Smokeless Tobacco Use and Onset of Cigarette Smoking Among Adolescents: Is There a Causal Relationship?

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Abstract

Background: Background: Smokeless tobacco (ST) use has been associated with subsequent onset of cigarette use (CU) among youth; however it is unclear whether this reflects a causal relationship. The aims of this study are (1) to provide estimates for the relationship between ST use and subsequent cigarette onset using PATH wave 3 data, and (2) to examine this relationship using two different approaches: an instrumental variable (IV) approach to assess the causality of the ST-cigarette relationship and a structural equation modeling (SEM) approach to investigate whether the ST-cigarette association is attributable to a general liability to use tobacco.

Methods: The study population is non-institutionalized civilian adolescents 12-17 years of age living in the United States, sampled in the longitudinal PATH wave 2 and 3 surveys. Information about ever use of a range of tobacco products, including ST and cigarette, was obtained via confidential self-report. Logistic regression, IV analysis, and SEM were used for the analyses. In the IV analyses, "best friends' ST use" was used to instrumentalize the individual's ST use.

Results: Among Wave 2 never cigarette users, ST user were more likely to start CU at wave 3 after adjusting for sex, age, and ethnicity (aOR=4.5, 95% CI=1.5, 12.8 for exclusive ST use; aOR=12.3, 95% CI=5.4, 27.8 for ST plus other tobacco use) compared to never tobacco users. Other tobacco use without ST use was also associated with the onset of CU (aOR=5.7, 95% CI=4.3, 7.7). In contrast, IV analysis shows a null association between ever ST use and CU onset after adjusting for sex, age, and ethnicity (β=0.1, p=0.906). Moreover, results from the SEM show that ST use does not predict the onset of CU (β=0.07; p=0.427) after accounting for the latent "common liability to use tobacco" construct, which is a robust predictor for the onset of cigarette use (β=0.54; p<0.001).

Conclusion: Findings from this study support the notion that the observed association between ST use and subsequent onset of CU does not reflect a causal relationship and is attributed to a general liability to use tobacco products.

Introduction

- Smokeless tobacco and cigarettes are two tobacco products with a long history of use in the US.
- There have been concerns that smokeless tobacco use may increase the risk of cigarette smoking among youth.
- Evidence from the literature is mixed:
  - Smokeless tobacco use has been shown to be prospectively associated with the onset of cigarette smoking among youth (e.g., Tomar, 2003; Soneji et al., 2015).
  - Other studies have shown null associations between smokeless tobacco use and cigarette onset (e.g., O'Connor, 2003; Timberlake et al., 2009).
- In observational studies, unobserved heterogeneity is always a concern for the inference of a causal relationship.
- A potential explanation for the observed association is the common liability theory, where liability denotes a latent (unobservable) quantitative trait that represents an individual's risk of using tobacco products.
- The common liability theory postulates that both smokeless tobacco use and combustible tobacco cigarette use are manifestations of the "liability" to use tobacco products of the individual; once this "common liability" is controlled for, there may be no causal relationship between smokeless tobacco use and cigarette smoking (e.g., Kozlowski & Warner, 2017).

Aims

1. To estimate the relationship between smokeless tobacco use and subsequent cigarette onset among youth;
2. To provide evidence for causal inference using an instrumental variable (IV) approach for the relationship between smokeless tobacco use and cigarette onset;
3. To estimate the prospective relationship between smokeless tobacco use and the onset of cigarette smoking after controlling for a "common liability" to use tobacco using a structural equation modeling approach.

References

1. Soneji S, Sargent JD, Tanski SE, Primack BA. (2015). Associations between initial water pipe tobacco smoking and snus use and subsequent cigarettes moking: results from a longitudinal study of US adolescents and young adults. JAMA Pediatr. 169:129-136.
2. Tomar SL. (2003). Is use of smokeless tobacco a risk factor for cigarette smoking? The U.S. experience. Nicotine Tob Res. 5:561-569.
3. O'Connor RJ, Flaherty BP, Quinio Edwards B, Kozlowski LT. (2003). Regular smokeless tobacco use is not a reliable predictor of smoking onset when psychosocial predictors are included in the model. Nicotine Tob Res. 5:535-543.
4. Kozlowski LT & Warner KE. (2017). Adolescents and e-cigarettes: Objects of concern may appear larger than they are. Drug Alcohol Depend. 174:209-214.
5. PATH Study Public Use Files: User Guide. www.icpsr.umich.edu/icpsrweb/NAHDAP/studies/36498. Accessed 05-Sep-2017.

Methods

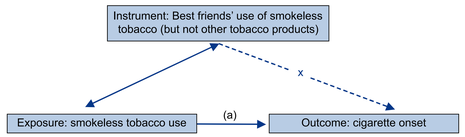
- Study population: non-institutionalized civilian adolescents 12-17 years of age living in the US, sampled in the longitudinal Population Assessment of Tobacco and Health (PATH) study.
- Analytic sample: never cigarette users at wave 2 assessment (n=8,668).
- Assessment: audio computer assisted self-interviews (ACASI), with standardized multi-item modules on use of various tobacco products, including cigarettes, smokeless tobacco, e-cigarettes, cigars, snus, hookah, pipe, dissolvable tobacco, bidis, and kretek.
- Information was also obtained about the number of best friends who use smokeless tobacco, cigarettes, e-cigarettes, and cigars.
- Main predictor of interest: ever use of smokeless tobacco at wave 2, which is defined as using smokeless tobacco (even once) by the time of wave 2 assessment.
- Outcome variable: onset of ever cigarette smoking at wave 3, which is defined as smoking cigarettes (even one or two puffs) for the first time between wave 2 and wave 3 assessments among adolescents who had never smoked cigarettes at wave 2.

Logistic Regression

- Odds ratios were produced for the association between smokeless tobacco use and cigarette onset.
- Estimates were produced for three mutually exclusive groups
  - smokeless tobacco use without ever use of any other tobacco products (i.e., exclusive smokeless);
  - smokeless tobacco use with ever use of at least one other tobacco product (smokeless + other tobacco);
  - ever use of any other tobacco product except for smokeless tobacco (other tobacco, no smokeless).
- Covariates included being male, age, race/ethnicity, parental education (≥bachelor's degree or not), ever alcohol drinking, living with tobacco users, noticing health warnings, and having a favorite tobacco advertisement.

Instrumental Variable Analysis

- Having at least one friend who used smokeless tobacco, but no other tobacco products, at wave 2 served as the instrumental variable for smokeless tobacco use.
- Participants who had friend(s) who used other tobacco products were excluded from the instrumental variable analysis.
- Male, age, and race/ethnicity were included as covariates.
- If the estimate for smokeless tobacco use (a) is not statistically significant, there is a lack of evidence for a causal relationship.
- Estimates from instrumental variable analysis will be compared with those from logistic regression.



Latent Variable Analysis

- Measurement model for a latent construct for the common liability to use tobacco products using confirmatory factor analysis methods.
- Observed variables for the latent construct: lifetime ever use of tobacco products assessed in PATH wave 2 youth survey.
- Structural equation model with
  - a path from the latent construct to the onset of first cigarette smoking
  - and a direct path from smokeless tobacco ever use to the onset of first cigarette smoking.
- If the direct path from smokeless tobacco use to cigarette smoking is statistically robust, it provides evidence that smokeless tobacco plays a role for cigarette smoking onset over and beyond the common liability to use tobacco products. If not, it suggests that the observed association between smokeless tobacco use and smoking is attributed to a common liability to use tobacco products.
- Fit indices: root mean square of approximation (RMSEA), comparative fit index (CFI), and Tucker-Lewis index (TLI).
- Analysis weights were used to adjust for selection probability, nonresponse patterns, possible deficiencies in the sampling frame, and attrition. Balanced repeated replication method was used to generate standard errors and 95% confidence intervals (CI).
- Analyses were conducted using Stata 15.0 (StataCorp, College Station, TX, USA) and Mplus 8.1 (Muthén & Muthén, Los Angeles, CA, USA).

Results

Incidence of smoking by baseline ST use status and estimated associations between ST use and smoking onset

TABLE 1. Incidence of cigarette smoking at W3 among never smokers at W2. Data from Population Assessment of Tobacco and Health wave 2 and 3, 2014-2016 (n=8,442)

	Incidence of cigarette smoking[1]				
	n	% (95% CI)	OR (95% CI)	aOR (95% CI)[3]	aOR (95% CI)[4]
Exclusive ST	58	11.9 (5.4,24.2)	**6.0 (2.3, 15.5)**	**4.5 (1.5, 12.8)**	2.8 (0.9, 9.2)
ST+ other tobacco	54	26.2 (14.7,42.2)	**15.7 (7.5, 33.2)**	**12.3 (5.4, 27.8)**	**6.4 (2.6, 16.1)**
Other tobacco, no ST	840	12.1 (9.8,14.8)	**6.1 (4.6, 8.1)**	**5.7 (4.3, 7.7)**	**3.6 (2.5, 5.2)**
No tobacco	7490	2.2 (1.9, 2.6)	Reference	Reference	Reference

[1] Number of new ever smokers at wave 3 divided by the number of never smokers at wave 2.
[2] Number of new ever smokers who smoked during the prior 30 days at wave 3 divided by the number of never smokers at wave 2.
[3] Odds ratios adjusted for sex, age (12-14 vs. 15-17), and race/ethnicity (only).
[4] Odds ratios adjusted for sex, age (12-14 vs. 15-17), race/ethnicity (3-categories for white only, black only, and others), parental education (>=bachelor degree or not), ever alcohol drinking, living with tobacco users, noticing health warnings, having a favorite tobacco advertisement.
Bold font indicates statistical significance at 0.05 level.

ST: smokeless tobacco.
Other tobacco products include cigars, hookah, pipe, bidi, kretek, snus, dissolvable tobacco, and e-vapor products.

ST use is positively associated with the onset of cigarette smoking. The association between exclusive ST use and cigarette onset became borderline significant when adjusting for other psychosocial variables studied.

Results from instrumental variable analysis for the relationship linking baseline ST use status with smoking onset and comparison with estimates from logistic regression

TABLE 2. Association between smokeless tobacco use and incidence of cigarette smoking using instrumental variable analysis. Data from Population Assessment of Tobacco and Health wave 2 and 3, 2014-2016 (n=6,183)

	Instrumental Variable Analysis		Logistic regression	
	Smokeless		Smokeless	
	β (95% CI)	p	β (95% CI)	p
Bivariate	**2.6 (0.4, 4.9)**	**0.022**	**2.0 (1.4, 2.5)**	**<0.001**
Adjusting for sex and age	1.0 (-1.8, 3.9)	0.477	**1.8 (1.2, 2.4)**	**<0.001**
Adjusting for sex, age, and being White	0.1 (-2.1, 2.4)	0.906	**1.6 (1.0, 2.3)**	**<0.001**
Adjusting for sex, age, and being White, and best friend's use of smokeless tobacco			**1.6 (0.3, 2.9)**	**0.020**

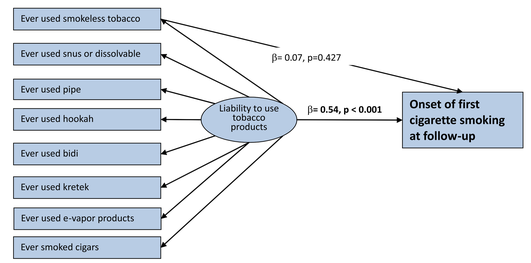
[1] Number of new ever smokers at wave 3 divided by the number of never smokers at wave 2.
Bold font indicates statistical significance at 0.05 level.

Instrumental variable anlaysis produced a null estimated causal relationship between baseline ST use and cigarette onset at follow-up after adjusting for sex, age, and race/ethnicity.

Best friends' use of smokeless tobacco is robustly associated with the participant's use of smokeless tobacco in all three models (beta=0.9, p<0.001 for the bivariate model; beta=0.8, p=0.006 for the sex-and-age adjusted model; and beta=0.6, p=0.013 for the sex-age-race/ethnicity adjusted model.)

Results from structural equation modeling

Depiction of a structural equation model to predict the onset of first cigarette smoking by smokeless tobacco use adjusting for a latent "liability to use tobacco" construct. Data from PATH wave 2 and wave 3 youth survey (n=8,668).



X2 (df=19)= 42.359
RMSEA (90% CI) = 0.012 (0.007, 0.017)
CFI = 0.982; TLI = 0.973

- **The measurement model fits data reasonably well (RMSEA=0.014, 90% CI=0.008, 0.019; CFI=0.979; TLI=0.968).**
- The latent "liability to use tobacco products" construct is a robust predictor of smoking onset. After accounting for the latent construct, ST use does not predict smoking onset.
- Including sex, age, and race/ethnicity as covariates introduced little change in estimates, and statistical inference remained the same
  - β=0.04; p=0.731; for the smokeless tobacco to cigarette onset path
  - β=0.57; p<0.001; for the "liability to use tobacco" latent construct to cigarette onset path

Limitations & Strengths

Limitations

- Observational study. Unobserved confounders are possible.
- The assessment was based on self-report information.
- The response level at the household screening is moderate.

Strengths

- Prospective design.
- Focus on the incidence of cigarette use without any interference of the persistence process.
- By using nationally representative data, our results are generalizable to the general US adolescent population.
- Use of ACASI and relatively low attrition enhances internal validity by reducing potential socially desirable responding and bias associated with attrition.
- Instrumental variable analysis provides more robust evidence for causal inference.
- Latent variable approach is
  - theory driven;
  - capable of appropriately handling inter-correlated observed variables which can be manifestations of a latent construct;
  - evaluates the fitness of model.

Conclusion

Findings from this study support the notion that the observed association between smokeless tobacco use and subsequent onset of cigarette use does not reflect a causal relationship and is attributed to a general liability to use tobacco products.