Association of Risk Perceptions and Behavioral Intentions with Use of Electronic Nicotine Delivery Systems among Adult Smokers

Introduction

- The adverse health consequences of cigarette smoking are primarily caused by exposure to the toxic chemicals produced by the combustion of tobacco^{1,2}
- Electronic nicotine delivery systems (ENDS) do not burn tobacco: US and international regulatory agencies and public health organizations recognize that nicotine-delivery products exist on a continuum of risk, with combustible cigarettes presenting the highest risk and ENDS at the lower end of the risk spectrum, above nicotine replacement therapies¹⁻⁶
- Despite this consensus, the proportion of US adults that perceive ENDS to be at least as harmful as cigarettes has increased in recent years to over 70%⁷⁻¹⁰
- Observational research demonstrates that smokers who perceive ENDS to be less harmful than cigarettes have greater odds of subsequently initiating use of ENDS^{11,12}
- Experimental evidence suggest that changes in risk perceptions may be one mechanism through which smokers decide to adopt ENDS,¹³ and dual users (smokers who concurrently use ENDS) who perceive ENDS to be less harmful than cigarettes are more likely to switch from smoking to exclusive ENDS use¹⁴
- Behavioral intentions are a key construct in theories of health behavior: the Theory of Planned Behavior posits that behavioral intentions are a proximal determinant of behavior,^{15,16} and can also serve as useful predictors of later behavior
- Experimental studies suggest that risk perceptions influence both behavioral intentions and subsequent behavior,¹⁷ however there is little longitudinal data assessing mechanisms through which risk perceptions may influence ENDS use by adult smokers
- The primary aim of the current analysis was to prospectively assess the association between adult smokers' relative risk perceptions and their subsequent adoption of ENDS, and to document whether the association is mediated by behavioral intentions to use ENDS.

Results

- Sample of ENDS-naïve adult smokers (N=171)
- Mean age=47.3 years
- 39.2% male
- Cigarettes/day, mean=12.7
- Perceiving ENDS as less harmful than cigarettes was associated with behavioral intentions to use ENDS (B=0.42; p=0.001; **Table 1**)
- Behavioral intentions to use ENDS were significantly associated with subsequent use of ENDS (OR=2.95; p<0.001; **Table 1**)
- There was no direct association between risk perceptions and use of ENDS (OR=1.00; p=0.99; **Table 1**)
- However, there was a significant indirect effect: smokers who perceived ENDS to be less harmful than cigarettes (vs. those who perceived ENDS to be at least as harmful as cigarettes) had 1.57 greater odds (Bootstrap 95% CI = 1.14, 2.55; **Table 1**) of subsequently adopting ENDS, as a result of the effect of risk perceptions on behavioral intentions, which, in turn, led to greater odds of using ENDS.
- 35% reported no intentions to try ENDS (mean composite score =1)
- Expressing any intention (vs. no intention) to try ENDS was significantly associated with 2.75 times greater odds (OR [95% CI] = 2.75 [1.20, 6.31]) of subsequently adopting ENDS

Juul Labs Science

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Methods

Participants

- A sample of US adults over the age of 18 (N=10,031) was recruited by *Qualtrics* (http://www.qualtrics.com) via Facebook.¹⁸
- Participants were invited to complete follow-up assessments 3, 6, 9 and 12 months after baseline. All surveys were completed online.
- Analytic sample ENDS-naive smokers eligibility criteria:
 - I. ≥21 years of age
- 2. Established smoker at baseline (smoked ≥100 cigarettes in lifetime, now smoke "every day" or "some days, smoked in the past 30 days).
- 3. Reported never having used ENDS at baseline
- 4. Had valid data for risk perceptions and behavioral intentions at baseline and for ENDS use at follow-up

Measures

- Adoption of ENDS across Follow-Up Past 3-month ENDS use was assessed at the 3-, 6-, 9- and 12-month follow-up assessments; a composite variable capturing any ENDS use over the 12-month follow-up (yes/no) served as the dependent variable
- Relative Risk Perceptions at baseline direct relative risk perceptions of ENDS (vs. cigarettes) were assessed with the item, "Do you believe using e-cigarettes is less harmful, equally harmful, or more harmful than smoking cigarettes?"¹⁹ with three response options:
- . "e-cigarettes are less harmful than smoking cigarettes"
- 2. "e-cigarettes are equally harmful as smoking cigarettes"
- 3. "e-cigarettes are more harmful than smoking cigarettes"

Risk Perception → Behavioral Intention Mediator (A path) ^a	Behavioral Intention Mediator → Adoption of ENDS Outcome (B path) ^b	Direct
0.42 **	2.95 ⁺	1.0



- Behavioral Intentions to Use ENDS Three widely-used and well-validated items assessed intentions to use ENDS²⁰⁻²⁴
- 1. "Have you ever been curious about using an e-cigarette?"
- 2. "Do you think you will use an e-cigarette in the next year?"
- 3. "If one of your best friends were to offer you an e-cigarette, would you try it?"
- All items were answered on four-point response scales ("Not at all curious" to "Very curious" or "Definitely not" to "Definitely yes"); calculated with higher scores indicating greater intentions to use an average intention score was ENDS (Range: 1-4).

Statistical Analysis

- A mediational model (Figure 1) that analyzed intentions continuosly used logistic regression to assess:
- . Association of risk perceptions and behavioral intentions ('a' path)
- 2. Association of behavioral intentions and adoption of ENDS adjusting for risk perceptions ('b' path)
- 3. Association of risk perceptions and adoption of ENDS that is accounted for via the behavioral intentions mediator ('indirect [mediated] effect')
- 4. Association of risk perceptions on adoption of ENDS after statistically adjusting for the behavioral intentions mediator ('direct effect' that is not accounted for by the mediator).
- In a separate model, behavioral intentions to try ENDS was also dichotomized (no interest vs. any interest, consistent with how "susceptibility to smoking²⁰ is analyzed) served as the independent variable in logistic regression

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Conclusions

- The results of this longitudinal observational study concord with and extend previous research assessing prospective associations between risk perceptions and behavioral intentions with adoption of ENDS
- The effect of risk perceptions on use of ENDS was not direct, but mediated by intent to use ENDS: specifically, adult ENDS-naïve smokers who perceived ENDS as carrying lower (vs. equal or higher) risk than cigarettes had higher behavioral intentions to use ENDS, which in turn lead to a higher likelihood of subsequently using ENDS
- These findings may elucidate psychological mechanisms through which smokers decide to adopt ENDS and may inform public health and regulatory strategies to reduce morbidity and mortality among smokers
- Accurate perceptions of the relative risk of ENDS compared to cigarettes are critical in facilitating smokers switching away from cigarettes and advancing tobacco harm reduction.

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