

Association Between Initial Some Days or Every Day Use of E-cigarettes and Subsequent Regular Cigarette Smoking Among Adults

Red Thaddeus D. Miguel, M.D., M.B.A., M.Sc.¹; Emery L. Ngamasana², M.Sc.; Geoffrey M. Curtin, Ph.D.³; and Mimi M. Kim², PhD

¹Thera-Business; ²RAI Services Company; ³Womble Bond Dickinson

Abstract

AIM: The current analyses examined the gateway theory by measuring the likelihood of becoming an established regular cigarette smoker among established e-cigarette users, compared to those who never used e-cigarettes. At the same time, we addressed several limitations of the current body of evidence including: adjustment for potential confounders; measurement beyond experimental cigarette smoking; and consideration of common liability between e-cigarette and cigarette use.

METHODS: The National Tobacco Use and Transitions Survey (NTTS) dataset was utilized. NTTS is a monthly repeated cross-sectional survey of the U.S. adult population, designed to collect information related to tobacco use behaviors across a broad range of tobacco product categories. Analyses investigated established regular cigarette smoking among established e-cigarette users compared to never e-cigarette users. A case-control design was implemented.

RESULTS: Logistic regression results suggest that established use of e-cigarettes was associated with a lower likelihood of being an established regular cigarette smoker compared to never e-cigarette use (OR: 0.58, 95% CI: 0.55 - 0.62). Results were similar in a fully adjusted model, controlling for age, gender, race, educational attainment, and risk-taking propensity (AOR: 0.62, 95% CI: 0.58 - 0.66).

These findings suggest that e-cigarettes impede rather than promote the transition to established regular cigarette smoking.

Introduction

- Despite evidence supporting the use of e-cigarettes to help smokers transition away from combustible cigarettes, **some believe that e-cigarettes have the potential to cause non-smokers to transition to regular cigarette smoking (gateway theory).**
- The current body of evidence on the gateway theory, however, **lacks appropriate adjustments for potential confounders, frequently applies measures of experimental tobacco use, and does not account for common liability between e-cigarette and cigarette use.**

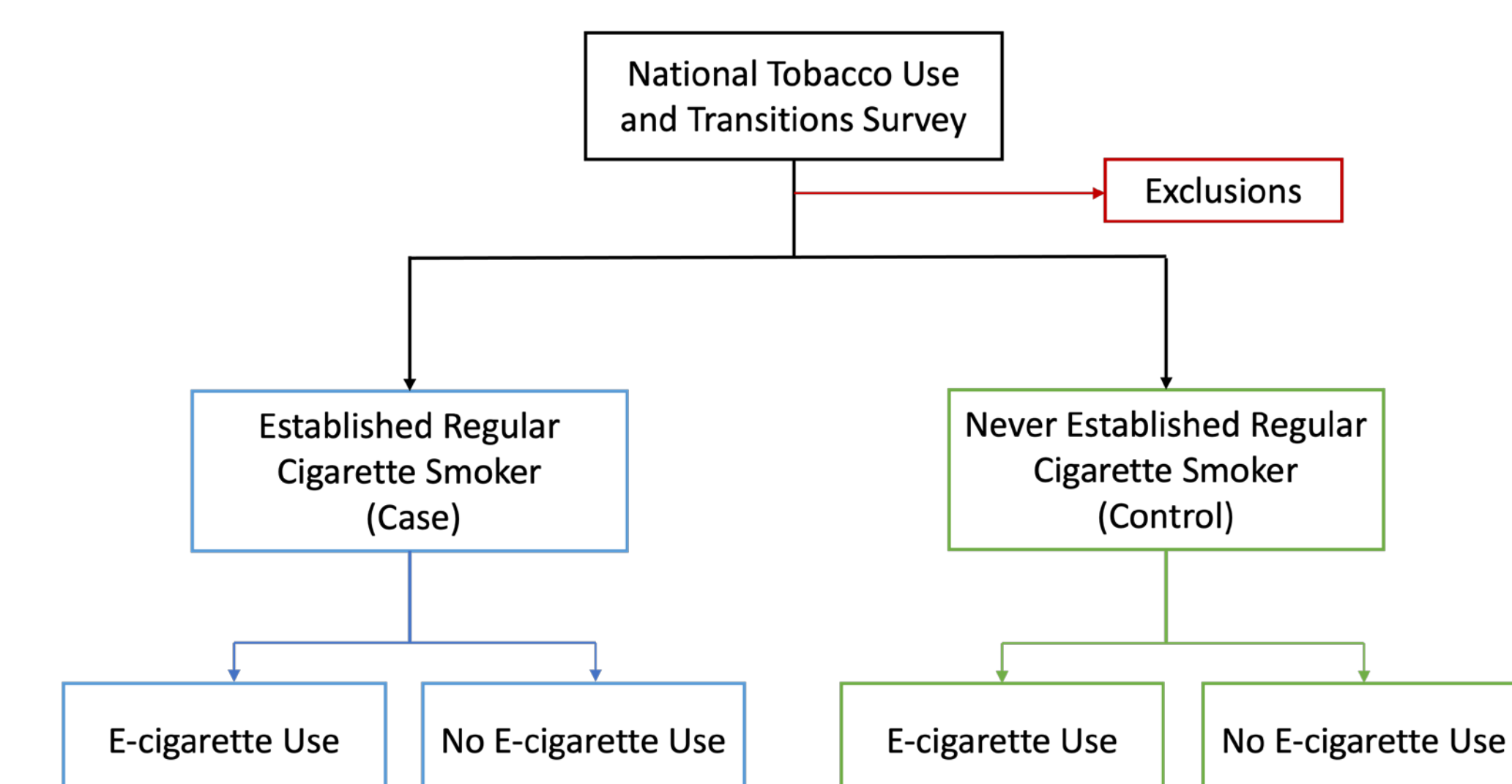
OBJECTIVE: To assess for an association between established regular cigarette smoking and established e-cigarette use compared to never e-cigarette use, while adjusting for key potential confounders.

Methods

DESIGN FRAMEWORK

- The study uses a case-control framework (Figure 1).

Figure 1. Case-Control Study Design Investigating the Outcome of Established Regular Cigarette Smoking between E-cigarette Use and No E-cigarette Use.



DATA SOURCE

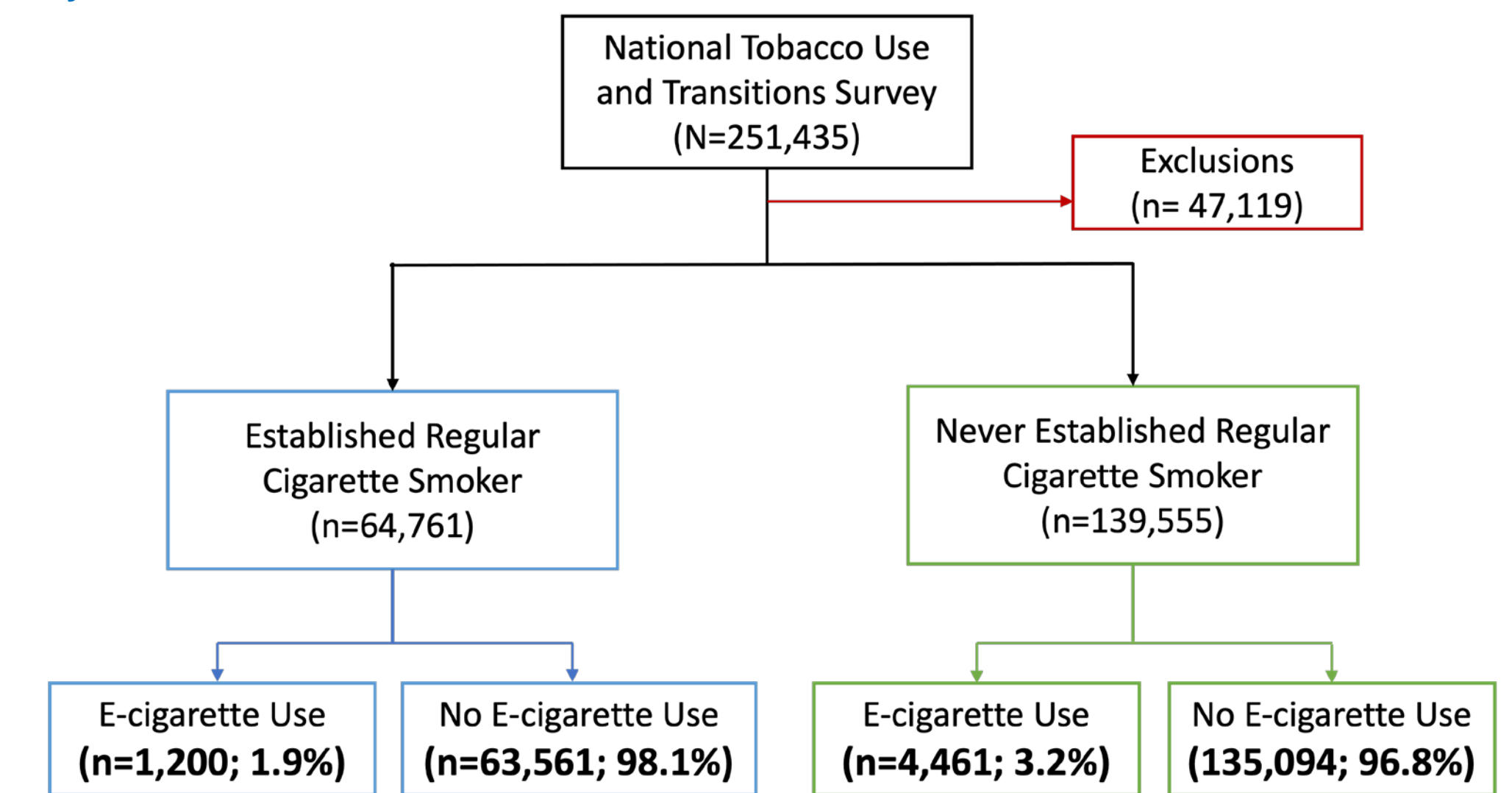
- The NTTS, March 2020 through April 2022 (N=251,435).
- The NTTS is a repeated, cross-sectional, online survey of U.S. adults (21 years and older), who are recruited from research panels and weighted to match U.S. census data.
- Approximately 10,000 respondents are recruited each month for the NTTS.

Participants
251,435

Results

ANALYTIC SAMPLE

Figure 2. Analytic Sample and Percentage of E-cigarette Use and No E-cigarette Use by Case and Control.



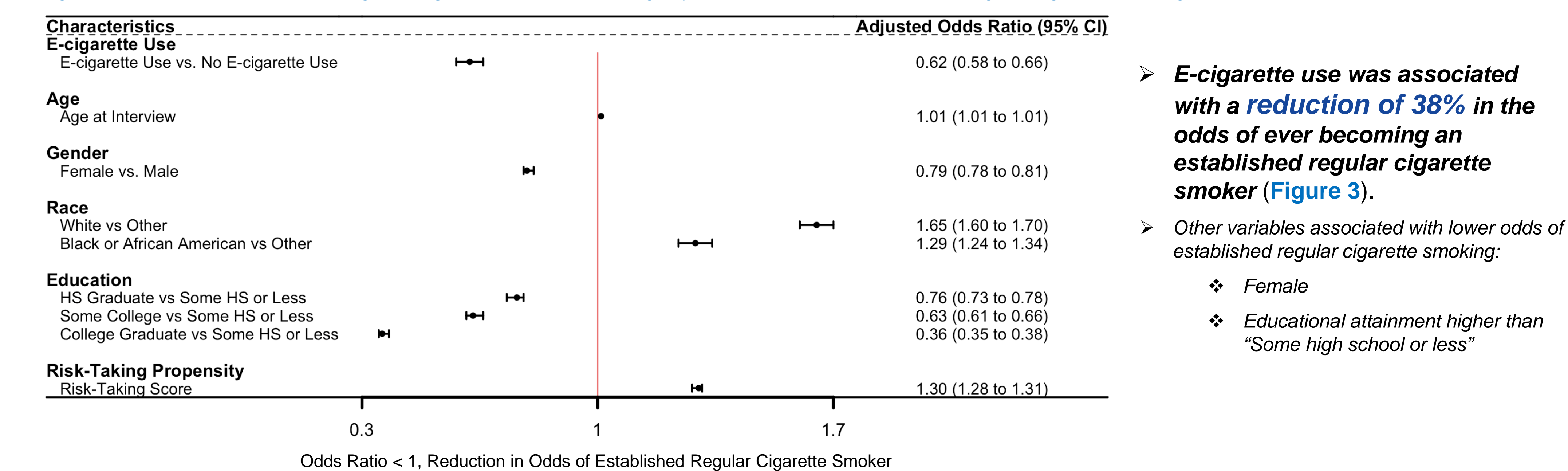
* Frequencies are unweighted counts;
** Weighted percentages are percent of exposed and unexposed groups in either case (established regular cigarette smoker) or control (never established regular cigarette smoker) group.

UNADJUSTED ODDS RATIO

E-cigarette use was associated with a reduction of 42% in the odds of ever becoming an established regular cigarette smoker (odds ratio: 0.58, 95% CI: 0.55 - 0.62).

MULTIVARIATE LOGISTIC REGRESSION MODEL

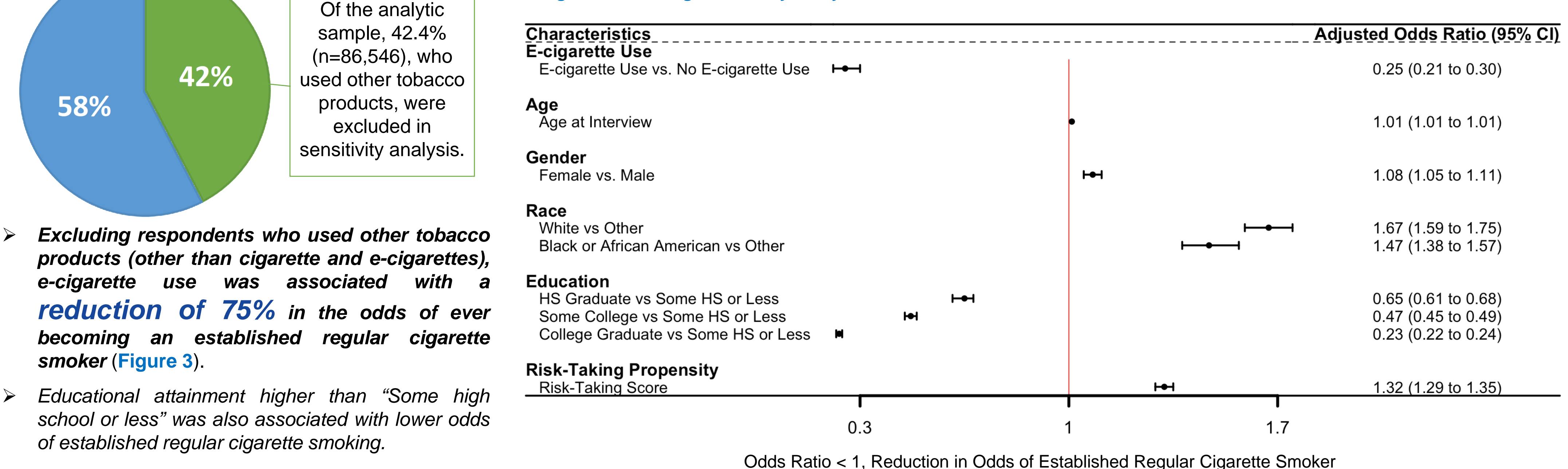
Figure 3. Forest Plot of Multivariate Logistic Regression Model Estimating Adjusted Odds Ratio of Established Regular Cigarette Smoking.



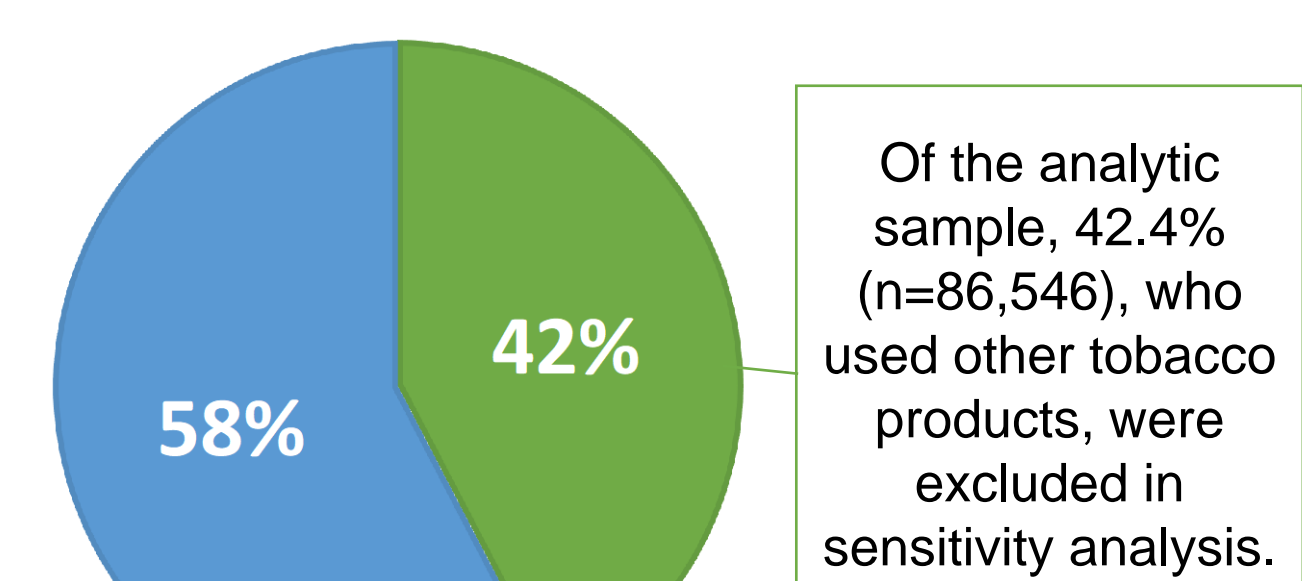
- E-cigarette use was associated with a reduction of 38% in the odds of ever becoming an established regular cigarette smoker (Figure 3).
- Other variables associated with lower odds of established regular cigarette smoking:
 - Female
 - Educational attainment higher than "Some high school or less"

SENSITIVITY ANALYSIS

Figure 4. Forest Plot of Multivariate Logistic Regression Model Estimating Adjusted Odds Ratio of Established Regular Cigarette Smoking, Sensitivity Analysis



- Excluding respondents who used other tobacco products (other than cigarette and e-cigarettes), e-cigarette use was associated with a reduction of 75% in the odds of ever becoming an established regular cigarette smoker (Figure 3).
- Educational attainment higher than "Some high school or less" was also associated with lower odds of established regular cigarette smoking.



SAMPLE CHARACTERISTICS

Characteristic	Case Established Regular Cigarette Smoker	Control Never Established Regular Cigarette Smoker	P-value
Age, mean (SD)	51.0 (16.2)	49.4 (17.2)	<0.0001
Sex, n (%) Male / Female	32,240 (50.6) / 35,521 (49.4)	65,580 (47.6) / 73,975 (52.4)	<0.0001
Race, n (%)			<0.0001
White	51,580 (79.3)	100,979 (72.4)	
Black or African American	7,103 (11.0)	18,039 (12.8)	
Other	6,078 (9.7)	20,537 (14.9)	
Education, n (%)			<0.0001
Some High School or Less	8,182 (13.2)	11,400 (8.8)	
High School Graduate	19,888 (30.3)	34,056 (24.3)	
Some College or Technical School	20,649 (31.4)	40,456 (28.5)	
College Graduate or More	16,042 (25.2)	53,643 (38.4)	
Risk Taking Score (1-4), mean (SD)	2.2 (0.7)	2.0 (0.7)	<0.0001
E-cigarette Use, n (%)	1,200 (1.9)	4,461 (3.2)	<0.0001

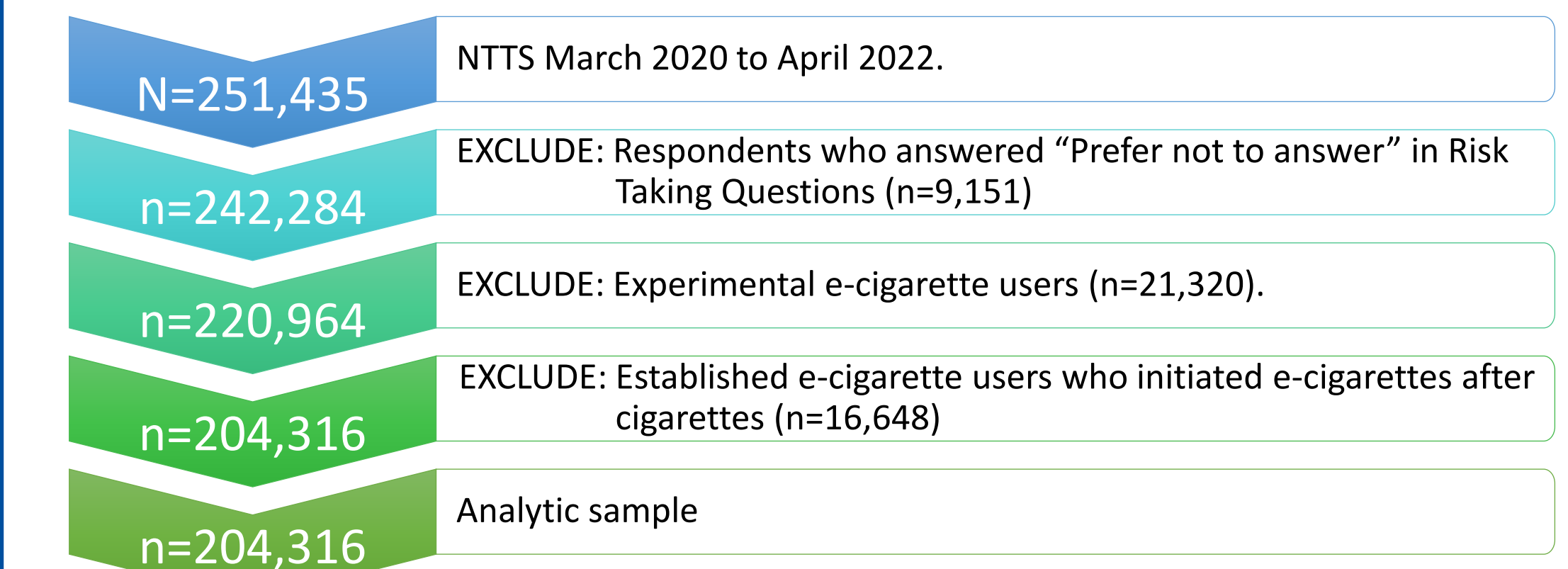
* Frequencies are unweighted counts; Percentages are weighted.

- Never established regular cigarette smokers compared to cases were younger (mean: 49 years; SD: 17 years), had more females (52.4%), had higher percentages of Black or African American (12.8%) and Other (14.9%) race, had a higher percentages of college graduate or more (38.4%), had lower risk-taking scores (mean: 2.0; SD: 0.7), and had higher proportion of e-cigarette use (3.2%).

Methods Cont'd

ANALYTIC SAMPLE

- From the overall NTTS sample, the following parameters excluded respondents from the analysis.



CASE AND CONTROL

Case: Established Regular Cigarette Smoker

- Regular Cigarette Smoker: Yes to, Have you ever considered yourself a regular user of the following product(s)? AND
- Established Cigarette Smoker: Yes to, Have you ever used the following product(s) at least 100 times in your entire life?

Control: No to either Regular Cigarette Smoker or Established Cigarette Smoker.

E-CIGARETTE EXPOSURE

- The e-cigarette users were defined as: (1) established (at least 100 lifetime uses) e-cigarette users who initiated e-cigarettes some days or every day before cigarettes; or (2) established e-cigarette users who were never established on cigarettes.
- Moreover, the non-exposed group, were those that never used e-cigarettes in their life, even once or twice.
- Together, e-cigarette exposure is isolated, and avoids the limitations of previous studies that investigated the gateway theory.

DEPENDENT VARIABLES

- Covariates included in the analysis were age, sex, race, education, and risk-taking propensity.
- Risk-taking propensity was assessed through five Likert-scale type questions (4 levels), and the mean of the questions were used as the risk-taking propensity score after factor analysis confirmed high loading on a single factor across all questions.

STATISTICAL ANALYSIS

- Cases and controls were compared using chi-square statistics for categorical variables and t-test for continuous variables.
- Logistic regression models were used to assess the multivariate associations between regular cigarette smoking and established use of e-cigarette, age, sex, race, education, and risk-taking propensity.

SENSITIVITY ANALYSIS

- A sensitivity analysis was conducted excluding respondents who ever used a tobacco product other than cigarettes or e-cigarettes.

Conclusions

- Never established regular cigarette smokers were younger, and had higher percentages of females, Black or African American and Other race, and college graduate or more.
- Established regular cigarette smokers had higher risk-taking scores but lower proportions of e-cigarette users.
- E-cigarette use when compared to no e-cigarette use showed reduction in the odds of ever becoming an established regular cigarette smokers in unadjusted analysis (OR: 0.58, 95% CI: 0.55 - 0.62), a fully adjusted model (OR: 0.62, 95% CI: 0.58 - 0.66), and in an adjusted model excluding respondents who use other tobacco products (OR: 0.25, 95% CI: 0.21 - 0.30).
- These analyses that address limitations of previous studies on the gateway theory, suggest that e-cigarette use impede rather than promote the transition to established regular cigarette smoking.