# Predicting Adolescents' Future Smoking Behavior through Anti-Smoking Ad Exposure: A Structural Equation Modeling Approach Based on the Theory of Planned Behavior.

By

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## Abstract

Predicting Adolescents' Future Smoking Behavior through Anti-Smoking Ad Exposure: A Structural Equation Modeling Approach Based on the Theory of Planned Behavior.

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**Introduction**: The prevalence of cigarette smoking among adolescents in the U.S. is the lowest in any other past years, yet more than 8.1% still reported using tobacco products. Despite a downward trend in recent years, approximately 472,000 middle school and 729,000 high school students reported current cigarette use, highlighting the need for ongoing prevention initiatives. Utilizing the Theory of Planned Behavior, this study evaluates the impact of exposure to anti-smoking advertisements on adolescents' psycho-cognitive factors—specifically attitudes, social norms, perceived control, intentions, and smoking behavior. The findings aim to inform individuals about more effective and accessible public health interventions as part of the "smoke-free future" initiative.

**Methods**: A cross-sectional analysis was conducted using 2023 *Monitoring the Future* (MTF) survey data, a nationally representative sample of 8th and 10th graders.4 Structural Equation Modeling (SEM) was used to test relationships derived from the Theory of Planned Behavior, examining how anti-smoking ad exposure and psycho-cognitive factors predict current smoking behavior and intentions while adjusting for demographic variables.

**Results**: Ad exposure showed minimal direct effects on psycho-cognitive predictors of smoking. Instead, adolescents' risk perceptions toward tobacco use, perceived peer disapproval, estimate of peer smoking, and confidence in resisting smoking were stronger predictors of both current behavior and future intentions. Demographic factors, including parental presence, race, gender, and grade, significantly influenced adolescents' smoking-related perceptions and behaviors.

**Conclusion**: Psycho-cognitive factors are more influential than anti-smoking ads in predicting adolescents' smoking behavior. The findings emphasized the significance of involving peer and family influences in prevention strategies. SEM highlights the complex behavioral pathways involved, offering evidence-based recommendations for strengthening early, family-centered interventions to promote a smoke-free future generation.

**Acknowledgements**

I want to extend my sincere gratitude to Dr. Weaver, Dr. Kirpich, and Boshi Wang for their invaluable support in the development of the thesis committee. I am especially thankful to Dr. Weaver for generously dedicating his time and sharing his expertise to design this comprehensive project. His guidance significantly deepened my understanding of the intricacies of Structural Equation Modeling. Boshi Wang has been exceptionally helpful in providing insightful guidance and thoughtful feedback to help me curate the most robust model possible. I also want to thank Dr. Kirpich for sparking my interest in statistical computing early in my academic career and encouraging the switch to Biostatistics concentration. Finally, I would like to thank my husband, parents, and in-laws for their unwavering support, and to my four-year-old son, whose cheerful presence brightened even the most challenging days.

## Author's Statement

This thesis is submitted in partial fulfillment of the requirements for the Master's degree in Public Health, with a concentration in Biostatistics, at Georgia State University. I affirm that the work presented is entirely my own and was conducted with integrity, under the guidance and support of my thesis committee.

This research symbolizes the final step of my academic training in Public Health and Biostatistics. It provided a meaningful opportunity to apply advanced statistical tools and concepts to address real-world health challenges. The thesis focuses on adolescent substance use, specifically cigarette smoking as a critical public health issue due to its long-term health consequences and widespread impact. By studying smoking behavior among adolescents, this research aims to contribute to early prevention strategies and raise awareness about the dangers of tobacco use in youth populations.

The research highlights my proficiency to create advanced statistical models, manage large and complex datasets, ensure reproducibility, and outline detailed, interpretable inferences. The research also emphasizes the competencies in statistical theory, research design, and applied data analysis within behavioral and population health frameworks. These skills have strengthened my capacity for evidence-based, data-driven decision-making and provided a solid foundation in modern Biostatistics developed throughout my graduate training.

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Myesha Choudhury Iqbal
Researcher

## Competencies Addressed in the Thesis

1. **Core Competencies**:

1.1. MPH 3. Analyze quantitative and qualitative data using biostatistics, informatics, computer-based programming, and software, as appropriate.

1.2. MPH 4. Interpret results of data analysis for public health research, policy, or practice.

1.3. MPH 22. Apply systems thinking tools to a public health issue.

2. **Concentration Competencies**:

2.1. MPH BSTP 3. Apply advanced (multivariate) descriptive and inferential techniques used with public health data.

2.2. MPH BSTP 8. Interpret results of statistical analyses found in public health studies.

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# 1. **Introduction**

Cigarette smoking among adolescents in the United States has declined to a historic low, with 2024 data showing the lowest prevalence since the National Youth Tobacco Survey (NYTS) began in 1999.[1] Nonetheless, tobacco use remains a persistent public health challenge. Over 2.22 million middle and high school students reported using tobacco products in the past 30 days which included 5.4% of middle schoolers and 10.1% of high schoolers.[2] These figures underscore the need for sustained and targeted prevention efforts, particularly during adolescence, a critical period for behavioral formation. One major contributor to youth tobacco uptake has been the tobacco industry's pervasive marketing strategies. In 2019, U.S. cigarette advertising and promotional expenditures totaled $7.62 billion.[3] Supporting widespread media portrayals link smoking to social approval and popularity. Across movies, video games, and celebrity culture, smoking is often depicted as normative and accepted. [4,5,6] This potentially reinforces both descriptive norms (perceived peer prevalence) and injunctive norms (perceived peer disapproval). [7] Anti-smoking messages and pro-smoking promotions can shape attitudes toward tobacco and affect intentions regarding smoking initiation or cessation.[8]

This thesis draws on the Theory of Planned Behavior (TPB) as its guiding theory. Developed by Icek Ajzen, TPB offers a validated model for understanding human behavior by emphasizing the role of intention as the primary predictor of action.[9] Behavioral intention is shaped by three central constructs: attitudes (positive or negative evaluation of the behavior), subjective norms (perceived social pressure to engage or not engage in the behavior), and perceived behavioral control (confidence in one's ability to perform the behavior). Subjective norms can be further categorized into injunctive norms, reflecting perceived peer approval or disapproval, and descriptive norms, reflecting the perceived prevalence of the behavior.[10] In the context of

adolescent smoking, these constructs map onto specific cognitive beliefs: perceived risk (attitudes) towards smoking, perceived peer smoking and peer disapproval of smoking (subjective norms), and confidence in resisting cigarettes (perceived behavior control). These factors influence future smoking intention and, subsequently, future smoking behavior.

While TPB does not explicitly include media exposure as a predictor, anti-smoking advertising may serve as a catalyst that activates changes across its core constructs. Public health campaigns commonly employ strategies to increase risk awareness, correct misperceptions about peer smoking, and promote refusal skills, aligning with TPB's mechanisms.[11] Empirical evidence supports the effectiveness of such messaging: graphic warnings and social disapproval-themed campaigns have been shown to elevate perceived risk, reduce perceived peer acceptance of smoking, and decrease adolescents' intentions to smoke. [12] [13] Thus, anti-smoking advertisements represent a key external influence that may indirectly affect smoking behavior by reshaping the psycho-cognitive factors within the theory.

This thesis examines how anti-smoking advertisements influence adolescent attitudes, social norms, perceived behavioral control, intentions, and smoking behavior. Using structural equation modeling (SEM), the study evaluates both direct and mediated effects of ad exposure within the TPB model. Findings are intended to contribute to the design of more effective, accessible public health interventions aligned with the "Smoke-Free Future" initiative to prevent tobacco initiation and reduce smoking prevalence among adolescents.

$H_0$: Anti-smoking advertisements have no direct or indirect correlation with adolescents' intentions to use tobacco and do not significantly influence attitudes, subjective norms, or perceived behavioral control in predicting current smoking behavior.

$H_1$: Anti-smoking advertisements have a direct and indirect correlation with adolescents' intentions to use tobacco. These advertisements influence key psycho-cognitive factors, such as attitudes, subjective norms, and perceived behavioral control, which, in turn, shape smoking intentions and affect current smoking behavior.

# 2. Methods

## 2.1 Study Design

The present study employs a cross-sectional design utilizing the Monitoring the Future (MTF) dataset of 8th and 10th graders from 2023.[14] The MTF survey is a nationally representative study conducted annually since 1991, with a repeated cross-sectional design that allows unique participants to be surveyed each year. MTF uses a multi-stage complex sampling design.[15] As this thesis reports only of secondary data analysis of public-use, de-identified data, this research does not meet the definition of human-subjects research.

## 2.2 Measures

This study is grounded in the Theory of Planned Behavior (Figure 1), expanded to include media exposure as a primary exogenous influence. The hypothesized model (Figure 2) consists of three latent constructs, four observed variables, and four demographic controls which include gender, parental presence, race, and grade level.

### 2.2.1 Outcome Measure

The primary outcome variable is current smoking behavior or smoking status, defined as cigarette use within the past 30 days. This is measured using a single observed binary indicator based on the question: “Have you smoked cigarettes in the past 30 days?” Responses were coded as 0 = No and 1 = Yes.

### 2.2.2 Primary Exposure Variable

Reported exposure to anti-smoking advertisements is a dichotomous observed variable constructed by combining two survey items: “How often have you seen anti-smoking commercials on TV or heard them on the radio?” and “How often have you seen anti-smoking ads on billboards or in magazines and newspapers?” Responses were recorded in SAS to create a

binary indicator reflecting recent exposure to anti-smoking media. The resulting variable, ADS, was labeled: “Have you seen or read about anti-smoking ads recently? (TV, radio, billboards, newspapers, or magazines),” with response options coded as 1 = Yes and 2 = No.

### 2.2.3 Putative Mediators

Attitudes: The TPB attitudes construct was operationalized using three items assessing respondents perceived risk of smoking cigarettes: (1) “How much do people risk harming themselves physically and in other ways when they smoke one or more packs of cigarettes per day?” (2) “How much do people risk harming themselves physically and in other ways when they use any smokeless tobacco regularly?” (3) “How much do people risk harming themselves physically and in other ways when they smoke one to five cigarettes per day?” Each item was assessed on a four-point scale: 1 = No Risk, 2 = Slight Risk, 3 = Moderate Risk, 4 = Great Risk.

Injunctive Norms: The TPB subjective norm construct was operationalized using two items assessing respondents’ perception of their close friend’s disapproval of smoking behavior: (1) “How do you think your close friends feel (or would feel) about you smoking one or more packs of cigarettes per day?” (2) “How do you think your close friends feel (or would feel) about you smoking cigarettes occasionally?” Each item was assessed on a four-point scale: 1="Not Disapprove" 2="Disapprove" 3="Strongly Disapprove".

Descriptive Norms: The TPB subjective norm construct was operationalized using two items assessing respondents’ estimate of how many of their peer smokes. Each item has a unique scale: (1) “How many of your friends would you estimate smoke cigarettes?” (2) “How many of your friends would you estimate use smokeless tobacco?” Each item was assessed on a five-point scale: 1="All" 2="Most" 3="Some" 4="A Few" 5="None".

Perceived Behavior Control: The TPB behavior control construct was operationalized using the item to assess respondents' confidence in their ability to refrain from smoking: "Would you consider trying tobacco if one of your closest friends offered it to you?" Each item was assessed on a four-point scale: 1="Definitely yes" 2="Probably yes" 3="Probably not" 4="Definitely not".

Intention represents the respondent's self-reported likelihood of refraining from smoking within the next five years. It was operationalized using a single item: "Do you think you will be smoking cigarettes five years from now?" with responses measured on a four-point Likert scale: 1 = I definitely will, 2 = I probably will, 3 = I probably will not, 4 = I definitely will not. The TPB intention construct is considered the immediate precursor of behavior and is typically modeled as an outcome of attitudes, subjective norms, and perceived behavioral control. Classifying intention as a putative mediator in the present model as SEM evaluates indirect pathways from TPB constructs to smoking behavior through intention.

**2.2.4 Sociodemographic covariates**

Gender, parental presence in the home, race, and grade level are the model's control variables, representing the respondents' demographics. Gender is categorized into male and female, which is dummy coded with female as the reference group. Parental household presence signifies as plh = 0 when no parent present, plh = 1 when father only, plh = 2 when mother only, and plh = 3 when both parents present in the household of the respondent.

Racial identity of the respondents is represented by three dummy-coded variables: Black, Hispanic, and White, where White is the reference group due to having the largest sample size in the dataset. All other responses for the race, including those of respondents who fell into more than one of the three categories had been recorded as missing data in the raw dataset from MTF

for de-identification of respondents. Grade variable is dummy coded as 0 for 8th grade and 1 for 10th grade.

**2.3 Analytical Plan**

Analyses were conducted using Mplus Version 8.9.[16] The analytical process utilized Structural Equation Modeling (SEM) to test hypothesized relationships. Confirmatory Factor Analysis (CFA) was included in SEM to validate the measurement model. All items were treated as ordinal categorical variables, and estimation was performed using the Weighted Least Squares Mean and Variance adjusted (WLSMV) estimator in Mplus. This estimator is robust to non-normality and is specifically recommended for structural equation modeling with ordinal outcomes. WLSMV accounts for the non-continuous distribution of the indicators by using polychoric correlations and a diagonal weight matrix.[17]

**2.3.1 Confirmatory Factor Analysis (CFA)**

CFA was conducted to assess the reliability and validity of the latent constructs. Model fit was evaluated using conventional thresholds: Comparative Fit Index (CFI) and Tucker-Lewis Index (TLI) ≥ 0.95, Root Mean Square Error of Approximation (RMSEA) ≤ 0.06, and Standardized Root Mean Square Residual (SRMR) ≤ 0.08.[18] Standardized factor loadings (β), Composite Reliability (CR > 0.70), and Average Variance Extracted (AVE > 0.50) were used to assess internal consistency and validity.[19] Note that values for CR <0.95 is considered redundant and problematic.[23] Model fit indices established during CFA informed the evaluation of the structural model, though overall fit was reassessed after full model estimation.

**2.3.2 Structural Equation Modeling (SEM)**

SEM was used to test the hypothesized pathways among psycho-cognitive factors and anti-smoking ad exposure on smoking intention and current smoking behavior. Demographic

covariates were included in the structural model to statistically control for background variability, though they were not hypothesized to directly affect the latent constructs. For significant paths, the standardized coefficient (β) revealed the strength of the relationship. The model assumed β of approximately 0.10 to be a small effect, around 0.30 to be moderate, and above 0.50 to be considerable. A lower standard error (S.E.) relative to β suggested a more reliable path effect. [20] The sign and size of β indicate the relationship's direction and intensity. The values nearing 1 or -1 represent strong positive or negative correlations. Explained Variance ($R^2$)'s effectiveness metrics depended on three criteria: $R^2 \geq 0.50$, substantial explained variance, $R^2$ around 0.30, moderate, and $R^2 < 0.10$, then weak.[21]

**2.4 Ethical Considerations**

This study used publicly available which only contained de-identified data from the MTF survey. IRB approval was not required, and the original data collection adhered to federal ethical standards, including informed consent. [14] Principles of scientific integrity and transparency were upheld throughout the study. AI tools were used solely for editorial support and were reviewed for originality and accuracy.

# 3. Results

## 3.1 Sample Characteristics and Descriptive Statistics

Table 3 presents descriptive statistics for the analytic sample comprising 14,734 adolescents, where approximately 51% identified as male and 49% as female. The racial composition was 62% White, 23% Hispanic, and 15% Black. Most participants were in the 10th grade (58%), with the remaining 42% in the 8th. Regarding household composition, 78% of respondents reported living with both parents, 17% with their mother, 4% with their father, and 1% with neither parent.

It is important to note that the analytic sample statistics differ slightly from those of the raw dataset due to Mplus's application of listwise deletion, which excludes cases with missing data on any model variable. Additionally, pairwise polychoric correlations were computed based on available complete case patterns for each variable pair. Table 4 presents univariate descriptive statistics for key model variables. These item-level distributions were examined to provide context for the latent constructs specified in the structural equation modeling framework. The final analytical model included 13,443 observations where descriptive statistics from the analytic model closely mirrored those of the full sample on key variables such as smoking behavior, behavioral intention, and exposure to anti-smoking advertisements. Only 1% identified as current smokers, while 99% reported not smoking in the past 30 days.

Regarding future intentions, 73% expressed the lowest intention to smoke within the next five years, whereas fewer than 1% reported the highest intention. Regarding perceived behavioral control, 75% of respondents indicated the highest confidence level in their ability to avoid smoking, while 1% reported the lowest confidence to refrain from smoking.

Approximately 80% of respondents reported recent exposure to anti-smoking ads, and 20% reported no exposure. Attitudes toward tobacco indicated a general trend toward the highest risk perceptions, “Great Risk”: Risk perception of smoking 1+ cigarette packs daily (74%), risk perception of using smokeless tobacco regularly (48%), and risk perception of smoking 1 or 5 cigarettes daily (44%). Similar patterns were observed in perceived injunctive norms, where respondents most frequently endorsed friends' strong disapproval of smoking: Peer disapproval of smoking 1+ cigarette packs daily (69%), and peer disapproval of smoking cigarettes occasionally (50%). Perceptions of peers not smoking or using smokeless tobacco (descriptive norms) are also reflected at an increasing trend for the highest categories: Estimation of friends not smoking cigarettes (78%), and estimation of friends not using smokeless tobacco (84%).

### 3.2. Global Model Fit Indices

Table 5 illustrates the global fit indices for the CFA analysis for assessing the TPB model's fit with anti-smoking ad exposure. The table includes the Chi-Square statistic ($\chi^2$), CFI, TLI, RMSEA, RMSEA 90% Confidence Interval, and SRMR. The Chi-Square statistic ($\chi^2$ =1778.805, df = 58) for the large dataset of over 13k observations shows decent fit, the RMSEA value of 0.039 confirms excellent model fit since the values below 0.05 indicate a close fit. The CFI (0.978) and the TLI (0.959) further validates exceptional model fitting Although the SRMR value of 0.084 is over the threshold of 0.08, it still suggests that the data fits reasonably and falls within an acceptable range.

### 3.3. Correlational Analysis

Polychoric correlation analysis provided valuable insights into the connections between adolescents' perceptions and behaviors regarding smoking. The analysis revealed a strong correlation between behavioral intention and perceived behavioral control (r = 0.747), suggesting

that confidence in one's ability to resist smoking is a key factor in maintaining a smoke-free future. Smoking behavior was strongly and negatively correlated with both intentions (r = -0.629) and perceived control (r = -0.731). This reflects the protective effect of these constructs against smoking. All latent constructs displayed strong internal consistency with injunctive norms (r = 0.875), attitudes (r = 0.762–0.878), and descriptive (r = 0.783,) emphasizing the significant influence of peer disapproval, peers' tobacco use, and risk perceptions of tobacco usage in shaping anti-smoking behaviors. Intention construct was correlated weakly with attitudes (r = 0.064-0.161), but moderately with both subjective norms. It is important to note that exposure to anti-smoking advertisements was weakly correlated with all other variables, suggesting that relying solely on anti-smoking ad exposure is not an effective strategy for preventing future smoking. Psychological factors need to be incorporated into the model for greater effectiveness.

**3.4. Confirmatory Factor Analysis (CFA) Results**

Table 7 presents the Factor Loadings and Reliability of the model. The standardized coefficients from STDYX section of Mplus output for the attitudes construct ranging from 0.840 to 0.966, the injunctive norms ranging from 0.890 to 0.985, and the descriptive norms ranging from 0.805 to 0.978 indicate a strong positive association between each observed indicator and its corresponding latent factor. All factor loadings were statistically significant at $p < .05$, and S.E. ranged from 0.001 to 0.039, suggesting high precision and model stability. The consistently low standard errors are likely attributable to the large sample size (N = 13,443), which increases statistical power and strengthens the reliability of parameter estimates. These high loadings suggest that the latent constructs are well-defined, internally consistent, and psychometrically powerful constructs within the theory.

Internal consistency is further assessed for the model using CR and AVE for latent constructs in Table 8 for attitudes, injunctive norms, and descriptive norms. All latent constructs confirm excellent internal consistency with reliable and valid measures of perceived risk, peer disapproval, and estimation of peer's tobacco use, with CR over the threshold but not exceeding the redundancy mark. AVE provides the percentage of the variance in the indicators explained by the latent factor where attitudes 82%, injunctive norms 59%, and descriptive norms 53% are explained by their respective latent factors.

### 3.5 Structural Equation Modeling (SEM) Results

Interpretation of path analysis data revealed to be significant when the p-value was less than 0.05 for the indicators.

#### 3.5.1 Path Coefficients

The path analysis for the factors from the model is shown below in Table 9. The paths for intention with all the connected constructs showed significant positive associations, where perceived behavior control ($\beta = 0.817$, $p = < .05$), attitudes ($\beta = 0.193$, $p = < .05$), injunctive norms ($\beta = 0.425$, $p = < .05$), and descriptive norms ($\beta = 0.368$ $p = < .05$). The pathways suggested that when there is more confidence to resist smoking, more negative perception of tobacco use, higher perceived disapproval of smoking from close friends, and perceptions of fewer peers using tobacco, then they are associated with stronger intentions to avoid smoking. The path for smoking status with intention showed a strong negatively significant association ($\beta = -1.340$, $p = < .05$), which suggests that higher intention to resist smoking in five years is associated with adolescents' refraining from smoking in the last 30 days. The path for current smoking status with behavior control showed a positively significant association ($\beta = 0.522$, $p = < .05$), suggesting that more confidence to resist smoking is associated with smoking in the last

30 days, which is contradictory to what is theorized, i.e., one was supposed to have greater confidence in resisting smoking if they did not smoke in the last 30 days. This development contradicts the theoretical expectation of TPB.

The paths for Anti-smoking ad exposure with attitudes (β = 0.294, $p$ = < .05), injunctive norms (β = 0.356, $p$ = < .05), and descriptive norms (β = 0.170 $p$ = < .05) display positive associations where descriptive norms are weakly associated but attitudes and injunctive norms are moderately associated with ad exposure. The pathways suggested that adolescents who were exposed to anti-smoking advertisements were more likely to perceive tobacco usage as risky, had higher perception of peer disapproval of smoking, and higher perception of fewer peers using tobacco. However, a negative association was found between anti-smoking ad exposure and intention (β = -0.283, $p$ = < .05), suggesting that exposure to anti-smoking ads was unexpectedly linked to lower intentions to refrain from smoking.

The path analysis results of the sociodemographic control variables to the model's latent constructs are presented in Table 10. Significant positive associations were observed between attitudes and parental presence (β = 0.033, $p$ = 0.004), and grade-level (β = 0.129, $p$ = < .05), indicating that adolescents who have one or both of their parents living in the household and those in 10th grade were more likely to perceive smoking as risky than 8$^{th}$ graders. In contrast, significant negative associations were found between attitudes and males (β = -0.045, $p$ = < .05), Hispanic (β = -0.040, $p$= 0.001), and Black (β = -0.059, $p$ = < .05), suggesting that adolescents who were male, and Hispanic or Black racially were associated with reporting lower perceived risk of using tobacco compared to their female and White peers. These results indicate that adolescents' attitudes toward tobacco use with higher perceived risk are linked to being female, White, having parental presence, and being in a higher grade level.

The path analysis results revealed that injunctive norms were positively associated with parental presence (β = 0.025, *p* = 0.195) and Black (β = 0.048, *p* = 0.013), where pathway from parental presence is not statistically significant at the conventional α = 0.05 level. This indicates that higher perceived close friends' disapproval of smoking and being black are associated for adolescents. Negative associations were observed between injunctive norms and grade-level (β = –0.028, *p*= 0.142), males (β = –0.018, *p* = 0.330), and Hispanic (β = –0.039, *p*= 0.045). Among these, only the path for Hispanic was statistically significant. This demonstrates that adolescents reported lower perceptions of peer disapproval toward smoking when they were associated with identifying as Hispanics. The results implies that there are no significant association between perceived close friends' disapproval of smoking and identifying as males, Blacks, and being in 10th grade.

The path analysis results for descriptive norms indicated positive associations with parental presence (β = 0.035, *p* = 0.026), males (β = 0.065, *p* = < .05), Hispanic (β = 0.024, *p* = 0.126), and Black (β = 0.095, *p* = < .05). However, only being Hispanic was not statistically significant at the α = .05 level. This indicates that having parental presence, being male, and being Black were associated with greater perceptions that peers engage in tobacco usage. In contrast, descriptive norms were negatively associated with grade-level (β = -0.115, *p* = < .05), suggesting that adolescents in the 10th grade were associated with lower perceptions of peer using tobacco than 8th grade.

Table 11 shows the path coefficients of the observed constructs and sociodemographic controls. The path analysis for intention revealed positive associations with grade-level (β = 0.115, *p* = < .05) which indicated higher intention to avoid smoking in the future associated with being in 10th grade and lower intention to avoid smoking in the future with being in 8th grade.

The paths for intention showed negative association with males (β = –0.053, $p$ = 0.035), Hispanic (β = –0.049, $p$ = 0.046), and Black (β = –0.105, $p$ = < .05). There were no significant differences in associations for having parental presence in the households at the α = .05 level. Lower future smoking intentions associated with being male, Black or Hispanic.

The path analysis results for behavior control showed positively significant associations with males (β = 0.073, $p$ = 0.007) and Black (β = 0.148, $p$ = < .05), while a negatively significant association with grade-level (β = –0.066, $p$ = 0.016). There were no significant associations observed between behavior control and parental presence or being Hispanic. These findings suggest that adolescents who identify as being males and Black are associated with perceiving greater control over resisting smoking compared to their female and White peers. In contrast, adolescents in higher grade levels (10th vs 8th) perceive less control over smoking behavior.

The path analysis results for Anti-smoking ad exposure revealed a positive association with parental presence (β = 0.074, $p$ = < .05), while negative associations were observed with being Hispanic (β = –0.060, $p$ = 0.005) and Black (β = –0.071, $p$ = 0.001). There were no significant associations with males or grade-level. These findings suggest that adolescents with one or both parents present in the households were more likely to report exposure to anti-smoking advertisements and significantly less likely to report ad exposure when they identified as Hispanic and/or Black compared to their White peers.

The path analysis results for smoking status revealed a positive and statistically significant association with grade-level (β = 0.200, $p$ = < .05), indicating that adolescents in 10th grade were more likely to have smoked in the past 30 days than 8$^{th}$ graders. Negative associations were found for smoking status with being Hispanic (β = –0.186, $p$ = < .05). There were no significant

associations found between recent smoking behavior with being male, Black, or having either parent present in the households.

### 3.5.2 Explained Variance ($R^2$)

Table 12 shows the structural model, which demonstrated a remarkable ability to predict adolescents' intention to avoid smoking, accounting for 97.5% of the variance, which indicates that the proposed theoretical model has strong predictive power. Key constructs such as attitudes, injunctive norms, descriptive norms, perceived behavioral control, and exposure to anti-smoking advertisements significantly contributed to explaining this intention. Additionally, the model explained 92.8% of the variance in actual smoking behavior over the past 30 days, further supporting the vital role of intention in the model. However, the model accounted for only 3.2% of the variance in perceived behavioral control and 1.5% of the variance in exposure to anti-smoking ads, demonstrating little explanatory power for both, which is likely due to the demographic controls used in the model.

### 3.5.3 Modification Indices (MI)

Modification Indices suggested by the Mplus output were not applied to alter the structural model in the analysis. While MIs can help identify areas of model misfit and suggest data-driven adjustments, modifying the model based on empirical suggestions risks deviating from the original theory and may introduce potential overfitting mainly due to the presence of overwhelming missing data. Given that the hypothesized model already demonstrated excellent fit indices, further modifications were deemed unnecessary.

# 4. Discussion

The structural equation modeling results confirmed the study hypothesis, demonstrating that exposure to anti-smoking advertisements significantly influenced adolescents' psycho-cognitive factors: attitudes, injunctive norms, descriptive norms, and perceived behavioral control, which in turn predicted smoking intentions and behavior, thereby rejecting the null hypothesis ($H_0$) as statistically unsupported.

Findings from the model provided practical evidence that anti-smoking advertisement exposure significantly influences adolescents' behavior toward smoking. Specifically, exposure to anti-smoking messages was associated with more negative attitudes toward smoking, stronger perceived social disapproval (injunctive norms), and lower perceived prevalence among peers (descriptive norms). These constructs, in turn, predicted reduced intention to smoke in the future, supporting the mediating role of the Theory of Planned Behavior. The model explained a substantial proportion of variance in adolescents' intention to smoke ($R^2 = 0.963$), suggesting that psychological factors such as attitudes, subjective norms, and perceived control, potentially shaped by anti-smoking advertisements, have played a critical role in smoking-related decision-making.

The study's strength lies in its focus on 8th and 10th-grade students, which is a critical developmental window for smoking prevention. By integrating demographic factors such as gender, race, parental presence, and grade level, the research offers a nuanced view of how cognitive and environmental influences shape adolescent attitudes toward smoking. This comprehensive approach supports evidence-based, demographically informed strategies for designing effective public health interventions targeting youth tobacco use.

## 4.1. Interpretation of Findings

The model was based on 2023 data from 8th and 10th-grade students and demonstrated that adolescents' perceptions of social disapproval and control were stronger predictors of intention to avoid smoking than attitudes or perceived peer behavior. While anti-smoking ad exposure had modest direct effects, it was linked to higher risk perception and peer disapproval, suggesting indirect pathways of influence. Notably, demographic analyses showed that being a female and White were associated with higher perceived risks and intentions to refrain from future smoking, while being a male and Black were associated with greater perceived control and descriptive norms. Parental presence was significantly correlated with higher risk perceptions and both subjective norms. Eighth graders were associated with current smoking status, lower attitudes and intentions, but higher descriptive norms and control.

Intention and behavior control were highly correlated than the other factors which illustrates that greater confidence in resisting smoking is the most effective means to influence adolescents to refrain from future smoking. The unexpected positive association between perceived behavioral control and current smoking behavior may be due to overestimation by adolescents of their ability to resist smoking, leading to overconfidence or cognitive dissonance. Similarly, the unexpected negative association between anti-smoking ad exposure and intention to refrain from future smoking may reflect message resistance or psychological reactance, where adolescents reject academic content perceived as controlling or experience desensitization from repeated exposure. These results underscore the importance of targeting psycho-social factors in preventive strategies and tailoring anti-smoking campaigns to specific demographic groups for greater impact.

**4.2. Implications for Future Research**

This prevention strategy presents a cost-effective and scalable model by leveraging publicly available datasets and low-cost communication channels such as anti-smoking media campaigns, peer-led initiatives, and social media. It emphasizes peer-centric approaches by capitalizing on the predictive strength of injunctive norms (e.g., peer disapproval) and descriptive norms (e.g., peer behavior) to promote anti-smoking attitudes and behaviors. The model also strengthens perceived behavioral control by equipping adolescents with strategies and support systems that enhance their confidence to resist smoking.

**4.3. Limitations of The Study**

This study's limitation involves measuring one of the indicators from the following latent constructs of attitudes and descriptive norms as smokeless tobacco use rather than cigarette smoking directly. Although it aligned statistically with other items in the construct, this discrepancy may weaken construct validity. A low percentage of variance in perceived behavioral control and anti-smoking advertisement exposure suggests a potential gap in the model's ability to capture external influences on adolescents' smoking behavior perceptions and media exposure.

Moreover, the analysis was based solely on the 2023 public-use MTF dataset for 8th and 10th-grade students, which constrained the study's scope. Longitudinal data and expanded measures are recommended to assess the sustained impact of anti-smoking advertisement exposure.

## 5. References


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## Appendix A: Mathematical Formulas[22]

1. $CR$ (Composite Reliability) $= \frac{(\sum \boldsymbol{\lambda_i})^2}{(\sum \boldsymbol{\lambda_i})^2 + \sum \boldsymbol{\theta_i}}$
2. AVE (Average Variance Extracted) $= \frac{\sum \boldsymbol{\lambda_i}^2}{\sum \boldsymbol{\lambda_i}^2 + \sum \boldsymbol{\theta_i}}$

## Appendix B: Additional Statistical Tables and Figures

### 1. List of Tables:

*Table 1:* Survey Items by Construct

| Construct | Item Code | Survey Question |
|---|---|---|
| **Attitudes** | att1 | How much do people risk harming themselves physically and in other ways when they smoke one or more packs of cigarettes per day? |
| | att2 | How much do people risk harming themselves physically and in other ways when they use any smokeless tobacco regularly? |
| | att3 | How much do people risk harming themselves physically and in other ways when they smoke one to five cigarettes per day? |
| **Injunctive Norms** | inj1 | How do you think your close friends would feel about smoking one or more packs of cigarettes per day? |
| | inj2 | How do you think your close friends would feel about smoking cigarettes occasionally? |
| **Descriptive Norms** | des1 | How many of your friends would you estimate smoke cigarettes? |
| | des2 | How many of your friends would you estimate use smokeless tobacco? |
| **Perceived Behavioral Control** | pbc | Would you consider trying tobacco if one of your closest friends offered it to you? |
| **Behavioral Intention** | int | Do you think you will be smoking cigarettes five years from now? |
| **Anti-Smoking Ads** | ads | Have you seen or read about anti-smoking ads recently? (TV, radio, billboards, newspapers, or magazines) |
| **Behavior: Smoking** | smk | Have you smoked cigarettes in the past 30 days? |
| **Demographics (Control)** | plh | Is either your father or mother living in the same household as you? |
| | gender | How do you identify yourself? |
| | race | What is your racial/ethnic background? |

| | | |
|---|---|---|
| | grade | Which grade are you in? |

*Table 2:* Ordinal Scale for Observed Indicators and Control Variables

| **Construct** | **Item Code** | **Response Scale** |
|---|---|---|
| Attitudes | att1 – att3 | 1 = "No Risk", 2 = "Slight Risk", 3 = "Moderate Risk", 4 = "Great Risk" |
| Injunctive Norms | inj1, inj2 | 1 = "Not Disapprove", 2 = "Disapprove", 3 = "Strongly Disapprove" |
| Descriptive Norms | des1, des2 | 1 = "All", 2 = "Most", 3 = "Some", 4 = "A Few", 5 = "None" |
| Perceived Behavioral Control | pbc | 1 = "Definitely yes", 2 = "Probably yes", 3 = "Probably not", 4 = "Definitely not" |
| Behavioral Intention | int | 1 = "I definitely will", 2 = "I probably will", 3 = "I probably will not", 4 = "I definitely will not" |
| Anti-Smoking Ads | ads | 1 = "No", 2 = "Yes" |
| Behavior: Smoking | smk | 0 = "No", 1 = "Yes" |
| Demographics (Control) | plh | 0 = "No", 1 = "Father only", 2 = "Mother only", 3 = "Both" |
| | gender | 1 = "Male", 2 = "Female" |
| | race | 1 = "Black or African American", 2 = "White (Caucasian)", 3 = "Hispanic" |
| | grade | 0 = "Eighth", 1 = "Tenth" |

*Table 3:* Descriptive Statistics of Demographics

| Number of observations: 14734 | | | |
|---|---|---|---|
| **Constructs** | **Scale/ Category** | **Count** | **Percentage (%)** |
| Parental Presence | No Parents | 194 | 1% |
| | Father Only | 509 | 4% |
| | Mother Only | 2270 | 17% |
| | Both Parents | 10477 | 78% |
| Gender | Male | 6744 | 51% |
| | Female | 6492 | 49% |
| Race | Black | 1617 | 15% |
| | White | 6636 | 62% |

| | | | |
|---|---|---|---|
| | Hispanic | 2531 | 23% |
| Grade Level | 8th | 6240 | 42% |
| | 10th | 8494 | 58% |

**Note:** Values are presented as counts and column percentages. Percentages may not total 100% due to rounding or missing data. Data is unweighted.

*Table 4:* Descriptive Statistics of Descriptive Statistics in the Model

| Number of observations: 13,443 | | | | |
|---|---|---|---|---|
| Variable | Scale | Category | Proportion (%) | Count |
| Behavioral Intention | 1 | I Definitely Will | 0.50% | 21 |
| | 2 | I Probably Will | 3.40% | 153 |
| | 3 | I Probably Will Not | 23.10% | 1043 |
| | 4 | I Definitely Will Not | 73.10% | 3305 |
| Perceived Behavioral Control | 1 | Definitely Yes | 1.30% | 30 |
| | 2 | Probably Yes | 4.30% | 97 |
| | 3 | Probably Not | 19.80% | 451 |
| | 4 | Definitely Not | 74.60% | 1696 |
| Anti-Smoking Ad Exposure | 1 | No Ad Exposure | 19.90% | 862 |
| | 2 | Ad Exposure | 80.10% | 3480 |
| Smoking Behavior | 1 | Not Smoking | 98.70% | 13259 |
| | 2 | Current Smoker | 1.30% | 172 |
| Attitudes (ATT1) | 1 | No Risk | 8.00% | 1022 |
| | 2 | Slight Risk | 3.50% | 447 |
| | 3 | Moderate Risk | 14.70% | 1877 |
| | 4 | Great Risk | 73.80% | 9423 |
| Attitudes (ATT2) | 1 | No Risk | 9.30% | 1103 |
| | 2 | Slight Risk | 10.10% | 1209 |
| | 3 | Moderate Risk | 32.50% | 3869 |
| | 4 | Great Risk | 48.10% | 5739 |
| Attitudes (ATT3) | 1 | No Risk | 12.10% | 520 |
| | 2 | Slight Risk | 8.40% | 362 |
| | 3 | Moderate Risk | 35.40% | 1525 |
| | 4 | Great Risk | 44.10% | 1900 |
| Injunctive Norms (INJ1) | 1 | Not Disapprove | 8.80% | 376 |
| | 2 | Disapprove | 22.10% | 940 |
| | 3 | Strongly Disapprove | 69.10% | 2946 |
| Injunctive Norms (INJ2) | 1 | Not Disapprove | 14.70% | 627 |
| | 2 | Disapprove | 35.40% | 1515 |

| | | | | |
|---|---|---|---|---|
| | 3 | Strongly Disapprove | 49.90% | 2134 |
| Descriptive Norms (DES1) | 1 | All | 0.30% | 27 |
| | 2 | Most | 1.10% | 90 |
| | 3 | Some | 3.50% | 299 |
| | 4 | A Few | 16.70% | 1410 |
| | 5 | None | 78.40% | 6629 |
| Descriptive Norms (DES2) | 1 | All | 0.30% | 24 |
| | 2 | Most | 1.00% | 84 |
| | 3 | Some | 3.40% | 290 |
| | 4 | A Few | 10.90% | 921 |
| | 5 | None | 84.40% | 7116 |

**Note:** All variables were treated as categorical or ordinal in the analysis.

*Table 5:* Global Fit Indices for the Model

| Fit Index | Value | Threshold |
|---|---|---|
| Model $\chi^2$ (df) | 1778.805 (58) | - |
| CFI | 0.978 | $\geqslant$ 0.95 |
| TLI | 0.959 | $\geqslant$ 0.95 |
| RMSEA | 0.047 | $\leqslant$ 0.05 |
| RMSEA 90% CI | [0.045, 0.049] | $\leqslant$ 0.08 |
| SRMR | 0.084 | $\leqslant$ 0.08 |

**Abbreviations**: Chi-square test, $\chi^2$. Comparative Fit Index, CFI. Tucker-Lewis Index, TLI. Root Mean Square Error of Approximation, RMSEA. Standardized Root Mean Squared Residual, SRMR.

**Note:** Key fits for the Confirmatory Factor Analysis (CFA) Model assessing the Theory of Planned Behavior (TPB) with anti-smoking ad exposure, such as $\chi^2$, CFI, TLI, RMSEA, SRMR, and their interpretations based on threshold criteria.

*Table 6*: Estimated Correlation Matrix of Ordinal Categorical Constructs.

| | INT | PBC | INJ1 | INJ2 | ATT1 | ATT2 | ATT3 | SMK | DES1 | DES2 | ADS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **INT** | | | | | | | | | | | |
| **PBC** | 0.747 | | | | | | | | | | |
| **INJ1** | 0.258 | 0.278 | | | | | | | | | |
| **INJ2** | 0.412 | 0.413 | 0.875 | | | | | | | | |
| **ATT1** | 0.064 | 0.042 | 0.26 | 0.144 | | | | | | | |
| **ATT2** | 0.161 | 0.171 | 0.192 | 0.187 | 0.806 | | | | | | |
| **ATT3** | 0.154 | 0.176 | 0.196 | 0.183 | 0.878 | 0.762 | | | | | |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **SMK** | -0.629 | -0.731 | -0.398 | -0.537 | -0.257 | -0.283 | -0.338 | | | |
| **DES1** | 0.315 | 0.361 | 0.205 | 0.339 | 0.002 | 0.044 | 0.067 | -0.573 | | |
| **DES2** | 0.209 | 0.228 | 0.2 | 0.249 | 0.006 | 0.039 | 0.028 | -0.418 | 0.783 | |
| **ADS** | -0.04 | -0.003 | 0.195 | 0.079 | 0.224 | 0.14 | 0.162 | -0.049 | -0.079 | -0.068 |

**Abbreviations**: INT, smoking intention; SMK, current smoking behavior; PBC, perceived behavioral control; ADS, anti-smoking advertisement exposure; ATT1–ATT3, attitude indicators; INJ1–INJ2, injunctive norm indicators; DES1–DES2, descriptive norm indicators.

**Note**: Values represent estimated polychoric correlations among ordinal variables from SEM based on the Theory of Planned Behavior. All variables are modeled as ordinal categorical indicators. Matrix is lower-triangular due to symmetry.

*Table 7*: Standardized Factor Loading for Latent Constructs.

| Construct | Indicator | β (Standardized Loading) | S.E. | p-value |
|---|---|---|---|---|
| ATT | att1 | 0.966 | 0.005 | < .05 |
| | att2 | 0.840 | 0.005 | < .05 |
| | att3 | 0.912 | 0.005 | < .05 |
| INJ | inj1 | 0.890 | 0.019 | < .05 |
| | inj2 | 0.985 | 0.021 | < .05 |
| DES | des1 | 0.978 | 0.019 | < .05 |
| | des2 | 0.805 | 0.017 | < .05 |

**Abbreviations**: ATT1–ATT3, attitude indicators; INJ1, INJ2, injunctive norm indicators; DES1, DES2, descriptive norm indicators.

**Note**: All values are standardized factor loadings from confirmatory factor analysis. The *p-values* indicate statistical significance of factor loadings.

*Table 8:* Internal consistency of Measurements/ Scales.

| Construct | CR (Composite Reliability) | AVE (Average Variance Extracted) |
|---|---|---|
| Attitudes | 0.93 | 0.82 |
| Injunctive Norms | 0.94 | 0.59 |

| | | |
|---|---|---|
| Descriptive Norms | 0.89 | 0.53 |

**Note**: Values indicate internal consistency estimates based on confirmatory factor analysis. Composite reliability ≥0.70 and AVE ≥0.50 are commonly considered acceptable thresholds.

*Table 9*: Path Coefficients of TPB with ADS Model

| Path | INT (β) | S.E. | p-value | SMK (β) | S.E. | p-value | ADS (β) | S.E. | p-value |
|---|---|---|---|---|---|---|---|---|---|
| PBC | 0.817 | 0.013 | < .05 | 0.556 | 0.074 | < .05 | - | - | - |
| ATT | 0.193 | 0.021 | < .05 | - | - | - | 0.294 | 0.022 | < .05 |
| INJ | 0.425 | 0.025 | < .05 | - | - | - | 0.356 | 0.025 | < .05 |
| DES | 0.368 | 0.024 | < .05 | - | - | - | 0.170 | 0.029 | < .05 |
| SMK | -1.34 | 0.073 | < .05 | - | - | - | - | - | - |
| ADS | -0.283 | 0.038 | < .05 | - | - | - | - | - | - |

**Abbreviations**: INT, smoking intention; SMK, current smoking behavior; PBC, perceived behavioral control; ADS, anti-smoking advertisement exposure; ATT, attitude indicators; INJ, injunctive norm indicators; DES, descriptive norm indicators.

**Note**: Standardized path coefficients (β), standard errors (S.E.), and *p* values are reported for the TPB model with ADS integration. Each column reflects a separate outcome variable. All paths shown are statistically significant ($p < .05$).

*Table 10:* Path Coefficients of Latent Constructs (ATT, INJ, DES) with Control Variables

| **Predictor** | **ATT (β)** | **S.E.** | ***p*-value** | **INJ (β)** | **S.E.** | ***p*-value** | **DES (β)** | **S.E.** | ***p*-value** |
|---|---|---|---|---|---|---|---|---|---|
| MALE | -0.045 | 0.012 | < .05 | -0.018 | 0.019 | 0.330 | 0.065 | 0.016 | < .05 |
| HISP | -0.040 | 0.012 | 0.001 | -0.039 | 0.019 | 0.045 | 0.024 | 0.016 | 0.126 |
| BLACK | -0.059 | 0.012 | < .05 | 0.048 | 0.019 | 0.013 | 0.095 | 0.017 | < .05 |
| GRADE | 0.129 | 0.012 | < .05 | -0.028 | 0.019 | 0.142 | -0.115 | 0.016 | < .05 |
| PLH | 0.033 | 0.012 | 0.004 | 0.025 | 0.020 | 0.195 | 0.035 | 0.016 | 0.026 |

**Abbreviations:** ATT, attitude; INJ, injunctive norm; DES, descriptive norm; PLH, parent-level harm perception variables; GRADE, grade level; MALE, male; HISP, Hispanic; BLACK, Black or African American race.

**Note:** Standardized path coefficients (β), standard errors (S.E.), and *p* values for associations between control variables and latent constructs are reported. Significant paths are indicated by $p < .05$.

*Table 11:* Path Coefficients of Observed Constructs with Control Variables

| **Predictor** | **INT (β)** | **S.E.** | ***p*-value** | **PBC (β)** | **S.E.** | ***p*-value** | **ADS (β)** | **S.E.** | ***p*-value** | **SMK (β)** | **S.E.** | ***p*-value** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MALE | -0.053 | 0.025 | 0.035 | 0.073 | 0.027 | 0.007 | -0.030 | 0.022 | 0.163 | -0.017 | 0.037 | 0.647 |
| HISP | -0.049 | 0.025 | 0.046 | -0.004 | 0.027 | 0.897 | -0.060 | 0.022 | 0.005 | -0.186 | 0.041 | < .05 |
| BLACK | -0.105 | 0.028 | < .05 | 0.148 | 0.031 | < .05 | -0.071 | 0.021 | 0.001 | -0.052 | 0.042 | 0.209 |
| GRADE | 0.115 | 0.026 | < .05 | -0.066 | 0.027 | 0.016 | -0.004 | 0.022 | 0.866 | 0.200 | 0.039 | < .05 |
| PLH | 0.003 | 0.026 | 0.903 | 0.012 | 0.028 | 0.678 | 0.074 | 0.021 | < .05 | -0.040 | 0.036 | 0.269 |

**Abbreviations:** INT, smoking intention; PBC, perceived behavioral control; ADS, anti-smoking advertisement exposure; SMK, current smoking behavior; PLH, parent-level harm perception variables; GRADE, school grade level; MALE, male gender; HISP, Hispanic ethnicity; BLACK, Black or African American ethnicity.

**Note:** Table reports standardized path coefficients (β), standard errors (S.E.), and *p* values for associations between observed control variables and selected constructs. Bolded *p* values indicate statistical significance ($p < .05$).

*Table 12:* Explained Variance ($R^2$) for Observed and Latent Variables

| **Observed Variables** | **Estimate** | **S.E.** | ***p*-value** |
|---|---|---|---|
| INT | 0.975 | 0.037 | 0.000 |
| PBC | 0.032 | 0.010 | 0.002 |

| | | | |
|---|---|---|---|
| INJ1 | 0.791 | 0.034 | 0.000 |
| INJ2 | 0.970 | 0.041 | 0.000 |
| ATT1 | 0.933 | 0.009 | 0.000 |
| ATT2 | 0.706 | 0.009 | 0.000 |
| ATT3 | 0.832 | 0.010 | 0.000 |
| SMK | 0.928 | 0.065 | 0.000 |
| DES1 | 0.959 | 0.051 | 0.000 |
| DES2 | 0.645 | 0.037 | 0.000 |
| ADS | 0.015 | 0.005 | 0.004 |

| **Latent Variables** | **Estimate** | **S.E.** | ***p*-value** |
|---|---|---|---|
| ATT | 0.118 | 0.013 | 0.000 |
| INJ | 0.133 | 0.018 | 0.000 |
| DES | 0.054 | 0.011 | 0.000 |
| INT | 0.975 | 0.037 | 0.000 |

**Abbreviations:** INT, smoking intention; SMK, current smoking behavior; PBC, perceived behavioral control; ADS, anti-smoking advertisement exposure; ATT1–ATT3, attitude indicators; INJ1–INJ2, injunctive norm indicators; DES1–DES2, descriptive norm indicators; ATT, attitude; INJ, injunctive norm; DES, descriptive norm.

**Note:** Table reports explained variance ($R^2$) estimates, standard errors (S.E.), and two-tailed *p* values. Values are based on structural equation modeling results.

## 2. List of Figures:

*Figure 1:* Theory of Planned Behavior Model

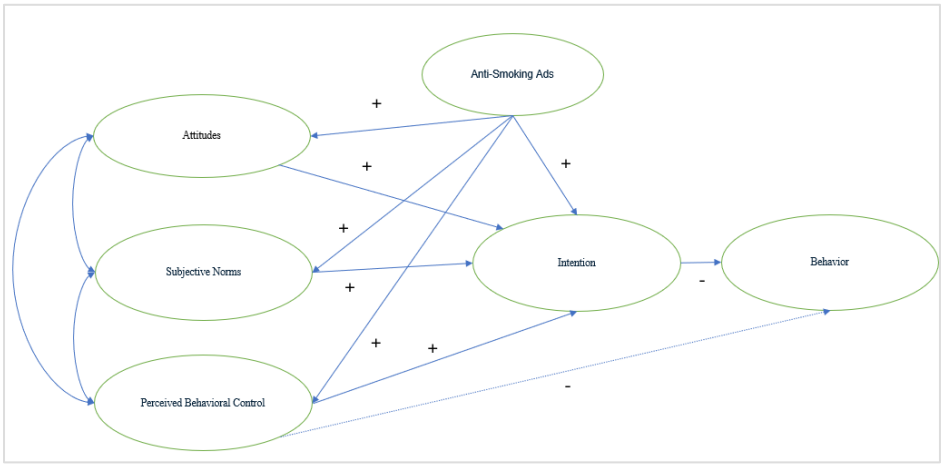



*Figure 2:* Hypothesized Model with Control Measurements

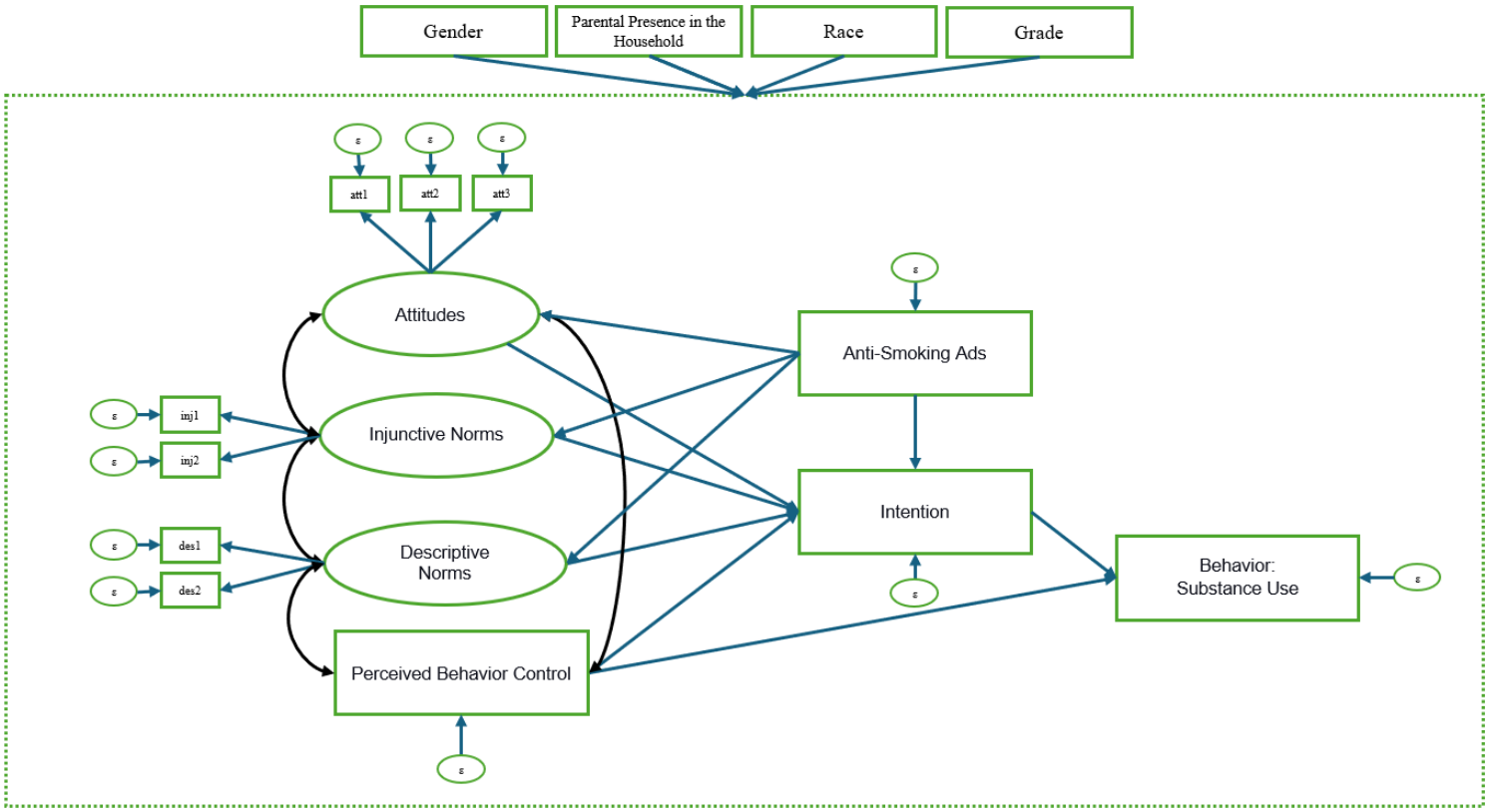



*Figure 3*: Attitudes Construct

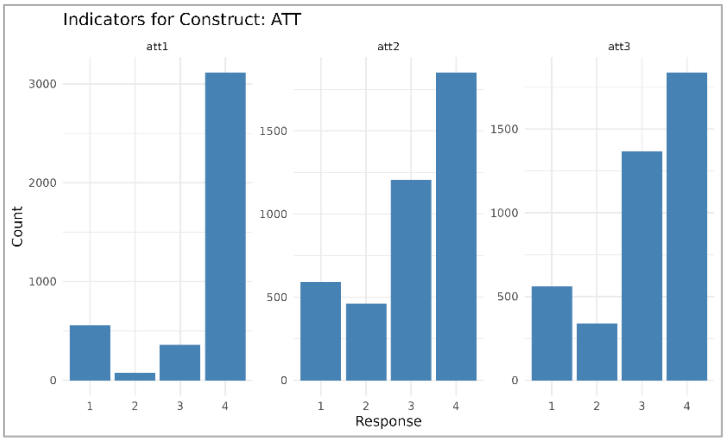



*Figure 4*: Injunctive Norms Construct

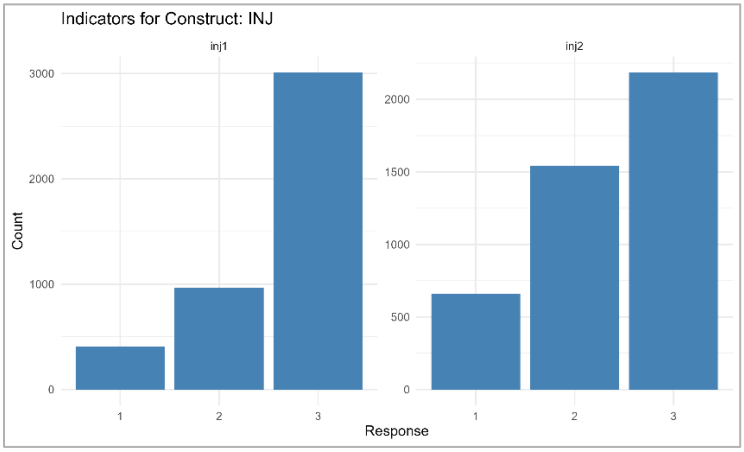



*Figure 5*: Descriptive Norms Construct

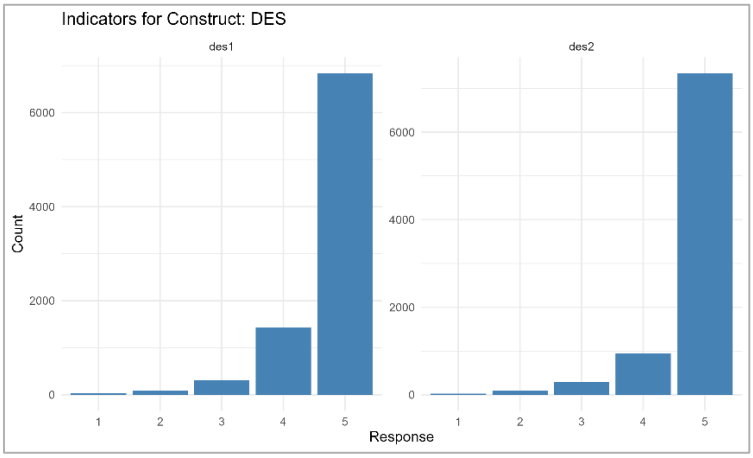



*Figure 6*: Intention Construct

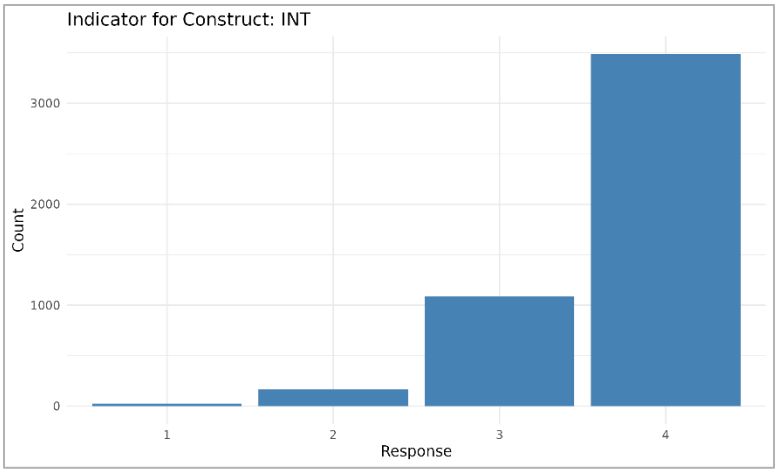



*Figure 7*: Perceived Behavioral Control Construct

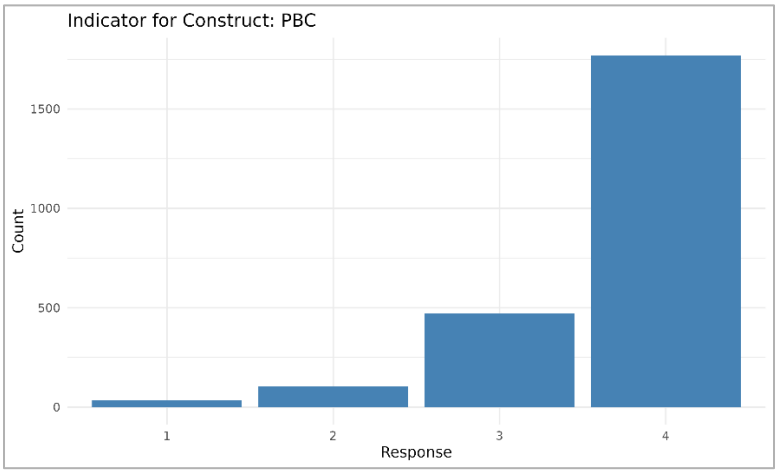



*Figure 8*: Current Smoking Behavior Construct

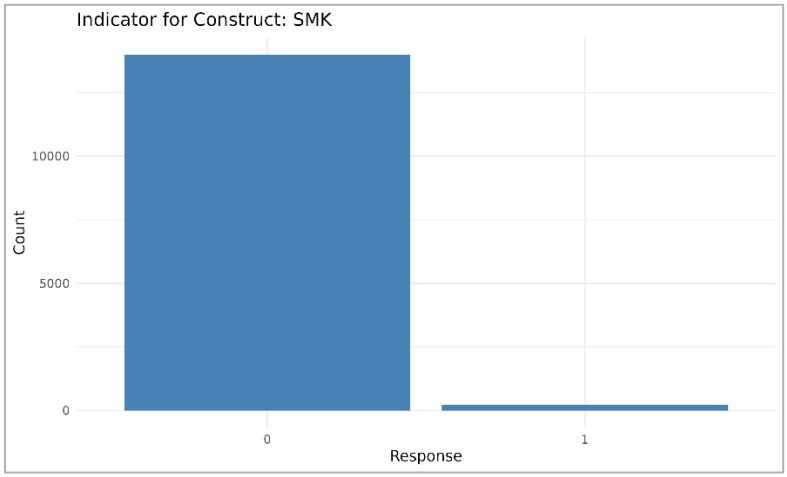
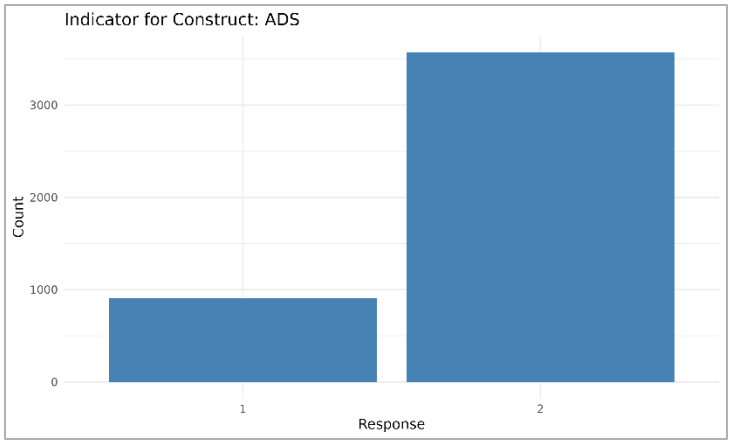



*Figure 9*: Anti-Smoking Ad Exposure Construct


Indicator for Construct: ADS
3000
2000
1000
0
Count
1
2
Response