Harm Perceptions of Secondhand Aerosol Exposure and Opinions About Acceptability and ECIG Use Inside of Vehicles Among ECIG Users

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March 2021

Abstract

Significance: Limited research has examined electronic cigarette (ECIG) secondhand aerosol (SHA) exposure. Initial research shows ECIG SHA exposure may be associated with negative health effects, but many ECIG users associate little harm with SHA exposure and may be more likely to engage in ECIG use in indoor settings, such as inside of vehicles. This study's purpose was to examine the association between harm perceptions of ECIG SHA and ECIG use inside of vehicles behaviors and perceptions.

Methods: Current (past 30-day) adult ECIG users in the US (n=1002; mean age=32.8; 50.4% women) completed an online survey examining harm perceptions of ECIG SHA ("no harm", "little harm", "some harm", "a lot of harm"), opinions about acceptability of ECIG use inside of vehicles in the presence of others("always allowed" or "be allowed under some conditions", "never be allowed"), and ECIG use behaviors inside of vehicles ("always", "sometimes", "rarely", "never"). Descriptive statistics and chi-square tests were conducted to examine associations between variables.

Results: Most participants (78.3%) who owned a vehicle reported ECIG use inside their vehicle "almost always" or "sometimes." Participants perceived ECIG SHA exposure was associated with "little harm" (34.6%) or "some harm" (36.5%), and few (8.6%) associated "a lot of harm." Over three-quarters (79.2%) reported ECIG use inside vehicles when adults were present and 36.6% reported ECIG use when children were present. Most (89.5%) stated that ECIG use should be allowed in the presence of other adults and 39.9% reported ECIG use should be allowed with children present. ECIG users who associated no or little harm with ECIG SHA exposure were more likely to report ECIG use inside of vehicles, ECIG use inside of vehicles

when adults or children were present, and to perceive ECIG use inside of vehicles when adults or children were present was acceptable (*p*s<0.05).

Conclusion: In this study, lower harm perception of ECIG SHA exposure was associated with increased ECIG use inside of vehicles. Future research should assess the impact of increasing harm perceptions of SHA on indoor ECIG use behaviors.

Introduction

Electronic Cigarette (ECIG) Overview

Since their introduction to the US market in 2006, the use of electronic cigarettes (ECIGs) has been increasing from 2.4% of 18-24 ECIG users in 2012 to 7.6% in 2018 (Truth Initiative, 2021). ECIGs are battery-operated devices that allow users to inhale nicotine, flavorings, and other chemicals (Breland et al., 2016). While ECIGs may come in various shapes and sizes, they all function using the same fundamental principles. ECIGs usually work when a person puffs on the device or presses a button which activates the battery powered device to aerosolize the ECIG liquid for user inhalation (NIH, 2021).

Secondhand ECIG Aerosol

Like traditional cigarettes, ECIGs produce secondhand emissions in the form of secondhand aerosol. Secondhand aerosol is made up of chemicals that are released from ECIGs in the form of solid and liquid particulate matter suspended in air (Haggart et al., 2021). There are many different chemicals that are released in the aerosol. Some common chemicals found across ECIGs include organic volatile compounds, aldehydes, acetone, acrolein, carcinogenic nitrosamines, polycyclic aromatic hydrocarbons, and heavy metals (Dinardo & Rome, 2019). Some heavy metals, such as chromium, cadmium, nickel, and lead, are sometimes found in higher concentrations in secondhand aerosol from ECIGs than in secondhand smoke from conventional cigarettes (Dinardo & Rome, 2019).

Harm Perceptions of ECIGs

Harm perceptions are how people perceive the relative harm of an action or object. Some studies have examined harm perceptions in surveys and have found harm perceptions to be predictive of ECIG use (O'Brien et al., 2021). For example, an online survey of 1,642 U.S. adults

that used 21 unique measures of ECIG harm perceptions found that ECIG harm perceptions were negatively associated with current ECIG use, ECIG use intentions, skepticism about ECIG harms; and positively associated with perceptions that ECIG use is equally or more harmful than cigarette smoking (O'Brien et al., 2021). However, few studies have focused on measuring harm perception of secondhand aerosol exposure. Of the few studies that have examined secondhand ECIG aerosol harm perceptions, most suggest people associate low harm with secondhand ECIG aerosol. In-depth semi-structured interviews of 39 ENDS users in New Zealand showed that many ECIG users believed that secondhand aerosol is just water vapor and nicotine, which can influence their behavior when using ECIGs (Haggart et al., 2021). This study further showed that less than half of the youth sampled expressed that ECIGs are harmful to their health (Haggart et al., 2021). The underemphasis of the harm of secondhand aerosol may encourage ECIG users to engage in ECIG use around children and other adults in indoor spaces such as in vehicles. Another study that surveyed over 22,000 teenage participants reported that ECIG users were less likely to report that aerosol from others' ECIGs were harmful relative to never ECIG users (Bernat et al., 2018). Thus, research suggests that many adults and youth believe secondhand aerosol to be associated with low harm.

Health Effects of ECIG Use

Lower harm perceptions of secondhand ECIG aerosol may also be due to a lack of knowledge regarding chemicals present in ECIG aerosol. Chemicals found in ECIG aerosol can affect ECIG user's health. ECIG use may negatively affect the brain by introducing nicotine into the bloodstream from the lungs (NIH, 2021). Due to the presence of nicotine, the body releases epinephrine which has a wide variety of effects which range from increasing blood pressure to heart rate. The brain continues to reinforce this behavior by releasing dopamine which causes

addiction (NIH, 2021). Another harm from vaping ECIGs include myocardial infarction. Data from the National Health Interview Surveys of 2014 (n=36,697) and 2016 (n=33,028) examining frequency of ECIG use, cigarette use, and myocardial infarction indicates a positive association between daily independent ECIG use and increased odds of having a myocardial infarction (Alzahrani et al., 2018). While other factors such as smoking conventional cigarettes have influenced this, daily ECIG use has been identified to increase the odd of having had myocardial infarction (Alzahrani et al., 2018).

ECIGs have also been associated with pulmonary problems. Aerosol from ECIGs have been shown to affect regular lung function. A study in which rats were exposed to ECIG aerosol found that exposure to ECIG aerosol was associated with decrements in parenchymal lung function (Larcombe et al., 2017). That is, mice exposed to ECIG aerosol had a decreased gas exchange rate in the alveolus of the lungs. This decreased gas exchange rate indicates that ECIG aerosol impairs lung function in early adolescence and young adulthood. While this study is limited to the effect on mice due to primary ECIG exposure, this study represents the potential effects on humans as well.

ECIG use can also cause oral and systemic problems. Oral problems may range from periodontal disease to oral lacerations and avulsions due to ECIG explosions. Systemic conditions can range from reduced control of attention and impulse to with electronic-cigarette or vaping product use-associated lung injury (EVALI) (Almeida-da-Silva et al., 2021). Particularly ECIGs containing tetrahydrocannabinol (THC) liquid with vitamin E acetate were shown to be associated with EVALI (CDC, 2021; Blount et al., 2020). Over 2,807 hospitalizations and deaths since 2019 have been determined to be due to EVALI (Almeida-da-Silva et al., 2021). Other research has corroborated the association between EVALI and vitamin

E acetate. BAL fluids were collected from 51 patients with EVALI and were subjected to isotope dilution mass spectrometry to measure several priority toxicants (Blount et al., 2020). Results identified that 48 out of 51 case patients had vitamin E acetate and that 47 of 50 had detectable THC or were known to have vaped THC products (Blount et al., 2020). Chemicals in non-THC liquids are also known to cause negative health consequences. Other findings by Delaware Health and Social Services show that other chemicals, such as acetone, found in secondhand aerosol cause health problems. Particularly acetone can cause headaches, dizziness, confusion, a faster pulse, nausea, vomiting, possible coma, and a shorter menstrual cycle in women (DHS, 2015). In addition, findings regarding maternal secondhand aerosol exposure using a pregnant mouse model showed other chemicals such as NNK, volatile carbonyl compounds, and toxic metals cause global DNA methylation alterations in 13 key chromatin enzymes which led to offspring that showed cognitive changes such as short-term memory deficits, anxiety, and hyperactivity (Yan et al. 2021, Nguyen et al., 2018).

Health Effects of Secondhand Aerosol Exposure to Non-ECIG Users

Negative health effects are not only limited to ECIG users, but to non-ECIG users due to secondhand aerosol. Traditional cigarette secondhand smoke is widely known to cause lung problems. However, studies examining the impacts of secondhand ECIG aerosol have shown that non-ECIG users exposed to secondhand aerosol have a higher prevalence of upper and lower respiratory tract symptoms and infections (Logue et al., 2017; Poulianiti et al., 2016; Ratajczak et al., 2018). Secondhand aerosol from ECIGs is also associated with harms for children. Children may experience increased risk of respiratory symptoms; ear, nose, and throat problems; and sleep-disordered breathing (Almeida-da-Silva et al., 2021). Another harm associated with ECIG secondhand aerosol exposure is asthma symptoms. Multiple cross-sectional studies have shown a

positive association between active and passive ECIG exposure and asthma or asthma symptoms in adolescents (Alnajem et al., 2020; Kim et al., 2017). For example, a school-based survey of 1,565 high school students in Kuwait which examined the association between exposure to secondhand aerosol and the presence and severity of asthma symptoms found that frequent exposure to household SHA was associated with current wheezing, current asthma, and current uncontrolled asthma symptoms. Another cross-sectional study in Korea showed that the association between secondhand ECIG exposure and asthma symptoms ranged across adolescents all around the world and is not limited to ECIG exposure effects in one specific country (Kim et al, 2017). While other factors may influence the results in a cross-sectional study, common results are found in similar studies in different countries.

ECIG Secondhand Aerosol Levels in Enclosed Spaces

ECIG use in enclosed spaces drastically increases the amount of ECIG aerosol concentrations that bystanders may be exposed to. Research demonstrates that ECIG use in indoor settings have a measurable impact on indoor air quality (Soule et al., 2017; Son et al., 2020). This is important to note as many ECIG users do not consider the impact ECIG use in enclosed spaces may have on others. One study showed that when comparing a room where active ECIG use occurred and another where no ECIG use occurred, the room with active ECIG use showed that fine particulate matter (PM) increased from 125 times to upwards of 330 times (Soule et al., 2017). Other studies have also corroborated the findings that ECIG aerosol increases PM levels in indoor setting especially with poor ventilation. A study done in New Jersey, also indicated $PM_{2.5}$ (PM 2.5 micrometers or less in diameter) levels increased by 21 times in indoor spaces such as vape shops (Son et al., 2020). $PM_{2.5}$ particles in the air that reduce visibility and are a concern for people's health when levels in air are high (Department of Health,

2018). In addition, the study showed that thirdhand exposures induced by ECIG use are comparable or higher than that induced by cigarette smoking (Son et al., 2020). Thirdhand exposure is aerosol that stays on surfaces and causes passive exposure to others. Enclosed spaces where ECIG use may occur not only include designated vaping rooms and shops, but also common places such as homes and personal vehicles. The lack of knowledge regarding the potential harms of exposure to ECIG secondhand aerosol also reinforces the idea of many ECIG users to mistakenly believe that ECIGs are safer than traditional cigarettes leading to ECIG use around others in enclosed spaces such as homes and cars.

ECIG in homes may increase the risk of negative health effects for exposed children, but research suggests many may not be concerned about the risks to others from indoor ECIG use. One study of parents who completed a self-administered paper survey during an office visit to determine the attitude towards ECIG use and the awareness of different risks associated with ECIG use with children showed that ECIG use occurred in 1 in 8 homes and most parents were unaware of health risks such as nicotine poisoning for children when vaping around children and not properly storing their ECIG liquids (Garbutt et al., 2015). Other research also demonstrates that ECIG use in homes is becoming increasingly common compared to cigarette smokers. One study performed a secondary analysis of 2017 parental interview data to examine the difference between smoke-free and vape-free home polices across ECIG users, cigarette smokers, and dual users (Drehmer et al., 2019). Dual users of ECIGs and cigarettes were more likely to have smoke-free policies than vape-free policies in their homes and cars. Dual users were also less likely than cigarette-only smokers to implement child protective measures in their homes and cars (Drehmer et al., 2019). Another study that used secondary data from the Population Assessment of Tobacco and Health (PATH) Study (Li et al., 2020). found that current ECIG

users who were once smokers or are currently dual users are less likely to have vape-free policies at home. In addition, only ECIG users were more likely to allow ECIG use in their homes compared to cigarette users (Li et al., 2020). While some ECIG users have voluntarily adopted vape-free homes as shown in a Minnesota study (Helgertz et al., 2020). Results show that most ECIG users will choose to still allow ECIG use in their houses even in the presence of children (Helgertz et al., 2020). Together, these data suggest that ECIG use in indoor settings may be common during a time when indoor cigarette smoking is decreasing which may result in increased exposure to non-ECIG users in indoor settings such as homes and cars.

Finally, most parents who are ECIG users do not know of other risks that are associated with ECIG use in their homes besides passive secondhand aerosol exposure for their children leading to low harm perception. Only 31.2% of parents who are ECIG users believed that skin contact of ECIG liquid was harmful to children (Garbutt et al., 2015). This shows that many ECIG users do not perceive secondhand aerosol to be harmful towards children and many do not even know of other health consequences to children leading to low harm perception. Low harm perception of ECIG users may lead to increased ECIG use inside of vehicles in the presence of children which in turn leads to negative health consequences.

Statement of Purpose

Research examining harm perceptions of ECIG aerosol and ECIG use in homes separately have been conducted, however, this research study aims to examine correlations between harm perceptions of secondhand ECIG aerosol and user's ECIG use inside of vehicles, acceptability of ECIG use inside of vehicles in the presence of adults and children and ECIG use behavior inside of vehicles in the presence of adults and children.

Research Questions and Hypotheses

This study examined five research questions: 1) “Is there an association between harm perception of secondhand ECIG exposure and perceived acceptability of ECIG use inside of vehicles when other adults are present?” Hypothesis 1: Lower harm perceptions of secondhand ECIG exposure will be associated with perceived acceptability of ECIG use inside of a vehicle when other adults are present. 2) “Is there an association between harm perception of secondhand ECIG exposure and perceived acceptability of ECIG use inside of vehicles when children are present?” Hypothesis 2: Lower harm perceptions of secondhand ECIG exposure will be associated with perceived acceptability of ECIG use inside of a vehicle when children are present. 3) “Is there an association between harm perception of secondhand ECIG aerosol exposure and reported ECIG use inside vehicles?” Hypothesis 3: Lower harm perception of secondhand ECIG aerosol exposure will be associated with ECIG use inside of vehicles. 4) “Is there an association between harm perception of secondhand ECIG aerosol exposure and reported ECIG use inside vehicles when other adults are present?” Hypothesis 4: Lower harm perception of secondhand ECIG aerosol exposure will be associated with ECIG use inside of vehicles when other adults are present. 5) “Is there an association between harm perception of secondhand ECIG aerosol exposure and reported ECIG use inside vehicles when children are present?” Hypothesis 5: Lower harm perception of secondhand ECIG aerosol exposure will be associated with ECIG use inside of vehicles when children are present.

Methods

Survey Development

A survey (Appendix A) was created to examine ECIG use and harm perceptions among ECIG users inside of vehicles. The survey was developed by first reviewing several national tobacco surveys. These surveys included the CDC National Youth Tobacco Survey, CDC

National Adult Tobacco Survey, Cancer Control Health Styles Survey, Population Assessment of Tobacco and Health, National Health Information Survey, and Monitoring the Future Survey. Due to the lack of existing questions regarding ECIG and other tobacco behaviors inside of vehicles, new survey questions were developed that addressed ECIG and tobacco use inside of vehicles. The research team tested the survey using cognitive interviews. Cognitive interviews served to determine how well the questions performed and whether the participants understood the questions. The survey was tested 5 times using the think aloud method. Participants were asked to answer the survey questions out loud and state if a question does not sense. The participants then explained what they thought that the question meant and any confusions they had when determining an answer. Survey questions were then changed to eliminate any confusions that arose when doing the cognitive interviews.

Study Participants

Participants who were over the age of 18, reported ECIG use in the past 30 days, were residing in the U.S were recruited via Qualtrics Panels and asked to complete an online survey. Several quotas utilized to ensure a diverse sample. Gender quotas of 50% men and 50% women while including transgender and non-gender binary-identified participants were implemented. Quotas also ensured that no more than 60% White participants, at least 15% Black/African American and 25% other races were asked to complete the survey. Finally, a quota was placed to ensure that at least 35% of the sample are between the ages of 18 and 24. The survey was administered by Qualtrics, and 1050 participants completed the survey. However, 48 participants reported current ECIG use, but also stated that they vaped 0 days in the past 30 days. Thus, 1002 participant surveys were retained for analysis.

Secondhand Aerosol and ECIG Use Inside of Vehicles Survey Items

To examine harm perceptions of secondhand ECIG use, the survey included the item, "Not including the smoke from cigarettes or other tobacco products, do you think that breathing vapor from others' vapes/e-cigarettes causes?" Response options included: no harm, little harm, some harm, a lot of harm, and I don't know. Two questions were used to examine acceptability of ECIG use inside of vehicles when others were present: 1) "Which BEST describes your opinion about vaping inside of a vehicle when there are other ADULTS present? Vaping SHOULD…" and 2)"Which BEST describes your opinion about vaping inside of a vehicle, when there are CHILDREN present? Vaping SHOULD…" Response options for both questions were always allowed, allowed under some conditions, and never be allowed. To examine frequency of ECIG use inside of a personal vehicle, the survey included the question, "When you are in your personal vehicle, such as a vehicle that you or your family owns or leases, how often do you vape inside of the vehicle?" The possible answer choices included: almost always, sometimes, rarely, never, and I/My family does not own or lease a personal vehicle. This question helped separate participants who vape in a vehicle from those who don't. Two questions were used to examine ECIG use behaviors inside of vehicles when others were present: 1) "How often do you vape inside of vehicles when other ADULTS are present?" and 2) How often do you vape inside of vehicles when CHILDREN are present?" The possible answer choices included: always, sometimes, rarely, never, I do not drive or ride in vehicles when other adults are present, and I do not vape when I am in vehicles.

Data Analyses

Survey data was analyzed using SPSS 26.0. Descriptive statistics were performed and crosstabs, post-hoc z tests, and chi-square tests of association were conducted to examine associations between harm perceptions and opinion about acceptability of ECIG use inside of

vehicles in the presence of other adults, opinion about acceptability of ECIG use inside of vehicles in the presence of children, reported ECIG use inside of vehicles, ECIG use inside of vehicles in the presence of other adults, and ECIG use inside of vehicles in the presence of other children.

The variables were recoded to omit participants that were not relevant. For example, reported ECIG use was recoded to omit participants that stated I/My family does not own or lease a personal vehicle. This was necessary as the participants that stated /My family does not own or lease a personal vehicle were not pertinent to the question. Harm perception was recoded into two categories, low harm, and high harm. Low harm was composed of no harm or little harm while high harm was composed of some harm or a lot of harm. These were classified as such as it was hypothesized that people who thought secondhand aerosol as having no harm or little harm would adopt similar behaviors and opinions. Likewise, people that thought secondhand aerosol had some harm or a lot of harm were thought to adopt a different set of behaviors than those who thought that secondhand aerosol as having low harm.

Results

Participant Characteristics

Of all the participants (n=1002), 50.4% were women and 47.1% were men. Over half of all the participants (n=600, 59.9%) were White/European American. The mean age of the participants was 32.8 years (SD = 12.8). Over half (61.7%) of all participants reported ECIG use every day. Participants reported their ECIG of choice with box mods constituting 21.1% of all participants, pod mods constituting 35.8% and disposables constituting 16.0%. Participants were asked to evaluate their harm perception of secondhand aerosol based on different levels (no harm, little harm, some harm, a lot of harm). Of all participants 20.3% stated no harm, 34.6%

stated little harm, 36.5% stated some harm and 8.6% stated a lot of harm. For acceptability of ECIG use inside of vehicles in the presence of other adults, 30.5% of all participants stated always be allowed, 59.0% stated be allowed under some conditions, and 10.6% stated never be allowed. For acceptability of ECIG use inside of vehicles in the presence of children, 13.1% of all participants stated always be allowed, 26.8% stated be allowed under some conditions, and 60.2% stated never be allowed. For frequency of ECIG use inside a personal vehicle, 44.2% of all participants stated almost always, 36.3% stated sometimes, 11.9% stated rarely, and 7.6% stated never. For reported ECIG use inside of vehicles in the presence of other adults, 21.7% of all participants stated always, 40.1% stated sometimes, 19.9% stated rarely, and 18.3% stated never. For reported ECIG use inside of vehicles in the presence of children, 12.1% of all participants stated always, 16.7% states sometimes, 60.8% stated rarely, and 10.5% stated never. Table 1 shows participant characteristics in more detail.

Harm Perceptions and Acceptability of ECIG Use Inside of Vehicles in the Presence of Others

Harm perceptions regarding secondhand aerosol exposure and opinions regarding ECIG use in a vehicle in the presence of other adults are displayed in Table 2 and Figure 1. There was a significant association between harm perception and ECIG use inside a vehicle in the presence of other adults ($\chi^2(6) = 95.246$). Among those who believed that secondhand aerosol was of no harm, 52.9% stated that ECIG use should always be allowed inside vehicles in the presence of other adults, 41.2% stated ECIG use should be allowed under some conditions, and 5.9% stated ECIG use should never be allowed. Among those who believed that secondhand aerosol was of little harm, 30.5% stated that ECIG use should always be allowed, 64.2% stated ECIG use should be allowed under some conditions, and 5.3% stated ECIG use should never be allowed.

Among participants that believed secondhand aerosol to be of some harm, 19.1% stated that ECIG use should always be allowed, 66.3% stated ECIG use should be allowed under some conditions, and 14.6% stated ECIG use should never be allowed. Among those who believed that secondhand aerosol was of a lot of harm, 25.3% stated that ECIG use should always be allowed, 49.4% stated ECIG use should be allowed under some conditions, and 25.3% stated ECIG use should never be allowed. Post-hoc z-tests indicated that among those who perceived that exposure to ECIG secondhand aerosol was associated with no harm, a significantly greater percentage stated ECIG use should always be allowed inside vehicles in the presence of other adults compared to be allowed under some conditions and never be allowed ($p<0.05$). Among those who perceived that exposure to ECIG secondhand aerosol was associated with a lot of harm, a significantly greater percentage stated never be allowed compared to always be allowed and be allowed under some conditions ($p<0.05$).

Harm perceptions regarding secondhand aerosol exposure and opinions regarding ECIG use in a vehicle in the presence of children are displayed in Table 3 and Figure 2. There was a significant association between harm perception and ECIG use inside a vehicle in the presence of children ($\chi 2(6) = 60.74$). Among those who believed that secondhand aerosol was of no harm, 24.6% stated that ECIG use should always be allowed inside vehicles in the presence of children, 33.7% stated ECIG use should be allowed under some conditions, and 41.7% stated ECIG use should never be allowed. Among those who believed that secondhand aerosol was of little harm, 9.7% stated that ECIG use should always be allowed, 30.2% stated ECIG use should be allowed under some conditions, and 60.1% stated ECIG use should never be allowed. Among participants that believed secondhand aerosol to be of some harm, 7.8% stated that ECIG use should always be allowed, 22.7% stated ECIG use should be allowed under some conditions, and 69.6% stated

ECIG use should never be allowed. Among those who believed that secondhand aerosol was of a lot of harm, 21.5% stated that ECIG use should always be allowed, 13.9% stated ECIG use should be allowed under some conditions, and 64.6% stated ECIG use should never be allowed. Post-hoc z-tests indicated that among those who perceived that exposure to ECIG secondhand aerosol was associated with no harm, a significantly greater percentage stated ECIG use should always be allowed inside of vehicles in the presence of children compared to be allowed under some conditions and never be allowed ($p<0.05$). In addition, among those who perceived that exposure to ECIG secondhand aerosol was associated with no harm, a significantly greater percentage stated ECIG use should be allowed under some conditions inside vehicles in the presence of children compared to never be allowed ($p<0.05$). Among those who perceived that exposure to ECIG secondhand aerosol was associated with some harm, a significantly greater percentage stated never be allowed compared to always be allowed and be allowed under some conditions ($p<0.05$).

Harm Perceptions and Frequency of Reported ECIG Use Inside of Personal Vehicles

Harm perceptions regarding secondhand aerosol exposure and reported ECIG use inside of personal vehicles are displayed in Table 4 and Figure 3. There was a significant association between harm perception and ECIG use inside a vehicle in the presence of children (χ^2 (9)= 72.856). Among those who believed that secondhand aerosol was of no harm, 65.9% reported almost always using ECIGs inside a personal vehicle, 27.8% reported sometimes, 2.8% reported rarely, and 3.4% reported never. Among those who believed that secondhand aerosol was of little harm, 46.1% reported almost always, 39.0% reported sometimes, 9.7% reported rarely, and 5.2% reported never. Among participants that believed secondhand aerosol to be of some harm, 33.7% reported almost always, 38.6% reported sometimes, 16.7% reported rarely, and 10.9% reported

never. Among those who believed that secondhand aerosol was of a lot of harm, 31.6% reported almost always, 35.4% reported sometimes, 20.3% reported rarely, and 12.7% reported never. Post-hoc z-tests indicated that among those who perceived that exposure to ECIG secondhand aerosol was associated with no harm, a significantly greater percentage stated almost always using ECIGs inside a personal vehicle ($p<0.05$). Among those who perceived that exposure to ECIG secondhand aerosol was associated with a lot of harm, a significantly lesser percentage stated almost always using ECIGs inside a personal vehicle compared to rarely, and never ($p<0.05$).

Harm Perceptions and Reported ECIG Use Inside of Vehicles in the Presence of Others

Harm perceptions regarding secondhand aerosol exposure and reported ECIG use inside of a vehicle in the presence of other adults are displayed in Table 5 and Figure 4. There was a significant association between harm perception and ECIG use inside a vehicle in the presence of children ($\chi^2(9)=54.778$). Among those who believed that secondhand aerosol was of no harm, 34.3% stated always using ECIGs inside of a vehicle in the presence of other adults, 44.4% stated sometimes, 11.2% stated rarely, and 10.1% stated never. Among those who believed that secondhand aerosol was of little harm, 21.5% stated always, 44.0% stated sometimes, 18.6% stated rarely, and 16.0% stated never. Among participants that believed secondhand aerosol to be of some harm, 14.9% stated always, 36.5% stated sometimes, 26.3% stated rarely, and 22.2% stated never. Among those who believed that secondhand aerosol was of a lot of harm, 21.3% stated always, 29.3% stated sometimes, 18.7% stated rarely, and 30.7% stated never. Post-hoc z-tests indicated that among those who perceived that exposure to ECIG secondhand aerosol was associated with no harm, a significantly greater percentage stated always using ECIGs inside vehicles in the presence of other adults compared to sometimes, rarely, and never ($p<0.05$).

Among those who perceived that exposure to ECIG secondhand aerosol was associated with some harm, a significantly greater percentage stated never using ECIGs inside vehicles in the presence of other adults compared to sometimes and always using ECIGs inside vehicles in the presence of other adults ($p<0.05$).

Harm perceptions regarding secondhand aerosol exposure and reported ECIG use inside of a vehicle in the presence of children are displayed in Table 6 and Figure 5. There was a significant association between harm perception and ECIG use inside a vehicle in the presence of children ($\chi^2(9)=16.215$). Among those who believed that secondhand aerosol was of no harm, 17.7% stated always using ECIGs inside of a vehicle in the presence of children, 17.0% stated sometimes, 51.0% stated rarely, and 14.3% stated never. Among those who believed that secondhand aerosol was of little harm, 9.7% stated always, 19.7% stated sometimes, 60.2% stated rarely, and 10.4% stated never. Among participants that believed secondhand aerosol to be of some harm, 10.9% stated always, 13.6% stated sometimes, 66.2% stated rarely, and 9.3% stated never. Among those who believed that secondhand aerosol was of a lot of harm, 15.4% stated always, 16.9% stated sometimes, 60.0% stated rarely, and 7.7% stated never. Post-hoc z-tests indicated that among those who perceived that exposure to ECIG secondhand aerosol was associated with no harm, a significantly greater percentage stated always using ECIGs inside vehicles in the presence of children compared to rarely using ECIGs inside vehicles in the presence of children ($p<0.05$).

Discussion

In this study of current ECIG users, ECIG use inside of vehicles was common and harm perceptions of secondhand ECIG aerosol were associated with opinions about acceptability of ECIG use inside vehicles in the presence of others, reported ECIG use inside of personal

vehicles, and reported ECIG use inside vehicles in the presence of others were examined. Results showed that low harm perception of secondhand aerosol exposure was associated with increased ECIG use inside of vehicles in the presence of both adults and children. Frequency of ECIG use inside a personal vehicle was greater among those with lower harm perceptions of secondhand ECIG aerosol. Harm perceptions of secondhand aerosol exposure affected participants opinions differently in the case of adults and children. For adults, as harm perception increased, acceptability of ECIG use decreased. For children, most believed it was never acceptable to use ECIGs for all harm perception levels.

These results show that decreased harm perceptions are associated with increased ECIG use behaviors and acceptability regarding ECIG use in vehicles near others. Lack of knowledge regarding secondhand aerosol is associated with increased unwanted secondhand exposure near others. Increased awareness regarding the harms of secondhand aerosol could decrease ECIG use near others in enclosed spaces. New policies are needed to address ECIG use in specific situations to prevent unwanted secondhand exposure. While Minnesota does have a voluntary policy in place to prevent ECIG use in houses in the presence of children, this has limited effect (Helgertz et al., 2020). These results show that homes are not the only place where children and other adults are at risk for secondhand aerosol exposure and that personal vehicles are a frequent location of ECIG use. These findings show that normal smoking behaviors in vehicles do not apply to ECIG use in vehicles. As shown in a previous research study, dual users were more likely to engage in ECIG use such as in homes and cars where they would otherwise not use traditional cigarettes (Drehmer et al., 2019). This study also complements an existing research study regarding parents' lack of knowledge regarding the harms of ECIG use around children (Garbutt et al., 2015). This study shows that low harm perception of the risks of secondhand

aerosol are associated with increased ECIG use around kids. This relates to the Garbutt et al.'s findings, as it corroborates that parents/adults that do not know of the risks associated with ECIG use near children are more at risk of harming the children.

The findings from the current study can be used to inform prevention efforts dedicated to raising harm perceptions. Since harm perceptions are associated with ECIG use in vehicles in the presence of others, raising awareness of the harms associated with secondhand aerosol may decrease unwanted secondhand aerosol exposure to non-ECIG users. Prevention efforts dedicated to raising harm perception regarding the risks of ECIG use as well as secondhand aerosol exposure may also serve to decrease ECIG use in general. In addition, educational institutions can also increase harm perception of students by explaining the various negative health effects to the user as well as to the non-users to further decrease ECIG use in vehicles in the presence of others. As existing studies show, parents are unaware of most of the dangers associated with ECIGs and ECIG use near children (Garbutt et al, 2015). Health professionals can use these findings to increase harm perceptions of parents which may lead to decreased ECIG use inside of vehicles near children.

This study several limitations. A causal relationship between harm perception, ECIG use inside of vehicles in the presence of others, and opinions of acceptability regarding ECIG use near others cannot be determined from the current study due to the cross-sectional design. However, this study was not meant to find the causation between the two variables, but to determine if there was an association between them. Another limitation is data was gathered using self-reported data from eligible participants. This may cause the data to be skewed even after removing surveys with straight-line and contradictory answers. Limitations of a regular survey also apply to this study as response bias can also limit the accuracy of this data. Next,

these results are based on the sample population based on the quotas imposed and not based on the public. While the quotas did not help generalize the population, they allowed for analyses to be conducted regarding certain sociodemographic groups.

In conclusion, lower harm perceptions of secondhand aerosol were associated with increased acceptability regarding ECIG use and ECIG use in vehicles in the presence of others. In addition, vehicles may be a common ECIG use location, which could result in unwanted secondhand aerosol exposure for non-ECIG users. While there are a few states that have adopted policies regarding vape free locations to protect non-ECIG users, most states do not. Future research should focus on determining a causal relationship between harm perception and ECIG use inside of vehicles near others. New research should determine if increasing harm perception of secondhand aerosol causes a decrease in ECIG use in enclosed spaces near others. Other research can include determining if thirdhand ECIG aerosol exposure is present in vehicles. If thirdhand aerosol is present in vehicles, then the health consequences of thirdhand aerosol should be explored.

Tables

Table 1. Participant characteristics (n=1002)

Characteristic	N	%
Age (M, SD)	(32.8,12.8)	
18-24	350	34.9
25-44	473	47.2
45-64	158	15.8
65+	21	2.1
Gender		
Man	472	47.1
Woman	505	50.4
Other	25	2.5
Ethnicity		
Hispanic/Latino	178	17.8
Not Hispanic/Latino	824	82.2
Race		
White/European American	600	59.9
Black/African American	206	20.6
Asian	70	7.0
American Indian/Alaskan Native	30	3.0
Native Hawaiian/Pacific Islander	11	1.1
More than one race	65	6.5
Unknown	20	2.0
Frequency of Use		
Everyday	618	61.7
Some Days	384	38.3
Reported Harm Perceptions		
No Harm	187	18.7
Little Harm	318	31.7
Some Harm	335	33.4
A lot of Harm	79	7.9
Acceptability of ECIG Use in the Presence of Other Adults		
Always Be Allowed	280	30.5
Be Allowed Under Some Conditions	542	59.0
Never Be Allowed	97	10.6
Acceptability of ECIG Use in the Presence of Children		
Always Be Allowed	120	13.1
Be Allowed Under Some Conditions	246	26.8
Never Be Allowed	553	60.2
Frequency of ECIG Use Inside a Personal Vehicle		
Almost Always	394	44.2
Sometimes	324	36.3
Rarely	106	11.9
Never	68	7.6

Reported ECIG Use Inside of Vehicles in the Presence of Other Adults		
Always	190	21.7
Sometimes	351	40.1
Rarely	174	19.9
Never	160	18.3
Reported ECIG Use Inside of Vehicles in the Presence of Children		
Always	97	12.1
Sometimes	134	16.7
Rarely	488	60.8
Never	84	10.5
Type of Device		
Cig-a-like	28	2.8
Pod mod	359	35.8
Box Mod	211	21.1
Disposable	160	16
Other	244	24.4

Table 2. Association between harm perception of secondhand aerosol and acceptability of ECIG use in vehicles in the presence of other adults

	Always Be Allowed		Be Allowed Under Some Conditions		Never Be Allowed		
Harm Perception	N	%	N	%	N	%	$\chi^2(1)$
No Harm	99_a	52.9	77_b	41.2	11_b	5.9	95.246
Little Harm	97_a	30.5	204_a	64.2	17_b	5.3	95.246
Some Harm	64_a	19.1	222_b	66.3	49_b	14.6	95.246
A Lot of Harm	20_a	25.3	39_a	49.4	20_b	25.3	95.246

Note. Each subscript letter denotes a subset of opinion about acceptability for ECIG use in a vehicle in the presence of adults whose column proportions do not differ significantly from each other at the .05 level. Percentages represent proportion of responses related to "Acceptability of ECIG Use in Vehicles" within each harm perception group.

Table 3. Association between harm perception of secondhand aerosol and acceptability of ECIG use in vehicles in the presence of children

	Always Be Allowed		Be Allowed Under Some Conditions		Never Be Allowed		
Harm Perception	N	%	N	%	N	%	$\chi^2(1)$
No Harm	46_a	24.6	63_b	33.7	78_c	41.7	60.704
Little Harm	31_a	9.7	96_b	30.2	$191_{a,b}$	60.1	60.704
Some Harm	26_a	7.8	76_a	22.7	233_b	69.6	60.704
A Lot of Harm	17_a	21.5	11_b	13.9	51_a	64.6	60.704

Note. Each subscript letter denotes a subset of opinion about acceptability for ECIG use in a vehicle in the presence children whose column proportions do not differ significantly from each other at the .05 level. Percentages represent proportion of responses related to "Acceptability of ECIG Use in Vehicles" within each harm perception group.

Table 4. Association between harm perception of secondhand aerosol and frequency of ECIG use in personal vehicles.

	Almost Always		Sometimes		Rarely		Never		
Harm Perception	N	%	N	%	N	%	N	%	$\chi^2(1)$
No Harm	116_a	65.9	49_b	27.8	5_c	2.8	$6_{b,c}$	3.4	72.856
Little Harm	142_a	46.1	120_a	39.0	$30_{a,b}$	9.7	16_b	5.2	72.856
Some Harm	111_a	33.7	127_b	38.6	55_c	16.7	36_c	10.9	72.856
A Lot of Harm	25_a	31.6	$28_{a,b}$	35.4	16_b	20.3	10_b	12.7	72.856

Note. Each subscript letter denotes a subset of frequency of ECIG use in personal vehicles whose column proportions do not differ significantly from each other at the .05 level. Percentages represent proportion of responses related to "Frequency of ECIG Use in Vehicles" within each harm perception group.

Table 5. Association between harm perception of secondhand aerosol and ECIG use in vehicles in the presence of other adults

	Always		Sometimes		Rarely		Never		
Harm Perception	N	%	N	%	N	%	N	%	$\chi^2(1)$
No Harm	61_a	34.3	79_b	44.4	20_c	11.2	18_c	10.1	54.778
Little Harm	66_a	21.5	135_a	44.0	57_a	18.6	49_a	16.0	54.778
Some Harm	47_a	14.9	115_a	36.5	83_b	26.3	70_b	22.2	54.778
A Lot of Harm	$16_{a,b}$	21.3	22_b	29.3	$14_{a,b}$	18.7	23_a	30.7	54.778

Note. Each subscript letter denotes a subset of reported ECIG use in a vehicle in the presence of adults whose column proportions do not differ significantly from each other at the .05 level. Percentages represent proportion of responses related to "ECIG Use in Vehicles" within each harm perception group.

Table 6: Association between harm perception of secondhand aerosol and ECIG use in vehicles in the presence of children

	Always		Sometimes		Rarely		Never		
Harm Perception	N	%	N	%	N	%	N	%	$\chi^2(1)$
No Harm	26_a	17.7	$25_{a,b}$	17.0	75_b	51.0	21_a	14.3	16.215
Little Harm	28_a	9.7	57_b	19.7	$174_{a,b}$	60.2	$30_{a,b}$	10.4	16.215
Some Harm	$33_{a,b}$	10.9	41_b	13.6	200_a	66.2	$28_{a,b}$	9.3	16.215
A Lot of Harm	10_a	15.4	11_a	16.9	39_a	60.0	5_a	7.7	16.215

Note. Each subscript letter denotes a subset of reported ECIG use in a vehicle in the presence of children whose column proportions do not differ significantly from each other at the .05 level. Percentages represent proportion of responses related to "ECIG Use in Vehicles" within each harm perception group.

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Figures

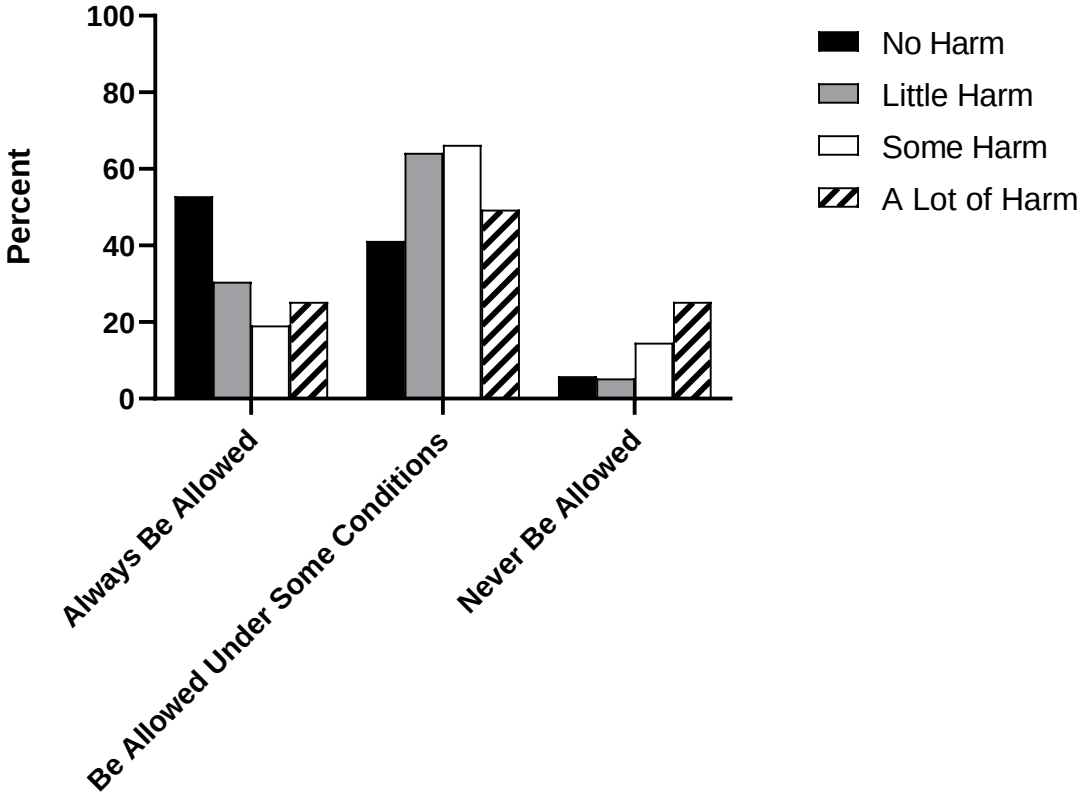

Figure 1. Graph showing harm perception of secondhand aerosol and opinions regarding ECIG use inside vehicles in the presence of other adults. Bars represent percentages within each harm perception group.

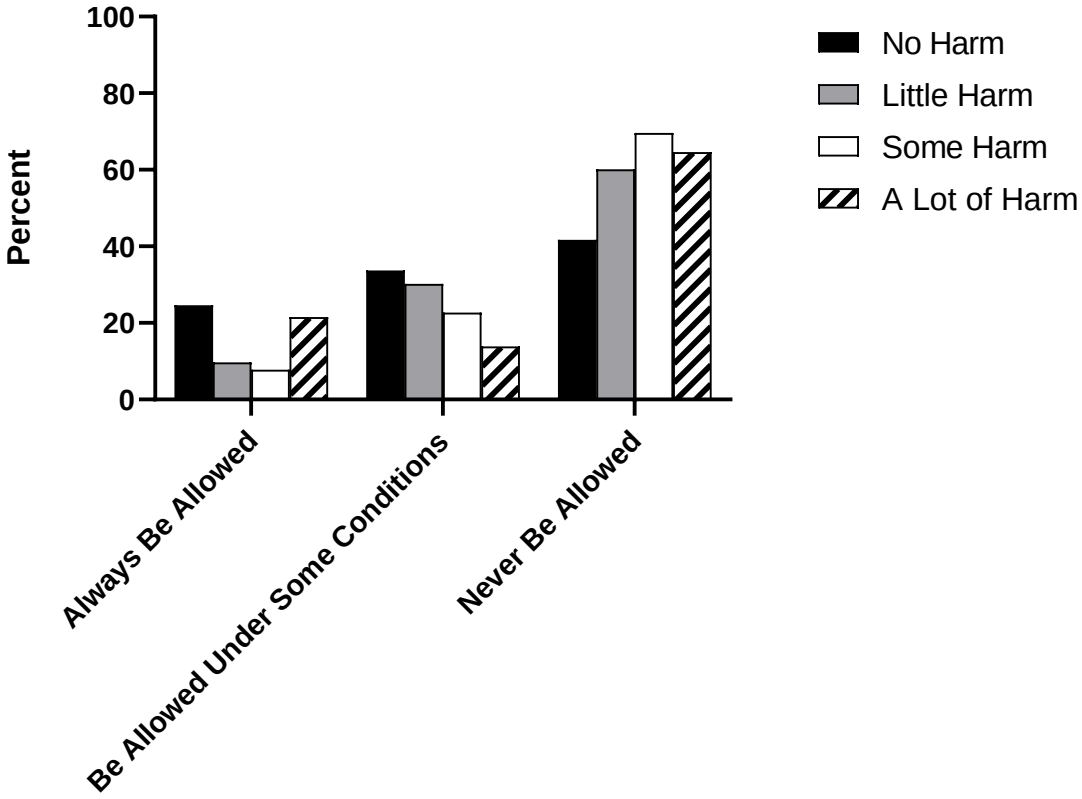

Figure 2. Graph showing harm perception of secondhand aerosol and opinions regarding ECIG use inside vehicles in the presence of children. Bars represent percentages within each harm perception group.

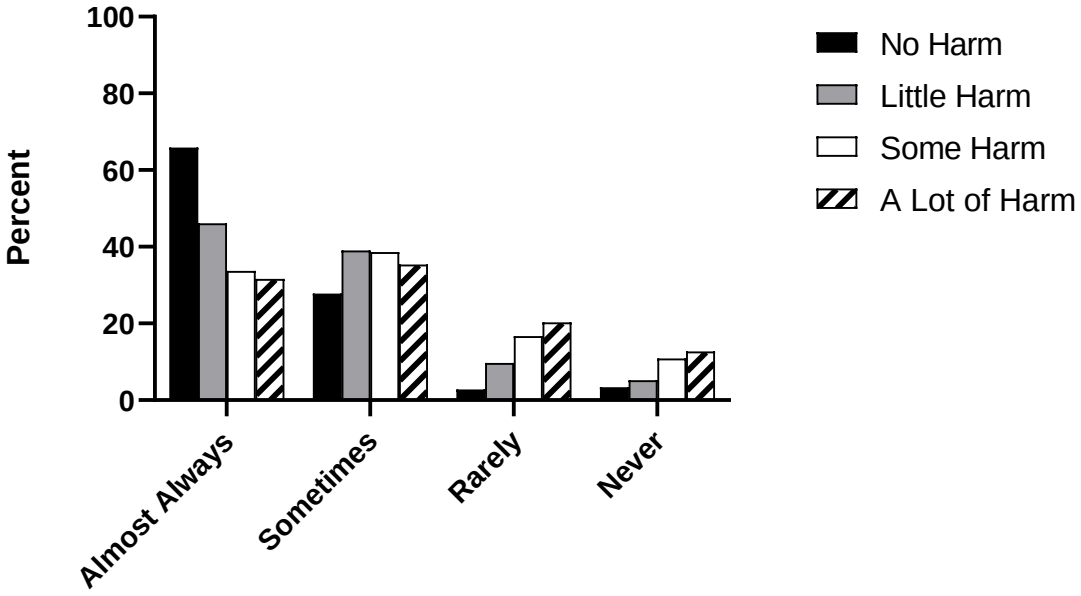

Figure 3. Graph showing harm perception of secondhand aerosol and frequency of reported ECIG use inside personal vehicles. Bars represent percentages within each harm perception group.

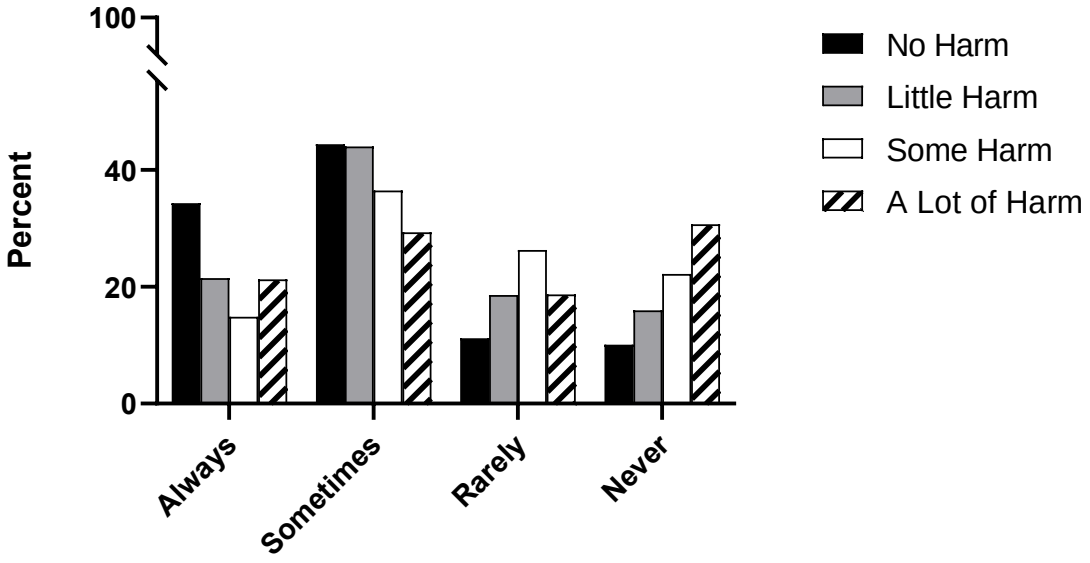

Figure 4. Graph showing harm perception of secondhand aerosol and reported ECIG use inside vehicles in the presence of other adults. Bars represent percentages within each harm perception group.

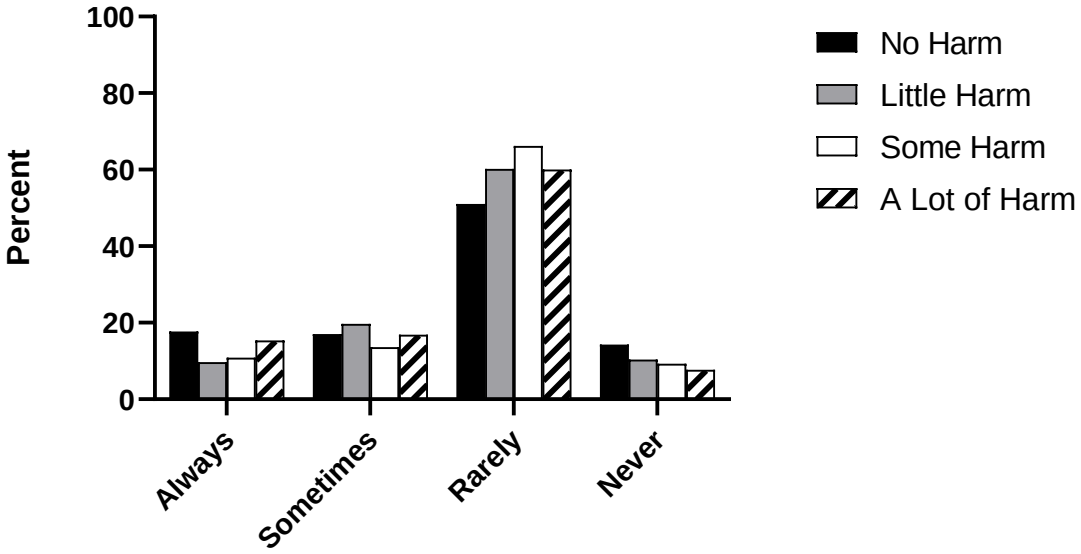

Figure 5. Graph showing harm perception of secondhand aerosol and reported ECIG use inside vehicles in the presence of children. Bars represent percentages within each harm perception group.

Appendix

Appendix A

Vaping Inside Vehicles Assessment Study

What is your ethnicity? (Q1)

- (1) Hispanic/Latino(a)
- (0) Not Hispanic/Latino(a)

Which of the following best describes your race? (Q2)

- (1) American Indian/Alaskan Native
- (2) Asian
- (3) Native Hawaiian/Pacific Islander
- (4) Black/African American
- (5) White/European American
- (6) More than one race
- (7) I prefer not to answer

Which of the following best describes you? (Q3)

- (1) Woman
- (2) Man
- (3) Transgender man
- (4) Transgender woman
- (5) Non-binary/ gender non-conforming
- (6) A different identify (please describe)_____

What is your age (in years)?(Q4)

[Free response]

What is the highest degree or level of school you have completed? (Q10)

- (1) No schooling completed
- (2) Nursery school to 8th grade
- (3) 9th, 10th, or 11th grade
- (4) 12th grade, no diploma
- (5) High school graduate with high school diploma
- (6) GED (general education diploma)
- (7) Some college credit, but less than 1 year
- (8) 1 or more years of college, no degree
- (9) Associate's degree

- (10) Bachelor’s degree
- (11) Master’s degree
- (12) Professional degree (e.g., MD)
- (13) Doctorate degree

The next questions ask about your use of vapes/e-cigarette devices. There are many devices that we consider vapes/e-cigarette devices including first generation e-cigarette devices (like cig-alikes), vapes, mods, pod mods (such as JUUL), vape pens, disposable vapes, e-hookahs, etc. Please see the picture below for some examples of the devices that we consider vapes/e-cigarette devices.

Do you currently use a vape/e-cigarette device every day, some days, or not at all? (Q13)

- (1) Every day
- (2) Some days
- (3) Not at all

Have you used a vape/e-cigarette device in the past 30 days? (Q14)

- (1) Yes
- (0) No

How many days in the past 30 days have you used a vape/e-cigarette device? (Q15) [Free response]

Look at the picture below. Which of the following best describes your vape/e-cigarette device you use regularly? (Q16)

- (1) 1 –Cig-alike
- (2) 2 – E-hookah
- (3) 3 – Vape pen/eGo style device
- (4) 4 – Box Mod or Rebuildable/Mechanical Mod
- (5) 5 – E-cigar
- (6) 6 – E-pipe
- (7) 7 – Pod mod such as JUUL or other similar device
- (8) 8 – Disposable vape such as a Posh, Puff Bar, Mojo, or other similar device
- (9) Some other device (please specify) _____

What is the name of the vape/e-cigarette device you use? If you don't know, please enter "Don't know" (Q17)

[Free response]

Look at the picture below. Which of the following types of vapes/e-cigarette devices do you currently use? Please select all that apply. (Q117)

- (1) 1 – Cig-alike
- (2) 2 – E-hookah
- (3) 3 – Vape pen/eGo style device
- (4) 4 – Box Mod or Rebuildable/Mechanical Mod
- (5) 5 – E-cigar
- (6) 6 – E-pipe
- (7) 7 – Pod mod such as JUUL or other similar device
- (8) 8 – Disposable vape such as a Posh, Puff Bar, Mojo, or other similar device

How many vapes/e-cigarette devices do you currently use? (Q118)

[Free response]

How long have you vaped/used an e-cigarette device on a regular basis (e.g., every day or some days)? (Q18)

- (1) I have never vaped on a a regular basis
- (2) Less than a month
- (3) 1-3 months
- (4) 4-6 months
- (5) 7-12 months
- (6) Between 1 and 2 years
- (7) More than 2 years

On average, when you used a vape/e-cigarette device during the past 30 days, about how often did you use it per day? (Q19)

- (1) I did not use a vape/e-cigarette device in the past 30 days
- (2) At least once per day
- (3) Every once in a while throughout the day
- (4) Fairly frequently throughout the day
- (5) Almost always throughout the day

What is your preferred e-liquid nicotine concentration/strength that you use most often in your primary vape/e-cigarette device? Please answer in mg/ml or nicotine %. (Q20)

- Exact mg/ml _____
- Nicotine % _____
- I don't know

Which of the following is closest to your preferred PG/VG ratio (propylene glycol/ vegetable glycerin) for your e-liquid? (Q119)

- 100 PG/ 0 VG
- 70 PG/ 30 VG
- 50 PG/ 50 VG
- 30 PG/ 70 VG
- 0 PG/ 100 VG
- I don't know

Do you use any other substances in your e-liquid besides nicotine such as CBD oil, THC oil, essential oils, or any other additives? Please select all that apply. (Q21)

- CBD oil
- THC oil

- Essential oils
- Some other additive (list all that apply) _____
- I do not use any other additives in my e-liquid
- I don't know

Where do you get your e-liquid? If someone else gets your e-liquid for you, where do they get the e-liquid? (Select all that apply) (Q22)

- Vape shop/tobacco store
- Gas station or convenience store
- Retail store like a grocery store, drug store, or department store
- Order e-liquid online/over the internet
- Homemade/Do-it-yourself (DIY)
- Other _____

Which of the following best categorizes the e-liquid flavors (i.e., smell and taste) you used in the past 30 days? Please select all that apply. (Q23)

- Menthol
- Mint
- Tobacco
- Clove, spice, nut
- Fruit
- Chocolate
- Vanilla or crème
- Alcoholic drink (such as margarita, strawberry daiquiri, wine, cognac, etc.)
- Coffee/tea
- Candy
- Desserts (such as ice cream, cake, cookies, etc.)
- Other _____
- I don't use a flavor

What is the wattage that your vape/e-cigarette device operates at? Please answer in watts. If you use a variable wattage device, what wattage do you vape at most often. (Q24)

- Watts _____[Free response]
- I don't know

This section asks you about your VAPING/E-CIGARETTE use inside of VEHICLES.
When you are in your personal vehicle, such as a vehicle that you or your family owns or leases, how often do you vape *inside of the vehicle*? (Q27)

- (1) Almost always
- (2) Sometimes
- (3) Rarely
- (4) Never
- (5) I/My family does not own or lease a vehicle

When you are in someone else's vehicle, such as a friend's vehicle, how often do you vape *inside of the vehicle*? (Q28)

- (1) Almost always
- (2) Sometimes
- (3) Rarely
- (4) Never
- (5) I don't ride in other people's vehicles

How often do you vape inside of vehicles when other ADULTS are present? (Q29)

- (1) Always
- (2) Sometimes
- (3) Rarely
- (4) Never
- (5) I do not drive or ride in vehicles when other adults are present
- (6) I do not vape when I am in vehicles

How often do you vape inside of vehicles when CHILDREN are present? (Q30)

- (1) Always
- (2) Sometimes
- (3) Rarely
- (4) Never
- (5) I do not drive or ride in vehicles when children are present
- (6) I do not vape when I am in vehicles
- (7) I do not drive or ride in vehicles

Do you ever use a work vehicle as part of your job? This includes your personal vehicle if you use it for part of your job (e.g., Uber/Lyft driver, delivery service, etc.) (Q31)

- (1) Yes
- (0) No

When you drive or ride in a work vehicle that you use as part of your job, how often do you vape *inside of the vehicle*? (Q32)

- (1) Almost always
- (2) Sometimes

- (3) Rarely
- (4) Never
- (5) I do not drive/ride in a work vehicle
- (8) I don't know

When you vape inside of a vehicle, do you roll down/ open the windows in the vehicle? (Q120)

- (1) Always
- (2) Sometimes
- (3) Rarely
- (4) Never
- (5) I don't vape inside of vehicles

When you vape inside of a vehicle, do you usually keep the window(s)…(Q33)

- (1) Completely closed/ all the way up
- (2) Partially closed/ part of the way up
- (3) Completely open/ all the way down
- (4) I do not vape inside of vehicles
-

Besides rolling down the window, when you vape inside of a vehicle, what behaviors do you use to control the amount of vapor inside the vehicle? (Please check all that apply). (Q113)

- Exhale the vapor out the window
- Exhale the vapor down or to the side
- Exhale the vapor away from me or other people in the vehicle
- Turn on air conditioning or air vents
- Take smaller puffs to make smaller clouds
- Hold vapor in longer so I exhale less vapor
- Use a vape/e-cigarette device and e-liquid that produces less vapor
- Something else (please describe) _____
- I don't vape inside of vehicles

Which of the following situations do you vape in while you are the driver of a vehicle? Please check all that apply. (Q34)

- (1) While driving and moving.
- (2) While in drive, but not moving (e.g. at stoplight or stop sign)
- (3) While parked.
- (4) I don't vape inside of vehicles.
- (5) I don't drive a vehicle

How often do you refill your vape/e-cigarette device while you are driving your vehicle? This includes refilling liquid or changing the pod or cartridge on your device. (Q35)

- (1) Always
- (2) Sometimes
- (3) Rarely
- (4) Never
- (5) I don't use a device that I can refill or change pods/cartridges
- (6) I don't vape inside of vehicles
- (7) I don't drive a vehicle

When you clean the inside of your vehicle, how do you clean? If someone else cleans your vehicle, please answer based on how they clean the inside of your vehicle. Please select all that apply. (Q114)

- Vacuum the interior
- Wipe or wash the windows
- Wipe or wash the steering wheel
- Wipe or wash the dashboard or other surfaces
- Wipe or wash the seats/upholstery
- Use air fresheners or other sprays
- I clean my vehicle some other way (please describe) _____
- I/my family does not own or lease a vehicle

In general, which BEST describes how often do you or someone else clean/wash the interior surfaces of your vehicle? (Q115)

- More than once per week
- Once every week
- Once every month
- Once every 2-5 months
- Once every 6-11 months
- Once every year or longer
- I never clean or wash the interior surfaces of my vehicle
- I/my family does not own or lease a vehicle

When you vape inside of a vehicle with others, how often do you share vapes/e-cigarette devices while you or someone else is driving? (Q121)

- (1) Always
- (2) Sometimes
- (3) Rarely
- (4) Never
- (5) I don't vape inside of vehicles

Are there any other behaviors related to vaping/e-cigarette use inside of a vehicle that you engage in? If yes, please describe them below. (Q106)
[Free response]

This next section asks you about VAPING/E-CIGARETTE USE inside your HOME.
Not counting decks, porches, or garages, during a typical week, how many days do vape *inside of your home*? (Q38)

- (0) 0 days
- (1) 1 day
- (2) 2 days
- (3) 3 days
- (4) 4 days
- (5) 5 days
- (6) 6 days
- (7) 7 days

This section asks you about your OPINIONS related to harms of secondhand vapor from VAPES/E-CIGARETTES.

Not including the smoke from cigarettes or other tobacco products, do you think that breathing vapor from others' vapes/e-cigarettes causes: (Q40)

- (1) No harm
- (2) Little harm
- (3) Some harm
- (4) A lot of harm
- (8) I don't know

How do you think opening the windows inside of a vehicle affects the harm from secondhand vaping inside of a vehicle? (Q41)

- (1) It decreases the harm a lot
- (2) It decreases the harm a little
- (3) It does not affect the harm
- (4) It increases the harm a little
- (4) It increases the harm a lot
- (8) I don't know

This section asks you about your OPINIONS about VAPES/E-CIGARETTES.

Which BEST describes your opinion about *vaping inside of a vehicle* when there are other ADULTS present? Vaping SHOULD…(Q44)

- (1) Always be allowed
- (2) Be allowed under some conditions
- (3) Never be allowed

Which BEST describes your opinion about *vaping inside of a vehicle*, when there are CHILDREN present? Vaping SHOULD… (Q45)

- (1) Always be allowed
- (2) Be allowed under some conditions
- (3) Never be allowed

Which BEST describes your opinion about *vaping in indoor public places* (e.g., stores, restaurants, movie theaters)? Vaping SHOULD …(Q46)

- (1) Always be allowed/ allowed in ALL areas
- (2) Be allowed under some conditions/ allowed in SOME areas
- (3) Never be allowed/ not allowed at all

Which BEST describes your opinion about vaping in *indoor bars, cocktail lounges, and clubs*? Vaping SHOULD…(Q47)

- (1) Always be allowed/ allowed in ALL areas
- (2) Be allowed under some conditions/ allowed in SOME areas
- (3) Never be allowed/ not allowed at all

Which BEST describes your opinion about *vaping inside indoor work areas*? Vaping SHOULD…(Q48)

- (1) Always be allowed/ allowed in ALL areas
- (2) Be allowed under some conditions/ allowed in SOME areas
- (3) Never be allowed/ not allowed at all

This next section asks you about RULES related to VAPES/E-CIGARETTES.
Not counting motorcycles, which BEST describes the rules about vaping in the vehicle(s) that you or your family owns or leases? If you or your family do not own or lease your own vehicle, please answer based on the rules for the vehicles you ride in. Vaping is…(Q50)

- (1) Always allowed
- (2) Sometimes allowed in at least one vehicle
- (3) Never allowed in any vehicle
- (8) I don't know

Which BEST describes the rules about vaping in the vehicles that you drive or ride in for your job? Vaping is…(Q51)

- (1) Always allowed
- (2) Sometimes allowed
- (3) Never allowed
- (8) I don't know
- (4) I don't drive or ride in a work vehicle.

Not counting decks, porches, or garages, which BEST describes the rules about vaping inside your home? Vaping is…(Q52)

- (1) Always allowed
- (2) Sometimes allowed/ allowed in some places
- (3) Never allowed
- (8) I don't know

Please answer the following questions based on your vaping experiences:

On the days that you vape, how soon after you wake up do you use your vape/e-cigarette device? (Q54)

- Within 5 minutes
- 6-30 minutes
- 31-60 minutes
- After 60 minutes

Do you feel like you are addicted to vaping/using e-cigarettes? (Q56)

- (1) Yes
- (0) No

I find myself reaching for my vape/e-cigarette device without thinking about it. (Q57)

- (0) Never
- (1) Rarely
- (2) Sometimes
- (3) Often
- (4) Almost always

I drop everything to go out and buy vapes/e-cigarettes or e-juice. (Q58)

- (0) Never
- (1) Rarely
- (2) Sometimes
- (3) Often
- (4) Almost always

I vape more before going into a situation where vaping is not allowed. (Q59)

- (0) Never
- (1) Rarely
- (2) Sometimes
- (3) Often
- (4) Almost always

When I haven’t been able to vape for a few hours, the craving gets intolerable. (Q60)

- (0) Never

- (1) Rarely
- (2) Sometimes
- (3) Often
- (4) Almost always

Since you started vaping, have you experienced any the following physical effects or respiratory symptoms from using your vape/e-cigarette device? Please check all that apply. (Q61)

- Cough
- Chest pain
- Shortness of breath
- Abdominal pain
- Nausea
- Diarrhea
- Fever
- Chills
- Headache
- Weight loss
- I have not experienced any of these symptoms

This next section asks you about your use of other tobacco products.
Have you ever smoked a cigarette, even one or two puffs? (Q64)

- (1) Yes
- (0) No

Have you smoked at least 100 cigarettes or more in your lifetime? (Q65)

- (1) Yes
- (0) No

Do you now smoke cigarettes every day, some days, or not at all? (Q66)

- (1) Not at all
- (2) Some days
- (3) Every day

On how many of the past 30 days did you smoke a cigarette? (Q67)
[Free response – with validated response of a number between 0-30]

When you smoked during the past 30 days, about how many cigarettes did you smoke per day? (Q68)
[Free response – with validated response of a number between 0 and 100]

In the past 30 days, did you usually smoke menthol or non-menthol cigarettes? (Q69)

- Menthol
- Non-menthol
- No usual type
- I did not smoke cigarettes in the past 30 days

In the past 30 days, on the days that you smoked, how soon after you wake up do you smoke your first cigarette? (Q70)

- Within 5 minutes
- 6-30 minutes
- 31-60 minutes
- After 60 minutes
- I did not smoke a cigarette in the past 30 days

Around this time 12 months ago, were you smoking cigarettes every day, some days or not at all? (Q71)

- (1) Not at all
- (2) Some days
- (3) Every day

Around this time 12 months ago, on average, about how many cigarettes did you smoke per day on the days that you smoked? (Q72)

[Free response]

During the past 30 days, did you smoke regular/large/premium cigars? (Q73)

Large/Regular/Premium Cigars

- Yes
- No

During the past 30 days, did you smoke cigarillos/little cigars to smoke tobacco (e.g., Black and Mild's, Swisher Sweets Cigarillos, White Owl, and Garcia y Vega and Phillies Blunt**)?** (Q74)

Cigarillos **Little Cigars**

- Yes
- No

During the past 30 days, did you use smokeless tobacco (e.g., chew, dip, snuff, snus)? (Q75)

Moist snuff

Dry snuff

Snus

- Yes
- No

During the past 30 days, did you smoke tobacco using a hookah or waterpipe? (Q76)

- Yes
- No

This section asks you about smoking CIGARETTES or other COMBUSTIBLE TOBACCO PRODUCTS inside of VEHICLES.

Not counting vaping, when you are your personal vehicle that you or your family owns or leases, how often do you smoke cigarettes or other tobacco products *inside of the vehicle*? (Q79)

- (1) Almost always
- (2) Sometimes
- (3) Rarely
- (4) Never
- (5) I do not ever smoke cigarettes or other combustible tobacco products
- (8) I/my family does not own or lease a vehicle

When you are in someone else's vehicle, such as a friend's vehicle, how often do you smoke cigarettes or other tobacco products *inside of the vehicle*? (Q80)

- (1) Almost always
- (2) Sometimes
- (3) Rarely
- (4) Never
- (5) I do not smoke cigarettes or other combustible tobacco products
- (6) I do not ride in other people's vehicles

How often do you smoke cigarettes or other tobacco products inside of vehicles when other ADULTS are present? Do you smoke…(Q81)

- (1) Always
- (2) Sometimes
- (3) Rarely
- (4) Never
- (5) I do not drive or ride in vehicles when other adults are present
- (6) I do not smoke cigarettes or other combustible tobacco products

Which BEST describes your smoking behaviors inside of vehicle when CHILDREN are present? Do you smoke…(Q82)

- (1) Always
- (2) Sometimes
- (3) Rarely
- (4) Never
- (5) I don't drive or ride in vehicles when children are present
- (6) I don't smoke cigarettes or other combustible tobacco products

When you drive or ride in a work vehicle that you use as part of your job, how often do you smoke cigarettes or other combustible tobacco products *inside of the vehicle*? (Q83)

- (1) Almost always
- (2) Sometimes
- (3) Rarely
- (4) Never
- (5) I do not smoke cigarettes or other combustible tobacco products
- (6) I do not drive/ride in a work vehicle

When you smoke cigarettes or other combustible tobacco products inside of a vehicle, how often do you roll down/ open the windows in the vehicle? (Q122)

- (1) Always
- (2) Sometimes
- (3) Rarely
- (4) Never
- (5) I do not smoke cigarettes or other combustible tobacco products
- (6) I do not drive/ride in vehicles

When you smoke cigarettes or other tobacco products inside of a vehicle, do you usually keep the window(s)… (Q84)

- (1) Completely closed/ all the way up
- (2) Partially closed/ part of the way up
- (3) Completely open/ all the way down
- (4) I don't smoke inside of vehicles
- (5) I don't smoke cigarettes or other combustible tobacco products

Besides rolling down the window, when you smoke cigarettes or other tobacco products inside of a vehicle, what behaviors do you use to control the amount of smoke inside the vehicle? (Please check all that apply). (Q116)

- Exhale the smoke out the window
- Exhale the smoke down or to the side
- Exhale the smoke away from me or other people in the vehicle
- Turn on air conditioning or air vents
- Take smaller puffs to make smaller amounts of smoke
- Hold the smoke in longer so I exhale less smoke
- Hold the cigarette/tobacco product out the window when I am not smoking
- Something else (please describe) _____
- I don't smoke inside of vehicles

Which of the following situations do you smoke tobacco products in while you are the driver of a vehicle? Please check all that apply. (Q86)

- (1) While driving and moving.
- (2) While in drive, but stopped (e.g. at a stoplight or stop sign).
- (3) While parked.
- (4) I don't smoke inside of vehicles

- (5) I don’t smoke cigarettes or other combustible tobacco products

Are there any other behaviors related to smoking tobacco products inside of a vehicle that you engage in? If yes, please describe them below. (Q107)
[Free response]

This next section asks you about smoking CIGARETTES or other COMBUSTIBLE TOBACCO PRODUCTS inside your HOME.

Not counting decks, porches, or garages, during a typical week, how many days do you smoke cigarettes or other tobacco products *inside of your home*? (Q89)

- (0) 0 days
- (1) 1 day
- (2) 2 days
- (3) 3 days
- (4) 4 days
- (5) 5 days
- (6) 6 days
- (7) 7 days

This section asks you about your OPINIONS related to harms of secondhand smoke from CIGARETTES or other COMBUSTIBLE TOBACCO PRODUCTS.

Not including the vapor from vapes/e-cigarettes, do you think that breathing smoke from other people's cigarettes or other tobacco products causes: (Q92)

- (1) No harm
- (2) Little harm
- (3) Some harm
- (4) A lot of harm
- (8) I don't know

How do you think opening the windows inside of a vehicle affects the harm from secondhand smoke from cigarettes or other tobacco products inside of a vehicle? (Q85)

- (1) It decreases the harm a lot
- (2) It decreases the harm a little
- (3) It does not affect the harm
- (4) It increases the harm a little
- (4) It increases the harm a lot
- (8) I don't know

This section asks you about your OPINIONS about CIGARETTES and other COMBUSTIBLE TOBACCO PRODUCTS.

Which BEST describes your opinion about smoking cigarettes or other tobacco products *inside of a vehicle* when there are other ADULTS present? Smoking SHOULD…(Q94)

- (1) Always be allowed
- (2) Be allowed under some conditions
- (3) Never be allowed

Which BEST describes your opinion about smoking cigarettes or other tobacco products *inside of a vehicle* when there are CHILDREN present? Smoking SHOULD…(Q95)

- (1) Always be allowed
- (2) Be allowed under some conditions
- (3) Never be allowed

Which BEST describes your opinion about smoking cigarettes or other tobacco products *in indoor public places* (e.g., stores, restaurants, movie theaters)? Smoking SHOULD…(Q96)

- (1) Always be allowed/ allowed in all areas
- (2) Be allowed under some conditions/ allowed in some areas
- (3) Never be allowed/ not allowed at all

Which BEST describes your opinion about smoking cigarettes or other tobacco products *in indoor bars*, *cocktail lounges, and clubs*? Smoking SHOULD…(Q97)

- (1) Always be allowed/ allowed in all areas
- (2) Be allowed under some conditions/ allowed in some areas
- (3) Never be allowed/ not allowed at all

Which BEST describes your opinion about smoking cigarettes or other tobacco products *inside indoor work areas*? Smoking SHOULD…(Q98)

- (1) Always be allowed/ allowed in ALL areas
- (2) Be allowed under some conditions/ allowed in SOME areas
- (3) Never be allowed/ not allowed at all

This next section asks you about RULES related to CIGARETTES and other COMBUSTIBLE TOBACCO PRODUCTS.

Not counting motorcycles, which BEST describes the rules about smoking cigarettes or other tobacco products in the vehicles that you or your family owns or leases? If you or your family do not own or lease your own vehicle, please answer based on the rules for the vehicles you ride in. (Q101)

- (1) Always allowed
- (2) Sometimes allowed in at least one vehicle
- (3) Never allowed in any vehicle
- (8) I don't know

Which BEST describes the rules about smoking cigarettes or other tobacco products in the vehicles that you drive or ride in for your job? Smoking is…(Q102)

- (1) Always allowed
- (2) Sometimes allowed
- (3) Never allowed
- (8) I don't know

Not counting decks, porches, or garages, which BEST describes the rules about smoking cigarettes or other tobacco products inside your home? (Q103)

- (1) Always allowed
- (2) Sometimes allowed/ allowed in some places
- (3) Never allowed
- (8) I don't know

Appendix B

EAST CAROLINA UNIVERSITY
University & Medical Center Institutional Review Board
4N-64 Brody Medical Sciences Building · Mail Stop 682
600 Moye Boulevard · Greenville, NC 27834
Office 252-744-2914 · Fax 252-744-2284 ·
rede.ecu.edu/umcirb/

Notification of Exempt Certification

From: Social/Behavioral IRB
To: Eric Soule
CC:
Date: 3/30/2020
Re: UMCIRB 20-000824
Vaping inside of vehicles study

I am pleased to inform you that your research submission has been certified as exempt on 3/30/2020. This study is eligible for Exempt Certification under category # 2ab.

It is your responsibility to ensure that this research is conducted in the manner reported in your application and/or protocol, as well as being consistent with the ethical principles of the Belmont Report and your profession.

This research study does not require any additional interaction with the UMCIRB unless there are proposed changes to this study. Any change, prior to implementing that change, must be submitted to the UMCIRB for review and approval. The UMCIRB will determine if the change impacts the eligibility of the research for exempt status. If more substantive review is required, you will be notified within five business days.

Document	Description
Brief Description at Study Website(0.01)	Recruitment Documents/Scripts
Cognitive Interview Guide(0.01)	Interview/Focus Group Scripts/Questions
ECIG Car Screener.docx(0.01)	Data Collection Sheet
Exempt Information Sheet - ECIG Car Cognitive Interview.docx(0.01)	Consent Forms
Exempt Information Sheet - ECIG Car Quantitative Survey.docx(0.01)	Consent Forms
Exempt Information Sheet - Screener for ECIG Car Cognitive Interview .docx(0.01)	Consent Forms
Flyer(0.01)	Recruitment Documents/Scripts
Grant Application (Please refer to Aim 1 for the current study)(0.01)	Study Protocol or Grant Application
Quantitative Questionnaire ECIG Car.docx(0.01)	Data Collection Sheet
Quantitative Survey(0.01)	Surveys and Questionnaires
Quantitative Survey Participants will Review During Cognitive Interview(0.01)	Interview/Focus Group Scripts/Questions
Screening Survey for In-Person Cognitive Interviews(0.01)	Surveys and Questionnaires