender, race, ethnicity, and ever any substance use at W1.

<sup>e</sup>Estimate has been suppressed because it is statistically unreliable. It is based on a (denominator) sample size of less than 50, or the coefficient of variation of the estimate (or its complement) is larger than 30%.

<sup>f</sup>Includes snus pouches, smokeless tobacco excluding snus pouches, and dissolvables.

<sup>g</sup>Model did not run.



**TABLE S3** New Tobacco Product Use at Wave 2 by Lifetime Severity of Combined Internalizing and Externalizing Problems at Wave 1 Among 9,067 Youth (Aged 12–17 Years) and 1,466 Young Adult (Aged 18–24 Years) Never Tobacco Users in the Population Assessment of Tobacco and Health (PATH) Study (continued)

Wave 1 Mental Health Problems							
High Externalizing Severity 18.6% <sup>b</sup>				High Internalizing/ High Externalizing Severity 20.6% <sup>b</sup>			
Unweighted n	Weighted % (SE) <sup>c</sup>	AOR <sup>d</sup>	95% CI <sup>d</sup>	Unweighted n	Weighted % (SE) <sup>c</sup>	AOR <sup>d</sup>	95% CI <sup>d</sup>
282	14.3 (1.2)	1.3	(1.1, 1.7)	433	19.5 (1.1)	1.9	(1.6, 2.3)
74	3.2 (.5)	1.0	(0.7, 1.4)	140	6.2 (.6)	2.0	(1.5, 2.6)
252	11.7 (1.0)	1.4	(1.1, 1.8)	396	16.2 (1.0)	1.9	(1.6, 2.4)
65	3.2 (.5)	1.1	(0.7, 1.7)	101	5.3 (.6)	2.1	(1.5, 3.0)
22	1.3 (.3)	0.7	(0.3, 1.3)	46	2.8 (.5)	1.8	(1.1, 3.0)
51	2.3 (.4)	1.3	(0.8, 2.0)	68	3.2 (.4)	1.8	(1.3, 2.7)
7	0.3 (.1)	0.5	(0.2, 1.3)	25	1.1 (.3)	2.3	(1.0, 5.1)
70	4.4 (.7)	1.1	(0.7, 1.7)	136	6.5 (.6)	1.7	(1.3, 2.3)
26	1.1 (.3)	0.8	(0.5, 1.4)	30	1.2 (.2)	1.0	(0.6, 1.7)
17	0.8 (.2)	0.6	(0.3, 1.1)	22	0.8 (.2)	0.8	(0.5, 1.4)
† <sup>e</sup>	† <sup>e</sup>	# <sup>g</sup>		12	0.6 (.2)	# <sup>g</sup>	