

# Individual Health Determinants That Predict Low Risk of Transitioning to Tobacco Use During Young Adulthood: An In-Depth Examination of Race and Ethnicity

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## Abstract

**Introduction:** The present study examines the contributions of individual-level health determinants on young adult tobacco use initiation to improve understanding of racial and ethnic distinctions and to inform effective tobacco prevention strategies.

**Methods:** Using time-to-event analyses, the 10-wave (2011–2016) Truth Initiative Young Adult Cohort, a probability-based, nationally representative sample of the US young adults aged 18–34 years ( $N = 7\,665$ ), provides data to examine differences in variables that influence tobacco uptake, by race and ethnicity.

**Results:** Among Non-Hispanic White young adults, having fewer peers who smoke cigarettes is protective against any tobacco initiation, whereas hazard of tobacco initiation increases for males, having low confidence to resist smoking, and having higher proclivity for sensation seeking. Depressive and anxiety symptoms increase uptake hazard most in the Non-Hispanic All Other Races group and least among Non-Hispanic Black individuals. Among Hispanic young adults, being female and perceiving tobacco as harmful are notably protective while being male is a notable uptake hazard. Unlike other groups, higher income levels do not lower hazards among Hispanic individuals. Cannabis use and overestimating the smoking rate among peers increase hazard least among Hispanic individuals. In the Non-Hispanic All Other Races group, aging is least protective; hazard increases notably if individuals engage in regular alcohol or cannabis use.

**Conclusions:** Tobacco prevention efforts are critical during young adulthood. Specific tobacco uptake hazard and protective factors exist by race and ethnicity and should be considered when developing selective young adult prevention, particularly among groups with the highest risk for tobacco initiation during this life stage.

**Implications:** Rising rates of tobacco initiation among the US young adults necessitate expanded efforts to prevent tobacco use initiation and progression beyond youth. Results highlight nuanced and differential tobacco uptake hazards by race and ethnicity for late initiation and sustained non-tobacco use among young adults. The study confirms existing evidence on tobacco use patterns and contributes to new knowledge on risk and protective factors. Tobacco prevention and control interventions, including policies, tailored in more meaningful ways could reduce tobacco use disparities among those most disproportionately affected.

## Introduction

Despite declines in the United States tobacco product use, prevalence, and uptake among young adults are increasing,<sup>1,2</sup> an age group once considered beyond the critical adolescence tobacco uptake period.<sup>3</sup> From 2002 to 2015 cigarette initiation among young adults (ages 18–21 years) surpassed youth (ages 15–17 years).<sup>3</sup> Daily cigarette smokers who began daily smoking in young adulthood increased from 39% in 2002 to 56% in 2018.<sup>4</sup> Commonly used tobacco products among 18–24 year-olds are e-cigarettes (9.3%) and combustible cigarettes (8.0%); 18.2% report currently using tobacco;<sup>5</sup> combustible cigarettes are the most used product after age 24 years.<sup>5</sup> Young adulthood tobacco initiation presents critical needs for expanded efforts to prevent or delay tobacco use.<sup>6</sup>

Better design of young adult tobacco prevention requires a better understanding of tobacco initiation risk and protective factors. Some factors from adolescence continue to be influential during young adulthood; however, other factors uniquely emerge.<sup>7</sup> Young adulthood, unlike other developmental stages, is a pivotal time of identity confusion and first-time responsibilities, including changes in residence, new independence, employment or college, and romantic relationships. Without sufficient socio-environmental and cultural supports, many young adults experience transition challenges to adult roles, some turn to tobacco or other substances to ease stress.<sup>7</sup>

While there are common characteristics and experiences among young adults, tobacco behaviors, notably tobacco initiation, use, and quitting, vary by race and ethnicity,

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contributing to significant tobacco-related health disparities. Among the largest the US racial and ethnic groups, adult cigarette smoking prevalence is 15.5% among Non-Hispanic White individuals, 14.9% among African Americans, and 8.8% among Hispanic or Latinos.<sup>4</sup> Black individuals initiate use at a later age than other racial/ethnic groups and use tobacco for longer periods before attempting to quit.<sup>3</sup> They also make more quit attempts and achieve less success in quitting than Non-Hispanic White individuals.<sup>8,9</sup> Racial and ethnic minorities also are increasingly using a greater number of tobacco products relative to White individuals.<sup>8,9</sup>

Gaps remain in understanding racial and ethnic heterogeneity,<sup>10</sup> limiting the development of novel interventions and fine-tuning existing prevention and policy efforts to reduce tobacco-related disparities. Accepting that there are common phases of young adulthood, it is reasonable to hypothesize universal aspects of effective prevention, regardless of race or ethnicity. However, recent studies support distinct racial and ethnic tobacco risk profiles.<sup>11</sup> Evidence shows individual-level disparities exist because of early and ongoing exposure to socio-environmental harms, including socially toxic environments, racism, and discrimination, all of which contribute to vulnerability to tobacco and other substance misuse.<sup>12</sup> If studies illuminate factors contributing to lower hazard of young adult tobacco uptake by race and ethnicity, we can tailor universal prevention in more meaningful ways, reducing tobacco-related health disparities.<sup>13</sup>

Informed by the National Institute of Minority Health Disparities (NIMHD) framework<sup>14</sup> and grounded in evidence on tobacco use determinants and young adult development, the present study examines contributions of select intra-personal, individual-level health determinants on tobacco use initiation among a US young adult cohort: Basic demographics (age, gender), income and financial independence, other substance use, mental health, and norms. The goal is to increase understanding of factors associated with preventing future tobacco initiation among young adults while systematically informing how factors vary by race and ethnicity.<sup>10,15</sup>

## Methods

### Truth Initiative Young Adult Cohort

The study examines longitudinal data from the 10-wave (2011–2016) Truth Initiative Young Adult Cohort (YAC); a probability-based, nationally representative sample of US young adults aged 18–34 years drawn from GfK's (Growth from Knowledge) online KnowledgePanel. Non-Hispanic Black and Hispanic young adults are oversampled to ensure sufficient subgroup analyses. YAC methods are detailed elsewhere.<sup>16,17</sup> The study has IRB approval from the Independent IRB, Inc. (Study Waves 1–3, Protocol #20036–007) and Chesapeake Institutional Review Board, Inc. (Waves 4–10, Protocol #20036020).

### Present Study

The sample includes participants in Waves 2–8 and 10 (fielded December 2011–July, 2015 every six months, and Wave 10 in September–October 2016). Waves one and nine are not included due to survey question inconsistencies: Wave one, tobacco ever users were not asked about their current use due to the survey's skip pattern. Wave nine, information about pipe use was not collected, unlike all other waves.

Panel recruitment rates vary from 12.7–14.9% across the eight waves. Each wave includes only one-panel member per household randomly selected for the study. Completion rates range from 46.2–68.4%, consistent with other published studies.<sup>18,19</sup>

## Measurement

### Critical Baseline Variables

#### *Race and Ethnicity and Other Demographics*

Participants identify as one or more of the following: American Indian or Alaska Native, Asian, Black or African American, Native Hawaiian or Other Pacific Islander, White, and Hispanic or Latino (yes or no). Sample sizes are insufficient for categories of two or more races (ie, American Indian or Alaska Native, Asian, Native Hawaiian or Other Pacific Islander) negating opportunities for meaningful separate analysis. Therefore, an analysis recodes race and ethnicity as Non-Hispanic White, Non-Hispanic Black, Hispanic, and Non-Hispanic All Other Races. Participant data also includes gender (male or female) and age (years) at baseline.

#### *Socio-Economic Indicators*

Participants' annual baseline income includes a 19-level categorical variable ranging from \$5 000 to greater than \$175 000 in intervals of five to ten thousand. Analysis recodes amounts into tertiles of less than \$35 000, \$35 000 - \$74 999, and at least \$75 000. Three values for income balance simplicity and expressiveness; class dividers are based on tertiles to maximize statistical power. Because this variable is categorical, tertiles are approximate. Participant's level of financial dependence is "dependent", "partially dependent", or "independent" on either their parents and/or guardians or on someone else.

### Individual-level Time Varying Variables

#### *Tobacco Use*

Current tobacco use includes the use of any of the following tobacco products for *at least one day in the previous 30 days*: Cigarettes, cigars, cigarillos or little cigarettes, e-cigarettes, smokeless tobacco products, waterpipes or hookahs, and pipes. Analysis does not examine distinct tobacco products separately.

#### *Other Substance Use*

Use includes the number of days in the past 30 days participants used alcohol and cannabis. Analysis collapses alcohol use into three categories (0, 1–5 days, 6+ days) and cannabis into two categories (yes or no).

#### *Anxiety and Depressiveness*

Patient Health Questionnaire four (PHQ-4) examines two anxiety-related and two depressiveness questions with scores from 0–3: Not at all, Several days, More than half the days, Nearly every day.<sup>20</sup> Anxiety questions include: "During the last two weeks, how often have you felt anxious or on edge" and "How often have you worried uncontrollably". Summed scores from anxiety-related questions are 3+ "Have anxiety" and 0–2 "Do not". A depressiveness construct provides scores of questions grouped in the same way as the anxiety questions: "During the last two weeks, how often have you

had little interest in doing things” and “How often have you felt depressed or down”.

#### *Sensation Seeking*

Eight questions assess participants’ proclivity for sensation seeking using a 5-point agreement scale, from “Strongly agree” to “Strongly disagree”. An average sensation seeking index reports scores as a number from 1–5, averaging them for each participant. A Cronbach’s alpha of 0.77 shows strong internal consistency. Questions include: “I get restless when I spend too much time at home”, “I like to do frightening things”, “I like wild parties”, “I’d like to take a trip with no itinerary”, “I prefer excitingly unpredictable friends”, “I would like to try bungee jumping”, “I would like to explore strange places”, and “I love exciting experiences, even if they’re illegal”. Analysis split mean sensation seeking into tertiles, with scores of 1–2.61 indicating little proclivity for sensation seeking, 2.62–3.11 moderate proclivity, and 3.21–5 high proclivity. Tertiles are used here for the same reasons as the income variable.

#### *Self-efficacy to Resist*

Ability to resist smoking around others who smoke uses a 4-item scale, with responses “Not at all confident”, “Somewhat confident”, “Moderately confident”, and “Very confident”. Over 90% of participants report being “Very confident”, warranting a dichotomous construct with “Not very confident” versus “Very confident”.

#### *Harm Perception*

Compared to cigarettes, participants indicate perceptions of the relative harmfulness of cigars; pipes; little cigars, cigarillos, or bidis; e-cigarettes; chewing tobacco; dip or snuff; snus; dissolvable tobacco products; hookah or shisha; and nicotine replacement products. A harm perception construct converts answers to consecutive integers from 1–5 and averages scores for each tobacco category. Averages less than three are “Less harmful”, averages equal to three are “Just as harmful”, and averages greater than three are “More harmful”. Cronbach’s alpha calculations at each survey wave ranges from 0.88–0.91, indicating a strong correlation.

#### *Number of Friends Who Smoke Or Use Other Tobacco Products*

Participants report on how many of their four closest friends smoke cigarettes, as well as how many use other tobacco products. Answers range from 0–4 for each question, with recodes to 0, 1, or 2 +for sample size reasons.

#### *Estimated Prevalence Of Peer Smoking*

Participants also indicate the number of people out of 100 their age that they think smoked cigarettes at least once a week (in increments of 10). Estimated rates of actual smoking rates used the American Lung Association data;<sup>21</sup> recoding “Correct or Under”, “Over”, and “Greatly over”. “Greatly over” consists of estimates too high by 30 or more, while “Over” includes responses too high by 10 or 20.

### **Statistical Analysis**

Analyses examine differences by race and ethnicity by determining which variables predict sustained tobacco non-use in a time-to-event framework. An *event* is a person transitioning from a tobacco non-user to a user, based on the definition of

current tobacco use. The study includes participants who were non-current tobacco users at first observation ( $N = 7\,665$ ), since current tobacco users already had the event, as defined here. A person’s time-to-event includes the number of waves between one. an individual’s first observation and the wave at which they initiated tobacco use, or two. an individual’s first and last observation for those who never became a current tobacco user during the study period. Because study waves are almost evenly spaced in time, we use the number of waves between two observations as the time duration between them. Cox proportional hazard (CPH) models estimate the effects of each predictor on the hazard for future tobacco use. The higher the hazard, the greater the likelihood of tobacco use in some interval of time in the future. For each predictor, a stratified model uses only observations with complete data for that predictor; sample sizes for each are not necessarily the same. Analysis uses R version 3.6.3<sup>22</sup> and Stata version 15.1.<sup>23</sup>

## **Results**

### **Survival Analysis By Race and Ethnicity**

There are  $N = 7\,665$  study participants across Waves 2–8 and 10;  $n = 2\,708$  completed one wave,  $n = 1\,337$  two waves,  $n = 927$  three waves,  $n = 741$  four waves,  $n = 462$  five waves,  $n = 471$  six waves,  $n = 456$  seven waves,  $n = 563$  four waves. A majority of the total sample is female (61.1%) and Non-Hispanic White (58%), with a mean age of 27 years. See other demographics in [Table 1](#). [Tables 2](#) and [3](#) show hazard ratios for future tobacco use for each category, with White individuals as a baseline. White and Non-Hispanic All Other Races categories reveal similar uptake hazard ratios whereas the Black and Hispanic young adults are similar to each other. Non-Hispanic All Other Races is not significantly different from White individuals ( $p = .656$ ); Hispanic individuals are significantly different than White individuals ( $p = .003$ ) and Black individuals are borderline ( $p = .074$ ), but with a similar hazard uptake ratio to Hispanic individuals (1.246 versus 1.298). Subsequent CPH models are univariate and stratify data by race. Refer to [Supplementary Table 1](#) for additional hazard ratio details.

### **Differential Effects of Predictor Variables by Race and Ethnicity**

#### **Gender**

Across all categories, males have a higher hazard ratio (HR) for tobacco use compared to females. HRs are lowest in the White population (HR = 1.374,  $p = .001$ ) and highest among Hispanic individuals (HR = 2.156,  $p < .001$ ).

#### **Age**

The 18–24 years age group serves as a baseline. Hazard for uptake decreases with age for all groups except Non-Hispanic All Other Races, where the 25–29 years age group has a lower uptake hazard (HR = 0.672,  $p = .305$ ) than the 30–34 years group (HR = 0.946,  $p = .862$ ), though neither HRs are significant. Age is marginally protective among White individuals (HRs = 0.838 and 0.765 and  $p = .139$  and  $.024$  for the 25–29 years and 30–34 years age groups respectively) and strongly protective among Hispanic individuals (HRs = 0.702 and 0.468 and  $p = .05$  and  $< .001$  for the 25–29 years and 30–34 years age groups respectively).

#### **Income and Financial Independence**

Higher-income levels are associated with a lower hazard of future tobacco use for all races except Hispanic young adults,

**Table 1.** Demographics at Baseline by Race.<sup>a</sup>

Variable (%)		Overall	Non-Hispanic White	Non-Hispanic Black	Hispanic	Non-Hispanic All Other Races	P <sup>b</sup>
N		7665	4501	742	1833	589	< .001
<b>Demographic characteristics.</b>							
Gender	Female	4724 (61.6)	2686 (59.7)	499 (67.3)	1184 (64.6)	355 (60.3)	< .001
	Male	2941 (38.4)	1815 (40.3)	243 (32.7)	649 (35.4)	234 (39.7)	
Age	18–24	3574 (46.6)	1982 (44.0)	393 (53.0)	899 (49.0)	300 (50.9)	< .001
	25–29	1941 (25.3)	1213 (26.9)	181 (24.4)	415 (22.6)	132 (22.4)	
	30–34	2150 (28.0)	1306 (29.0)	168 (22.6)	519 (28.3)	157 (26.7)	
<b>Socio-economic indicators.</b>							
Income Range	Low	2272 (29.6)	992 (22.0)	357 (48.1)	789 (43.0)	134(22.8)	< .001
	Medium	2145 (28.0)	1374 (30.5)	169 (22.8)	443 (24.2)	159 (27.0)	
	High	1924 (25.1)	1437 (31.9)	94 (12.7)	231 (12.6)	162 (27.5)	
Financial Independence	Dependent	639 (8.3)	352 (7.8)	42 (5.7)	182 (9.9)	63 (10.7)	< .001
	Partially Independent	641 (8.4)	392 (8.7)	50 (6.7)	134 (7.3)	65 (11.0)	
	Independent	585 (7.6)	364 (8.1)	70 (9.4)	97 (5.3)	54 (9.2)	
	NA	5800 (75.7)	3393 (75.4)	580 (78.2)	1420 (77.5)	407 (69.1)	
<b>Other Substance Use</b>							
Alcohol Use (past 30 days)	None	2770 (36.1)	1486 (33.0)	301 (40.6)	776 (42.3)	207 (35.1)	< .001
	1–5	1890 (24.7)	1157 (25.7)	187 (25.2)	407 (22.2)	139 (23.6)	
	6+	951 (12.4)	703 (15.6)	53 (7.1)	137 (7.5)	58 (9.8)	
	NA	2054 (26.8)	1155 (25.7)	201 (27.1)	513 (28.0)	185 (31.4)	
Cannabis Use (past 30 days)	No	6178 (80.6)	3575 (79.4)	586 (79.0)	1539 (84.0)	478 (81.2)	.001
	Yes	338 (4.4)	210 (4.7)	42 (5.7)	69 (3.8)	17 (2.9)	
	NA	1149 (15.0)	716 (15.9)	114 (15.4)	225 (12.3)	94 (16.0)	
	NA	1324 (17.3)	698 (15.5)	122 (16.4)	370 (20.2)	134 (22.8)	
<b>Mental Health-related Factors</b>							
Depressiveness	Not Depressive	6634 (86.5)	4016 (89.2)	583 (78.6)	1553 (84.7)	482 (81.8)	< .001
	Depressive	925 (12.1)	433 (9.6)	142 (19.1)	253 (13.8)	97 (16.5)	
	NA	106 (1.4)	52 (1.2)	17 (2.3)	27 (1.5)	10 (1.7)	
Anxiety	Not Anxious	6509 (84.9)	3870 (86.0)	598 (80.6)	1560 (85.1)	481 (81.7)	< .001
	Anxious	1014 (13.2)	565 (12.6)	121 (16.3)	235 (12.8)	93 (15.8)	
	NA	142 (1.9)	66 (1.5)	23 (3.1)	38 (2.1)	15 (2.5)	
Sensation Seeking (SS) Nature	Low SS	2098 (27.4)	1259 (28.0)	225 (30.3)	463 (25.3)	151 (25.6)	< .001
	Moderate SS	1702 (22.2)	1006 (22.4)	174 (23.5)	399 (21.8)	123 (20.9)	
	High SS	2065 (26.9)	1259 (28.0)	169 (22.8)	492 (26.8)	145 (24.6)	
	NA	1800 (23.5)	977 (21.7)	174 (23.5)	479 (26.1)	170 (28.9)	
Ability to resist smoking	Very Confident	7073 (92.3)	4262 (94.7)	656 (88.4)	1630 (88.9)	525 (89.1)	< .001
	Not Very Confident	519 (6.8)	206 (4.6)	70 (9.4)	187 (10.2)	56 (9.5)	
	NA	73 (1.0)	33 (0.7)	16 (2.2)	16 (0.9)	8 (1.4)	
<b>Descriptive Norms</b>							
Average Harm Perception	Less Harmful	987 (12.9)	696 (15.5)	57 (7.7)	161 (8.8)	73 (12.4)	< .001
	More Harmful	920 (12.0)	426 (9.5)	103 (13.9)	297 (16.2)	94 (16.0)	
	As Harmful	591 (7.7)	355 (7.9)	68 (9.2)	122 (6.7)	46 (7.8)	
	NA	5167 (67.4)	3024 (67.2)	514 (69.3)	1253 (68.4)	376 (63.8)	



Table 1. Continued

Variable (%)		Overall	Non-Hispanic White	Non-Hispanic Black	Hispanic	Non-Hispanic All Other Races	P <sup>b</sup>
Friends who smoke	0	4635 (60.5)	2885 (64.1)	419 (56.5)	959 (52.3)	372 (63.2)	< .001
	1	1471 (19.2)	834 (18.5)	155 (20.9)	374 (20.4)	108 (18.3)	
	2+	1444 (18.8)	726 (16.1)	150 (20.2)	470 (25.6)	98 (16.6)	
	NA	115 (1.5)	56 (1.2)	18 (2.4)	30 (1.6)	11 (1.9)	
Friends who use other tobacco	0	5108 (66.6)	3086 (68.6)	443 (59.7)	1184 (64.6)	395 (67.1)	< .001
	1	736 (9.6)	444 (9.9)	71 (9.6)	178 (9.7)	43 (7.3)	
	2+	508 (6.6)	249 (5.5)	91 (12.3)	133 (7.3)	35 (5.9)	
	NA	1313 (17.1)	722 (16.0)	137 (18.5)	338 (18.4)	116 (19.7)	
Estimation of Smoking rate among peers	Correct or Under	2231 (29.1)	1442 (32.0)	168 (22.6)	453 (24.7)	168 (28.5)	< .001
	Over	1942 (25.3)	1234 (27.4)	140 (18.9)	425 (23.2)	143 (24.3)	
	Greatly Over	2260 (29.5)	1137 (25.3)	305 (41.1)	655 (35.7)	163 (27.7)	
	NA	1232 (16.1)	688 (15.3)	129 (17.4)	300 (16.4)	115 (19.5)	

<sup>a</sup> NA denotes either a skip pattern or non-response.

<sup>b</sup> P values are from chi-squared tests for categorical variables and t-tests for continuous un-weighted variables.

where analysis shows no effect. No clear relationships exist between financial independence and the hazard of tobacco use.

#### Alcohol or Cannabis Use in the Last 30 Days

Compared with no alcohol use, which is overall protective, uptake hazard is higher for those who drink between 1 and 5 days per week, and higher for those who drank 6 + days, except Non-Hispanic All Other Races who show a significantly larger hazard for drinking between 1 and 5 days compared to those who drink more (HRs 9.057 versus 5.044). Cannabis use is significantly associated with a greater hazard of future tobacco use. Hazard for uptake is highest among individuals in the Non-Hispanic All Other Races groups and lowest in Hispanic young adults.

#### Depressiveness and Anxiety

Compared to the baseline of “Not depressive”, depressiveness is associated with increased hazard among White (HR = 1.648,  $p = .001$ ) and Non-Hispanic All Other Races (HR = 2.949,  $p = .002$ ) individuals. Depressiveness is not associated with increased tobacco initiation hazard among Hispanic or Black individuals. Compared to the baseline of “Not anxious”, symptoms of anxiety are associated with increased uptake hazard among White (HR = 2.048,  $p < .001$ ), Non-Hispanic All Other Races (HR = 1.434,  $p = .002$ ), and Hispanic (HR = 1.501,  $p = .036$ ) individuals. Depressiveness is not associated with an increased hazard of tobacco use uptake among Black young adults.

#### Sensation Seeking Behaviors

Hazard for future tobacco use is higher among those with a higher high sensation seeking, compared to low sensation seeking, which is protective. Effect sizes are most robust for White individuals.

#### Self-Efficacy to Resist Smoking

Individuals not very confident in resisting smoking around others have a higher uptake hazard than those who are confident. This difference is largest among White and Non-Hispanic All Other Races groups. While the relationship is

less strong for Hispanic and Black young adults, effect sizes are notable.

#### Harm Perception

Those who perceive other tobacco products are as relatively harmful as cigarettes have the lowest hazard for future tobacco use. Perceiving other products are more harmful versus less harmful as cigarettes are associated with lower uptake hazard among Hispanic individuals but greater hazard among Non-Hispanic All Other Races individuals. White and Non-Hispanic Black individuals show no significant difference.

#### Friends Who Smoke

Compared to having no friends who smoke, those who report having either 1 friend or 2 + friends who smoke have uniformly significantly higher tobacco uptake hazard. Effects are least pronounced for Hispanic young adults (HRs of 1.955 and 4.403 for 1 and 2 + friends respectively,  $p = .002$  and  $p < .001$ ) and most pronounced among White individuals (HRs of 3.001 and 5.657 for 1 and 2 + friends respectively,  $p < .001$ ).

#### Friends Who Use Other Tobacco Products

Having no friends who use other tobacco products, relative to those with either 1 friend or with 2 + friends, shows a significantly lower uptake hazard. Among Non-Hispanic All Other Races group, the uptake hazard is higher for those reporting having 1 friend who uses other tobacco products compared to 2 + (HR = 6.344 for 1 friend, HR = 3.631 for 2 + friends,  $p < .001$  for both), though sample sizes are small ( $n = 43$  and  $n = 35$  respectively).

#### Estimated Rate of Smoking Among Peers

Accurate norm perceptions are protective. Overestimation of smoking rates among peers is associated with a greater hazard for tobacco use among individuals in the White and Non-Hispanic All Other Races groups. Magnitude of effect is relatively large for the “Greatly Over” category (HR = 1.731,  $p < .001$  for White individuals; HR = 2.198,  $p = .028$

**Table 2.** Hazard ratios, 95% Confidence Intervals, and *p* Values From the Race-Stratified Cox Proportional Hazards Models.

Variable	Race and Ethnicity											
	Non-Hispanic White			Non-Hispanic Black			Non-Hispanic All Other Races			Hispanic		
	N	HR (CI)	<i>P</i>	N	HR (CI)	<i>P</i>	N	HR (CI)	<i>P</i>	N	HR (CI)	<i>P</i>
Overall	4501	Baseline	-	742	1.25 (0.98,1.59)	.074	589	0.94 (0.70,1.25)	.656	1833	1.30 (1.09,1.55)	.003
Gender												
Female	2686	Baseline	-	499	Baseline	-	355	Baseline	-	1184	Baseline	-
Male	1815	1.37 (1.13,1.66)	.001	243	1.40(0.88,2.21)	.156	234	1.49 (0.86,2.58)	< .001	649	2.16 (1.61,2.89)	< .001
Age												
18–24	1982	Baseline	-	393	Baseline	-	300	Baseline	-	899	Baseline	-
25–29	1213	0.84 (0.66,1.06)	.139	181	0.70 (0.34,1.23)	.216	132	0.67 (0.32,1.44)	.305	415	0.70 (0.49,1.00)	.050
30–34	1306	0.77 (0.61,0.97)	.024	168	0.70 (0.40,1.21)	.202	157	0.95 (0.51,1.77)	.862	519	0.47 (0.32,0.69)	< .001
Income												
Low	992	Baseline	-	357	Baseline	-	134	Baseline	-	789	Baseline	-
Medium	1374	0.73 (0.58,0.93)	.011	169	0.79 (0.48,1.30)	.353	159	1.12 (0.61,2.04)	.725	443	0.91 (0.65,1.26)	.725
High	1437	0.77 (0.61,0.97)	.025	94	0.44 (0.20,0.98)	.044	162	0.42 (0.19,0.92)	.030	231	0.98 (0.65,1.47)	.030
Financial Independence												
Dependent	352	Baseline	-	42	Baseline	-	63	Baseline	-	182	Baseline	-
Partially	392	0.98 (0.70,1.36)	.890	50	2.70 (0.90,8.08)	.076	65	0.76 (0.27,2.12)	.593	134	1.88 (1.14,3.09)	.013
Independent	364	0.91 (0.67,1.24)	.552	70	1.92 (0.65,5.63)	.238	54	1.01 (0.40,2.56)	.976	97	1.50 (0.91,2.46)	.111

HR = hazard ratio; CI = 95% confidence interval.

for other), but non-significant for “Slightly Over” relative to “Correct or Under.” No clear pattern appears among Black and Hispanic individuals.

## Discussion

Critical and unique tobacco uptake hazard and protective factors exist along racial and ethnic lines (Table 4). Overall uptake hazard is highest among Hispanic young adults and only slightly lower among Non-Hispanic Black young adults. Individuals in the Non-Hispanic White and Non-Hispanic All Other Races groups have similar and lower tobacco uptake hazards. Gender and age reveal important demographic differences. Gender is an important factor across categories, as being female is associated with a lower risk of tobacco uptake over time. Being a Hispanic female is a particularly salient protective factor for young adult tobacco initiation; consistent with literature showing that Hispanic females have lower rates of tobacco use than Non-Hispanic females.<sup>4</sup> Other studies show that female tobacco users significantly influence their peers’ tobacco behavior, whereas males do not. Accordingly, young adult females, notably Hispanics, could be particularly influential agents in non-use as well.<sup>24</sup>

Age is another important protective factor and, among Hispanic individuals, the relationship is significant and of a large magnitude. Consistent with other research young adult Hispanic males aged 22–25 years are at increased risk early use.<sup>3</sup> Relatedly, aging is strongly protective among Hispanic males and females up to age 25 years. If Hispanic individuals progress to age 25 years without using tobacco, the risk of uptake is very low. While Hispanic young adults are at highest risk of tobacco uptake overall, the protective effect of being older is most pronounced in this category. Individuals in the Non-Hispanic All Other Races group are least protected by age, showing that 30 + age groups persists

with some hazard of uptake, and initiates use later compared to White individuals. Findings reinforce the importance of continuing prevention efforts into young adulthood and suggest that efforts should be intensive earlier (eg, 18–24 years). Consistent with an extensive body of literature, our findings show an association between higher income levels and lower hazard of future tobacco use for all groups, except Hispanic young adults for whom increased income alone is not protective against tobacco uptake. In other words, the magnitude of benefits of higher-income appears to be less for Hispanic individuals than for other groups. Partially explained by the Marginalization-related Diminished Returns (MDR) theory,<sup>25,26</sup> there are diminished returns of favorable socioeconomic status factors (eg, income and educational attainment), critical but historically neglected mechanisms for racial and ethnic tobacco-related disparities. Our findings are different in that they show diminished returns of income or lesser protective effects for Hispanics only. As such, Hispanic and Black adults in our study do not share the same MDRs (relative to White adults), as found in other studies. While there’s a need to better understand why the income and tobacco uptake gradient is “washed out” for Hispanic individuals compared to other minority groups, we offer a few socio-environmental-driven speculations. First, associations between income and health outcomes are weaker for immigrants compared to native-born adults; 33% of Hispanic adults identify as are immigrants.<sup>27</sup> Second, Hispanic individuals (30%) are more likely than Black (24%) or White individuals (15%) or other races to live in multi-generational households,<sup>27</sup> thus income must go further in Hispanic households because sizes are larger. Third, different from other races, Hispanic individuals may leave traditional cultural enclaves to pursue higher incomes, which often comes with acculturation stress.<sup>28–30</sup> Fourth, while Hispanic individuals view tobacco use as harmful to themselves and others, they also perceive use as

**Table 3.** Hazard ratios, 95% Confidence Intervals, and p Values From the Race-Stratified Cox Proportional Hazards Models.

Variable	Race and Ethnicity											
	Non-Hispanic White			Non-Hispanic Black			Non-Hispanic All Other Races			Hispanic		
	N	HR (CI)	P	N	HR (CI)	P	N	HR (CI)	P	N	HR (CI)	P
Number of days using alcohol out of the last 30												
None	1486	Baseline	-	301	Baseline	-	207	Baseline	-	776	Baseline	-
1-5	1157	2.15 (1.51,3.07)	<.001	187	2.03 (0.99,4.18)	.055	139	9.06 (2.65,30.91)	<.001	407	2.88 (1.85,4.48)	<.001
6+	703	4.21 (2.97,5.97)	<.001	53	3.69 (1.65,8.26)	.001	58	5.04 (1.20,21.15)	.027	137	5.24 (3.16,8.70)	<.001
Cannabis use in the last 30 days												
No	3575	Baseline	-	586	Baseline	-	478	Baseline	-	1539	Baseline	-
Yes	210	4.79 (3.56,6.44)	<.001	42	6.08 (3.11,11.89)	<.001	17	8.40 (3.41,20.71)	<.001	69	3.39 (1.98,5.81)	<.001
Depressiveness												
Not Depressive	4016	Baseline	-	583	Baseline	-	482	Baseline	-	1553	Baseline	-
Depressive	433	1.65 (1.24,2.18)	.001	142	1.15 (0.61,2.17)	.675	97	2.95 (1.63,5.35)	<.001	253	1.32 (0.89,1.96)	.165
Anxiety												
Not Anxious	3807	Baseline	-	598	Baseline	-	481	Baseline	-	1560	Baseline	-
Anxious	565	2.05 (1.62,2.60)	<.001	121	0.96 (0.50,1.87)	.909	93	1.43 (1.23,4.82)	.002	235	1.50 (1.03,2.19)	.036
Sensation seeking (SS) score												
Low SS	1259	Baseline	-	225	Baseline	-	151	Baseline	-	463	Baseline	-
Moderate SS	1006	1.72 (1.30,2.27)	<.001	174	2.14 (1.16,3.98)	.016	123	1.55 (0.68,3.51)	.295	399	1.15 (0.73,1.79)	.549
High SS	1259	2.44 (1.89,3.14)	<.001	169	2.69 (1.47,4.94)	.001	145	2.46 (1.19,5.10)	.016	492	2.11 (1.44,3.08)	<.001
Confidence in one's ability to resist smoking												
Very confident	4262	Baseline	-	656	Baseline	-	525	Baseline	-	1630	Baseline	-
Not very confident	206	9.04 (7.28,11.22)	<.001	70	5.44 (3.39,8.73)	<.001	56	9.45 (5.37,16.71)	<.001	187	5.31 (3.89,7.25)	<.001
Harm perceptions												
Less harmful	696	Baseline	-	57	Baseline	-	73	Baseline	-	161	Baseline	-
As harmful	355	0.68 (0.48,0.97)	.031	68	0.63 (0.30,1.33)	.223	46	0.68 (0.21,2.21)	.520	122	0.23 (0.11,0.48)	<.001
More harmful	426	1.02 (0.75,1.39)	.903	103	0.71 (0.36,1.43)	.339	94	2.28 (1.03,5.05)	.041	297	0.50 (0.32,0.80)	.004
Friends who smoke out of one's closest four												
0	2885	Baseline	-	419	Baseline	-	372	Baseline	-	959	Baseline	-
1	834	3.00 (2.35,3.84)	<.001	155	2.10 (1.10,4.01)	.024	108	2.91 (1.42,5.96)	.004	374	1.96 (1.28,2.99)	.002
2+	726	5.66 (4.30,7.11)	<.001	150	4.77 (2.81,8.11)	<.001	98	4.97 (2.55,9.68)	<.001	470	4.40 (3.10,6.26)	<.001
Friends who use other tobacco products out of one's closest four												
0	3086	Baseline	-	443	Baseline	-	395	Baseline	-	1184	Baseline	-
1	444	2.75 (2.11,3.59)	<.001	71	3.10 (1.54,6.23)	.002	43	6.34 (3.15,12.79)	<.001	178	3.37 (2.28,4.98)	<.001
2+	249	5.88 (4.46,7.76)	<.001	91	5.07 (2.86,8.99)	<.001	35	3.63 (1.51,8.72)	.004	133	4.37 (2.97,6.45)	<.001
Estimation of rate of smoking among peers												
Correct or under	1442	Baseline	-	168	Baseline	-	168	Baseline	-	453	Baseline	-
Slightly over	1234	1.27 (0.98,1.65)	.073	140	0.99 (0.47,2.08)	.977	143	0.48 (0.52,1.29)	.147	425	0.91 (0.62,1.36)	.675
Greatly over	1137	1.73 (1.32,2.27)	<.001	305	1.47 (0.77,2.80)	.248	163	2.20 (1.09,4.44)	.028	655	0.79 (0.54,1.15)	.222

HR = hazard ratio; CI =95% confidence interval

**Table 4.** Summary of Racial and Ethnic Distinctions in Protective Factors for Young Adult Tobacco Initiation

Variable	Non-Hispanic White	Non-Hispanic Black	Hispanic	Non-Hispanic All Other Races
Being female	+	+	++	+
Delaying use to an older age	+	+	++	-
Earning moderate income	+	+	-	+
Being financially independent	-	-	-	+
Not using alcohol	+	+	+	+
Not using cannabis	+	+	+	+
Having mental health symptoms	+	-	+	++
Low sensation seeking	+	+	+	+
Being confident about resisting smoking around peers who smoke	++	+	+	++
Perceiving tobacco as harmful	+	+	+	-
Having low number of friends smoke	++	+	+	+
Having a low number of friends other tobacco products	++	+	+	+
Having accurate perceptions of percentage of peers who smoke	++	+	+	++

+ protective; ++ protective (notably robust); - neutral or no effect

a favorable to acculturate into communities and to manage stress. Indeed, in-depth descriptive studies show multiple social and familial influences on Hispanic young adults tobacco use and non-use.<sup>31</sup> However, some racial and ethnic tobacco disparities are beyond individual choices, shaped by external forces that marginalize and increase their risk of tobacco exposure,<sup>32,33</sup> notably predatory tobacco marketing. Data show that Hispanic communities have higher densities of tobacco retailers, especially those with high proportions of Hispanics and low-income.<sup>32,33</sup> Findings are consistent with studies showing that the longer immigrants stay in the United States and the more culturally embedded they become, the more likely they are to become tobacco users.<sup>34,35</sup> Thus, individuals with favorable socioeconomic status indicators in predominantly minority areas remain disproportionately exposed to tobacco marketing. Culturally-tailored cessation or prevention interventions for Hispanic populations should include content about relationships between tobacco and assimilation and acculturation as a denormalization strategy.<sup>36</sup> Further, comprehensive public policies should include ways to equalize returns of income on a range of health behaviors among at-risk groups.<sup>37</sup>

Regarding **psychosocial variables**, findings confirm other studies showing relationships between mental health and tobacco use differ by race and ethnicity.<sup>38</sup> Greater frequencies of depressive and anxiety symptoms are associated with higher hazards of tobacco use in all groups, except for Black individuals. Uptake hazard is notably stronger in the Non-Hispanic All Other Races group. A speculation is that individuals who experience depression, notably Whites, may hold exaggerated expectations about tobacco's ability to relieve negative affect, which could enhance their likelihood of initiating tobacco use in young adulthood when new life stressors mount. For Black young adults, it is plausible that tobacco is not seen as a sufficient relief agent; they may be more likely to believe in the power of other positive strategies (eg, religiosity, social support) more than substances to cope.<sup>39</sup> If protective effects of social and cultural support lower negative affect and indirectly buffer effects of depression on tobacco use among Black individuals, more resources need to be

put towards enhancing social supports to prevent tobacco use. Of note, alcohol, and cannabis use signal robust tobacco uptake risks among Non-Hispanic All Other Races individuals. Findings call into question implicit assumptions about relations between mental health and health behavior and beg for greater understanding about how negative affect such as depression and anxiety influence health behaviors across different racial and ethnic groups. Research must also determine differential views on tobacco as a stress relief agent.

Finally, results show important differences in **norms and harm perceptions**. Overall, having fewer peers who use smoke tobacco is protective against young adult tobacco initiation. Conversely, having more friends who smoke is strongly associated with increased hazard of future tobacco use. This effect is notably strong among White individuals, suggesting that, despite its decline in prevalence, we cannot dismiss cigarette smoking as an influential peer factor in this group. Having prevention programs focused on social networks beyond individuals could reduce the risk of tobacco product use. Over estimation of individuals who actually smoke is noteworthy.<sup>40</sup> During the study period, rates of smoking decreased from 18.9–13.1% among those aged 18–24 years, and from 22.1–17.6% among those 25 years and older ages. Approximately, one-third overestimate rates of smoking by 10–20%, and another third by 30% or higher. Individuals who are White and Non-Hispanic All Other Races who greatly overestimate rates of smoking show greater hazard for future tobacco use, emphasizing a need for research on norms formation,<sup>41</sup> including social, physical, or symbolic environment influences. Future research should examine whether patterns of misestimation by group are influenced by differential exposure to tobacco marketing or stronger marketing effects by group. In support, and consistent with previous research confirming general societal understanding that cigarette smoking is harmful to health, the present study shows that perceiving tobacco as harmful is associated with lowered tobacco uptake hazard across all groups. Using a measure of relative risk, the lowest hazard for future tobacco use is perceiving that other products are as harmful as cigarettes, a finding most pronounced in Hispanic individuals. While normative beliefs



are demonstrated to precede tobacco intention and behavior, and often applied to youth prevention, our findings suggest that impact and importance of normative information continue into adulthood.

### Limitations

A few limitations warrant mention. First, YAC protocols subscribe to completeness and quality of minority data using recommended standards for recoding racial and ethnic categories and reporting smallest available minority units to minimize inaccurate attributions.<sup>42</sup> Still, there is heterogeneity across and within race and ethnicity categories for which analysis cannot account, including multi-racial identities or distinctions within “Other” categories.<sup>43</sup> Arguably, these results are hard to interpret given heterogeneity of the All Other Races group. We caution against speculation but also assert that to exclude this group altogether would be negligent. Second, a multi-level framework for explaining health disparities is important. The current study intentionally addresses only intra-personal factors, providing insights not previously uncovered about individual-level influences on tobacco resiliency among racial and ethnic minorities. Third, given sample size limitations we do not examine patterns of uptake of particular tobacco products, which may also vary by race and ethnicity. However, for purposes of identifying factors associated with *sustained non-use* of any tobacco, the aggregate tobacco use variable is most comprehensive. Fourth, the time-to-event framework handles survey non-response and dropout naturally via censoring, so certain segments of the population have fewer waves of data than others, and is associated with being younger and non-white. While this does not introduce bias, it does reduce power for these segments, limiting abilities to detect subtle group changes. Finally, the study hypothesizes differential outcomes by race and ethnicity across a range of empirically-based intra-personal variables on the single outcome of tobacco initiation. Experiment-wise type I error is higher than 0.05 levels for each hypothesis. Given a lack of robust literature on the topic, analyses does not report adjustments for multiple comparisons and instead provides details of effect sizes, confidence intervals, and *p* values as a more comprehensive picture of results.<sup>44,45</sup> Findings also emphasize the most scientifically promising results to confirm what is known from prior research or hint at new relationships about which little is known.<sup>45</sup>

### Conclusion

Young adults are a distinct at-risk population, especially given increases in emerging tobacco product use, e-cigarette use, and poly tobacco use.<sup>46</sup> Findings provide a nuanced look at roles of race and ethnicity in late initiation and sustained non-tobacco use, confirming existing findings on tobacco use patterns and contributing to new knowledge on protective factors. Confirmatory findings reinforce aspects of prevention that are essential for all groups, suggesting that there are many interpersonal, individual-level protective and risk factors that should be and remain common elements of prevention, regardless of race and ethnicity. Similar to other research,<sup>47-49</sup> our findings show perceiving tobacco use as harmful as cigarettes predicts lowered hazard across all groups; those with a lower proclivity for sensation

seeking behaviors also have lower hazard of future tobacco use. Yet, when examining data through a race and ethnicity lens, factors are not equally protective. For example, there is a need to understand why higher incomes shows smaller effects on tobacco uptake behaviors of Hispanics compared to other racial groups; a finding that suggests that tobacco health disparities are not simply a low socioeconomic status problem. Identifying common elements of intervention has bearing on broad dissemination and cost-effectiveness of population-based, universal prevention approaches. But it is among nuanced findings that we will discover ways to more boldly target and tailor universal prevention. Because socio-environmental harms can be mapped onto individual-level tobacco behaviors, moderating and mediating effects of population-level factors, such as society, culture, and community must be considered across racial and ethnic groups. Interventions, including public policies, must consider preventing and reducing socio-environmental harms by equalizing structural and environmental barriers that lead to tobacco uptake across the lifespan.

### Supplementary Material

A Contributorship Form detailing each author’s specific involvement with this content, as well as any supplementary data, are available online at <https://academic.oup.com/ntr>

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### Data Sharing

A data sharing agreement is required for use of all data. Investigators seeking access to data used in the study should make a written request to Truth Initiative authors and submit a detailed research plan including the purpose of the proposed research, required variables, duration of the analysis phase, IRB approval with FWA (Federalwide Assurances) information, and investigator training in human subjects. Approved investigators may access datasets via an analytic Portal owned and administered by Truth Initiative.

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