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SUPPORT FOR SMOKING IN CARS WHEN PASSENGERS ARE PRESENT

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Abstract

Background: Smoke-free policies protect people in the US from exposure to secondhand smoke in public spaces and the workplace, but fewer protections exist for non-smokers in private cars. This dissertation examined demographic, regulatory, and occupational characteristics associated with support for and against smoking being allowed inside cars when others and children, specifically, were present. **Methods**: Data derived from 128,835 participants in the 2018-19 wave of the Tobacco Use Supplement to the Current Population Survey (TUS-CPS). For each manuscript, multinomial logistic regressions were conducted using SAS 9.4 to analyze characteristics associated with thinking that smoking should "never," "under some conditions," and "always" be allowed in a car. Models were calculated separately for participant responses to two items asking about smoking in cars "when others are present" and "when children are present", with "never allowed" as the referent response for smoking in cars. **Results**: *Manuscript I*: Those who identified as White, male, non-Hispanic, and everyday smokers were more likely to indicate that smoking should be allowed in cars under some conditions or always when others and when children were present. *Manuscript II*: Characteristics of those who were more likely to indicate that smoking should be allowed in cars under some conditions or always when others including children were present included living in a state which restricted smoking in cars when children under age 12 were present, not having a smoke free rule in their home, and indicating that smoking should be allowed in multiunit housing, recreational areas like bars and clubs, and indoor work areas. *Manuscript III*: Among those who were currently employed, those exposed to smoke at their place of work were more likely to think smoking should under some conditions and always be allowed in cars when others and when children were present. **Conclusions**: This dissertation identified specific characteristics linked to indicating that smoking in cars should be allowed. This project also provides guidance on specific populations who are at higher risk of thinking smoking in a car is acceptable.

Keywords: Environmental tobacco smoke, smoking in cars, secondhand smoke exposure, tobacco control, smoke-free policies

Chapter I: Introduction

Introduction to the Problem

Smoking remains the leading cause of preventable death and disease in the United States, where 14 percent of adults ages 18 and older were considered current cigarette smokers as of 2019 [1]. Exposure to carcinogens found in environmental tobacco smoke (ETS) created by combustion of tobacco products has been shown to lead to cancer, cardiovascular disease, and respiratory damage for both smokers who choose to smoke and non-smokers who may be exposed [2]. Exposure to ETS does not affect everyone equally, with those from populations such as those with low socioeconomic status, ethnic minorities, and those from rural or urban populations experiencing health disparities with worse health outcomes, higher exposure rates, and higher smoking initiation rates attributable to ETS [1, 3-5].

Use of tobacco products and exposure to ETS have seen consistent declines over the past several decades [5]. While legislative measures such as clean air laws have had success in reducing ETS exposure in areas such as the workplace and public areas, non-smokers may still be exposed to ETS in many other areas where it is not regulated such as the private car [6]. Due to the confined nature of the private car and misconceptions by smokers who believe that they are mitigating the risk of ETS exposure through actions such as lowering windows or turning on air conditioning, many non-smokers could be highly exposed while traveling with smokers [7]. Some locations have created smoke-free laws for the private car; within the United States nine states and three territories have passed legislation banning smoking within the private car when transporting children [8]. However, these regulations do not protect all non-smokers and children are unequally protected between states, with some regulating all under 18 years of age (California) to some only protecting those under 8 years of age (Virginia) [8]. While some smokers may be motivated to protect non-smokers by abstaining from smoking in their cars, not all smokers are, thus requiring a better understanding of the characteristics and attitudes related to legislation restricting smoking held by adult smokers to inform targeted efforts etc. etc. [9, 10]. This series of studies identifies specific characteristics associated with and specific populations who would be more likely to indicate that smoking should be allowed inside of a car when others are present and when children are present.

Purpose of the Study

The purpose of this study is to examine demographic, regulatory, and occupational factors that relate to whether adult smokers in cars support the ban of smoking in their car when 1) other passengers are present in the car, or 2) children are present in the car.

Research Questions

Overarching RQ for Manuscript I: What sociodemographic factors and smoking characteristics are associated with beliefs that smoking in a car should not be allowed when either other people are present or when children are present?

1. What demographic and socioeconomic status factors are associated with those who believe that smoking in a car should not be allowed when either other people are present or when children are present?
2. Is more frequent use of tobacco products associated with beliefs regarding whether smoking in a car should not be allowed when either other people are present or when children are present?

Overarching RQ for Manuscript II: Are policies and rules restricting tobacco use in a variety of scenarios and settings associated with someone believing that smoking in a car should not be allowed when either other people are present or when children are present?

1. Are smoking rules or policies at work associated with the belief that smoking in a car should not be allowed when either other people are present or when children are present?
2. Is the presence of smoking rules or policies at home associated with the belief that smoking in a car should not be allowed when either other people are present or when children are present?
3. Are those who live in states where smoking in cars is regulated more likely to believe that smoking in a car should not be allowed when either other people are present or when children are present?
4. Are beliefs towards smoking in other locations associated with the belief that smoking in a car should not be allowed when either other people are present or when children are present?

Overarching RQ for Manuscript III: What occupational factors are associated with support for restricting smoking when other people are present and when children are present?

1. Which occupations are associated with belief that smoking in a car should not be allowed when either other people are present or when children are present?
2. Are workplace restrictions on smoking associated with the belief that smoking in a car should not be allowed when either other people are present or when children are present?
3. Is others' use of tobacco products at someone's place of work associated with the belief that smoking in a car should not be allowed when either other people are present or when children are present?

Overview of Methods

In order to answer these questions, data collected from the Tobacco Use Supplement: Current Population Survey (TUS-CPS) were used to examine any potential relationships between support for smoking restrictions in cars when either children are present or when others are present and the demographic, regulatory, and occupational factors through cross-sectional analysis. Study I examined how demographic factors are associated with smokers' support of smoking restrictions within private cars. Study II examined support for tobacco use within private cars in the most recent wave of the TUS-CPS and whether the implementation of new tobacco control policies is associated with support for tobacco use in cars by smokers and non-smokers. Study III examined TUS-CPS data from employed adults to examine whether those within certain occupational groups and other profession- related factors are associated with support for tobacco use within private cars.

Significance of the Study

By understanding factors associated with support for tobacco use in cars, new health communication strategies and further tobacco control could reduce exposure to ETS. This series of studies intends to provide more detail regarding the characteristics of those who both support and do not support rules for smoking in cars, which should provide information for developing future interventions for reducing smoking in cars tailored to specific audiences based on demographic and occupational factors. Additionally, while some studies have looked at the support for car bans in the United States, most are framed around the context of specifically banning smoking when children are present rather than all passengers, which is also addressed in this study. The most recent analysis of support for smoking within cars using the TUS-CPS was conducted using the 2010/2011 wave, providing an opportunity for a more recent analysis of the TUS-CPS data to both look at more up to date results regarding support as well as to provide an

additional time to compare general trends of support through the existence of the TUS-CPS. Lastly, while policy implementation and change can be a long process, this research proposal hopes to add to the current body of literature that supports efforts to reduce undue exposure to ETS among non-smokers.

Operational Definitions

- *Environmental Tobacco Smoke* (ETS): Smoke produced by the combustion of tobacco products that is released into the surrounding environment, this paper refers to environmental tobacco smoke as a blanket term for all types of smoke including secondhand and thirdhand smoke.
- *Secondhand Smoke* (SHS): The smoke produced from the burning of a tobacco product that is exhaled by smokers and released into the surrounding environment.
- *Ultrafine Particle* (PM 2.5): Particulate matter under 2.5 μm in diameter capable of being absorbed into the bloodstream through the respiratory tract.
- *Every day Smoker*: had smoked 100 cigarettes in their life and are currently smoking every day
- *Some day Smoker*: had smoked 100 cigarettes in their life and are currently smoking some days
- *Car*: Refers to any non-public form of closed transportation including cars, trucks, vans, SUVs, etc.
- *Smoking Policy*: Refers to non-legislative rules and guidelines set up by non-governing bodies such as families, roommates, etc. to limit smoking in designated areas or at designated times.
- *Smoke-free Legislation*: Refers to rules and guidelines set up by a legislative body such as cities, counties, states, and nations that may regulate or enforce non-smoking laws in certain locations or in certain situations.
- *Occupation*: a craft, trade, profession, or other means where one receives payment through work; comprised of white-collar, blue-collar, and services for this series of studies
- *White-collar*: occupations in management, business, education, etc.
- *Blue-collar*: occupations in construction, extraction, installation, etc.
- *Services*: occupations in food preparation, cleaning, personal care, etc.

Chapter II: Literature Review

Purpose

The purpose of this study was to analyze factors that relate to whether adult smokers in cars support the ban of smoking in their car when either other passengers are present in the car or when there are children present in the car. This literature review discusses aspects associated with smoking within the car such as exposure to environmental tobacco smoke (ETS), or the byproduct of the combustion of tobacco products, and its different forms, current tobacco control methods that reduce or eliminate exposure to ETS in the private car, and other behaviors that have been regulated in the private car.

Health Effects of Smoking

Cancer and Smoking

Carcinogens present in tobacco smoke can lead to the development of different forms of cancer in humans, with higher levels of biomarkers associated with tobacco smoke exposure such as tobacco-specific nitrosamines and DNA adducts increasing the risk of developing cancer [2]. Exposure to tobacco smoke carcinogens, both directly to smokers through smoking and indirectly to non-smokers through ETS exposure can result in mutations or changes to genes that decrease the body's ability to effectively manage cancer causing cells that develop and lead to both lung cancer and other smoking-related cancers such as bladder, cervical, colon, and oral cancer [2]. Additionally, the carcinogens in smoke themselves have to ability to cause cancer directly [2].

Respiratory Effects

Smoking directly causes damage to the respiratory pathways when inhaled, with the bronchioles and alveoli of the lungs becoming irritated and damaged due to chronic exposure to tobacco smoke and damaging the elastin of respiratory tissues reducing the ability of the lungs to exchange carbon dioxide and oxygen [2, 11]. Oxidative stress caused by free radicals created from smoking has the potential to lead to cellular mutations, tissue damage, and reduced immunity in the lungs that can lead to the development of chronic obstructive pulmonary disease (COPD) [2, 12]. Additionally, the cilia of the respiratory pathways that normally remove mucus and other debris become paralyzed and ineffective at removing these particles or destroyed when exposed to tobacco smoke [2, 13]. For those with asthma, both direct smoking and ETS exposure can trigger an asthma attack due to the gases and fine particles present in tobacco smoke [1].

Cardiovascular Effects

Exposure to tobacco smoke can have several immediate effects on the cardiovascular system, including vasoconstriction of vasculature due to nicotine and increased production of fibrin from fibrinogen due to oxidative stress; both increasing the risk of occlusion and potential cause of stroke and heart disease [2, 14]. Smoking also over time increases the buildup of plaque in blood vessels which over time leads to atherosclerosis, where vasculature becomes stiffened and narrowed increasing the risk of a clot formation and blockage of blood flow [2]. Similar to the respiratory system, smoking also causes oxidative stress by free radicals in the endothelial linings of vasculature, leading to dysfunction of the vascular tissue [2]. Lastly, smoking has been associated with insulin resistance through hormone activation of the hypothalamic-pituitary-adrenal axis which results in the body producing higher levels of cortisol [2, 15].

Reproductive and Developmental Effects

Smoking has been shown to affect both the fertility of both men and women, but also create developmental anomalies. For men, smoking has been shown to cause chromosomal changes and DNA damage to sperm cells that result in less dense and less motile sperm compared to non-smokers as well as increases the likelihood of developing erectile dysfunction [1, 16]. For women, smoking results in menstrual cycle irregularities that may reduce fertility and if pregnant, smoking increases the risk of complications in the development process. These complications include miscarriage, likely due to reduced blood flow caused by the interference of smoking in the development of uterine arteries, ectopic pregnancy, likely due to smoking interfering in the function of the oviduct, preterm delivery, likely caused by a combination of impaired functions of pregnancy such as placental abruption and uterine overdistention, and development of orofacial clefts, likely due to the teratogenic and DNA damaging effects of smoking related carcinogens [2, 17].

Additive Effects

The key chemical compound of tobacco products, nicotine, works on nicotinic cholinergic receptors in the brain and results in the release of neurotransmitters that produce rewarding sensations in the brain such as reductions in stress and anxiety and increases in pleasure [18]. However, long-term exposure to nicotine results in decreased sensitivity in receptors, thus reducing the initial benefits of nicotine and creates a new physical dependence to nicotine which requires consistent use or withdrawal symptoms will develop such as irritability,

anger, anxiety, and depression [2, 18]. There may also be some genetic factors present for development of addiction, with some studies finding that those with lower expression of the gene CYP2A6 were less likely to become smokers, less likely to become addicted to nicotine, and more likely to have successful quit attempts [2, 19, 20]

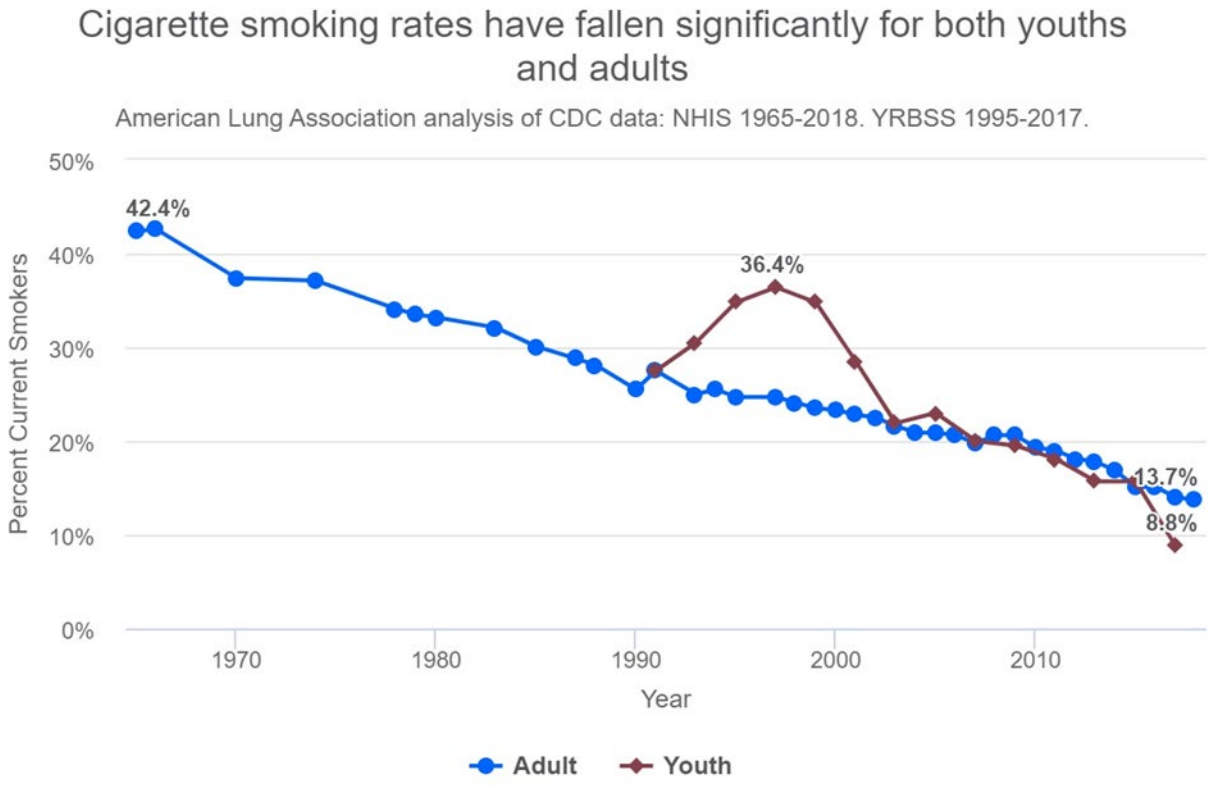
History of Smoking in the United States

Initial Rise of Tobacco Use

Use of tobacco has been present in North America for thousands of years, with estimates dating Indigenous populations having smoked tobacco in pipes as a form of intoxicant rooted deeply in social, spiritual, and ceremonial events beginning at minimum 3,000 years up to approximately 12,000 years ago based on archaeological samples [21-23]. When European colonization began in full in the Americas in the late 16th to 17th century, they acquired knowledge of tobacco use from those originally living in the Caribbean and Gulf of Mexico areas and began trading tobacco back to Europe, which resulted in those from the old world eventually using tobacco primarily smoked through pipes or ground to a powder and snorted through the nose as snuff [24]. In the United States, tobacco use often increased during war, with use of chewing tobacco, cigars, and cigarettes initially increasing during the Civil War with cigarettes mass manufacturing capabilities rapidly expanding in the postbellum United States as factories integrated the use of the newly developed cigarette rolling machine in the 1880s [24]. While cases of deaths associated with tobacco use were noted during this period and referred to as "tobaccosis," the medical community as a whole during this period did not take note of its toxicity to humans [24]. Up until the early 1920s, chewing tobacco, pipe or rolled tobacco, and cigars were the primary forms of tobacco utilized in the United States, with this trend changing between the 1920s and early 1940s due to a combination of targeted marketing of cigarettes to women to reduce the stigma of smoking among women and increased use during World War I and World War II due to soldiers receiving free cigarettes as part of their rations [25-27]. Cigarette advertising also found new ways to target potential smokers, starting in the 1940s with advertising featuring endorsements from physicians to celebrities like movie and television stars both directly using cigarettes in their film and television features as product placement as well as starring in tobacco industry sponsored programs [28, 29]. During the 1950s, however, scientifically rigorous case-control and cohort studies were able to establish the causal link between cigarette smoking and increased odds of death from lung cancer [30]. Prevalence of

cigarette smoking in the United States peaked in the early 1960s but was followed by a strong national effort by public health agencies to help reduce its impact on the populations health [1]. Despite the clear health risk due to smoking, the tobacco industry would still make efforts to remain relevant such as making what they referred to as healthier alternatives over the following decades such low tar, light, and filtered cigarettes and using successful marketing strategy campaigns to increase cigarette use such as Marlboro targeting men using masculine imagery such as the iconic “Marlboro Man” and advertising to increase brand recognition among children such as Camel brand’s “Joe Camel” [31, 32]. Additionally, the tobacco industry spent large amounts of money to lobby United States legislative bodies to ensure further efforts to reduce the prevalence of cigarette smoking would be combated such as funding to counter clean indoor air legislation, tax increases, and advertising restrictions [33]. Through legislative, educational, and scientific efforts, current cigarette smoking being reported at its lowest declining from when the Centers for Disease Control first began measuring cigarette use at approximately 42% among adults ages 18 and older in 1965 to 14% in 2019 [5, 34]. However, the fight against tobacco use is not over, with cigarette smoking remaining the leading cause of preventable death in the United States with more than 480,000 attributable deaths annually and the introduction of new tobacco products such as electronic cigarettes posing new health risks and potentially undermining efforts to reduce smoking by increasing smoking initiation [1, 35].

Figure 1. United States Current Smoking Rate of Adults and Youth by Decade



Current Smoking in the United States

Smoking remains the leading cause of preventable death in the United States despite the broad body of research linking smoking to chronic diseases such as cardiovascular disease, respiratory disease, and cancers [1]. As of 2019, 14 percent of United States adults ages 18 and older were considered current cigarette smokers; while this represents a decline in percent of cigarette smokers in the United States from 20.9 percent in 2005, it conceals growing disparities especially among those with lower education, some ethnic minorities such as American Indians/Alaska Natives, those of lower socioeconomic status, and those in the Midwestern and Southern regions of the United States [1, 5].

Race/Ethnicity Smoking Characteristics

Of all racial or ethnic groups that comprise the United States, American Indian/Alaska Natives are the group with the highest rate of cigarette smoking with 20.9% of adults as reported in the 2019 National Health Interview Survey (NHIS) and 7.5% of youth ages 12 to 17 years old as reported in the 2013 National Survey on Drug Use and Health (NSDUH) [5, 36]. Additionally,

this group also has the lowest rate of cessation compared to other racial and ethnic groups [37]. American Indian/Alaska Natives also experience high rates of targeting by the tobacco industry, with many products using traditionally American Indian imagery and cultural themes in their advertising as well as using specific promotional targeting to increase sales among this population [38, 39]. White Americans have the second highest prevalence of cigarette smoking for both adults and youth among racial and ethnic groups, with 15.5% prevalence of adults being reported in the 2019 NHIS and 7.2% of youth ages 12 to 17 years old in the NSDUH [5, 36]. Those who are Black/African American were reported to have the third highest prevalence of smoking for adults at 14.9% as reported in the 2019 NHIS and the lowest prevalence of smoking of youth ages 12 to 17 at 3.2% in the 2013 NSDUH [5, 36]. Black/African Americans experience the highest rate of secondhand smoke exposure among nonsmokers of all racial/ethnic groups, with exposure among children ages 3 to 11 being exceptionally high at 66.1% [40]. Tobacco industry marketing and advertising is extremely aggressive among the Black/African American community, with high rates of targeted advertising for menthol cigarettes, a more addictive and harmful tobacco product than cigarettes, in this population as well as increased tobacco retailers and advertising among Black/African American communities [41-43]. Hispanic/Latino populations in the United States have a prevalence of cigarette smoking of 8.8% among adults and 3.7% among youths ages 12 to 17 in the 2019 NHIS and 2013 NSDUH respectively [5, 36]. This racial/ethnic group also experiences disproportional tobacco industry influence, with large contributions and support to both Hispanic youth for educational scholarships and to Hispanic organizations such as cultural, political, and art groups [44]. Asian Americans typically have the lowest rates of cigarette smoking compared to other racial and ethnic groups, with 7.2% of adults reporting current use in the 2019 NHIS and 2.5% of youth ages 12 to 17 in the 2013 NSDUH [5, 36].

Geographic Smoking Characteristics

Tobacco use in the United States varies between regions and states. For U.S. Census regions, the highest prevalence of adult cigarette smoking is in the South at 22.7% followed by the Midwest at 22.2%, the Northeast at 20.1%, and the West at 16.3% [45]. Within those regions, states located around the Appalachian mountains such as West Virginia and Kentucky, the deep south such as Alabama and Mississippi, and the Ozarks such as Missouri and Arkansas all have comparatively higher prevalence of cigarette use among adults as seen in the Behavior Risk

Factor Surveillance System [46]. For population characteristics, those who live in rural areas have the highest prevalence of cigarette smoking for adults at 28.5% followed by urban areas at 25.1%, small metropolitan areas at 22.0%, and large metropolitan areas at 18.3% [45]. Rural smokers typically smoke a larger amount of cigarettes per day and also have an earlier age of smoking initiation compared to other smokers living in different population areas [3]. Both rural and urban populations also have higher rates of targeting by the tobacco industry with more advertising of products and urban populations specifically have high tobacco retailer density [41, 47]. Lastly, rural populations are more likely to allow smoking in the presence of children in both the home and the private car compared to other population areas [3].

Socioeconomic Smoking Characteristics

Socioeconomic status (SES) is typically referred to both through level of educational attainment, income level, and occupation. Those who are considered to have low SES, either through low educational status or live near, at, or below the national poverty level, are disproportionally affected by the negative impacts of tobacco use.

Educational attainment and income: Adults with less than a high school education compared to those with at least a college education and adults who live below the national poverty level compared to those above both have higher incidence of lung cancer [48]. Additionally, these lower SES groups experience less success in tobacco cessation compared to those who have access to higher incomes or more educational attainment [1]. Additionally, those with lower income typically do not have access to health care compared to higher income groups and will either not receive a diagnosis at an earlier stage of the disease process for a tobacco-related disease or will either receive worse treatment or no treatment at all [4]. Lower SES populations also receive disproportionate marketing from the tobacco industry, with prior research showing that low SES women will be marketed more coupons or discounts compared to other groups and communities with high populations of low SES having higher tobacco retailer density [47, 49].

Occupational Smoking Characteristics

Rates of smoking differ among adults with different occupations. One study found that working in a blue-collar workplace in the United States were positively associated with both large amounts of smoking and higher rates of ETS exposure [50]. Certain industries also have higher prevalence of current cigarette smoking, with 16% of those working in health care or

social assistance being a current smoker and 25.9% of those working in the accommodation and food services industry [51, 52]. Those employed in construction and extraction were to be found to have some of the highest prevalence of smoking with 31.4% of those industries being current cigarette smokers compared to those in education having the lowest prevalence at 9.7% [53].

Environmental Tobacco Smoke (ETS)

Environmental tobacco smoke (ETS) is created when a tobacco product such as cigarettes, cigars, etc. are combusted and the resultant smoke is released into the surrounding air, either directly from the tobacco product which is referred to as sidestream smoke or exhaled out from the smoker which is referred to as mainstream smoke. Both of these forms of ETS are typically referred to as secondhand smoke (SHS) when nonsmokers are exposed [54]. Another form of ETS, thirdhand smoke (THS) occurs when either of these two forms of ETS settles on surfaces and will reemit carcinogenic compounds back into the air [55]. Human exposure to THS shows carcinogenic effects similar to exposure to SHS [56, 57].

Secondhand Smoke (SHS)

SHS as a Harmful Substance

Current scientific evidence identifies secondhand smoke (SHS) as a cause of both decreased life expectancy as well as increased risk of chronic health conditions such as cardiovascular disease and respiratory symptoms among non-smokers [1]. SHS exposure annually causes almost 34,000 deaths from heart disease, 7,300 deaths from lung cancer, and 8,000 deaths from stroke among non-smoking adults [1]. SHS exposure can also immediately cause or trigger heart attacks and strokes by damaging blood vessels and making blood stickier, thus more likely to clot [58]. SHS exposure among the young presents its own adverse health conditions, including higher risk of Sudden Infant Death Syndrome (SIDS) occurring among SHS exposed infants and higher risk of ear infections, respiratory conditions such as bronchitis, pneumonia, and asthma, and consistent respiratory symptoms like coughing and shortness of breath among SHS exposed children [1, 40, 59]. Despite the success of several federal and statewide policies to reduce exposure to SHS such as smoking bans in public places, workplaces, and restaurants, exposure to SHS among non-smokers still occurs at an excessive rate [6, 60, 61]. Rates of non-smoker exposure have dropped from 87.5% in 1988 to 25% in 2011 but stalled at 25% in recent years [40]. While these declines show promise, continued reduction in SHS exposure among nonsmoking individuals is important as there is no risk-free amount of exposure

to SHS [1, 62]. Many non-smokers still find themselves exposed to SHS in areas not protected by clean indoor air laws such as in private homes, cars, and bars. A report from the Bureau of Labor Statistics in 2019 found that Americans on average spend over an hour per day of their total awake time in transit (1.24 hours) or at the home (7.62 hours) both locations where smoking is not regulated at a federal level [63, 64]. Increased efforts are needed to reduce non-smoker SHS exposure; a study among rural, blue-collar workers found that anti-smoking messaging had no effect on tobacco quit intention and had little to no effect on their adoption of non-smoking family rules [65].

SHS Pollution in Cars

The private car is a location where non-smokers can be exposed to extremely high concentrations of SHS byproducts compared to other locations such as the private home or workplaces. A study among pregnant Greek women found that exposure to SHS in cars increased tobacco exposure biomarkers such as urinary 4-(methylnitrosamino)-1-(3-pyridyl)-1-butanone (NNK), 4-(methylnitrosamino)-1-(3-pyridyl)-1-butanol (NNAL), and urinary cotinine at a higher level than other locations of SHS exposure such as cafes, bars, or restaurants [66]. Airborne particulate matter of less than 2.5 microns in size ($PM_{2.5}$) has the ability to impair lung function by irritating and damaging the alveolar wall and is considered a marker for SHS exposure [67, 68]. While smoking in homes can potentially lead to concentrations of $PM_{2.5}$ approximately 10 times higher than non-smoking homes, smoking in cars can lead to even higher concentrations of $PM_{2.5}$ [67]. One study analyzed different factors such as airflow from open windows, vehicular speed, and air-conditioning in a large, consumer truck affected how the particles from ETS interacted in this environment. Study findings showed approximately 120 times the typical $PM_{2.5}$ one would experience in normal air conditions without combustible tobacco smoke [69]. This study along with another study that conducted a methodological review of current modeling formulas to calculate air quality factors such as air density of $PM_{2.5}$ after tobacco use and created a series of formulas in order to estimate vehicular air quality based on a variety of factors found that vehicular $PM_{2.5}$ concentrations were increased during weather conditions that require closed windows and when using air conditioning such as during hot summer months [69, 70]. Lowering windows while using tobacco products does reduce total $PM_{2.5}$ concentrations in a car; however, a systematic review of studies that measured $PM_{2.5}$ concentrations in cars that lowered at least one window still produced unsafe increases in $PM_{2.5}$

concentrations [7]. This systematic review also highlighted that the majority of testing focuses on only measurements occurring when a smoker is in the driver's seat, with airflow likely being different for backseat smokers [7]. Other methods smokers use to reduce concentration of smoke in a car such as turning on the air conditioning also slightly lowers $PM_{2.5}$ concentrations, but concentrations still remain well over safe levels for exposure [69]. While smokers may take these factors into consideration and choose not to smoke in the presence of others in order to protect them from SHS exposure harms, their smoking still poses health risks to non-smokers through the deposition of SHS on to car surfaces as THS.

Frequency of SHS Exposure in Cars

Despite declines over the past 20 years in adolescent exposure, data from multiple secondary data sources have shown there is still substantial exposure rates to SHS. Two studies examined self-reported SHS exposure rates among non-smoking adolescents from previous waves of the National Youth Tobacco Survey (NYTS), with 39.0% of non-smoking adolescent participants reporting past 7-day exposure to SHS in cars in the 2000 wave, 22.8% of non-smoking adolescent participants in the 2009 wave, and 14.7% of non-smoking adolescent participants during the 2013 wave [9, 10]. Data from the 2019 NYTS showed that 23.3% (approximately 6.1 million) US middle and high school students had been exposed to SHS in the past 7 days [71]. Additionally, a study using the 2006 South Carolina Youth Tobacco Survey found that out of all adolescents exposed to SHS, 85% of those exposed to SHS noted the location of exposure as cars compared to other areas like the home [72]. Adolescents themselves often complain about being exposed to SHS in cars. A qualitative study interviewing children found that they disliked exposure in cars much more than in homes, noting that it was more "claustrophobic" and that methods to reduce smoke like rolling down windows were ineffective [73].

Effects of Exposure to SHS in Cars

A study using data from the 2011 wave of the Behavioral Risk Surveillance System (BRFSS) examined the association of adults possessing a chronic disease outcome with reported rates of SHS exposure, with those who were exposed to SHS in cars being 2.01 times more likely to currently have asthma compared to those who were unexposed. [74]. Additionally, immediate health effects due to SHS exposure in cars can happen as well. A study exposing healthy, non-smoking adults to simulated car concentrations of SHS resulted in decreased exhalation of nitric

oxide, an indicator for pulmonary function, and an increase in both peripheral and central airway resistance [75]. Additionally, there are other, non-physiological effects of exposure of SHS in cars. Youth who were exposed to SHS within the last 7 days in cars in a British cross sectional study were more likely to have a more positive view towards SHS exposure in cars, have lower perceived harm of SHS in cars, and were less likely to support car non-smoking legislation compared to youth who were not exposed to SHS [76]. A study out of New Zealand also found similar results with increased likelihood of smoking susceptibility and initiation among non-smoking youth who were exposed to SHS in cars [77].

SHS Conclusions

The private car remains a location where non-smokers can be exposed to large amounts of SHS due to the smaller amount of space in the car where SHS can be more densely packed. Additionally, misconceptions about the risk of SHS exposure in a car increase the likelihood of non-smoker exposure due to smokers believing efforts such as rolling down windows or turning on air conditioning fully mitigates the risks of SHS exposure. Lastly, while some smokers may fully commit to eliminating non-smokers' direct exposure to SHS by completely eliminating smoking in their car when non-smokers are present, there are still threats to health through exposure to thirdhand smoke.

Thirdhand Smoke

THS as a Harmful Substance

A less well-known byproduct of tobacco use, thirdhand smoke (THS), is found in many indoor locations, including cars, after a tobacco product has been used, including both combustible tobacco products such as cigarettes as well as electronic cigarettes [78, 79]. THS is a toxic residue that forms due to the settling of tobacco smoke on to surfaces. It is comprised of several different carcinogenic compounds referred to as carcinogenic tobacco-specific nitrosamines (TSNAs) which are often used as biomarkers for tobacco smoke exposure, including 4-(methylnitrosamino)-1-(3-pyridyl)-1-butanone (NNK), a tobacco-specific byproduct [56, 57]. These compounds are an additional source of exposure for non-smokers, oftentimes settling on surfaces after the smoke has cleared and can be absorbed through the skin or through hand to mouth behaviors common in children [80]. Additionally, these compounds can off-gas after landing on surfaces, releasing further amounts of carcinogenic compounds into the air long after smoking occurs [55]. Even if a smoker does not smoke in the presence of non-smokers they

are trying to protect, ETS exposure related biomarkers such as cotinine among those who frequent that space will show ETS exposure due to THS, with one study showing urine cotinine levels five to seven times higher in infants whose parents smoke indoors but away from children compared to infants whose parents smoke outdoors [81] The measurement of THS can also be used to measure general exposure to total ETS, with hand wipes used on children having been shown to be a suitable exposure detector to stand in for serum cotinine when airborne measures of smoke are no longer detectable [82]. While THS has received comparatively less focus than SHS in tobacco cessation messaging, there are some situations where when used correctly in health messaging, it could be helpful. A study among people living in a socioeconomically disadvantaged community found that both non-smokers and smokers believed that information about THS would be motivating to create smoke-free home rules [83].

Third Hand Smoke in Cars

Private cars have a much smaller inside volume compared to homes and have been shown to have much higher levels of $PM_{2.5}$ concentrations. This smaller space means more THS particles can deposit on car surfaces such as on seat materials, windows, and panels. In addition to previous methods mentioned in regards to SHS mitigation, one method that smokers employ to attempt to reduce its presence is by cleaning surfaces and using fragrances [84]. However, most cleaning efforts do not completely remove THS from surfaces such as carpets or any cloth based material and any cleaning efforts being negated by continued exposure to ETS [85]. Additionally, locations that are not consistently smoked in but have been in the past can still hold THS on surfaces and even accumulate over time as seen in rented cars, where even designated non-smoking cars still had THS residue despite cleaning efforts [86]. While no study has looked at how long THS can remain on car surfaces, studies in locations such as multiunit housing have shown THS still being present two months after a smoking tenant moved out and the unit was cleaned [87, 88]. For parents who smoke, a study examining home and car smoking policies found that parents who believed that THS was harmful to children were 1.69 times more likely to institute a smoking ban in their car compared to those who did not believe it was harmful [89].

THS Conclusions

Even if smokers attempt to protect non-smokers by not smoking in their presence inside of their cars, they may still be exposing others to the negative health effects of tobacco through THS. Highlighting the need for smokers to refrain from smoking inside of their car and choosing

other locations needs to be a focus for future health communication efforts. Additionally, emphasizing the ineffectiveness of cleaning methods may be needed to redirect smokers away from use inside of their cars.

Smoking Rules and Policies

Most household rules and legislative actions designed to reduce the amount of ETS exposure that non-smokers experience is not focused on the private car, instead, these measures instead happen more frequently in workplaces, public spaces, or on public transportation [90]. There are two primary methods that impose some form of restriction on smokers while in private spaces like the car or home: the use of self-enforced rules established by households for the safety of their passengers or the use of legislation that is regulated by enforcing agencies. Most current research on these forms of restriction focus on smokers' and nonsmokers' support or lack of support for the use of self-managed or governmentally enforced smoke-free policies within cars.

Smoking Policies

Smokefree Legislation

Both smokers and non-smokers support smoke-free policies, with high levels of support for smoking regulations in workplaces and restaurants [91]. In addition, approval for smoke-free policies has been shown to increase even after implementation, with data from California, New York, and Minnesota all showing increasing support for smoke-free legislation after a policy had been enacted [92, 93]. Within the United States, only nine states (Arkansas, California, Illinois, Louisiana, Maine, Oregon, Utah, Vermont, and Virginia) and three territories (Puerto Rico, Guam, and the Northern Mariana Islands) have any law that regulates smoking within the private car [8]. However, the legislation for these locations does not protect all non-smokers, instead only those of certain ages, typically designed to protect children under certain ages, from less than 8 years of age (Virginia) up to less than 18 years of age (California, Illinois, Oregon, Puerto Rico) [8]. Internationally, similar legislation is framed around protecting non-smoking children when in the car, with several European Union countries (France, Belgium, Poland, etc.) and Oceania countries (Australia, New Zealand, Malaysia, etc.) banning smoking in cars when minors are present [94]. There are few countries that have complete smoking and driving laws regardless of age, with examples such as Turkmenistan, Argentina, and Jordan [94]. However, these laws are framed more towards reducing distracted driving rather than protecting non-

smokers. Smoke-free policies have been successful in reducing exposure among those who the legislation is designed to protect, such as non-smoking workers in businesses like restaurants or passengers on public transportation. Smoke-free car legislation passed in 2007 in California resulted in decreases in reported student SHS exposure at a higher rate than national averages [95]. In England and Scotland, banning smoking when children were present has also shown success in reducing SHS exposure, with a reported decrease in self-reported exposure by children ages 13 to 15 in England from 6.3% to 1.6% [96]. Likewise, a study out of Quebec (one of the only Canadian provinces that does not ban smoking when children are present in a car) found the frequency of smoking with children present in the car decreased when the driver believed that there was a policy present that banned smoking in cars with children compared to those who did not [97].

Attitudes Towards and Support for Smoke-Free Legislation

An analysis of the 2010-2011 Tobacco Use Supplement of the Current Population Survey (TUS-CPS) found substantial support from participants for general smoke-free policies when passengers were present (73.7%) as well as even greater support for when children were present (93.4%). [98]. Additionally, a survey from the International Tobacco Control Four Country Survey identified a majority of US smokers (60%) supported smoke-free car laws, primarily among those who believed that ETS exposure could harm non-smokers and children [99]. However, this study also showed that the US had comparatively lower rates of support for smoke free car bans from smokers compared to participants from Canada, the United Kingdom, and Australia. A cross-sectional study of adults living in Spain found that adults typically favor legislation that regulates smoking in cars with children at a higher percent (90.1%) compared to just a cumulative ban for all passengers (61.6%); non-smokers in this sample were also more supportive of total car smoking bans compared to current smokers [100]. Other international studies from New Zealand and Italy have similar findings, with non-smokers having higher support for a car smoking-ban compared to current smokers, with both groups having higher support for a ban for when children are present in the car compared to when there are only adults [101, 102]. Despite having positive effects on reducing exposure to SHS, smoke-free legislation does not fully prevent SHS and THS exposure, with one study reporting that regardless of the presence of clean air laws, almost half of young adults living in areas with smoking restrictions still reported SHS exposure in cars [63].

Family Rules

Prevalence of Smoke-Free Family Rules

A randomized control trial of US parents whose child was enrolled with selected pediatric offices found that smoke-free family rules were more often seen in non-smoking parents and parents who smoked less than 10 cigarettes per day compared to parents who were current smokers or smoked more than 10 cigarettes per day [103]. Likewise, a study using 2012-2013 data from the National Adult Tobacco Study (NATS) found that nonsmokers had a higher prevalence of smoke-free car rules (88.9%) compared with current tobacco users (34.2%) [104]. Similar to traditional tobacco products, 63.8% of adult US participants from a cross sectional, 2017 survey had personal rules prohibiting the use of electronic smoking devices within their personal cars. [105] A South Carolina study of families showed that those with more non-smoking household rules were associated with a reduction in self-reported SHS smoke exposure in their children, with those having strict non-smoking family rules having reported SHS exposure of 36% compared to 84% and 91% SHS exposure among those who have partial or no smoking rules respectively [72].

Attitudes Towards and Support for Smoke-Free Family Rules

There are a variety of reasons why families will establish their own non-smoking rules in the private car. A qualitative study on smoking rules in private cars among rural families from Georgia found that rules were typically enforced if there were children or non-smokers in the car or if the smoker caused damage to the car through dumping hot ashes or causing burns but allowed smoking if windows were cracked [106]. This study also noted that total bans would happen due to non-health reasons such as the purchase of a new car. Car smoking bans can be associated with increased likelihood of smoking cessation among current smokers as well as greater perceived self-control among New York women who were self-reported smokers [107]. Lastly, Kai-wen et al. found that those with a voluntary smoke-free rule in a personal car was four percent more likely to live a location that has general smoke-free legislation, indicating that smoke-free legislation as a whole can have a positive effect on reducing tobacco exposure in the private car [108].

When comparing the United States to other countries, there are many similarities in factors that influence presence of family smoking rules. A study sampling current smokers from France, Germany, and the Netherlands found that being a non-smoker, being older aged, having

younger children, smoking less, and having non-smoking home rules were associated with having a family based non-smoking rule in the private car [109]. Similar findings were present in England, where students from the second wave of a cohort study were more likely to be exposed to smoke if they had no family rules, and those coming from an economically disadvantaged family and having family members who smoked decreasing the presence of a non-smoking family car rule [110].

Other Behaviors regulated in Cars

While some may argue that smoking bans in cars would be ineffective, other behaviors in the private car have been successfully regulated. Use of seatbelts, personal electronic devices, and alcohol. One thing to note for any sort of regulation is that the efficacy of a policy relies on it being enforced; if people believe that they are unlikely to be caught breaking a law and that the consequences of infraction of a law are minimal, then that law will likely be ineffective. For most car related traffic laws, laws can be divided into primary and secondary enforcement. Primary enforcement of a law allows law enforcement to perform a stop directly for the behavior in question, such as stopping a driver for not wearing a seatbelt if requiring a seatbelt was a primary law. For secondary enforcement using seatbelts as an example, a law enforcement officer would not be able to directly stop someone for not wearing a seatbelt, but would be able to give a citation for not wearing a seatbelt if they were pulled over for another offense such as a crime [111].

Seatbelts

By 1996, 49 out of 50 states had some form of seatbelt law requiring at least the driver of a car to use a seatbelt [112]. Implementation of a seatbelt law typically saw large increases in seatbelt use; for example, in 1985 when Michigan passed a seatbelt law, use of seatbelts went from 19.8% utilization to 58.4% within 5 months of passage [113]. For locations with a seatbelt law, according to data from the 2008 wave of BRFSS found that 88.2 percent of adults living in a state with primary enforcement of seatbelt laws reported always wearing a seatbelt compared to 79.2 percent of adults in a state with secondary enforcement [114]. Additionally, data from the National Highway Traffic Safety Administration between 1991 and 2003 showed that states that switch from secondary enforcement of seat belts to primary enforcement would see a 10 percent increase in seatbelt usage [115].

Texting

A somewhat more recent issue in the United States due to the explosion of use and availability of cellphones, use of these devices while operating a motor car has seen increasing regulation, with 48 states currently banning text messaging and driving and 24 states banning hand-held use of cellphones while driving [116]. Similar to seatbelt laws, research has shown states with primary enforcement of texting while driving has lower fatality rates compared to locations with secondary enforcement or no enforcement [117].

Alcohol

More restrictive alcohol-related policies also can help reduce the risks associated with alcohol use in a motor car. A policy assessment of alcohol focused policies in the United States found that stricter policy environments were associated with fewer motor car fatalities, with scaling benefits where more restrictions further reduced fatalities [118]. Likewise, other regulatory practices such as increasing fines for those driving under the influence of alcohol, increased beer taxes, and open container policies has been shown to reduce rates of fatalities [119].

Smoking Policies and Rules Conclusion

While some smokers may be motivated to protect non-smokers by abstaining from smoking in their cars and having smoke-free rules in spaces where non-smokers are at risk of ETS exposure, not all smokers are motivated and may require regulation in order to protect non-smokers from their health decisions resulting from use of tobacco products. While use of policies restricting smoking while in the car have been shown to be effective, they also contain several gaps that do not protect nonsmokers such as only regulating smoking when children are present in a car instead of all non-smokers. Groups that may experience health disparities due to ETS exposure such as ethnic minorities, the elderly, or children may be further affected by exposure in the car. Lastly, when looking at other car regulations, the need for stronger enforcement of policies through primary enforcement is important when looking at future efforts to reduce exposure in cars if one either lives in an area that regulates smoking while in a car or intends to pass legislation regulating use while in a car.

Chapter III: Methodology

Purpose

The purpose of this chapter is to introduce the research methodology that was used for the analysis of factors that are associated with the support for use of tobacco within private cars. Study I examined how demographic factors are associated with smokers' support of smoking restrictions within private cars. Study II examined support for tobacco use within private cars in the most recent wave of the TUS-CPS and whether the implementation of new tobacco control policies is associated with support for tobacco use in cars by smokers and non-smokers. Study III examined TUS-CPS data from employed adults to examine whether those within certain occupational groups and other profession- related factors are associated with support for tobacco use within private cars. By understanding factors associated with support for tobacco use in cars, new health communication strategies and further tobacco control could reduce the disparities associated with environmental tobacco exposure.

Tobacco Use Supplement – Current Population Survey (TUS-CPS) Research Design

Current Population Survey Sampling and Participant Universe.

The Current Population Survey (CPS), the parent survey of the TUS-CPS, is a longitudinal national survey for labor force information administered by the United States Census Bureau to about 56,000 households across the United States each month for the primary purpose of understanding the economic and social factors of the American people as a labor force. The CPS's secondary purpose is to collect demographic information regarding this population.

The CPS uses a probability selected sample following a 4-8-4 sampling scheme, where respondents are in the survey for four months, out for eight, and then return for a final four months in order to ensure continuity of the sample and minimize participant dropout. Additionally, this sampling allows for reliable comparison of the sample between months or years. This sampling also follows a stratified two-stage sampling scheme with the first stage comprised of the selection of primary sampling units which include geographic regions nested within a state such as metropolitan areas, large counties, or a group of smaller counties and then sample housing units selected from those. These primary sampling units are then grouped into strata in order to create as homogenous selections as possible based on social and economic characteristics that are related to unemployment. One primary sampling unit is sampled in each

stratum with probability of selection being equal to its proportion of the population as of the most recent US census, with this data's sample coming from the 2010 census.

The second stage of sampling is conducted annually, with housing units grouped together into larger cluster blocks based on similar demographic and geographic characteristics then sampled from using area sampling techniques. The housing unit addresses, which serve as a proxy for the unit of observation as person level data, comes from the Master Address File which is used and updated by the United States Postal Service by tracking the maintenance of mail delivery points. Data for the CPS is person level, with self-responses for those 15 years of age or older and proxy responses for non-respondents. Sample design is state based with a designee for the house, typically the homeowner or primary renter, representing all household data.

Data is collected by field representatives and telephone interviewers to collect survey data from each sample. Eligible households are determined by first identifying whether an address is A) occupied, B) the primary residence of the occupants, and C) civilians. A field representative first tries to identify a household designee (reference person) who would be knowledgeable about the characteristics of all household members (demographics) as well as primary place of residence. The field representative then collects data regarding labor and occupation from all household members ages 15 and older. For the rest of the first portion of the 4-8-4 schedule, the field researcher conducts primarily phone interviews (85%) for the second, third, and fourth months. Subjects are excluded from the basic CPS survey if they are ages 14 years or younger, considered institutionalized (living in correctional institutions or nursing home), or live in university dormitories due to the majority of university students having a primary address elsewhere. Table 1 provides a timeframe for sampling for the CPS.

Table 1. Sampling Timeframe for the Current Population Survey

Year 1		Year 2	
Calendar Month	**Month in Sample**	**Calendar Month**	**Month In Sample**
January	1	January	5
February	2	February	6
March	3	March	7
April	4	April	8
May	**Eight Months Off**	May	**No Longer in CPS Sample**
June		June	
July		July	
August		August	
September		September	
October		October	
November		November	
December		December	

Current Population Survey – Tobacco Use Supplement Sampling and Participant Universe

The Tobacco Use Supplement – Current Population Survey (TUS-CPS) is a National Cancer Institute sponsored supplemental cross-sectional survey subcomponent of the CPS. The TUS-CPS is a nationally representative periodic survey given every three to four years which began with the 1992-1993 wave. All waves include 1992-1993, 1995-1996, 1998-1999, 2001-2002, 2003, 2006-2007, 2010-2011, 2014-2015, and 2018-2019. Data from waves after 2006 covers United States civilians from non-institutionalized populations over 18 years old with 1992-2006 data for those 15 years or older. Data for the TUS-CPS is collected during three time points, typically with the first time point in July of the first year of sampling in the 4-8-4 design then the second and third time points coming in January and May of the second year of sampling. Current eligibility for TUS-CPS includes all requirements for the standard CPS, with additional criteria of having 1) completed the primary CPS survey as well as being 18 years of age. For households with two or less TUS-CPS eligible members, all eligible members are selected. For households with three or four eligible members, two are randomly selected. For households with more than four eligible members, three are randomly selected. The current national sample size for TUS-CPS is approximately 240,000 individuals, with about 64% of respondents completing the survey via telephone. Non-response for the TUS-CPS is 17.8 percent for total eligible respondents (self-and proxy) and 37.7 percent for self-respondents only. Inclusion criteria for the TUS-CPS accounting for both the base survey and the supplement includes additional criteria, being that the participant is aged 18 years or above and in the civilian noninstitutional population

of the United States. Exclusion criteria for the TUS-CPS is that they are aged 17 years or younger, in the armed forces, and have an incomplete CPS interview. All TUS-CPS data is weighted and available to the public for use via the National Institutes of Health's National Cancer Institute website. TUS-CPS does have the ability to examine data from county-level data as well as state and national data; however, county data level may not be available in counties with too small of a population.

Survey Specific Limitations

There are some limitations for the TUS-CPS survey. First, data is self-reported, so tobacco use amounts are not validated by forms of biomarker such as serum cotinine levels like other nationally relevant surveys. However, in a general, non-clinical population, self-reported smoking is typically an accurate measure [120]. Additionally, the CPS base survey reports that there are coverage differences when it comes to race/ethnicity and sex, with those who identify as Black being less covered in sampling than those who identify as non-Black and those who identify as male being less covered in sampling than those who identify as female. There is potential for selection bias, but weighting practices found in the TUS-CPS reduces the impact of these differences. There may be some overlap between the two questions asking about smoking in a car due to the first prompt, whether others are present, being broadly worded and could be interpreted by the participant as including children as well. However, this potential overlap is likely not an issue due to the overall goal looking at general support to reduce tobacco smoke exposure for all non-smokers rather than just only children. While the term "car" is oftentimes taken to be considered any sort of personal motor car, a limitation in the wording may be present due to the subject not considering the options of other forms of transportation like trucks or SUVs to be included in this designation, thus potentially creating a false negative response when they answered. Lastly, the data were collected cross-sectionally from the different waves of the TUS-CPS, so no causal inferences can be made.

Proposed Manuscripts

Overarching RQ for Manuscript I: What factors are associated with beliefs that smoking in a car should not be allowed when either other people are present or when children are present?

Overarching RQ for Manuscript II: Are tobacco rules or policies limiting smoking in the home, car, and/or workplace associated with someone believing that smoking in a car should not be allowed when either other people are present or when children are present?

Overarching RQ for Manuscript III: What occupational factors are associated with support for restricting smoking when other people are present and when children are present?

Inclusion and Exclusion Criteria for Manuscripts I-III. Eligibility for all three analyses followed general TUS-CPS criteria which are comprised of the base CPS survey requirements as well as additional TUS-CPS requirements.

Subjects are included in the basic CPS survey if:

- They are U.S. residents
- They are civilian and non-institutionalized

Subjects are excluded from the basic CPS survey if:

- They are ages 14 years or younger
- They are considered institutionalized
- They live in areas outside of the 50 U.S. states or Washington D.C. yet within U.S. sovereignty
- They are living in a residence not considered their primary residence like university housing
- They lack a permanent residence

Subjects are excluded from the TUS-CPS supplement if:

- They did not complete the base CPS survey
- They are ages 17 years or younger
- They are part of the armed forces

Creation and Management of Shared Measures for All Studies

Creation of Weighted Data.

Analysis and management of data files were conducted using the statistical software SAS 9.4 (SAS Institute Inc) due to the dataset being weighted. SAS data in the form of replicate weights and datasets from the July 2018, January 2019, and May 2019 SAS datasets from the

National Cancer Institute's online database were used. Analysis steps followed guidelines created by the National Cancer Institute for specific weighted analysis of the TUS-CPS [121]. Replicate weights for each TUS-CPS dataset wave were used and concatenated. The TUS-CPS data needs to be converted into full-sample and replicate weights in order to account for sampling differences of participants between waves of data and to estimate standard errors by accounting for survey design [121]. The TUS-CPS uses standard CPS final weights to adjust for selection into the base survey and then accounts for non-response by creating TUS-specific non-response weights to account for self non-responses and proxy non-responses. These two non-response groups are post-stratified to match state-specific Black alone and non-Black alone population distribution based on the 2010 US census, matched by national demographic totals for age by sex by race by origin groups, then matched to state specific population totals for the age by sex by race groupings based on the US Census Bureau's Population Estimates program.

Replicate weights were generated by algorithms designed by the US Census Bureau simulating drawing subsamples with the full design. These replicate weights help extrapolate findings from the sampled units to the larger population that they represent. Variation between estimates from this algorithm are created using the subsamples and full sample to compute adjusted standard errors for weighted point estimates. Standard error for estimating variances was measured using replicate weights provided by the National Institute of Health (NIH) and using Fay's method of Balanced Repeated Replication (BRR), a form of BRR that prevents undefined estimates due to division by zero [122].

Management of Secondary Data.

First, main TUS-CPS data from each of the three survey waves, July 2018, January 2019, and May 2019, were compiled into one main dataset using SAS. Self-respondents were selected for each survey wave by choosing variables selecting for adult civilian household members ages 18 years and older, complete interview entries, and self-respondents. Data for each wave were sorted by their unique household identifier, the self-response replicate weight files was read in and merged, and then concatenated with the other TUS-CPS waves to create a complete 2018-2019 TUS-CPS data file. In order to account for the new increased data file size, person-unit weights and replicate weights was divided by three to match a sample representative of the US population. Study specific analyses are discussed in their corresponding sections.

Common Variables Used for Each Research Question.

In order to answer the proposed research questions, smoking-related variables from the TUS were selected to assess tobacco product use and dependence. Demographic variables were imported from the base CPS survey into the TUS-CPS data set. Appendix I shows the full question and answer options for each question used in the study.

Demographic characteristics:

Because support for smoke-free policies is influenced by several factors, accounting for demographics is important to properly analyze factors that are being hypothesized to be associated with support for smoking in cars. For example, prior analysis of the TUS-CPS data regarding support for smoking in cars found that those who identify as male, younger in age, and have lower educational status to have lower odds of supporting not smoking in a car when others are present or when children are present [98].

Sex: What is your sex?

Age: What is your date of birth?

Hispanic Origin: See Appendix I for entire question set probing for race and ethnicity. To summarize, multiple questions are designed to ascertain whether the respondent is of Hispanic, Latino, or Spanish origin.

Race: After assessing Hispanic origin, the survey then asks the respondent to identify what race they identify as then provides follow up questions to determine more specific subgroup membership of either Asian or Native Hawaiian and Pacific Islander.

Educational Attainment: What is the highest level of school you have completed or the highest degree you have received?

Tobacco Use:

Tobacco use questions are included due to previous studies showing that smokers who are considered more dependent to nicotine by smoking every day are less likely to support smoke-free cars compared to both light smokers and non-smokers [98, 99].

Cigarette Smoking Status: Do you now smoke cigarettes every day, some days, or not at all?

Recoding of Variables. Due to the wide range of entries available for certain responses, some variables entries were recoded. For example, the variables for smoking when others are present and when children are present include entries of “no response,” “refused,” “don’t know,” “not in

universe," "always be allowed," "be allowed under some conditions," and "never be allowed." For purposes of data management, variables that are not "always be allowed," "be allowed under some conditions," and "never be allowed" for those two items was recoded to missing and analyzed to see if there are any differences between those who answer these questions and those who do not. To account for this missing data as non-response error, the TUS-CPS provides nonresponse replicate weight files to apply to the dataset for analysis [121].

Data Analysis: Weighted Analyses. For each manuscript, basic frequencies, cross-tabulations, and regression analysis were conducted using SAS 9.4 (SAS Institute Inc) to determine if there were associations between support or opposition to smoking when others are present or when children are present in a car and the demographic variables and covariates of interest. Due to the overarching goal of understanding relationships associated with thinking smoking should never, under some conditions, and always be allowed in a car when others are present or when children are present within a car, the primary regression model was a multinomial logistic regression.

Human Subjects Protection.

The TUS-CPS is a publicly accessible, federally conducted survey which is deidentified to prevent linkage of responses and subject identity. Due to the anonymity of the data, this collection of manuscripts has minimal to non-existent opportunities to cause harm to participants. The CPS survey requires that informed consent is obtain for responses to be recorded [123].

Study Specific Methodology

Manuscript I

Overarching RQ for Manuscript I: What factors are associated with beliefs that smoking in a car should not be allowed when either other people are present or when children are present?

1. What demographic and socioeconomic status factors are associated with those who believe that smoking in a car should not be allowed when either other people are present or when children are present?
2. Is more frequent use of tobacco products associated with the belief that smoking in a car should not be allowed when either other people are present or when children are present?

Hypotheses for Manuscript I:

HR1: Those who identify as male will have lower odds of thinking that smoking in a car should not be allowed either when other people are present or when children are present.

HR2: Those who have lower educational attainment will have greater odds of thinking that smoking in a car should not be allowed either when other people are present or when children are present.

HR3: Those who are everyday tobacco users will have lower odds of thinking that smoking in a car should not be allowed either when other people are present or when children are present.

Analysis Strategy to Answer Manuscript I Research Questions

To answer the overarching research question for Manuscript I, associations was assessed between the two items of interest involving support for smoking in cars and demographic characteristics.

Variables:

Demographic Variables. Demographic variables for Manuscript I include those listed prior for the shared manuscript variables. These variables have been selected due to their unique relationships to rates of smoking as discussed in Chapter II.

Sex: Because smoking rates and support for smoking non-smoking policies differ between sexes, this variable is important to include for analysis [5, 98].

Age: Smoking rates differ by age groups, with adults ages 25 to 44 and adults ages 45 to 64 having a higher rate of current cigarette smoking than adults ages 18 to 24 and adults

ages 65 and older [5]. Additionally, support for smoke-free policies typically increases with age [98].

Race/Ethnicity: Different races and ethnicities have both different rates of smoking as well as different rates of tobacco smoke exposure [5, 40].

Highest Level of Educational Attainment: Smoking status rates differ by level of education, with higher education typically being associated with higher rates of tobacco use [5].

Demographic Variable Recoding.

Appendix I shows the complete item list that was used for this series of studies. Some items were recoded for analysis. For 'Hispanic Origin,' a question first asks whether the respondent is of Hispanic, Latino, or Spanish origin. The next question asks what specific subgroup within those three selections the respondent identifies as if they responded yes. Those who identify as any of these groups was recoded as 'Yes' for Hispanic origin and those who did not choose any of those responses was recoded as 'No' for the purposes of analysis. The respondent was then asked what race they identify as with several specific race only responses as well as combination of races responses. For this study, only 'White only', 'Black or African American only', and 'Asian only', and 'Native Hawaiian or other Pacific Islander only', was used. Following standards established by the federal Office of Management and Budget, 'Asian only' and 'Native Hawaiian or other Pacific Islander only' were grouped into a new code of 'Asian or Pacific Islander' [123]. Highest level of school completed or degree received was recoded into fewer variables from the original item listing multiple grade levels rather than a variable denoting less than high school education in order to better match traditional reporting of education variable groups. The new groups were 'Less than high school degree' comprised of all grade completions lower than high school graduate, 'high school degree or equivalent' comprised of those who earned either a high school degree, a GED, or who completed some college with no degree, 'associate degree in college' with both selections, and lastly 'Four year degree or higher' comprised of those who selected 'bachelor's degree', 'master's degree', 'professional school degree', and 'doctorate degree'. For more detail regarding each educational attainment selection, please refer to Appendix I.

Smoking Variables.

Not all smokers are likely to have the same outlook when it comes to exposing others to their tobacco smoke. For example, heavy smokers may be less concerned about their smoke affecting others compared to smokers who do not smoke as often. Current smokers and heavy smokers are less likely to support smoking bans in cars [5, 124].

Tobacco Smoke Variable Recoding

The NIH recommends recoding a new variable referred to as "current smoking status" by taking the continuous variable for cigarettes smoked per day and recoding it into three new groups: "current cigarette smoker," "former cigarette smoker," and "never cigarette smoker." This current smoking status variable also incorporates the response of having smoked at least 100 cigarettes in the respondent's lifetime to account for the minimum amount of cigarettes needed to match the standard definition of being a current cigarette smoker. The basic cigarette questions of has the subject has smoked at least 100 cigarettes in their life, answered with 'yes' and 'no' and the current cigarette smoking status of smokes cigarettes 'every day', 'some days', or 'not at all' is used to create a new recoded variable with responses of 'Current cigarette smoker', 'former cigarette smoker', and 'never cigarette smoker'. Number of cigarettes smoked per day provides number entry of number of cigarettes smoked. Smoking initiation age provides a number entry for the age the subject first started smoking cigarettes regularly or whether they are not a regular smoker.

Data Analysis.

Analysis of data was conducted using SAS 9.4 (SAS Institute Inc). Frequencies were run to ensure the data appeared normal and free of coding errors. Then, cross-tabulations were conducted to assess any relationships between smoking and demographic variables and the variables of interest related to smoking in cars. Two multinomial logistic regressions were then conducted to test whether demographic variables are associated with an increase in odds of that a person reporting that smoking should never, under some conditions, or always be allowed in a car. One regression model tested for when others are present in a car and the other tested when children are present in a car. Model fit statistics including Akaike's Information Criterion (AIC), the Schwarz Criterion (SC), and -2 Log L were conducted to ensure the models that included the covariates were a better model fit than a model with the intercept only. The global null hypothesis consisting of three chi-square statistics for each model was tested to either accept or

reject the null hypothesis. Estimation of the logistic models' coefficients were conducted using maximum likelihood estimation. Standard errors and p-values were assessed to determine whether data were statistically significant. Due to the items having either yes/no or categorical response options, logistic regressions were used to identify and measure associations and acquire odds ratios for whether each variable increases or decreases the odds of supporting smoking inside a car when either others are present or when children are present. Referent variables for regression analysis are identified in Appendix I and II. Multicollinearity was assessed and found to be not in effect in the models with all tolerances for variables above cutoff recommendations and variance inflation factors falling within acceptable ranges [125].

Potential Limitations and Strategies.

There are some potential limitations for manuscript I. First, some items may be subject to recall bias such as age when first regularly smoking or estimation issues of smoking frequency by the smoker. Additionally, smoking rates from the TUS-CPS do not have biochemical marker validation such as serum cotinine measurements so there may be issues due to self-report having the potential to slightly underestimate smoking prevalence [126]. However, this underestimation of self-reported smoking appears to be minimal in the United States compared to other countries studied [127]. Social desirability bias may be present in the items related to children. Participants could under report their thoughts regarding smoking in the presence of children from always allowed to sometimes or never allowed due to the social stigma of smoking [128]. However, a review found that exposure for children to ETS smoke is accurately reported by their parents but further research is needed for other children present in the car [129]. A limitation that can arise with using regression for analysis is incorrectly choosing predictor variables which has the potential to result in incorrect estimation of associations; however, to mitigate this risk, univariate analyses of each variable with the variables of interest that involve smoking in cars were used prior to running any logistic regressions [130].

Manuscript II

Overarching RQ for Manuscript II: Are tobacco rules or policies limiting smoking in the home, car, and/or workplace associated with someone believing that smoking in a car should not be allowed when either other people are present or when children are present?

1. Are smoking rules or policies at work associated with the belief that smoking in a car should not be allowed when either other people are present or when children are present?
2. Is the presence of smoking rules or policies at home associated with the belief that smoking in a car should not be allowed when either other people are present or when children are present?
3. Are those who live in states where smoking in cars is regulated more likely to believe that smoking in a car should not be allowed when either other people are present or when children are present?
4. Are beliefs towards smoking in other locations associated with the belief that smoking in a car should not be allowed when either other people are present or when children are present?

Hypotheses for Manuscript II:

HR1: Having smoke-free work policies will be associated with having higher odds to support the belief that smoking in a car should not be allowed when either other people are present or when children are present.

HR2: Having smoke-free home policies will be associated with higher odds of supporting the belief that smoking in a car should not be allowed when either other people are present or when children are present.

HR3: The use of electronic cigarettes to smoke in areas where cigarette smoking is not allowed will be associated with greater odds of the belief that smoking in a car should not be allowed when either other people are present or when children are present.

HR4: The odds of having the belief that smoking in a car should not be allowed when either other people are present or when children are present will be lower among those who live in states that have policy that restricts smoking in cars when children are present.

Analysis Strategy to Answer Manuscript II Research Questions

To answer the overarching research question for Manuscript II, associations were assessed between the two items of interest involving support for smoking in cars and whether the

respondent has different smoke free rules and policies in their life. Previous studies from other countries have shown that those who are regulated by other smoking bans in indoor spaces are more likely to support regulation on smoking in cars [92, 93]. Frequencies were run to ensure the data appears normal and then cross-tabulations were conducted to assess any relationships between the variables of interest. Multinomial logistic regressions were run to test whether the smoke-free rules variables are associated with an increase in odds of that a person thinks that smoking in a car when either others or children are present. Demographic variables found to be highly associated with support for rules restricting smoking in a car when either others or when children are present were controlled for at this stage in order to test specifically the effect of other smoke-free policies on the main items of interest.

Presence of Smoking Policies Variables. Several items ask if both smoking is restricted in certain locations and what that restriction entails. These presence of smoking policy items were included due to past research showing that living in areas with smoke free policies were more likely to have a voluntary smoke free policy in their own cars [108]. Additionally, having voluntary smoke free policies in the home have been associated with also having non-smoking car policies [109].

> **Home Smoking Ban**: Which statement best describes the rules about smoking inside your home?

Opinion of other Smoking Policies Variables. Because the items of interest are looking at support for non-smoking rules in cars when others are present, analysis of support of smoking policies in other locations could provide additional insight into patterns of support.

> **Opinion of Multiunit Housing Smoking Ban**: In buildings with multiple apartments or living areas, do you think that smoking should be… allowed inside apartments or living areas, allowed inside some apartments, or not allowed at all inside apartments?
>
> **Opinion of Indoor Work Smoking Ban**: In indoor work areas, do you think that smoking should be allowed in all areas, allowed in some areas, or not allowed at all?
>
> **Opinion of Indoor Recreation Area Ban**: Inside bars, cocktail lounges, and clubs, do you think that smoking should be allowed in all areas, allowed in some areas, or not allowed at all?

Living with a State or Territory Car Smoking Ban Recode. Since some states and territories have already banned smoking in cars when children are present, identification of participants

who live in these regions was needed. Federal information processing standards (FIPS) state codes was used to identify participants' place of residence and then sorted into four groups as a new variable option. Final items included: 'Lives in a State with Children (12 and Younger) Present Car Ban' which was comprised of Vermont and Virginia, 'Lives in a State with Teenagers (13-17) Present Car Ban' which was Arkansas, Louisiana, Maine, and Utah, "Lives in a State with All Minors (Under 18) Present Car Ban" which was California and Oregon, and "Does not live in a state with Child Present Car Ban" which was every US state other than what were previously mentioned.

Control Variables. Sex and smoking status were identified as significantly associated with support for smoking bans in cars when others or when children are present in Manuscript I were used as control variables to adjust for the factors in this manuscript.

Data Analysis. Analysis of data was conducted using SAS 9.4 (SAS Institute Inc). Frequencies were run to ensure the data appeared normal and free of coding errors. Then, cross-tabulations were conducted to assess any relationships between smoking and demographic variables and the variables of interest related to smoking in cars. Two multinomial logistic regressions were then conducted to test whether demographic variables are associated with an increase in odds of that a person thinks that smoking should never, under some conditions, or always be allowed in a car. One regression model tested for when others are present in a car and the other tested when children are present in a car. Model fit statistics including Akaike's Information Criterion (AIC), the Schwarz Criterion (SC), and -2 Log L were conducted to ensure the models that included the covariates were a better model fit than a model with the intercept only. The global null hypothesis consisting of three chi-square statistics for each model was tested to either accept or reject the null hypothesis. Estimation of the logistic models' coefficients were conducted using maximum likelihood estimation. Standard errors and p-values were assessed to determine whether data is normally distributed and statistically significant. Due to the items having either yes/no or categorical response options, logistic regressions were used to identify and measure associations and acquire odds ratios for whether each variable increases or decreases the odds of supporting smoking inside a car when either others are present or when children are present. Referent variables for regression analysis are identified in Appendix I and III. Multicollinearity was assessed and found to be not in effect in the models with all tolerances for variables above cutoff recommendations and variance inflation factors falling within acceptable ranges [125].

Potential Limitations and Strategies. There are some limitations for the proposed manuscript. First, phrasing of certain items may lead to unclear responses by participants. For example, certain areas that may be work areas may be inside an enclosed space but not be considered "indoors" such as those who work in cars where they could be exposed to high concentrations of environmental tobacco smoke. Social desirability bias may be present in the items related to children as well as home smoking rules. Participants could under report their thoughts regarding smoking in the presence of children from always allowed to sometimes or never allowed due to the social stigma of smoking [128]. However, a review found that exposure for children to ETS smoke is accurately reported by their parents but further research is needed for other children present in the car [129].

Summary and Implications. The purpose of this manuscript is to identify tobacco rule or policy factors that are associated with the belief that smoking in a car should not be allowed when either others are present or when children are present. The findings from this study have the potential to show how effective different smoke-free rules or policies are at reducing support for smoking in specifically cars. There would also be justification for wide integration for regulating smoking in multiple areas to reduce tobacco smoke exposure for non-smokers.

Manuscript III

Overarching RQ for Manuscript III: What occupational factors are associated with support for restricting smoking when other people are present and when children are present?

1. Which occupations are associated with belief that smoking in a car should not be allowed when either other people are present or when children are present?
2. Are workplace restrictions on smoking associated with the belief that smoking in a car should not be allowed when either other people are present or when children are present?
3. Is others' use of tobacco products at someone's place of work associated with the belief that smoking in a car should not be allowed when either other people are present or when children are present?

Hypotheses for Manuscript III

HR1: Working in occupations that are considered more "blue-collar" will be associated with having lower odds of supporting the belief that smoking in a car should not be allowed when either other people are present or when children are present.

HR2: The presence of others using tobacco products at the respondent's place of work will be associated with lower odds of having the belief that smoking should not be allowed either when other people are present or when children are present.

HR3: The presence of smoking restrictions at respondent's place of work will be associated with lower odds of having the belief that smoking should not be allowed either when other people are present or when children are present.

Analysis Strategy to Answer Manuscript III Research Questions

To answer the overarching research question for Manuscript III, associations were assessed between the two items of interest involving support for smoking in cars and occupational factors. Frequencies were run to ensure the data appears normal and then cross-tabulations were conducted to assess any relationships between the variables of interest. Logistic regressions were run to test whether the smoke-free rules variables are associated with an increase in odds of that a person thinks that smoking in a car when either others or children are present. Demographic variables found to be highly associated with support for rules restricting smoking in a car when either others or when children are present were controlled for at this stage in order to test specifically the effect of occupational characteristics on the main items of interest.

Occupation Characteristics Variables.

Because certain occupations where one is outdoors may be more lenient with occupational smoking rules, some items have been identified for use in this manuscript. Some occupations are associated with either higher exposure to tobacco smoke or generally higher use among those who work in that occupation [50-53]. Specific occupation items are pulled from the base CPS survey and are coded directly by the US Census Bureau.

Occupation Type: What kind of business or industry is this (entered business name)?

Others' use of Tobacco Products at Occupation Variables. Since being exposed to others using tobacco products is associated with higher odds of also using tobacco products, others' use of tobacco products at work is an important measure to identify for analysis [75, 76].

Occupation Variables Recode.

Some items were recoded in order for analysis to occur. For occupation and industry, the US Census Bureau directly provides a recoded variable. For the purpose of this study, occupation groups of 'Blue-collar', 'White-collar', and 'Services' were used based on prior research grouping US Census Bureau occupation types [131]. Appendix IV shows the complete list as well as the recoding groups.

Control Variables.

Sex and smoking status were identified as significantly associated with support for smoking bans in cars when others or when children are present in Manuscript I were used as control variables to adjust for the factors in this manuscript.

Data Analysis.

Analysis of data was conducted using SAS 9.4 (SAS Institute Inc). Frequencies were run to ensure the data appeared normal and free of coding errors. Then, cross-tabulations were conducted to assess any relationships between smoking and demographic variables and the variables of interest related to smoking in cars. Two multinomial logistic regressions were then conducted to test whether demographic variables are associated with an increase in odds of that a person thinks that smoking should never, under some conditions, or always be allowed in a car. One regression model tested for when others are present in a car and the other tested when children are present in a car. Model fit statistics including Akaike's Information Criterion (AIC), the Schwarz Criterion (SC), and -2 Log L were conducted to ensure the models that included the

covariates were a better model fit than a model with the intercept only. The global null hypothesis consisting of three chi-square statistics for each model was tested to either accept or reject the null hypothesis. Estimation of the logistic models' coefficients were conducted using maximum likelihood estimation. Standard errors and p-values were assessed to determine whether data is normally distributed and statistically significant. Due to the items having either yes/no or categorical response options, logistic regressions were used to identify and measure associations and acquire odds ratios for whether each variable increases or decreases the odds of supporting smoking inside a car when either others are present or when children are present. Referent variables for regression analysis are identified in Appendix I and IV. Multicollinearity was assessed and found to be not in effect in the models with all tolerances for variables above cutoff recommendations and variance inflation factors falling within acceptable ranges [125].

Potential Limitations and Strategies.

There are some limitations for the proposed manuscript. First, items asking about anyone using tobacco products in work areas may have some inherent flaws in their wording. "Areas where you work" could be interpreted as an immediate workstation or an entire workspace. Additionally, the use of anyone could be interpreted to mean either the respondent themselves using tobacco products in that area or to mean just other coworkers. Social desirability bias may be present in the items related to children. Participants could under report their thoughts regarding smoking in the presence of children from always allowed to sometimes or never allowed due to the social stigma of smoking [128]. However, a review found that exposure for children to ETS smoke is accurately reported by their parents but further research is needed for other children present in the car [129]. Finally, within the occupation subcategories, some occupation types grouped together may diminish group results due to different rates of smoking and ETS exposure. For example, within the 'Service' group, those that work in locations such as bars or gaming services, which are occupations where there are higher rates of tobacco smoke exposure, would be grouped with those working in occupations such as child care, which likely would not have such smoking or exposure rates [51, 53].

Summary and Implications.

The purpose of this manuscript is to identify occupational factors that are associated with the belief that smoking in a car should not be allowed when either others are present or when children are present. The findings from this study have the potential to identify occupations that

would benefit from increased smoke-free policies as well as increase workplace-based interventions in occupations where there is low support for smoke-free tobacco policies.

Chapter IV: Manuscript I

Introduction

Smoking remains the leading cause of preventable death and disease in the United States, where 14 percent of adults ages 18 and older were considered current cigarette smokers as of 2019 [1]. Exposure to carcinogens found in environmental tobacco smoke (ETS) created by combustion of tobacco products has been shown to lead to cancer, cardiovascular disease, and respiratory damage for both smokers who choose to smoke and non-smokers who may be exposed [2]. Exposure to ETS does not affect everyone equally; low socioeconomic status, ethnic minorities, and those from rural or urban populations experiencing higher exposure rates to ETS as well as worse health outcomes [1, 3-5].

Use of tobacco products and exposure to ETS have consistently declined over the past sixty years [5]. While legislative measures such as clean air laws have contributed to the reduction in ETS exposure in areas such as the workplace and public spaces, non-smokers may still be exposed to ETS in other areas where it is not regulated such as the private car [6]. The car is a location where the average American can spend large percents of their days, with Americans ages 15 and older spending on average one hour and eleven minutes per day between 2012 and 2016 [132]. While no current time data is present for amounts of time that children spend in a car, traveling to school is often done in the private vehicle, with the 2017 National Household Travel Survey reporting 54.2% of children ages 5 to 17 using this method [133]. Due to the confined nature of the private car and misconceptions by smokers who believe that they are mitigating the risk of ETS exposure through actions such as lowering windows or turning on air conditioning, many non-smokers are exposed to ETS while traveling with smokers in their cars [7].

Nine states and three US territories have passed legislation banning smoking within the private car when transporting children [8]. However, these regulations do not protect adult non-smokers riding in a car. In states that do have a car smoking ban, children are unequally protected, with some states passing legislation banning smoking in a car with anyone under 18 years of age (California) to some only protecting those under eight years of age (Virginia) [8].

There are some differences in which demographic groups are more or less likely to support smoke-free policies. Males typically have both higher rates of smoking and a lower likelihood of supporting non-smoking policies compared to females [98, 134]. Differences by

race/ethnic identity exist as well, with those who identify as White having lower support for smoke-free policies compared to those who identify as Black, Hispanic, or Asian/Pacific Islander [36, 98, 99]. Additionally, White adults have lower rates of smoke-free car family rules compared to other races [99, 108]. Prior studies have also found that those with higher levels of education are also less likely to support bans on smoking in a car with children [99]. Current smokers have been shown to be less likely to support non-smoking legislation in cars as well as less likely to have smoke-free car rules compared to non-smokers [100, 104].

Prior research assesses beliefs towards allowing smoking in a car as a dichotomous yes or no scenario [98, 99]. Identifying population segments that believe that smoking should be allowed in cars both always and under some conditions is crucial for finding targets for interventions to protect vulnerable populations from ETS exposure. This study aims to identify characteristics of US adults who believe that smoking should, should under some conditions, and should not be allowed inside of a car when others are present and more specifically when children are present.

Methods

Sample

Pooled data from the three waves of the 2018-2019 Tobacco Use Supplement to the U.S. Current Population Survey (TUS-CPS) was used in this study. The TUS-CPS is a nationally representative periodic survey supplemental to the Current Population Survey that utilizes multiple stages in its sampling design, with Primary Sampling Units first being selected based on its 2010 Census population then households selected from the US Postal Service Master Address File based on its state population [135]. Inclusion criteria for the base CPS are 15 years of age or older, are noninstitutionalized, and not in the armed forces with further inclusion criteria for the TUS-CPS requiring that participants completed the base CPS and are 18 years of age or older [121]. For this study, only those who were self-respondents were included in the sample with a final, unweighted sample size of 128,835 and weighted sample size of 230,417,213.

Measures

Socioeconomic and Demographic Characteristics

Socioeconomic and demographic characteristics assessed in this study include sex (male or female), race which does not include Hispanic origin (White only, Black only, Asian/Pacific

Islander only), Hispanic origin (yes or no), and highest educational attainment (less than a high school diploma, a high school diploma or equivalent (GED), four-year degree or more).

Current Tobacco Use

Current tobacco use (never, former, every day, some days) was identified using a combination of items, including whether participants had smoked 100 or more cigarettes in their lifetime and whether they reported at the time of interview whether they were smoking every day, some days, or not at all. Every day smokers had indicated they had smoked at least 100 cigarettes in their lifetime and were currently smoking every day. Some days smokers indicated they had smoked at least 100 cigarettes in their lifetime and were smoking some days. Former smokers had indicated they had smoked at least 100 cigarettes in their lifetime but were currently not smoking at all. Never smokers had never smoked 100 or more cigarettes in their lifetime.

Support for Smoking in Cars

The items of interest were measured were in two separate questions: 1) "Inside a car, when other people are present, do you think that smoking should…" and 2) "If children are present inside the car, do you think that smoking should…." Both questions had response options of "always be allowed, be allowed under some conditions, or never be allowed." (see Appendix I and II for a list of TUS-CPS questions used).

Data Analysis

Weights for data provided by TUS-CPS were used in order to account for the survey's complex sampling design and clustering effects and to adjust for sampling selection based on which state each participant was sampled from. The three waves of data from the 2018-2019 TUS-CPS were combined into one data set and weights were applied. The data were analyzed first in simple frequency distributions. Next, two separate multinomial logistic regressions (MLR) were conducted, with the first model assessing the item "when others are present" and the second model assessing the item "when children are present." Both models used "never be allowed" as the referent group for the regression with both also controlling by participant age. All data analysis was conducted using SAS version 9.4 (SAS Institute Inc).

Results

Demographics and Descriptive Statistics

The total sample shown in Table 2 shows the base sample in the 2018-2019 waves of the TUS-CPS, with the majority being White (79.2%), non-Hispanic (83.1%), never smokers (70.7%), and having at least a high school diploma or equivalent (G.E.D.) (55.2%).

Table 2. Base Demographics of US Adults Sampled from the 2018-2019 TUS-CPS

		Total Unweighted Sample (n=128,835) Total Weighted Sample (n=230,417,213)		
		Unweighted Freq	Weighted Freq	Weighted Percent
Sex	Male	59,213	115,889,540	48.6%
	Female	69,622	122,683,681	51.4%
Race	White Only	106,106	184,426,815	79.2%
	Black Only	13,032	30,717,718	13.2%
	Asian/Pacific Islander Only	7,225	17,721,179	7.6%
Hispanic Origin	Yes	14,525	40,434,570	16.9%
	No	114,310	198,138,652	83.1%
Educational Attainment	Less than HS Diploma	10,189	21,861,264	9.2%
	HS Diploma or Equivalent	70,935	131,599,708	55.2%
	4 Year Degree or More	47,711	85,112,250	35.7%
Smoking Status	Never	85,649	167,953,816	70.7%
	Former	26,257	41,454,087	17.5%
	Some Days	3,567	6,623,471	2.8%
	Every Day	12,759	21,431,092	9.0%

Table 3 shows that approximately 76.1% of adults thought that smoking in a car should never be allowed when others are present and 95.8% of adults thought that smoking should not be allowed when children are present. Additionally, 20.3% of adults thought that smoking in a car should be allowed under some conditions when others are present and 3.4% of adults that smoking in a car should be allowed when children are present.

Table 3.Support for Smoking in a Car when Others are Present and When Children are Present Frequencies

		When Others are Present (n=124,563)			When Children are Present (n=124,973)		
		Unwgt Freq	Weighted Freq (Wgt Row %)	Wgt S.E of Row	Unwgt Freq	Weighted Freq (Wgt Row %)	Wgt S.E. of Row
Total	Never be Allowed	94,976	175,435,688 (76.1%)	0.1892	119,441	221,455,935 (95.8%)	0.0951
	Be Allowed Under Some Conditions	24,982	46,700,640 (20.3%)	0.1707	4,400	7,816,285 (3.4%)	0.0872
	Always Be Allowed	4,605	8,280,886 (3.6%)	0.0765	1,132	1,924,353 (0.8%)	0.0324

Responses by Sex

Frequencies: Table 4 examines differences in beliefs on whether smoking should be allowed in cars based on sex. Males had the lowest frequency of all socio-demographic characteristics of never allowing smoking in a car both when others are present and when children are present (72.5% and 95.0%) as well as the highest frequency of always allowing smoking in a car when others are present (4.4%).

Table 4. Beliefs about Smoking in a Car by Sex Frequencies

			When Others are Present (n=124,563)			When Children are Present (n=124,973)		
			Unwgt Freq	Weighted Freq (Wgt Row %)	Wgt S.E. of Row	Unwgt Freq	Weighted Freq (Wgt Row %)	Wgt S.E. of Row
Sex	Female	Never be Allowed	53,733	94,628,961 (79.6%)	0.2308	65,299	115,167,025 (96.5%)	0.0995
		Be Allowed Under Some Conditions	11,847	20,975,899 (17.6%)	0.2122	1,984	3,375,385 (2.8%)	0.0962
		Always Be Allowed	1,978	3,319,794 (2.8%)	0.0826	475	766,543 (0.6%)	0.0327
	Male	Never be Allowed	41,243	80,806,727 (72.5%)	0.2442	54,142	106,288,910 (95.0%)	0.1320
		Be Allowed Under Some Conditions	13,135	25,724,741 (23.1%)	0.2225	2,416	4,440,900 (4.0%)	0.1177
		Always Be Allowed	2,627	4,961,091 (4.4%)	0.1118	657	1,157,810 (1.0%)	0.0492

Responses by Race/Ethnicity

Frequencies: Table 5 examines differences in beliefs on whether smoking should be allowed in cars based on race. Those who identified as White only had the lowest percentages of those who thought that smoking in a car should never be allowed and highest percentage of

allowing smoking under some conditions when others are present (75.1% and 21.1%). In contrast, those who identified as Asian/Pacific Islander only had the highest percentage of thinking that smoking should never be allowed in a car and lowest percentage for thinking that smoking should be allowed under some conditions in a car (84.3% and 13.9%). When children were present, frequencies were similar between races.

Table 5. Beliefs about Smoking in a Car by Race Frequencies

			When Others are Present (n=122,174)			When Children are Present (n=122,579)		
			Unwgt Freq	Weighted Freq (Wgt Row %)	Wgt S.E. of Row	Unwgt Freq	Weighted Freq (Wgt Row %)	Wgt S.E. of Row
Race	White Only	Never be Allowed	77,481	134,014,937 (75.1%)	0.2099	98,310	171,136,295 (95.6%)	0.1020
		Be Allowed Under Some Conditions	21,278	37,647,039 (21.1%)	0.1952	3,753	6,262,955 (3.5%)	0.0923
		Always Be Allowed	3,975	6,776,639 (3.8%)	0.0819	1,009	1,634,677 (0.9%)	0.0357
	Black Only	Never be Allowed	9,949	23,161,330 (78.7%)	0.4784	12,037	28,350,705 (96.0%)	0.2666
		Be Allowed Under Some Conditions	2,121	5,270,503 (17.9%)	0.4249	406	988,069 (3.3%)	0.2488
		Always Be Allowed	412	988,435 (3.4%)	0.2132	78	193,822 (0.7%)	0.1046
	Asian/PI Only	Never be Allowed	5,818	14,353,632 (84.3%)	0.5513	6,812	16,710,736 (97.8%)	0.2415
		Be Allowed Under Some Conditions	1,005	2,374,721 (13.9%)	0.5266	151	334,981 (2.0%)	0.2277
		Always Be Allowed	135	300,622 (1.8%)	0.1927	23	46,813 (0.3%)	0.0663

Responses by Hispanic Origin

Frequencies: Table 6 examines differences in beliefs on whether smoking should be allowed in cars based on Hispanic origin. Those who identified as Hispanic had lower percentages of those who believed smoking should be allowed in a car in all conditions both when others are present and when children are present compared to those of non-Hispanic origin**.**

Table 6. Beliefs about Smoking in a Car by Hispanic Origin

			When Others are Present (n=124,563)			When Children are Present (n=124,973)		
			Unwgt Freq	Weighted Freq (Wgt Row %)	Wgt S.E. of Row	Unwgt Freq	Weighted Freq (Wgt Row %)	Wgt S.E. of Row
Hispanic	Yes	Never be Allowed	12,048	33,551,246 (85.6%)	0.4461	13,844	38,605,802 (98.1%)	0.1518
		Be Allowed Under Some Conditions	1,748	4,937,358 (12.6%)	0.4105	228	621,675 (1.6%)	0.1392
		Always Be Allowed	279	723,320 (1.8%)	0.1324	54	129,906 (0.3%)	0.0555
	No	Never be Allowed	82,928	141,884,442 (74.2%)	0.2004	105,597	182,850,133 (95.3%)	0.1057
		Be Allowed Under Some Conditions	23,234	41,763,281 (21.8%)	0.1844	4,172	7,194,611 (3.8%)	0.0949
		Always Be Allowed	4,326	7,557,565 (4.0%)	0.0874	1,078	1,794,447 (0.9%)	0.0370

Responses by Educational Attainment

Frequencies: Table 7 examines differences in beliefs on whether smoking should be allowed in cars based on educational attainment. Those who had a high school degree or equivalent had the lowest percentages of those who thought that smoking in a car should never be allowed and highest percentage of allowing smoking under some conditions when others are present (74.9% and 21.4%). Those who had less than a high school diploma had the highest percentage of those who believed that smoking should always be allowed when others were present (3.9%) followed closely by those with a high school degree or equivalent (3.8%).

Table 7. Beliefs about Smoking in a Car by Education Frequencies

			When Others are Present (n=124,563)			When Children are Present (n=124,973)		
			Unwgt Freq	Weighted Freq (Wgt Row %)	Wgt S.E. of Row	Unwgt Freq	Weighted Freq (Wgt Row %)	Wgt S.E. of Row
Educational Attainment	Less Than HS Diploma	Never be Allowed	7,493	16,350,566 (78.0%)	0.5789	9,248	19,984,897 (95.1%)	0.2688
		Be Allowed Under Some Conditions	1,816	3,792,985 (18.1%)	0.5140	433	863,902 (4.1%)	0.2488
		Always Be Allowed	441	811,228 (3.9%)	0.2288	104	175,399 (0.8%)	0.1014
	HS Diploma or Equivalent (GED)	Never be Allowed	51,310	95,083,612 (74.9%)	0.2492	65,353	121,551,302 (95.4%)	0.1249
		Be Allowed Under Some Conditions	14,483	27,121,326 (21.4%)	0.2274	2,688	4,719,739 (3.7%)	0.1137
		Always Be Allowed	2,701	4,803,559 (3.8%)	0.1013	644	1,084,658 (0.9%)	0.0444
	4 Year Degree or More	Never be Allowed	36,173	64,001,509 (77.6%)	0.2666	44,840	79,919,736 (96.5%)	0.1143
		Be Allowed Under Some Conditions	8,683	15,786,328 (19.1%)	0.2412	1,279	2,232,644 (2.7%)	0.1000
		Always Be Allowed	1,463	2,666,098 (3.2%)	0.1044	384	664,296 (0.8%)	0.0457

Responses by Smoking Status

Frequencies: Table 8 examines differences in beliefs on whether smoking should be allowed in cars based on current smoking status. Every day smokers had the highest percentage of those believing that smoking should be allowed in a car when others are present, with a larger percentage thinking that smoking should be allowed under some conditions compared to never allowed (46.8% vs 40.7%). Every day smokers also had the lowest percentage of participants who thought that smoking should never be allowed when children are present in a car (85.6%) and a high percentage of those who believed that smoking should be allowed under some conditions when children are present (11.2%). Some days smokers also had a high percentage when compared to former and never smokers of believing that when others are present that smoking should be allowed under some conditions (37.8%) or always allowed (6.6%).

Table 8. Beliefs about Smoking in a Car by Smoking Status Frequencies

			When Others are Present (n=124,353)			When Children are Present (n=124,756)		
			Unwgt Freq	Weighted Freq (Wgt Row %)	Wgt S.E. of Row	Unwgt Freq	Weighted Freq (Wgt Row %)	Wgt S.E. of Row
Smoking Status	Never	Never be Allowed	69,110	134,224,553 (82.2%)	0.2080	81,292	159,349,920 (97.2%)	0.0976
		Be Allowed Under Some Conditions	12,448	25,482,123 (15.6%)	0.1972	1,889	3,668,977 (2.2%)	0.0909
		Always Be Allowed	1,791	3,576,764 (2.2%)	0.0739	466	872,503 (0.5%)	0.0312
	Former	Never be Allowed	18,881	29,242,062 (72.7%)	0.3280	24,449	38,525,943 (95.4%)	0.1659
		Be Allowed Under Some Conditions	5,597	9,245,609 (23.0%)	0.3019	925	1,465,359 (3.6%)	0.1531
		Always Be Allowed	1,053	1,756,091 (4.4%)	0.1566	242	382,307 (0.9%)	0.0649
	Some Days	Never be Allowed	1,885	3,467,889 (55.6%)	1.0859	3,116	5,808,436 (92.8%)	0.5615
		Be Allowed Under Some Conditions	1,251	2,360,075 (37.8%)	1.0910	202	367,179 (5.9%)	0.5137
		Always Be Allowed	217	409,722 (6.6%)	0.5593	45	80,169 (1.3%)	0.2228
	Every Day	Never be Allowed	4,959	8,257,936 (40.7%)	0.6074	10,390	17,437,256 (86.0%)	0.4194
		Be Allowed Under Some Conditions	5,630	9,498,060 (46.8%)	0.6103	1,364	2,266,923 (11.2%)	0.3668
		Always Be Allowed	1,531	2,518,294 (12.4%)	0.4044	376	580,087 (2.9%)	0.1915

Multinomial Logistic Regression Models: Tables 11 and 14 present the results of two separate multinomial logistic regression models, with Table 11 examining support for smoking when other passengers are present in a car and Table 14 examining support for smoking when children are present in a car. Multicollinearity was assessed and found to be not in effect in the models with all tolerances for variables above cutoff recommendations and variance inflation factors falling within acceptable ranges [125].

Regression Results by Sex

When others are present: Males had higher odds than females of agreeing that when others are present, smoking should be allowed under some conditions (AOR = 1.36; 95% CI = 1.31 – 1.41, p-value = <.0001) and always be allowed (AOR = 1.65; 95% CI = 1.53 - 1.77, p-

value = <.0001) compared to never be allowed, after accounting for the effects of [other control variables].

When children are present: Similarly, when children are present, males had higher odds compared to females of believing that smoking should be allowed under some conditions (AOR = 1.36; 95% CI = 1.27 - 1.47, p-value = <.0001) and always allowed (AOR = 1.57; 95% CI = 1.38 - 1.78, p-value = <.0001) compared to never be allowed.

Regression Results by Race

When others are present: Compared to those who identified as White only, those who identified as Black only possessed lower odds of believing smoking should be allowed in a car when others are present both under some conditions (AOR = 0.74; 95% CI = 0.69 - 0.79, p-value = <.0001) and always allowed (AOR = 0.79; 95% CI = 0.52 - 0.62, p-value = .0013) compared to never be allowed. Similarly, compared to those who identified as White only, those who identified as Asian/Pacific Islander only possessed lower odds of believing smoking should be allowed in a car when others are present both under some conditions (AOR = 0.57; 95% CI = 0.52 - 0.62, p-value = <.0001) and always allowed (AOR = 0.43; 95% CI = 0.34 - 0.54, p-value = <.0001) compared to never be allowed.

When children are present: Compared to those who identified as White only, those who identified as Asian/Pacific Islander only possessed lower odds of believing smoking should be allowed in a car when children are present under some conditions (AOR = 0.60; 95% CI = 0.47 - 0.79, p-value = <.0001) and always allowed (AOR = 0.32; 95% CI = 0.20 - 0.53, p-value = <.0001) compared to never be allowed. Compared to those who identified as White only, those who identified as Black only had lower odds of believing smoking should always allowed (AOR = 0.70; 95% CI = 0.50 - 0.97, p-value = .0342) compared to never be allowed.

Regression Results by Hispanic Origin

When others are present: Those who are of Hispanic origin had lower odds than those who were not of agreeing that when others are present, smoking should be allowed under some conditions (AOR = 0.47; 95% CI = 0.44 - 0.51, p-value = <.0001) and always be allowed (AOR = 0.420; 95% CI = 0.36 - 0.49, p-value = <.0001) compared to never be allowed.

When children are present: Similarly, those who are of Hispanic origin had lower odds than those who were not of agreeing that when children are present, smoking should be allowed

under some conditions (AOR = 0.42; 95% CI = 0.35 - 0.51, p-value = <.0001) and always be allowed (AOR = 0.42; 95% CI = 0.30 - 0.60, p-value = <.0001) compared to never be allowed.

Regression Results by Education

When others are present: Compared to those who had a four year degree or higher, those who had less than a high school degree possessed lower odds of believing smoking should be allowed in a car when others are present both under some conditions (AOR = 0.93; 95% CI = 0.89 - 0.97, p-value = <.0001) and always allowed (AOR = 0.84; 95% CI = 0.77 - 0.92, p-value = .0013) compared to never be allowed. Similarly, compared to those who had a four year degree or higher, those who had a high school diploma or equivalent possessed lower odds of believing smoking should be allowed in a car when others are present both under some conditions (AOR = 0.82; 95% CI = 0.75 - 0.89, p-value = .0284) and always allowed (AOR = 0.85; 95% CI = 0.73 - 0.98, p-value = <.0001) compared to never be allowed.

When children are present: Compared to those who had a four year degree or higher, those who had less than a high school degree possessed higher odds of believing smoking should be allowed in a car when children are present under some conditions (AOR = 1.33; 95% CI = 1.15 – 1.54, p-value = .0002) compared to never be allowed. Compared to those who had a four year degree or higher, those who had a high school diploma or equivalent had lower odds of believing smoking should always allowed (AOR = 0.82; 95% CI = 0.70 - 0.96, p-value = .0130) compared to never be allowed.

Regression Results by Smoking Status

When others are present: Former smokers, when compared to never smokers, had the lowest odds of believing that smoking in a car when others are present should be allowed under some conditions (AOR = 1.89; 95% CI = 1.81 – 1.98, p-value = <.0001) and always allowing smoking (AOR = 2.28; 95% CI = 2.05 – 2.53, p-value = <.0001) compared to never being allowed. Conversely, every day smokers, when compared to never smokers, were over 6 times more likely to allow smoking when others were present of allowing smoking in a car under some conditions (AOR = 6.41; 95% CI = 6.01 – 6.82, p-value = <.0001), and over 11 times more likely to always allowing smoking (AOR = 11.53; 95% CI = 10.36 – 12.83, p-value = <.0001) compared to never allowing smoking. Compared to never smokers, some days smokers when others are present had 3.6 times the odds of believing smoking should be allowed under some conditions (95% CI = 3.23 - 3.98, p-value = <.0001) and 4.4 times the odds of believing smoking

should always be allowed (95% CI = 3.63 – 5.41, p-value = <.0001) when compared to never being allowed.

When children are present: Similarly, former smokers when compared to never smokers as having the lowest odds of allowing smoking in a car when children are present under some conditions (AOR = 1.50; 95% CI = 1.35 – 1.67, p-value = <.0001) and always allowing smoking (AOR = 1.46; 95% CI = 1.20 – 1.76, p-value = .0002) compared to never allowing smoking. Every day smokers had the highest odds of allowing smoking when children were present in a car under some conditions (AOR = 4.86; 95% CI = 4.73 – 5.40, p-value = <.0001), and always allowing smoking (AOR = 5.58; 95% CI = 4.68 – 6.66, p-value = <.0001) compared to never allowing smoking. Compared to never smokers, some days smokers when children are present had 2.5 times the odds of believing smoking should be allowed under some conditions (AOR = 2.52; 95% CI = 2.03 - 3.14, p-value = <.0001) and 2.6 times the odds of believing smoking should always be allowed (AOR = 2.58; 95% CI = 1.76 - 3.78, p-value = <.0001) when compared to never being allowed.

Table 9. Testing Global Null Hypothesis for Support for Smoking in a Car when Others are Present Multinomial Logistic Regression

Test	F Value	Num DF	Den DF	Pr > F
Likelihood Ratio	645.60	17.2435	2758.97	<.0001
Score	397.54	20	160	<.0001
Wald	406.83	20	160	<.0001
NOTE: Second-order Rao-Scott design correction 0.1599 applied to the Likelihood Ratio test.				

Table 10. Type 3 Analysis of Effects for Support for Smoking in a Car when Others are Present Multinomial Logistic Regression

Effect	F Value	Num DF	Den DF	Pr > F
Sex	197.43	2	160	<.0001
Age	639.28	2	160	<.0001
Race	53.67	4	160	<.0001
Hispanic Origin	202.65	2	160	<.0001
Smoking Status	819.10	6	160	<.0001
Education	9.82	4	160	<.0001

Table 11. Support for Smoking in a Car when Others are Present Multinomial Logistic Regression

			When Others are Present (n=124,563)			
			Wgt Freq %	AOR	95% C.I.	P Value
Sex (*Referent = Female*)	Male	Never be Allowed (*Referent*)	72.5%			
		Be Allowed Under Some Conditions	23.1%	**1.362**	**1.314 - 1.412**	**<.0001*** **
		Always Be Allowed	4.4%	**1.646**	**1.531 - 1.769**	**<.0001*** **
Race (*Referent = White Only*)	Black Only	Never be Allowed (*Referent*)	78.7%			
		Be Allowed Under Some Conditions	17.9%	**0.736**	**0.690 - 0.786**	**<.0001*** **
		Always Be Allowed	3.4%	**0.794**	**0.691 - 0.912**	**0.0013** **
	Asian/PI Only	Never be Allowed (*Referent*)	84.3%			
		Be Allowed Under Some Conditions	13.9%	**0.566**	**0.515 - 0.623**	**<.0001*** **
		Always Be Allowed	1.8%	**0.430**	**0.342 - 0.540**	**<.0001*** **
Hispanic (*Referent = Not Hispanic*)	Hispanic	Never be Allowed (*Referent*)	85.6%			
		Be Allowed Under Some Conditions	12.6%	**0.471**	**0.436 - 0.510**	**<.0001*** **
		Always Be Allowed	1.8%	**0.420**	**0.359 - 0.491**	**<.0001*** **
Education (Referent = 4 Year Degree or Higher)	Less Than HS	Never be Allowed (*Referent*)	78.0%			
		Be Allowed Under Some Conditions	18.1%	**0.930**	**0.890 - 0.972**	**<.0001*** **
		Always Be Allowed	3.9%	**0.838**	**0.768 - 0.915**	**0.0013** **
	HS or GED	Never be Allowed (*Referent*)	74.9%			
		Be Allowed Under Some Conditions	21.4%	**0.820**	**0.754 - 0.891**	**0.0284***
		Always Be Allowed	3.8%	**0.846**	**0.729 - 0.982**	**<.0001*** **
Smoking Status (*Referent = Never*)	Former	Never be Allowed (*Referent*)	72.7%			
		Be Allowed Under Some Conditions	23.0%	**1.893**	**1.810 - 1.981**	**<.0001*** **
		Always Be Allowed	4.4%	**2.278**	**2.053 - 2.529**	**<.0001*** **
	Some Days	Never be Allowed (*Referent*)	55.6%			
		Be Allowed Under Some Conditions	37.8%	**3.587**	**3.233 - 3.979**	**<.0001*** **
		Always Be Allowed	6.6%	**4.427**	**3.625 - 5.407**	**<.0001*** **
	Every Day	Never be Allowed (*Referent*)	40.7%			
		Be Allowed Under Some Conditions	46.8%	**6.404**	**6.013 - 6.820**	**<.0001*** **
		Always Be Allowed	12.4%	**11.528**	**10.362 - 12.827**	**<.0001*** **

Controlled by Age
*p<0.05
**p<0.01
***p<0.001

Table 12. Testing Global Null Hypothesis for Support for Smoking in a Car when Children are Present Multinomial Logistic Regression

Test	F Value	Num DF	Den DF	Pr > F
Likelihood Ratio	128.20	17.0703	2731.25	<.0001
Score	64.06	20	160	<.0001
Wald	111.76	20	160	<.0001
NOTE: Second-order Rao-Scott design correction 0.1716 applied to the Likelihood Ratio test.				

Table 13. Type 3 Analysis of Effects for Support for Smoking in a Car when Children are Present Multinomial Logistic Regression

Effect	F Value	Num DF	Den DF	Pr > F
Sex	60.51	2	160	<.0001
Age	8.76	2	160	0.0002
Race	9.51	4	160	<.0001
Hispanic Origin	49.42	2	160	<.0001
Smoking Status	230.78	6	160	<.0001
Education	6.10	4	160	0.0001

Table 14. Support for Smoking in a Car when Children are Present Multinomial Logistic Regression

			When Children are Present (n=124,973)			
			Wgt Freq %	AOR	95% C.I.	P Value
Sex (*Referent = Female*)	Male	Never be Allowed (*Referent*)	95.0%			
		Be Allowed Under Some Conditions	4.0%	**1.363**	**1.267 - 1.465**	**<.0001*** **
		Always Be Allowed	1.0%	**1.570**	**1.383 - 1.782**	**<.0001*** **
Race (*Referent = White Only*)	Black Only	Never be Allowed (*Referent*)	96.0%			
		Be Allowed Under Some Conditions	3.3%	0.894	0.769 - 1.038	0.1409
		Always Be Allowed	0.7%	**0.700**	**0.503 - 0.973**	**0.0342***
	Asian/PI Only	Never be Allowed (*Referent*)	97.8%			
		Be Allowed Under Some Conditions	2.0%	**0.602**	**0.472 - 0.768**	**<.0001*** **
		Always Be Allowed	0.3%	**0.323**	**0.196 - 0.532**	**<.0001*** **
Hispanic (*Referent = Not Hispanic*)	Hispanic	Never be Allowed (*Referent*)	98.1%			
		Be Allowed Under Some Conditions	1.6%	**0.422**	**0.351 - 0.507**	**<.0001*** **
		Always Be Allowed	0.3%	**0.422**	**0.295 - 0.604**	**<.0001*** **
Education (Referent = 4 Year Degree or Higher)	Less Than HS	Never be Allowed (*Referent*)	95.1%			
		Be Allowed Under Some Conditions	4.1%	**1.332**	**1.150 - 1.542**	**0.0002*** **
		Always Be Allowed	0.8%	0.824	0.616 - 1.103	0.1924
	HS or GED	Never be Allowed (*Referent*)	95.4%			
		Be Allowed Under Some Conditions	3.7%	1.094	0.996 - 1.201	0.0598
		Always Be Allowed	0.9%	**0.819**	**0.701 - 0.958**	**0.0130***
Smoking Status (*Referent = Never*)	Former	Never be Allowed (*Referent*)	95.4%			
		Be Allowed Under Some Conditions	3.6%	**1.502**	**1.353 - 1.667**	**<.0001*** **
		Always Be Allowed	0.9%	**1.455**	**1.200 - 1.764**	**.0002*** **
	Some Days	Never be Allowed (*Referent*)	92.8%			
		Be Allowed Under Some Conditions	5.9%	**2.527**	**2.031 - 3.143**	**<.0001*** **
		Always Be Allowed	1.3%	**2.582**	**1.763 - 3.783**	**<.0001*** **
	Every Day	Never be Allowed (*Referent*)	85.6%			
		Be Allowed Under Some Conditions	11.2%	**4.858**	**4.373 - 5.397**	**<.0001*** **
		Always Be Allowed	2.9%	**5.580**	**4.676 - 6.658**	**<.0001*** **

Controlled by Age
*p<0.05
**p<0.01
***p<0.001

Discussion

This study found that there were socio-demographic characteristics associated with believing that smoking should be allowed under some conditions and always be allowed in a car both when others and when children are present. Additionally, smoking status was associated with whether one thought that smoking should or should not be allowed inside of a car with passengers.

When considering current smoking status, the findings from this study are consistent with prior research documenting that current smokers are less likely to support legislation that bans smoking in a car compared to non-smokers [100, 104]. This study reinforces the need to reduce smokers' use of tobacco products in a car either completely or at least from every day to some days when it comes to potentially reducing ETS exposure to others around them. For example, when comparing every day smokers to some days smokers, the odds of allowing smoking in a car either always or under some conditions both when others and when children are present are doubled for every day smokers. Even if a smoker will not reduce their tobacco use, finding ways to reduce their smoking in a car could also help reduce likelihood of health impacts from sustained exposure to ETS including decreasing their risk for developing asthma [74, 77]. However, health communication regarding smoking in cars should highlight abstaining from smoking in a car altogether rather than just when passengers are present. Thirdhand smoke, which can accumulate on car's interior surfaces, can both release toxic compounds long after smoking has occurred and be absorbed through the skin on contact [55, 79].

Males, as seen in prior research, were more likely to support smoking in cars compared to females [98]. In this study, males had the highest odds compared to all other socio-demographic factors of allowing smoking under some conditions or always allowing smoking in a car. There are several potential factors that could be influencing these differences, such as gender norms regarding smoking patterns as well as the power dynamic that males may have in a car compared to females. Additionally, males may be more likely to believe that it is more socially acceptable to smoke in a car compared to females.

In this sample, those who identify as Black or Asian/Pacific Islander were more likely to believe that smoking should always be allowed or allowed under some conditions compared to those who are White. The odds of participants from this sample believing smoking should or should not be allowed in a car compared to never allowed align with prior findings where those who identify as White were less likely to have a smoke-free car rule compared to other races [98, 108]. However, this finding should not ignore the impact ETS exposure in a car can have on all races. While this study found that those who identify as Black had lower odds of thinking that smoking should be allowed in a car compared to White, prior research shows they also experience the highest rates of SHS exposure as well as potentially absorbing more tobacco toxicants compared to those who identify as White so there may be a disconnect between support

for never allowing smoking and actual rates of exposure [40, 136]. For those of Hispanic origin, this study found that those who were from that ethnicity had lower odds of thinking that smoking should be allowed in a car compared to those of non-Hispanic origin. However, these findings should not undermine the role that social norms play, with prior research finding that young Latino adults believing that their peers were more approving of smoking norms if they were current smokers compared to non-smokers [137].

Educational attainment presented inconsistencies as those with less than a high school degree and those with a high school degree or equivalent (GED) were less likely to think that smoking should be allowed under some conditions or always allowed when others are present compared to those with a four-year degree or higher. Differences between educational attainment disappear when considering whether children are present. While rates of smoking and educational attainment have been found to be inversely related and those who have lower educational status have higher odds of supporting smoking in a car when others are present, this study's findings are consistent with findings from prior waves of the TUS-CPS as well as other international studies [97, 98, 134]. Personal beliefs about smoking in a car may also not align with lack of adherence to a non-smoking policy in a car where respondents with higher educational attainment may believe that smoking in a car should not be regulated but they still personally adhere to non-smoking in a car. One finding of note from this study however is that those with less than a high school diploma were 1.3 times more likely to indicate that smoking should be allowed under some conditions when children were present compared to those with a four-year degree or higher. However, further research is needed to help explain these educational differences involving the reasons and circumstances in which people believe smoking when others and children are present should or should not be allowed.

Across all socio-economic groups included in this study, most had higher odds of believing that smoking should be allowed under some conditions compared to always allowed in relation to never allowed. Focused health communication showing that use of ventilation in cars does not reduce ETS to safe levels could have success reaching those who believe that smoking should be allowed under some conditions. Current misconceptions regarding ventilation was supported by the tobacco industry which stated that ventilation was an acceptable alternative to smoke-free laws [138].

This study does possess some limitations. First, the CPS base survey reports that there are potential coverage differences when it comes to race/ethnicity and sex, with those who identify as Black being less likely to be included in the study than those who identify as a race other than Black and those who identify as male being less likely to be included in the study than those who identify as female [135]. Additionally, cell counts for races not included in this study were too small for analysis and were removed from the model. There is also potential for selection bias, but weighting practices found in the TUS-CPS reduces the impact of these differences by applying stronger weights to under-sampled populations [121]. Social desirability bias may be present in the items related to children. Participants could under report their thoughts regarding smoking in the presence of children from always allowed to sometimes or never allowed due to the social stigma of smoking [128]. However, a review found that exposure for children to ETS smoke is accurately reported by their parents but further research is needed for other children present in the car [129]. Further research expanding on reasons why smokers choose to smoke around adults but not around children may help explain this study's findings. The response of "be allowed under some conditions" may skew results away from participants' actual use patterns due to the vague phrasing of the question. For example, if a participant chooses "under some conditions" and considers their use as conditional due to behaviors such as rolling down windows or using air conditioning when smoking in their car when passengers are present, their passengers would be exposed to ETS at unsafe levels [7].

Findings from this study highlight some areas for interventions focused on reducing smoking in the private car. First, messaging for reducing smoking rates in cars should emphasize that there are no safe levels of ETS exposure and that the methods that smokers often do in a car that they consider applicable to smoke with others and children present "under some conditions" such as roll down windows, using fragrances to mask the smell of smoke, and using air conditioning does not safely reduce ETS levels for their passengers [7]. Additionally, further clarifying the conditional situations where one may or may not smoke in their car based on potential factors such as weather, who their passenger is, and amount smoked could help guide more specific health messaging.

In conclusion, the private car is an important location that is not as emphasized as other locations when it comes to tobacco control where other people may be unnecessarily exposed to harmful ETS. This study identified specific groups at higher risk of believing that smoking in

cars should be allowed under both some conditions and always allowed such as males, Whites, and those with a history of smoking, especially those who are current smokers. These groups should be the focus on targeted efforts to change attitudes towards smoking in cars and moving their current behavior towards abstinence of smoking in the car. If unaddressed, continued ETS exposure in cars could lead to increased health disparities among those they expose despite their best intentions.

Chapter V: Manuscript II

Introduction

Smoking remains the leading cause of preventable death and disease in the United States, where 14 percent of adults ages 18 and older were considered current cigarette smokers in 2019 [139]. Exposure to carcinogens found in environmental tobacco smoke (ETS) created by combustion of tobacco products has been shown to lead to cancer, cardiovascular disease, and respiratory damage for both smokers who choose to smoke and non-smokers who may be unwillingly exposed [2]. Exposure to ETS does not affect everyone equally; those with low socioeconomic status, ethnic minorities, and those from rural or urban populations have worse health outcomes, higher exposure rates, and higher smoking initiation rates attributable to ETS [3-5, 139].

Tobacco use and exposure to ETS have consistently declined over the past several decades [5]. While legislative measures such as clean air laws have reduced ETS exposure in the workplace and public spaces, non-smokers may still be exposed to ETS in non-regulated areas such as the private car [6]. Non-smokers are exposed to ETS while traveling with smokers in their cars due to the confined space of the private car and smoker misconceptions that they are reducing ETS exposure through actions such as lowering windows or turning on air conditioning, [7]. Some legislative bodies have created smoke-free laws for the private car; nine states and three territories within the United States have passed legislation banning smoking within the private car when transporting children [8]. However, these regulations do not protect adult non-smokers riding in a car and within states that do have a car smoking ban, children are unequally protected, with some states regulating not smoking in a car with anyone under 18 years of age (California) to some only protecting those under eight years of age (Virginia) [8].

A majority of both smokers and non-smokers support general smoke-free policies, with highest support for workplaces and restaurants. Additionally, smoke-free policies have been shown to increase in popularity after implementation. Previous studies have shown that a majority of Americans, including current smokers, support smoke-free policies in cars, but they also are less likely to support smoke-free cars compared to other western countries such as Canada or the United Kingdom [98, 140]. Smoke-free laws in cars have been proven to be successful; after California passed their smoking in a car with children law, reported student SHS exposure decreased at a higher rate among Californians compared to the national average [95].

Without a smoke-free car law in place, many have to rely on household-based rules to limit smoking exposure in the car. However, these are much more prevalent in non-smoking households (88.9%) compared to smoking households (34.2%) who would benefit more from a non-smoking rule [104]. A study in South Carolina showed that those with more non-smoking household rules were associated with a reduction in self-reported SHS smoke exposure in their children, with those having strict non-smoking family rules having reported SHS exposure of 36% compared to 84% and 91% SHS exposure among those who have partial or no smoking rules respectively [72]. Additionally, most families who implement voluntary smoke-free rules in cars were more likely to live in locations that also had general smoke-free legislation in place.

This study aims to examine how beliefs of US adults towards other smoke-free rules as well as living in a state that has some form of ban on smoking in a car when children are present is associated with believing that smoking should, should not, or under some conditions allow smoking inside of a car when others are present and when children are present.

Methods

Sample

Pooled data from the three waves of the 2018-2019 Tobacco Use Supplement to the U.S. Current Population Survey (TUS-CPS) was used. The TUS-CPS is a nationally representative periodic survey supplemental to the Current Population Survey that utilizes multiple stages in it sampling design, with PSUs first being selected based on its 2010 Census population then households selected from the US Postal Service Master Address File based on its state population [16]. Inclusion criteria for the base CPS are 15 years of age or older, are noninstitutionalized, and not in the armed forces with further inclusion criteria for the TUS-CPS requiring that participants completed the base CPS and are 18 years of age or older [17]. For this study, only those who were self-respondents were included in the sample.

Measures

Socioeconomic and Demographic Characteristics

Socioeconomic and demographic characteristics assessed in this study include age and sex (male or female).

Current Tobacco Use

Current tobacco use (never, former, every day, some days) was identified using a combination of items, including whether participants had smoked 100 or more cigarettes in their lifetime and whether they reported at the time of interview whether they were smoking every day, some days, or not at all.

Support for Smoking in Cars

The items of interest were measured were in two separate questions: "Inside a car, when other people are present, do you think that smoking should…" followed by "If children are present inside the car, do you think that smoking should…." Both questions had response options of "always be allowed, be allowed under some conditions, or never be allowed."

Living in a State with a Child Passenger Smoking Restriction

Each participant's data had attached information regarding their state of residence as a FIPS code which was sorted into groups based on the state's minimum age of child passenger restriction listed in by American Nonsmokers' Rights Foundation passed and in effect prior to the collection of the 2018-2019 waves of the TUS-CPS [8]. Final items included: "Lives in a State with Children (12 and Younger) Present Car Ban" which were Vermont and Virginia, "Lives in a State with Teenagers (13-17) Present Car Ban" which were Arkansas, Louisiana, Maine, and Utah, "Lives in a State with All Minors (Under 18) Present Car Ban" which were California and Oregon, and "Does not live in a state with Child Present Car Ban" which was every US state other than what were previously mentioned.

Home Smoking Rules

A question regarding the participant's home smoking rules included valid entries of "No one is allowed to smoke anywhere," "Smoking is allowed in some places or at some times," and "Smoking is permitted anywhere."

Support for Smoking in Indoor Recreation Locations

This question asked participants their belief regarding the allowance of smoking in locations such as bars, cocktail lounges, and clubs with valid entries of "Allowed in all areas," "Allowed in some areas," and "Not allowed at all."

Multiunit Housing

Participants were asked their belief about allowing smoking in buildings with multiple apartments or living areas with valid entries of "Allowed inside all apartments and living areas," "Allowed inside some apartments," and "Not allowed at all inside apartments."

Support for Smoking in Indoor Work Areas Locations

This question asked participants their belief about smoking being allowed in indoor work areas with valid entries of "Allowed in all areas," "Allowed in some areas," and "Not allowed at all."

Data Analysis

Weights for data provided by TUS-CPS were used in order to account for the survey's complex sampling design and clustering effects and to adjust for sampling selection based on the participants' state's demographic distribution. The three waves of data from the 2018-2019 TUS-CPS were concatenated and weighted then analyzed first in simple frequency distributions and crosstabulations. Next, two separate multinomial logistic regressions (MLR) were conducted, with the first model assessing the item "when others are present" and the second model assessing the item "when children are present." Both models used "never be allowed" as the referent group for the regression with both also controlling by participant age, current smoking status, and sex. All data analysis was conducted using SAS version 9.4 (SAS Institute Inc).

Results

Demographics and Descriptive Statistics

Table 15 shows the unstratified sample of the 2018-2019 TUS-CPS wave with both control variables and the items of interest for this study. The majority of participants were White (79.2%), non-Hispanic (83.1%), never smokers (70.7%), and having at least a high school diploma or equivalent (G.E.D.) (55.2%). For this study, the majority of participants lived in a state without a ban on smoking in a car when a child was present (80.1%), had a non-smoking rule in their own home (90.0%), believed that smoking should not be allowed at all in multiunit housing (68.1%), and thought that smoking should not be allowed in recreational locations such as bars (68.1%).

Table 15. Base Demographics of US Adults Sampled from the 2018-2019 TUS-CPS

		Total Unweighted Sample (n=128,835) Total Weighted Sample (n=230,417,213)		
		Unweighted Freq	Weighted Freq	Weighted Percent
Sex	Male	59,213	115,889,540	48.6%
	Female	69,622	122,683,681	51.4%
Smoking Status	Never	85,649	167,953,816	70.7%
	Former	26,257	41,454,087	17.5%
	Some Days	3,567	6,623,471	2.8%
	Every Day	12,759	21,431,092	9.0%
Residence in State with Car Smoking Ban Law	No Ban	103,916	191,174,412	80.1%
	Children U12	4,356	6,601,974	2.8%
	Teenagers U13-17	8,254	8,564,038	3.6%
	All Minors U18	12,309	32,232,798	13.5%
Home Smoking Rule	No One is Allowed Anywhere	113,033	210,268,405	90.0%
	Some Places or at Some Times	6,435	11,825,201	5.1%
	Allowed Anywhere	6,754	11,533,210	4.9%
Opinion of MUH Smoking	Not allowed at all	83,104	154,630,863	68.1%
	Allowed in Some Apartments	28,260	52,167,517	23.0%
	Allowed inside All Apartments	11,021	20,231,887	8.9%
Opinion of Smoking in Recreation Areas	Not Allowed at All	73,455	133,991,562	58.6%
	Allowed in Some Areas	41,051	78,936,243	34.5%
	Allowed in All Areas	9,000	15,705,322	6.9%
Opinion of Smoking in Indoor Work Areas	Not Allowed at All	104,752	194,046,935	84.1%
	Allowed in Some Areas	17,631	32,597,556	14.1%
	Allowed in All Areas	2,276	4,050,507	1.8%

Responses by Presence of a Car Ban when a Child is Present

Frequencies: Table 16 examines differences in beliefs on whether smoking should be allowed in cars based on whether the participant lived in a state with some form of restriction on smoking in a car when a child was present. Those who lived in states restricting only the youngest age group (12 years of age and younger) had the lowest percent of believing that smoking should never be allowed when others are present (71.8%) and those living in states restricting smoking when all minors were present had the highest (79.8%). The percent differences between the states with different car restrictions shrunk when asking about belief about smoking in a car when children were present.

Table 16. Beliefs about Smoking in a Car by Presence of a Car Ban when a Child is Present Frequencies

			When Others are Present (n=124,563)			When Children are Present (n=124,973)		
			Freq	Weighted Freq (Wgt Row %)	Wgt S.E. of Row	Freq	Weighted Freq (Wgt Row %)	Wgt S.E. of Row
Car Law	No Ban	Never be Allowed	76,060	139,447,944 (75.6%)	0.2012	95,978	176,787,088 (95.5%)	0.1135
		Be Allowed Under Some Conditions	20,556	38,332,477 (20.8%)	0.1898	3,750	6,582,318 (3.6%)	0.1026
		Always Be Allowed	3,780	6,650,555 (3.6%)	0.0788	980	1,669,367 (0.9%)	0.0379
	Children U12	Never be Allowed	3,155	4,587,149 (71.8%)	1.1766	4,023	6,037,272 (94.0%)	0.7148
		Be Allowed Under Some Conditions	878	1,442,510 (22.6%)	0.9509	182	348,331 (5.4%)	0.6564
		Always Be Allowed	172	362,392 (5.7%)	0.6464	26	34,933 (0.5%)	0.1572
	Teenagers U13-17	Never be Allowed	6,301	6,454,410 (77.5%)	0.7023	7,777	8,070,089 (96.7%)	0.2308
		Be Allowed Under Some Conditions	1,469	1,610,970 (19.3%)	0.6505	208	227,063 (2.7%)	0.2166
		Always Be Allowed	248	264,333 (3.2%)	0.2309	49	45,251 (0.5%)	0.0839
	All Minors U18	Never be Allowed	9,460	24,946,184 (79.8%)	0.5010	11,663	30,561,486 (97.3%)	0.1624
		Be Allowed Under Some Conditions	2,079	5,314,683 (17.0%)	0.4747	260	658,573 (2.1%)	0.1467
		Always Be Allowed	405	1,003,606 (3.2%)	0.1983	77	174,801 (0.6%)	0.0731

Responses by Home Smoking Rules

Frequencies: Table 17 examines differences in beliefs on whether smoking should be allowed in cars based on the participant's home smoking rules. Those that did not allow smoking in their home also had the highest percent of believing that smoking should never be allowed in a car when others were present (79.9%) compared to those who had a home smoking rule of always allowed had the lowest percent (39.6%). Both those who had a home smoking rule of allowing at some places or times and always allowed had a majority percent believe that smoking in a car when others were present should be allowed under some conditions (47.5% and 44.5%) respectively as well as fairly a high percent of believing that smoking in a car when children were present should be allowed under some conditions (12.4% and 14.4%) respectively. Those who had a home smoking rule of always allowed had the highest percent of believing that

smoking should always be allowed in a car both when others were present (15.9%) and when children were present (4.6%).

Table 17. Beliefs about Smoking in a Car by Presence of Smoking in Home Rule Frequencies

			When Others are Present (n=122,987)			When Children are Present (n=124,853)		
			Freq	Weighted Freq (Wgt Row %)	Wgt S.E. of Row	Freq	Weighted Freq (Wgt Row %)	Wgt S.E. of Row
Home Smoking Rule	Not allowed	Never be Allowed	89,417	165,547,511 (79.9%)	0.1932	108,538	202,044,134 (97.1%)	0.0830
		Be Allowed Under Some Conditions	19,038	36,071,338 (17.4%)	0.1789	2,640	4,739,927 (2.3%)	0.0764
		Always Be Allowed	3,028	5,664,179 (2.7%)	0.0697	692	1,235,799 (0.6%)	0.0270
	Some places or times	Never be Allowed	2,936	5,314,479 (45.7%)	0.8530	5,466	10,046,787 (86.3%)	0.6284
		Be Allowed Under Some Conditions	2,958	5,517,780 (47.5%)	0.8606	784	1,439,055 (12.4%)	0.6122
		Always Be Allowed	441	790,312 (6.8%)	0.4023	94	154,061 (1.3%)	0.1663
	Always allowed	Never be Allowed	2,571	4,483,540 (39.6%)	0.7349	5,328	9,175,681 (81.0%)	0.6432
		Be Allowed Under Some Conditions	2,948	5,048,834 (44.5%)	0.7738	969	1,626,565 (14.4%)	0.5955
		Always Be Allowed	1,124	1,802,411 (15.9%)	0.5949	342	526,628 (4.6%)	0.3166

Responses by Belief about Smoking in Multiunit Housing

Frequencies: Table 18 examines differences in beliefs on whether smoking should be allowed in cars based on participant's beliefs about smoking in multiunit housing. Those that believed that smoking should not be allowed in multiunit housing had the highest percent of believing that smoking should never be allowed in a car when others were present (87.1%) compared to those who believed that smoking should always be allowed in multiunit housing having the lowest percent (46.4%). Both those who believed that smoking should be allowed in multiunit housing in some apartments and always allowed had high percentages of those who believe that smoking in a car when others were present should be allowed under some conditions (40.0% and 35.5%) compared to those who thought that smoking should never be allowed in multiunit housing (11.4%). While percent differences between groups shrink when asking about

smoking in cars in the presence of children, those who believe that smoking should always be allowed in multiunit housing had the lowest percent of respondents believe that smoking should never be allowed in a car (83.4%) compared to those who believed that smoking in multiunit housing should not be allowed (98.9%) and be allowed in some apartments (91.6%). Those who believed that smoking should always be allowed in multiunit housing had the highest percent of believing that smoking should always be allowed in a car both when others were present (18.0%) and when children were present (5.7%).

Table 18. Beliefs about Smoking in a Car by Belief about Smoking in Multiunit Housing Frequencies

			When Others are Present (n=121,840)			**When Children are Present (n=122,970)**		
			Freq	Weighted Freq (Wgt Row %)	Wgt S.E. of Row	Freq	Weighted Freq (Wgt Row %)	Wgt S.E. of Row
Multiunit Housing	Not allowed	Never be Allowed	72,287	134,222,925 (87.1%)	0.1819	81,926	152,548,272 (98.9%)	0.0458
		Be Allowed Under Some Conditions	9,350	17,630,202 (11.4%)	0.1738	805	1,395,816 (0.9%)	0.0399
		Always Be Allowed	1,154	2,169,566 (1.4%)	0.0558	174	309,738 (0.2%)	0.0182
	Some apartments	Never be Allowed	15,841	28,965,248 (55.8%)	0.4744	25,686	47,608,397 (91.6%)	0.2761
		Be Allowed Under Some Conditions	11,075	20,755,148 (40.0%)	0.4471	2,223	3,962,608 (7.6%)	0.2743
		Always Be Allowed	1,207	2,191,192 (4.2%)	0.1625	243	406,644 (0.8%)	0.0604
	Always allowed	Never be Allowed	5,050	9,315,186 (46.4%)	0.6250	9,035	16,706,835 (83.4%)	0.4218
		Be Allowed Under Some Conditions	3,815	7,128,361 (35.5%)	0.5866	1,203	2,186,819 (10.9%)	0.3700
		Always Be Allowed	2,061	3,617,846 (18.0%)	0.4645	675	1,145,259 (5.7%)	0.2812

Responses by Belief about Smoking in Recreational Facilities

Frequencies: Table 19 examines differences in beliefs on whether smoking should be allowed in cars based on participant's beliefs about smoking in recreational facilities such as bars, cocktail lounges, and clubs. Those that believed that smoking should not be allowed in recreational facilities had the highest percent of believing that smoking should never be allowed in a car when others were present (88.1%) compared to those who believed that smoking should

be allowed in all areas of recreational facilities having the lowest percent (40.8%). Both those who believe that smoking should be allowed in recreational facilities in some areas and in all areas had high percentages of those who believe that smoking in a car when others were present should be allowed under some conditions (33.7% and 37.9%) compared to those who thought that smoking should never be allowed in recreational facilities (10.3%). While percent differences between groups shrink when asking about smoking in cars in the presence of children, those who believe that smoking should be allowed in all areas of recreational facilities had the lowest percent of respondents believe that smoking should never be allowed in a car (82.1%) compared to those who believed that smoking in recreational facilities should not be allowed (98.8%) and be allowed in some areas of recreational facilities (93.3%). Those who believed that smoking should be allowed in all areas of in recreational facilities had the highest percent of believing that smoking should always be allowed in a car both when others were present (21.3%) and when children were present (6.8%).

Table 19. Beliefs about Smoking in a Car by Belief about Smoking in Recreational Facilities Frequencies

			When Others are Present (n=122,987)			**When Children are Present (n=123,195)**		
			Freq	Weighted Freq (Wgt Row %)	Wgt S.E. of Row	Freq	Weighted Freq (Wgt Row %)	Wgt S.E. of Row
Bars/Clubs	Not allowed	Never be Allowed	64,543	117,696,080 (88.1%)	0.1764	72,476	132,263,621 (98.8%)	0.0562
		Be Allowed Under Some Conditions	7,602	13,801,594 (10.3%)	0.1654	714	1,275,830 (1.0%)	0.0514
		Always Be Allowed	1,066	2,048,213 (1.5%)	0.0629	156	270,918 (0.2%)	0.0194
	Some areas	Never be Allowed	25,627	49,287,042 (62.7%)	0.3604	38,017	73,399,078 (93.3%)	0.1933
		Be Allowed Under Some Conditions	13,698	26,474,562 (33.7%)	0.3499	2,569	4,706,527 (6.0%)	0.1857
		Always Be Allowed	1,507	2,787,776 (3.5%)	0.1186	324	570,649 (0.7%)	0.0459
	All Areas	Never be Allowed	3,610	6,368,502 (40.8%)	0.6984	7,249	12,805,154 (82.1%)	0.5324
		Be Allowed Under Some Conditions	3,379	5,911,637 (37.9%)	0.6833	1,055	1,728,224 (11.1%)	0.4509
		Always Be Allowed	1,955	3,318,668 (21.3%)	0.5545	635	1,054,224 (6.8%)	0.3681

Responses by Belief about Smoking in Indoor Work Areas

Frequencies: Table 20 examines differences in beliefs on whether smoking should be allowed in cars based on participant's beliefs about smoking in indoor work areas. Those that believed that smoking should not be allowed in indoor work areas had the highest percent of believing that smoking should never be allowed in a car when others were present (81.5%) compared to those who believed that smoking should be allowed in all areas of indoor work areas having the lowest percent (39.9%). Those who believed that smoking should be allowed in some areas of indoor work areas had high percentages of those who believed that smoking in a car when others were present should be allowed under some conditions (44.5%) compared to those who thought that smoking should never be allowed in indoor work areas (16.1%) and that smoking should be allowed in all indoor work areas (25.1%). While percent differences between groups shrink when asking about smoking in cars in the presence of children, those who believe that smoking should be allowed in all areas of indoor work areas had the lowest percent of respondents believe that smoking should never be allowed in a car (69.9%) compared to those who believed that smoking in indoor work areas should not be allowed (98.0%) and be allowed in some areas of indoor work areas (86.1%). Those who believed that smoking should be allowed in all areas of in indoor work areas had the highest percent of believing that smoking should always be allowed in a car both when others were present (35.0%) and when children were present (16.3%).

Table 20. Beliefs about Smoking in a Car by Belief about Smoking in Indoor Work Areas Frequencies

			When Others are Present (n=123,949)			When Children are Present (n=124,233)		
			Freq	Weighted Freq (Wgt Row %)	Wgt S.E. of Row	Freq	Weighted Freq (Wgt Row %)	Wgt S.E. of Row
Indoor Work Area	Not Allowed	Never be Allowed	85,244	157,394,512 (81.5%)	0.1905	102,241	189,611,113 (98.0%)	0.0590
		Be Allowed Under Some Conditions	16,462	30,998,313 (16.1%)	0.1796	1,760	3,112,393 (1.6%)	0.0521
		Always Be Allowed	2,476	4,621,826 (2.4%)	0.0690	449	796,296 (0.4%)	0.0230
	Some Areas	Never be Allowed	8,516	15,802,647 (48.8%)	0.5237	14,964	27,899,249 (86.1%)	0.3988
		Be Allowed Under Some Conditions	7,774	14,404,081 (44.5%)	0.5075	2,294	4,074,196 (12.6%)	0.4024
		Always Be Allowed	1,218	2,157,823 (6.7%)	0.2310	276	442,239 (1.4%)	0.0965
	All Areas	Never be Allowed	846	1,601,677 (39.9%)	1.3056	1,564	2,792,317 (69.9%)	1.1363
		Be Allowed Under Some Conditions	571	1,008,173 (25.1%)	1.0855	297	549,522 (13.8%)	0.8412
		Always Be Allowed	842	1,404,856 (35.0%)	1.3091	388	652,977 (16.3%)	1.0567

Multinomial Logistic Regression Models: Tables 23 and 26 present the results of two separate multinomial logistic regression models, with Table 23 examining support for smoking when other passengers are present in a car and Table 26 examining support for smoking when children are present in a car. Multicollinearity was assessed and found to be not in effect in the models with all tolerances for variables above cutoff recommendations and variance inflation factors falling within acceptable ranges [125].

Regression Results by State Car Law Restriction

When Others are Present: Compared to those who lived in a state without a child present smoking restriction, those who lived in a state with an under 13 to 17 years of age child restriction possessed lower odds of believing smoking should be allowed in a car when others are present both under some conditions (AOR = 0.82; 95% CI = 0.75 - 0.90, p-value = <.0001) and always allowed (AOR = 0.82; 95% CI = 0.68 - 0.98, p-value = .0268) compared to never be allowed. However, those who lived in a state with an under 12 years of age child restriction

possessed higher odds of believing smoking should be allowed in a car when others are present both under some conditions (AOR = 1.29; 95% CI = 1.15 - 1.46, p-value = <.0001) and always allowed (AOR = 2.21; 95% CI = 1.66 - 2.94, p-value = <.0001) compared to never be allowed. Similarly, those who lived in a state with an under 18 years of age child restriction possessed higher odds of believing smoking should always be allowed in a car when others are present (AOR = 1.28; 95% CI = 1.10 - 1.49, p-value = .0013) compared to never be allowed.

When Children are Present: Compared to those who lived in a state without a child present smoking restriction, those who lived in a state with an under 13 to 17 years of age child restriction possessed lower odds of believing smoking should be allowed in a car when children are present both under some conditions (AOR = 0.68; 95% CI = 0.57 - 0.82, p-value = <.0001) and always allowed (AOR = 0.58; 95% CI = 0.41 - 0.82, p-value = .0022) compared to never be allowed. Similarly, those who lived in a state with an under 18 years of age child restriction possessed lower odds of believing smoking should always be allowed in a car when children are present (AOR = 0.79; 95% CI = 0.67 - 0.94, p-value = .007) compared to never be allowed. However, those who lived in a state with an under 12 years of age child restriction possessed higher odds of believing smoking should be allowed under some conditions in a car when children are present (AOR = 1.87; 95% CI = 1.38 - 2.54, p-value = <.0001) compared to never be allowed.

Regression Results by Home Smoking Rule

When Others are Present: Compared to those who had a no smoking rule in their home, those who had some places or some times rules had higher odds of both believing that smoking should be allowed under some conditions (AOR = 1.90; 95% CI = 1.73 – 2.09, p-value = <.0001) and always allowed (AOR = 1.32; 95% CI = 1.13 - 1.54, p-value = .0005) when others were present compared to never be allowed. Similarly, those who had an always allowed home smoking rule when compared to those with a no smoking allowed in the home rule had higher odds of both believing that smoking should be allowed under some conditions (AOR = 2.07; 95% CI = 1.91 – 2.25, p-value = <.0001) and always allowed (AOR = 2.33; 95% CI = 2.02 - 2.69, p-value = <.0001) when others were present compared to never be allowed.

When Children are Present: Similar to when others were present, when compared to those who had a no smoking rule in their home, those who had some places or some times rules had higher odds of both believing that smoking should be allowed under some conditions (AOR

= 2.10; 95% CI = 1.80 – 2.47, p-value = <.0001) when children were present compared to never be allowed. Similarly, those who had an always allowed home smoking rule when compared to those with a no smoking allowed in the home rule had higher odds of both believing that smoking should be allowed under some conditions (AOR = 2.30; 95% CI = 2.01 – 2.64, p-value = <.0001) and always allowed (AOR = 1.56; 95% CI = 1.26 – 1.92, p-value = <.0001) when others were present compared to never be allowed.

Regression Results by Multiunit Housing Smoking Opinion

When Others are Present: Compared to those who believed that smoking should never be allowed in multiunit housing, those who believed that smoking should be allowed in some apartments possessed higher odds of believing smoking should be allowed in a car when others are present both under some conditions (AOR = 3.25; 95% CI = 3.07 – 3.44, p-value = <.0001) and always allowed (AOR = 2.97; 95% CI = 2.61 -3.38, p-value = <.0001) compared to never be allowed when others were present in a car. Similarly when compared to those who believe that smoking should never be allowed in multiunit housing, those who believed that smoking should always be allowed in multiunit housing possessed higher odds of believing smoking should be allowed in a car when others are present both under some conditions (AOR = 3.35; 95% CI = 3.12 -3.59, p-value = <.0001) and always allowed (AOR = 8.37; 95% CI = 7.31 – 9.58, p-value = <.0001) compared to never be allowed when others were present in a car.

When Children are Present: Compared to those who believed that smoking should never be allowed in multiunit housing, those who believed that smoking should be allowed in some apartments possessed higher odds of believing smoking should be allowed in a car when children are present both under some conditions (AOR = 3.69; 95% CI = 3.32 – 4.10, p-value = <.0001) and always allowed (AOR = 2.35; 95% CI = 1.78 – 3.09, p-value = <.0001) compared to never be allowed when others were present in a car. Similarly when compared to those who believe that smoking should never be allowed in multiunit housing, those who believed that smoking should always be allowed in multiunit housing possessed higher odds of believing smoking should be allowed in a car when children are present both under some conditions (AOR = 4.84; 95% CI = 4.27 – 5.48, p-value = <.0001) and always allowed (AOR = 8.13; 95% CI = 6.15 – 10.76, p-value = <.0001) compared to never be allowed when others were present in a car.

Regression Results by Recreational Area Smoking Opinion

When Others are Present: Compared to those who believed that smoking should never be allowed in recreational facilities, those who believed that smoking should be allowed in some areas of recreational facilities possessed higher odds of believing smoking should be allowed in a car when others are present both under some conditions (AOR = 2.32; 95% CI = 2.20 – 2.45, p-value = <.0001) and always allowed (AOR = 1.69; 95% CI = 1.49 – 1.91) compared to never be allowed when others were present in a car. Similarly when compared to those who believe that smoking should never be allowed in recreational facilities, those who believed that smoking should be allowed in all areas of recreational facilities possessed higher odds of believing smoking should be allowed in a car when others are present both under some conditions (AOR = 2.74; 95% CI = 2.54 – 2.96, p-value = <.0001) and always allowed (AOR = 5.96; 95% CI = 5.23 – 6.80) compared to never be allowed when others were present in a car.

When Children are Present: Compared to those who believed that smoking should never be allowed in recreational facilities, those who believed that smoking should be allowed in some areas of recreational facilities possessed higher odds of believing smoking should be allowed in a car when children are present both under some conditions (AOR = 2.22; 95% CI = 1.96 – 2.53, p-value = <.0001) and always allowed (AOR = 2.43; 95% CI = 1.87 – 3.16, p-value = <.0001) compared to never be allowed when others were present in a car. Similarly when compared to those who believe that smoking should never be allowed in recreational facilities, those who believed that smoking should be allowed in all areas of recreational facilities possessed higher odds of believing smoking should be allowed in a car when children are present both under some conditions (AOR = 2.53; 95% CI = 2.14 – 2.98, p-value = <.0001) and always allowed (AOR = 7.55; 95% CI = 5.59 – 10.20, p-value = <.0001) compared to never be allowed when others were present in a car.

Regression Results by Indoor Work Area Smoking Opinion

When Others are Present: Compared to those who believed that smoking should never be allowed in indoor work areas, those who believed that smoking should be allowed in some areas of indoor work areas possessed higher odds of believing smoking should be allowed in a car when others are present both under some conditions (AOR = 1.51; 95% CI = 1.42 – 1.60, p-value = <.0001) and always allowed (AOR = 1.36; 95% CI = 1.22 – 1.51) compared to never be allowed when others were present in a car. Similarly, when compared to those who believe that

smoking should never be allowed in indoor work areas, those who believed that smoking should be allowed in all areas of indoor work areas possessed higher odds of believing smoking should always be allowed in a car when others are present (AOR = 2.86; 95% CI = 2.44 – 3.34) compared to never be allowed.

When Children are Present: Compared to those who believed that smoking should never be allowed in indoor work areas, those who believed that smoking should be allowed in some areas of indoor work areas possessed higher odds of believing smoking should be allowed in a car when children are present under some conditions (AOR = 2.83; 95% CI = 2.57 – 3.11, p-value = <.0001) compared to never be allowed. Similarly when compared to those who believe that smoking should never be allowed in indoor work areas, those who believed that smoking should be allowed in all areas of indoor work areas possessed higher odds of believing smoking should be allowed in a car when children are present both under some conditions (AOR = 2.84; 95% CI = 2.38 – 3.40, p-value = <.0001) and always allowed (AOR = 5.33; 95% CI = 4.24 – 6.70, p-value = <.0001) compared to never be allowed when children were present in a car.

Table 21. Testing Global Null Hypothesis for Support for Smoking in a Car when Others are Present Multinomial Logistic Regression

Test	**F Value**	**Num DF**	**Den DF**	**Pr > F**
Likelihood Ratio	918.64	26.1849	4189.58	<.0001
Score	522.27	32	160	<.0001
Wald	547.48	32	160	<.0001
NOTE: Second-order Rao-Scott design correction 0.2221 applied to the Likelihood Ratio test.				

Table 22. Type 3 Analysis of Effects for Support for Smoking in a Car when Others are Present Multinomial Logistic Regression

Effect	F Value	Num DF	Den DF	Pr > F
Sex	72.08	2	160	<.0001
Age	546.20	2	160	<.0001
Smoking Status	275.06	6	160	<.0001
State Car Law	12.39	6	160	<.0001
Home Smoking Rule	118.37	4	160	<.0001
Indoor Recreation	491.95	4	160	<.0001
Multiunit Housing	765.38	4	160	<.0001
Indoor Work Area	108.20	4	160	<.0001

Table 23. Support for Smoking in a Car when Others are Present Multinomial Logistic Regression

			When Others are Present (n=124,563)			
			Wgt Freq %	AOR	95% C.I.	P Value
State Car Law Restriction (*Referent = No Ban*)	U12	Never be Allowed (*Referent*)	71.8%			
		Be Allowed Under Some Conditions	22.6%	**1.298**	**1.151 - 1.463**	**<.0001*** **
		Always Be Allowed	5.7%	**2.206**	**1.656 - 2.939**	**<.0001*** **
	U13-17	Never be Allowed (*Referent*)	77.5%			
		Be Allowed Under Some Conditions	19.3%	**0.823**	**0.749 - 0.904**	**<.0001*** **
		Always Be Allowed	3.2%	**0.817**	**0.683 - 0.977**	**0.0268***
	U18	Never be Allowed (*Referent*)	79.8%			
		Be Allowed Under Some Conditions	17.0%	0.932	0.863 - 1.007	0.0733
		Always Be Allowed	3.2%	**1.283**	**1.104 - 1.491**	**0.0013** **
Home Smoking Rule (*Referent = Not Allowed*)	Some places or times	Never be Allowed (*Referent*)	45.7%			
		Be Allowed Under Some Conditions	47.5%	**1.897**	**1.726 - 2.085**	**<.0001*** **
		Always Be Allowed	6.8%	**1.321**	**1.131 - 1.544**	**0.0005*** **
	Always Allowed	Never be Allowed (*Referent*)	39.6%			
		Be Allowed Under Some Conditions	44.5%	**2.073**	**1.907 - 2.253**	**<.0001*** **
		Always Be Allowed	15.9%	**2.329**	**2.016 - 2.692**	**<.0001*** **
Multiunit Housing (*Referent = Not Allowed*)	Some apartments	Never be Allowed (*Referent*)	55.8%			
		Be Allowed Under Some Conditions	40.0%	**3.248**	**3.070 - 3.436**	**<.0001*** **
		Always Be Allowed	4.2%	**2.970**	**2.611 - 3.379**	**<.0001*** **
	All apartments	Never be Allowed (*Referent*)	46.4%			
		Be Allowed Under Some Conditions	35.5%	**3.349**	**3.123 - 3.593**	**<.0001*** **
		Always Be Allowed	18.0%	**8.371**	**7.312 - 9.584**	**<.0001*** **
Recreation Areas (*Referent = Not Allowed*)	Some Areas	Never be Allowed (*Referent*)	62.7%			
		Be Allowed Under Some Conditions	33.7%	**2.321**	**2.202 - 2.446**	**<.0001*** **
		Always Be Allowed	3.5%	**1.687**	**1.493 - 1.906**	**<.0001*** **
	All Areas	Never be Allowed (*Referent*)	40.8%			
		Be Allowed Under Some Conditions	37.9%	**2.740**	**2.540 - 2.957**	**<.0001*** **
		Always Be Allowed	21.3%	**5.964**	**5.227 - 6.804**	**<.0001*** **
Indoor Work Areas (*Referent = Not Allowed*)	Some Areas	Never be Allowed (*Referent*)	48.8%			
		Be Allowed Under Some Conditions	44.5%	**1.505**	**1.419 - 1.597**	**<.0001*** **
		Always Be Allowed	6.7%	**1.355**	**1.217 - 1.508**	**<.0001*** **
	All Areas	Never be Allowed (*Referent*)	39.9%			
		Be Allowed Under Some Conditions	25.1%	0.952	0.826 - 1.098	0.4999
		Always Be Allowed	35.0%	**2.858**	**2.443 - 3.343**	**<.0001*** **

Controlled by Age, Sex, and Smoking Status
*p<0.05
**p<0.01
***p<0.001

Table 24. Testing Global Null Hypothesis for Support for Smoking in a Car when Children are Present Multinomial Logistic Regression

Test	**F Value**	**Num DF**	**Den DF**	**Pr > F**
Likelihood Ratio	307.49	25.2917	4046.67	<.0001
Score	73.73	32	160	<.0001
Wald	233.16	32	160	<.0001
NOTE: Second-order Rao-Scott design correction 0.2652 applied to the Likelihood Ratio test.				

Table 25. Type 3 Analysis of Effects for Support for Smoking in a Car when Children are Present Multinomial Logistic Regression

Effect	F Value	Num DF	Den DF	Pr > F
Sex	8.43	2	160	.0003
Age	6.44	2	160	.0020
Smoking Status	8.27	6	160	<.0001
State Car Law	8.62	6	160	<.0001
Home Smoking Rule	46.55	4	160	<.0001
Indoor Recreation	85.54	4	160	<.0001
Multiunit Housing	268.21	4	160	<.0001
Indoor Work Area	177.64	4	160	<.0001

Table 26. Support for Smoking in a Car when Children are Present Multinomial Logistic Regression

			When Children are Present (n=124,563)			
			Wgt Freq %	AOR	95% C.I.	P Value
State Car Law Restriction (*Referent = No Ban*)	U12	Never be Allowed (*Referent*)	94.0%			
		Be Allowed Under Some Conditions	5.4%	**1.875**	**1.382 - 2.543**	**<.0001*****
		Always Be Allowed	.05%	0.730	0.389 - 1.370	0.3253
	U13-17	Never be Allowed (*Referent*)	96.7%			
		Be Allowed Under Some Conditions	2.7%	**0.684**	**0.573 - 0.815**	**<.0001*****
		Always Be Allowed	0.5%	**0.580**	**0.410 - 0.820**	**0.0022****
	U18	Never be Allowed (*Referent*)	97.3%			
		Be Allowed Under Some Conditions	2.1%	**0.793**	**0.671 - 0.938**	**0.0070****
		Always Be Allowed	0.6%	0.903	0.665 - 1.226	0.5100
Home Smoking Rule (*Referent = Not Allowed*)	Some places or times	Never be Allowed (*Referent*)	86.3%			
		Be Allowed Under Some Conditions	12.4%	**2.097**	**1.799 - 2.446**	**<.0001*****
		Always Be Allowed	1.3%	0.809	0.604 - 1.085	0.1554
	Always Allowed	Never be Allowed (*Referent*)	81.0%			
		Be Allowed Under Some Conditions	14.4%	**2.304**	**2.009 - 2.641**	**<.0001*****
		Always Be Allowed	4.6%	**1.556**	**1.263 - 1.916**	**<.0001*****
Multiunit Housing (*Referent = Not Allowed*)	Some apartments	Never be Allowed (*Referent*)	91.6%			
		Be Allowed Under Some Conditions	7.6%	**3.688**	**3.316 - 4.102**	**<.0001*****
		Always Be Allowed	0.8%	**2.346**	**1.784 - 3.086**	**<.0001*****
	All apartments	Never be Allowed (*Referent*)	83.4%			
		Be Allowed Under Some Conditions	10.9%	**4.835**	**4.266 - 5.479**	**<.0001*****
		Always Be Allowed	5.7%	**8.134**	**6.150 - 10.759**	**<.0001*****
Recreation Areas (*Referent = Not Allowed*)	Some Areas	Never be Allowed (*Referent*)	93.3%			
		Be Allowed Under Some Conditions	6.0%	**2.224**	**1.955 - 2.530**	**<.0001*****
		Always Be Allowed	0.7%	**2.430**	**1.867 - 3.164**	**<.0001*****
	All Areas	Never be Allowed (*Referent*)	82.1%			
		Be Allowed Under Some Conditions	11.1%	**2.525**	**2.143 - 2.975**	**<.0001*****
		Always Be Allowed	6.8%	**7.551**	**5.588 - 10.204**	**<.0001*****
Indoor Work Areas (*Referent = Not Allowed*)	Some Areas	Never be Allowed (*Referent*)	86.1%			
		Be Allowed Under Some Conditions	12.6%	**2.829**	**2.570 - 3.114**	**<.0001*****
		Always Be Allowed	1.4%	1.204	0.992 - 1.463	0.0608
	All Areas	Never be Allowed (*Referent*)	69.9%			
		Be Allowed Under Some Conditions	13.8%	**2.840**	**2.376 - 3.395**	**<.0001*****
		Always Be Allowed	16.3%	**5.331**	**4.240 - 6.701**	**<.0001*****

Controlled by Age, Sex, and Smoking Status
*p<0.05
**p<0.01
***p<0.001

Discussion

This study found that several beliefs related to smoking in certain locations were associated with beliefs towards smoking in a car when others and when children are present. Thinking that smoking should be allowed in recreational locations and multiunit housing were associated with support for smoking in a car. Similarly, believing that smoking should never be allowed in those locations was associated with believing that smoking should never be allowed in a car. When considering multiunit housing, prior research has shown that a lay audience can have misconceptions about how smoke interacts in indoor environments both in smoke's longevity in the air as well as how effective methods of dispersing smoke such as using windows to vent smoke actually are [7]. Additionally, many people may not know that smoke is capable of drifting between multiunit housing units through cracks in the wall and ventilation, potentially increasing favorability towards partial or a total lack of rules of smoking indoors since they do not realize that units are not isolated from each other [141]. Another reason that conditional and total support for smoking in these areas may exist due to these two locations being some of the few remaining indoor areas where smoking is still legal [142]. In multiunit housing, indoor smoke-free restrictions often are reliant on voluntary adoption of smoke-free rules by multiunit housing owners rather than policy. Bars, through indoor smoke-free exemptions, are often seen as more socially acceptable to smoke in when permitted but will see declines in acceptability when restricted [143]. Strengthening the belief that smoking should not be allowed in a variety of areas could potentially help provide a wider range of locations that someone would find smoking to be unacceptable in. Indoor work areas, which have seen much more regulation and acceptance of smoke free rules compared to housing and recreational areas, had comparatively smaller odds when others were present. Messaging that highlights the risks of ETS exposure in some locations might also reduce favorability towards smoking in places like cars.

Comparing associations between living in a state with varying levels of passenger age restriction on smoking in a car when a child is present and participants' beliefs towards smoking in a car when others or children were present were similar to prior research showing implementation of statewide smoke-free policies in bars and restaurants increased favorable opinions towards abstaining from smoking in those areas [92]. However, inconsistencies can be found in states that restrict smoking in a car when children 12 years of age or younger are present. Participants in this sample from those states had higher odds of believing smoking in a

car should be allowed under some conditions and always when both others and children were present compared to states without a ban. Differences between states with varying restriction ages may have confounding effects that are not able to be included in the analysis that would better explain these differences, such as different forms of enforcement or cultural differences which requires further investigation. For example, primary enforcement, when law enforcement is able to directly perform a stop a car for an infraction, has been shown to increase compliance for other car-based behaviors such as texting and driving or failing to wear a seatbelt [114, 117].

Participants who did not have a home smoking rule of "no smoking allowed" when compared to those who did were more likely to believe that smoking in a car when others or children were present should be allowed under some conditions or always allowed compared to never allowed. This aligns with prior research from European countries that found non-smoking home rules were associated with non-smoking car rules [109, 110]. Finding ways to increase support for voluntary non-smoking rules across multiple locations may indirectly assist efforts to increase non-smoking compliance in cars.

This study does possess some limitations. Social desirability bias could be present in items related to smoking in a car when children are. Participants could move their selection regarding smoking in the presence of children from always allowed to under some conditions or never allowed due to the social stigma of smoking [128]. However, a review of ETS exposure reporting accuracy found that exposure for children to ETS smoke is accurately reported by their parents but further research is needed for other children present in the car [129]. Further research that expands on reasons why smokers choose to smoke around adults but not around children may help explain this study's findings. The response of "be allowed under some conditions" may also shift results away from participants' actual use patterns due to the vague phrasing of the question. For example, if a participant chooses "under some conditions" and considers their use as conditional due to behaviors such as rolling down windows or using air conditioning when smoking in their car when passengers are present, their passengers would be exposed to ETS at unsafe levels [7].

In sum, findings from this study identify areas of need regarding health policy focused on reducing smoking in the private car. First, a consensus model policy for regulating smoking in a car designed and supported by national public health groups similar to Tobacco 21 model policies that were utilized by legislatures would be beneficial in making sure that there are no

inconsistencies between states in the design and implementation of car-based regulation of smoking based on factors such as age of passengers as well as enforcement. Additionally, having an age restriction that includes all ages under 18 instead of younger ages could not only increase the likelihood of not thinking that smoking in a car is acceptable, but could also help reduce ETS exposure rates among children and adolescents. Health communication focused on reducing smoking rates in cars should emphasize that there are no safe levels of ETS exposure and that the methods that smokers may do a car that they consider applicable to smoke with others and children present “under some conditions” such as roll down windows, using fragrances to mask the smell of smoke, and using air conditioning does not safely reduce ETS levels for their passengers [7]. Additionally, further clarifying the conditional situations where one may or may not smoke in their car based on potential factors such as weather, who their passenger is, and amount smoked could help guide more specific health messaging.

Chapter VI: Manuscript III

Introduction

Smoking remains the leading cause of preventable death and disease in the United States, where 14 percent of adults ages 18 and older were considered current cigarette smokers as of 2019 [139]. Exposure to carcinogens found in environmental tobacco smoke (ETS) created by combustion of tobacco products has been shown to lead to cancer, cardiovascular disease, and respiratory damage for both smokers who choose to smoke and non-smokers who may be unwillingly exposed [2]. Smoking and exposure to its byproducts does not affect everyone equally as those with low socioeconomic status, ethnic minorities, service and blue-collar workers, and those from rural or urban populations experiencing worse health outcomes, higher exposure rates, and higher smoking initiation rates attributable to ETS [3-5, 50, 139].

Use of tobacco products and exposure to ETS have seen consistent declines over the past several decades [5]. While legislative measures such as clean air laws have had success in reducing ETS exposure in areas such as the workplace and public spaces, non-smokers may still be exposed to ETS in an area that average American spends a large amount of their time, the private car [6]. The 2010 American Time Use Survey found that 67.6% of Americans ages 15 years and older were current drivers, spending an hour and 18 minutes per day driving [144]. Due to the confined nature of the private car and misconceptions by smokers who believe that they are mitigating the risk of ETS exposure through actions such as lowering windows or turning on air conditioning, many non-smokers could be exposed to high levels of ETS while traveling with smokers in their cars [7]. Some legislative bodies have created smoke-free laws for the private car; nine states and three territories within the United States have passed legislation banning smoking within the private car when transporting children [8]. However, these regulations do not protect adult non-smokers riding in a car. Children are unequally protected, with some states regulating smoking in a car when anyone under 18 years of age is present (California) to only protecting those under eight years of age (Virginia) [8]. While some smokers may be motivated to protect non-smokers by abstaining from smoking in their cars, not all smokers are, thus requiring legislation to protect non-smokers [9, 10].

While smoking has decreased over the past several decades, those in occupations such as food service and preparation, construction, and resource extraction, still experience a higher rate of exposure [145, 146]. Certain industries also have a higher prevalence of current cigarette

smoking, with 16% of those working in health care or social assistance being a current smoker while 25.9% of those working in the accommodation and food services industry [51, 52] and 25.8% of construction and resource extraction workers currently smoke cigarettes in the 2014-16 National Health Interview Survey [146].

Prior research has shown that the benefits of a smoke-free workplace can extend to other areas where ETS exposure can occur and help decrease smoking rates [108, 147]. Having a smoke-free workplace law is associated with increases in voluntary smoke-free rule implementation among both smokers and non-smokers [108]. Additionally, quit intention and quit attempts both increase among workers whose workplace has a strong non-smoking policy compared to weak or nonexistent policies [147].

The purpose of this study is to identify characteristics of employed US adults who believe that smoking should, should under some conditions, and should not be allowed inside of a car when both others and when children are present as well as examine whether workplace and occupational characteristics are associated with these beliefs.

Methods

Sample

Pooled data from the three waves of the 2018-2019 Tobacco Use Supplement to the U.S. Current Population Survey (TUS-CPS) was used. The TUS-CPS is a nationally representative periodic survey supplemental to the Current Population Survey that utilizes multiple stages in it sampling design, with PSUs first being selected based on its 2010 Census population then households selected from the US Postal Service Master Address File based on its state population [16]. Inclusion criteria for the base CPS are 15 years of age or older, are noninstitutionalized, and not in the armed forces with further inclusion criteria for the TUS-CPS requiring that participants completed the base CPS and are 18 years of age or older [17]. For this study, only those who were self-respondents as well as employed were included in the sample.

Measures

Questions assessing demographic, smoking, and occupation with their possible response options can be found in Appendix I, II, and IV and are summarized below.

Employment Status

Employment status was identified using the TUS-CPS labor force recode from the Current Population Survey which categorized employment status into subgroups of employed, unemployed, and not in the labor force (https://www2.census.gov/programs-surveys/cps/techdocs/questionnaires/Labor%20Force.pdf). For this study, only those who were "Employed-at work" and "Employed-absent" were selected for analysis, which was 67.1% of the total sample, with both being grouped as "Employed."

Socioeconomic and Demographic Characteristics

Socioeconomic and demographic characteristics assessed in this study include sex (male or female), race which does not include Hispanic origin (White only, Black only, Asian/Pacific Islander only), Hispanic origin (yes or no), and highest educational attainment (less than a high school diploma, a high school diploma or equivalent (GED), four-year degree or more).

Current Tobacco Use

Current tobacco use (never, former, some days, every day) was identified using a combination of items, including whether participants had smoked 100 or more cigarettes in their lifetime and whether they reported at the time of interview whether they were smoking every day, some days, or not at all. Every day smokers had indicated they had smoked at least 100 cigarettes in their lifetime and were currently smoking every day. Some days smokers indicated they had smoked at least 100 cigarettes in their lifetime and were smoking some days. Former smokers had indicated they had smoked at least 100 cigarettes in their lifetime but were currently not smoking at all. Never smokers had never smoked 100 or more cigarettes in their lifetime.

Support for Smoking in Cars

The items of interest were measured were in two separate questions: 1) "Inside a car, when other people are present, do you think that smoking should…" and 2) "If children are present inside the car, do you think that smoking should…." Both questions had response options of "always be allowed, be allowed under some conditions, or never be allowed." (see Appendix I.

Occupation Type

Occupation type was created using the base CPS survey records organized by the 2010 Census codes. While these categories are internally sorted into 11 specific major occupation groups by the TUS-CPS, this study grouped them into white-collar, services, and blue-collar

using categories created by Ham et al. in a prior study examining occupation and workplace policies in relation to smoking behaviors [131]. Specific sorting of occupations into these groups can be found in Appendix IV.

Work Smoking Items

Work related smoking was assessed using two items. The first item asked participants whether smoking was restricted in any way at their place of work with possible responses of "yes" or "no." The second item asked whether anyone had smoked in the participant's in the area in which they work within the past two weeks with possible response options of "yes" and "no." These items were only given to participants who answered in preceding items that they worked either indoors, equally indoors and outdoors, or mainly indoors in environments such as a warehouse and when working indoors, they mainly work in either an office building or another indoor place.

Data Analysis

Weights for data provided by TUS-CPS were used in order to account for the survey's complex sampling design and clustering effects and to adjust for sampling selection based on the participants' state's demographic distribution. The three waves of data from the 2018-2019 TUS-CPS were concatenated and weighted then analyzed first in simple frequency distributions. Next, two separate multinomial logistic regressions (MLR) were conducted, with the first model assessing the item "when others are present" and the second model assessing the item "when children are present." Both models used "never be allowed" as the referent group for the regression with both also controlling by participant age, current smoking status, and sex. All data analysis was conducted using SAS 9.4 (SAS Institute Inc).

Results

Demographics and Descriptive Statistics

Table 27 shows the unstratified sample of the 2018-2019 TUS-CPS wave with both control variables and the items of interest for this study. The weighted majority of participants in this study was White only (79.4%), never smokers (73.6%), and had at least a high school diploma or equivalent (G.E.D.) (55.2%) and male (52.8%). For this study, the majority of participants had a White-Collar occupation (64.7%), had a workplace where smoking was

restricted (93.3%), did not have anyone smoke in their work area within the past two weeks (95.1%). Table 28 shows responses to the questions regarding smoking in a car when others and when children are present by occupational type and workplace smoking. When others are present, a majority believe that smoking should never be allowed (75.0%) with the next largest group believing that smoking should be allowed under some conditions (21.4%). When children are present, most believe that smoking should never be allowed (96.1%) with a smaller percentage believing that smoking should be allowed under some conditions (3.1%).

Table 27. Base Demographics of Employed US Adults Sampled from the 2018-2019 TUS-CPS

		Total Unweighted Sample (n=79,037) **Total Weighted Sample (n=154,531,300)**			
		Unweighted Freq	Weighted Freq	Weighted Percent	Study I Sample Weighted Percent
Sex	Male	39,556	81,664,280	52.8%	48.6%
	Female	39,481	72,867,021	47.2%	51.4%
Race	White Only	65,061	119,605,101	79.4%	79.2%
	Black Only	7,662	19,524,720	13.0%	13.2%
	Asian/Pacific Islander Only	4,738	11,509,603	7.6%	7.6%
Educational Attainment	Less than HS Diploma	3,967	9,581,624	6.2%	9.2%
	HS Diploma or Equivalent	40,949	81,199,216	52.5%	55.2%
	4 Year Degree or More	34,121	63,750,460	41.3%	35.7%
Smoking Status	Never	55,526	113,215,272	73.6%	70.7%
	Former	13,955	23,929,288	15.5%	17.5%
	Some Days	2,172	4,280,158	2.8%	2.8%
	Every Day	7,064	12,469,813	8.1%	9.0%
Occupation Type	White-Collar	52,704	99,910,364	64.7%	~~~
	Services	14,332	29,610,663	19.2%	~~~
	Blue-Collar	12,001	25,010,274	16.2%	~~~
Is Smoking Restricted at Work	Yes	53,202	103,702,047	93.3%	~~~
	No	3,591	7,452,551	6.7%	~~~
Anyone Smoked at Work	Yes	2,645	5,421,445	4.9%	~~~
	No	53,926	105,258,458	95.1%	~~~

Table 28. Support among Employed US Adults for Smoking in a Car when Others and When Children are Present

		When Others are Present (n=76,520)			When Children are Present (n=73,617)		
		Unwgt Freq	Weighted Freq (Wgt Freq %)	Wgt S.E of Row	Unwgt Freq	Weighted Freq (Wgt Row %)	Wgt S.E. of Row
Total	Never be Allowed	57,237	112,014,628 (75.0%)	0.2253	73,617	144,102,773 (96.1%)	0.1090
	Be Allowed Under Some Conditions	16,507	32,034,528 (21.4%)	0.2063	2,522	4,700,424 (3.1%)	0.0992
	Always Be Allowed	2,776	5,375,699 (3.6%)	0.0957	674	1,213,694 (0.8%)	0.0397

Responses by Sex

Frequencies: Table 29 shows that males had the lowest frequency of all socio-demographic characteristics of never allowing smoking in a car both when others are present and when children are present (72.0% and 95.4%).

Table 29. Support among Employed US Adults for Smoking in a Car When Others and Children are Present by Sex

			When Others are Present (n=76,520)			When Children are Present (n=76,813)		
			Unwgt Freq	Weighted Freq (Wgt Row %)	Wgt S.E. of Row	Unwgt Freq	Weighted Freq (Wgt Row %)	Wgt S.E. of Row
Sex	Female	Never be Allowed	30,033	55,357,753 (78.3%)	0.2815	37,224	68,688,100 (96.8%)	0.1162
		Be Allowed Under Some Conditions	7,255	13,361,441 (18.9%)	0.2600	998	1,812,788 (2.6%)	0.1146
		Always Be Allowed	1,073	1,973,766 (2.8%)	0.1109	270	464,678 (0.7%)	0.0425
	Male	Never be Allowed	27,204	56,656,875 (72.0%)	0.2657	36,393	75,414,673 (95.4%)	0.1508
		Be Allowed Under Some Conditions	9,252	18,673,087 (23.7%)	0.2514	1,524	2,887,636 (3.7%)	0.1345
		Always Be Allowed	1,703	3,401,933 (4.3%)	0.1288	404	749,016 (0.9%)	0.0563

Responses by Race/Ethnicity

Frequencies: Table 30 shows differences by race. Those who identified as White only had the lowest percentages of those who thought that smoking in a car should never be allowed and highest percentage of allowing smoking under some conditions when others are present (73.7% and 22.5%). In contrast, those who identified as Asian/Pacific Islander only had the highest percentage of thinking that smoking should never be allowed in a car and lowest

percentage for thinking that smoking should be allowed under some conditions in a car (83.6% and 14.4%). When children were present, frequencies were similar between races.

Table 30. Support among Employed US Adults for Smoking in a Car When Others and Children are Present by Race

			When Others are Present (n=74,991)			When Children are Present (n=75,281)		
			Unwgt Freq	Weighted Freq (Wgt Row %)	Wgt S.E. of Row	Unwgt Freq	Weighted Freq (Wgt Row %)	Wgt S.E. of Row
Race	White Only	Never be Allowed	46,452	85,334,352 (73.7%)	0.2557	60,512	111,436,016 (95.8%)	0.1190
		Be Allowed Under Some Conditions	14,176	26,029,210 (22.5%)	0.2347	2,172	3,796,595 (3.3%)	0.1057
		Always Be Allowed	2,417	4,452,948 (3.8%)	0.1050	604	1,033,096 (0.9%)	0.0454
	Black Only	Never be Allowed	5,903	14,768,106 (78.7%)	0.5948	7,167	18,196,802 (96.6%)	0.2933
		Be Allowed Under Some Conditions	1,270	3,423,744 (18.3%)	0.5367	200	535,314 (2.8%)	0.2762
		Always Be Allowed	205	567,643 (3.0%)	0.2551	36	107,814 (0.6%)	0.1209
	Asian/PI Only	Never be Allowed	3,791	9,268,621 (83.6%)	0.6590	4,478	10,891,418 (97.8%)	0.2426
		Be Allowed Under Some Conditions	680	1,600,579 (14.4%)	0.6377	94	208,178 (1.9%)	0.2296
		Always Be Allowed	97	213,471 (1.9%)	0.2266	18	35,374 (0.3%)	0.0873

Responses by Educational Attainment

Frequencies: Table 31 shows how allowing smoking in a car varies by educational attainment. Those who had a high school degree or equivalent had the lowest percentages of those who thought that smoking in a car should never be allowed and highest percentage of allowing smoking under some conditions when others are present (73.7% and 22.5%). Those who a high school diploma or equivalent had the highest percentage of those who believed that smoking should always be allowed when others were present (3.8%) and those with less than a high school diploma having the lowest percent (3.1%).

Table 31. Support among Employed US Adults for Smoking in a Car When Others and Children are Present by Education

			When Others are Present (n=76,520)			When Children are Present (n=76,813)		
			Freq	Weighted Freq (Wgt Row %)	Wgt S.E. of Row	Freq	Weighted Freq (Wgt Row %)	Wgt S.E. of Row
Education	Less than HS Diploma	Never be Allowed	2,922	7,204,266 (78.4%)	0.9248	3,641	8,881,674 (96.3%)	0.3787
		Be Allowed Under Some Conditions	730	1,693,410 (18.4%)	0.8356	137	278,543 (3.0%)	0.3281
		Always Be Allowed	140	286,024 (3.1%)	0.3040	33	63,248 (0.7%)	0.1524
	HS Diploma or Equivalent (GED)	Never be Allowed	29,043	57,812,465 (73.7%)	0.2956	37,899	75,345,761 (95.7%)	0.1463
		Be Allowed Under Some Conditions	9,011	17,672,606 (22.5%)	0.2731	1,473	2,764,685 (3.5%)	0.1381
		Always Be Allowed	1,553	3,002,676 (3.8%)	0.1304	363	640,086 (0.8%)	0.0535
	Four Year Degree or More	Never be Allowed	25,272	46,997,897 (76.1%)	0.3156	32,077	59,875,338 (96.5%)	0.1258
		Be Allowed Under Some Conditions	6,766	12,668,513 (20.5%)	0.2903	912	1,657,196 (2.7%)	0.1085
		Always Be Allowed	1,083	2,086,999 (3.4%)	0.1260	278	510,360 (0.8%)	0.0557

Responses by Smoking History

Frequencies: Table 32 shows the distribution of responses by smoking history. Every day smokers had the highest percentage of those believing that smoking should be allowed in a car when others are present, with a larger percentage thinking that smoking should be allowed under some conditions compared to never allowed (47.3% vs 41.4%). Every day smokers also had the lowest percentage of participants who thought that smoking should never be allowed when children are present in a car (87.7%) and a high percentage of those who believed that smoking should be allowed under some conditions when children are present (9.8%). Some days smokers also had a high percentage when compared to former and never smokers of believing that when others are present that smoking should be allowed under some conditions (39.0%) or always allowed (6.4%).

Table 32. Support among Employed US Adults for Smoking in a Car When Others and Children are Present by Smoking Status

			When Others are Present (n=76,412)			When Children are Present (n=76,698)		
			Unwgt Freq	Weighted Freq (Wgt Row %)	Wgt S.E. of Row	Unwgt Freq	Weighted Freq (Wgt Row %)	Wgt S.E. of Row
Smoking Status	Never	Never be Allowed	43,820	88,729,386 (80.6%)	0.2429	52,734	107,488,078 (97.2%)	0.1121
		Be Allowed Under Some Conditions	8,979	18,720,079 (17.0%)	0.2280	1,200	2,425,693 (2.2%)	0.1033
		Always Be Allowed	1,258	2,638,186 (2.4%)	0.0948	331	630,816 (0.6%)	0.0406
	Former	Never be Allowed	9,462	16,046,353 (69.1%)	0.4935	12,972	22,227,314 (95.4%)	0.2289
		Be Allowed Under Some Conditions	3,480	6,048,093 (26.0%)	0.4667	513	852,221 (3.7%)	0.2025
		Always Be Allowed	631	1,130,760 (4.9%)	0.2297	139	227,864 (1.0%)	0.0902
	Some Days	Never be Allowed	1,125	2,219,631 (54.7%)	1.5030	1,930	3,802,797 (93.5%)	0.6954
		Be Allowed Under Some Conditions	811	1,581,970 (39.0%)	1.4296	110	223,453 (5.5%)	0.6085
		Always Be Allowed	122	258,778 (6.4%)	0.7447	25	42,909 (1.1%)	0.2754
	Every Day	Never be Allowed	2,767	4,907,332 (41.4%)	0.7603	5,883	10,416,436 (87.7%)	0.4939
		Be Allowed Under Some Conditions	3,198	5,603,261 (47.3%)	0.7770	685	1,160,475 (9.8%)	0.4408
		Always Be Allowed	759	1,335,079 (11.3%)	0.5075	176	302,817 (2.5%)	0.2321

Responses by Occupation Type

Frequencies: Table 32 examine differences in beliefs on whether smoking should be allowed in cars based on the participant's occupation type. Those in a services occupation had the lowest percent of those that believe that smoking should never be allowed in a car when others were present (79.9%) as well as the highest percent of those that believed that smoking should be allowed under some conditions (23.7%) and always allowed (4.4%). Both those who are in a white-collar or blue-collar occupation had similar percentages for never, under some conditions, and always allowing smoking when others are present. When children are present, all occupation groups had similar distributions of percentages of smoking beliefs.

Table 33. Support among Employed US Adults for Smoking in a Car When Others and Children are Present by Occupation

			When Others are Present (n=76,520)			When Children are Present (n=76,813)		
			Freq	Weighted Freq (Wgt Row %)	Wgt S.E. of Row	Freq	Weighted Freq (Wgt Row %)	Wgt S.E. of Row
Occupation Type	White Collar	Never be Allowed	38,886	73,372,098 (75.8%)	0.2442	49,432	93,700,439 (96.4%)	0.1024
		Be Allowed Under Some Conditions	10,541	20,143,117 (20.8%)	0.2301	1,471	2,726,439 (2.8%)	0.0944
		Always Be Allowed	1,714	3,323,685 (3.4%)	0.1119	432	789,575 (0.8%)	0.0448
	Services	Never be Allowed	9,693	20,481,800 (71.9%)	0.4848	13,082	27,215,747 (95.2%)	0.2505
		Be Allowed Under Some Conditions	3,444	6,751,760 (23.7%)	0.4438	606	1,088,196 (3.8%)	0.2252
		Always Be Allowed	656	1,244,767 (4.4%)	0.2202	159	273,809 (1.0%)	0.0906
	Blue Collar	Never be Allowed	8,658	18,160,730 (75.3%)	0.5854	11,103	23,186,587 (95.7%)	0.2681
		Be Allowed Under Some Conditions	2,522	5,139,651 (21.3%)	0.5409	445	885,788 (3.7%)	0.2440
		Always Be Allowed	406	807,248 (3.3%)	0.2187	83	150,310 (0.6%)	0.0863

Responses by Presence of Work Smoking Restriction

Frequencies: Table 34 examines differences in beliefs on whether smoking should be allowed in cars based on the presence of a work smoking restriction. When both others or children are present, no large differences exist in percentages between those with different work smoking restrictions with only a slightly higher percentage of those without a work smoking restriction believing that smoking should always be allowed (4.7%) but a slightly lower percentage believing smoking should be allowed under some conditions (19.8%).

Table 34. Support among Employed US Adults for Smoking in a Car When Others and Children are Present by Work Smoking Restriction

			When Others are Present (n=55,873)			When Children are Present (n=56,077)		
			Freq	Weighted Freq (Wgt Row %)	Wgt S.E. of Row	Freq	Weighted Freq (Wgt Row %)	Wgt S.E. of Row
Work Smoking Restriction	Yes	Never be Allowed	39,074	76,210,733 (74.7%)	0.2559	50,484	98,515,368 (96.2%)	0.1208
		Be Allowed Under Some Conditions	11,472	22,333,444 (21.9%)	0.2403	1,636	3,108,441 (3.0%)	0.1110
		Always Be Allowed	1,795	3,442,634 (3.4%)	0.0987	411	734,723 (0.7%)	0.0411
	No	Never be Allowed	2,679	5,536,491 (75.5%)	0.8731	3,398	7,057,116 (96.0%)	0.3809
		Be Allowed Under Some Conditions	698	1,451,783 (19.8%)	0.8143	116	238,688 (3.2%)	0.3410
		Always Be Allowed	155	344,052 (4.7%)	0.4712	32	55,335 (0.8%)	0.1387

Responses by Whether Anyone Had Smoked at their Work within the Past Two Weeks

Frequencies: Table 35 examines differences in beliefs on whether smoking should be allowed in cars based on whether someone had smoked in their work area within the past two weeks. Those who had anyone smoke in their work area had a much lower percentage of those who believed that smoking should never be allowed when others were present in a car (63.1%) compared to those who did not have anyone smoke in their work area (75.4%). Additionally, those who had someone smoke in their work area had higher percentages of believing that smoking should be allowed under some conditions in a car (30.7%) and always allowed (6.2%) when others were present compared to those who did not have someone smoke in their area at work. These differences between whether someone had or had not smoked at their place of work are also present when children are present in a car, with those who had someone smoke in their place of work having higher percentages of those believing smoking should be allowed under some conditions (4.5%) and always allowed (1.2%)

Table 35. Support among Employed US Adults for Smoking in a Car When Others and Children are Present by Smoking at Work

			When Others are Present (n=55,773)			When Children are Present (n=55,970)		
			Freq	Weighted Freq (Wgt Row %)	Wgt S.E. of Row	Freq	Weighted Freq (Wgt Row %)	Wgt S.E. of Row
Anyone Smoked at Work	No	Never be Allowed	40,040	78,225,199 (75.4%)	0.2580	51,322	100,293,640 (96.3%)	0.1196
		Be Allowed Under Some Conditions	11,337	22,091,995 (21.3%)	0.2418	1,627	3,104,625 (3.0%)	0.1098
		Always Be Allowed	1,787	3,455,435 (3.3%)	0.1010	400	721,499 (0.7%)	0.0410
	Yes	Never be Allowed	1,642	3,376,483 (63.1%)	1.0407	2,456	5,064,555 (94.3%)	0.5332
		Be Allowed Under Some Conditions	806	1,641,379 (30.7%)	1.0176	125	243,567 (4.5%)	0.5029
		Always Be Allowed	161	331,605 (6.2%)	0.6267	40	62,685 (1.2%)	0.1912

Multinomial Logistic Regression Models: Tables 38 and 41 present the results of two separate multinomial logistic regression models, with Table 38 examining support for smoking when other passengers are present in a car and Table 41 examining support for smoking when children are present in a car. Multicollinearity was assessed and found to be not in effect in the models with all tolerances for variables above cutoff recommendations and variance inflation factors falling within acceptable ranges [125].

Regression Results by Sex

When others are present: Males had higher odds than females of agreeing that when others are present, smoking should be allowed under some conditions (AOR = 1.34; 95% CI =1.27 – 1.41, p-value = <.0001) and always be allowed (AOR = 1.70; 95% CI =1.51 - 1.90, p-value = <.0001) compared to never be allowed.

When children are present: Similarly, when children are present, males had higher odds compared to females of believing that smoking should be allowed under some conditions (AOR = 1.44; 95% CI =1.27 - 1.62, p-value = <.0001) and always allowed (AOR = 1.46; 95% CI =1.16 - 1.83, p-value = .0012) compared to never be allowed.

Regression Results by Race

When Others are Present: Compared to those who identified as White only, those who identified as Black only possessed lower odds of believing smoking should be allowed in a car when others are present both under some conditions (AOR = 0.79; 95% CI =0.72 - 0.86, p-value = <.0001) and always allowed (AOR = 0.78; 95% CI =0.62 - 0.98, p-value = .0331) compared to never be allowed. Similarly, compared to those who identified as White only, those who identified as Asian/Pacific Islander only possessed lower odds of believing smoking should be allowed in a car when others are present both under some conditions (AOR = 0.58; 95% CI =0.52 - 0.65, p-value = <.0001) and always allowed (AOR = 0.49; 95% CI =0.36 - 0.66, p-value = <.0001) compared to never be allowed.

When Children are Present: Compared to those who identified as White only, those who identified as Asian/Pacific Islander only possessed lower odds of believing smoking should be allowed in a car when children are present under some conditions (AOR = 0.60; 95% CI =0.45 - 0.81, p-value = .0008) and always allowed (AOR = 0.36; 95% CI =0.16 - 0.81, p-value = .0130) compared to never be allowed. Compared to those who identified as White only, those who identified as Black only had lower odds of believing smoking should always be allowed (AOR = 0.54; 95% CI =0.30 - 0.97, p-value = .0393) compared to never be allowed.

Regression Results by Education

When Others are Present: Compared to those who had a four year degree or higher, those who had less than a high school degree had lower odds of believing smoking should be allowed in a car when others are present both under some conditions (AOR = 0.66; 95% CI =0.56 - 0.78, p-value = <.0001) and always allowed (AOR = 0.60; 95% CI =0.44 - 0.82, p-value = .0013) compared to never be allowed. Similarly, compared to those who had a four year degree or higher, those who had a high school diploma or equivalent possessed lower odds of believing smoking should be allowed in a car when others are present both under some conditions (AOR = 0.90; 95% CI =0.85 - 0.96, p-value = .0017) and always allowed (AOR = 0.81; 95% CI =0.72 - 0.92, p-value = .0013) compared to never be allowed.

When Children are Present: Compared to those who had a four year degree or higher, those who had less than a high school degree possessed lower odds of believing smoking should be allowed in a car when children are present under some conditions (AOR = 0.72; 95% CI =0.52 – 0.99, p-value = .0433) compared to never be allowed. Compared to those who had a four

year degree or higher, those who had a high school diploma or equivalent had lower odds of believing smoking should always allowed (AOR = 0.75; 95% CI =0.59 - 0.96, p-value = .0217) compared to never be allowed.

Regression Results by Smoking Status

When others are present: Former smokers, when compared to never smokers, had the lowest odds of believing that smoking in a car when others are present should be allowed under some conditions (AOR = 1.75; 95% CI =1.63 – 1.88, p-value = <.0001) and always allowing smoking (AOR = 2.34; 95% CI =2.03 – 2.71, p-value = <.0001) compared to never being allowed. Conversely, every day smokers, when compared to never smokers, were over 5 times more likely to allow smoking when others were present of allowing smoking in a car under some conditions (AOR = 5.49; 95% CI =5.01 – 6.02, p-value = <.0001), and over 9 times more likely to always allowing smoking (AOR = 9.14; 95% CI =7.77 – 10.76, p-value = <.0001) compared to never allowing smoking. Compared to never smokers, some days smokers when others are present had 3.4 times the odds of believing smoking should be allowed under some conditions (AOR = 3.44; 95% CI =2.97 - 3.98, p-value = <.0001) and 3.9 times the odds of believing smoking should always be allowed (AOR = 3.94; 95% CI =2.88 – 5.39, p-value = <.0001) when compared to never being allowed.

When children are present: Similarly, former smokers when compared to never smokers as having the lowest odds of allowing smoking in a car when children are present under some conditions (AOR = 1.63; 95% CI =1.39 – 1.90, p-value = <.0001) and always allowing smoking (AOR = 1.74; 95% CI =1.27 – 2.37, p-value = .0006) compared to never allowing smoking. Every day smokers had the highest odds of allowing smoking when children were present in a car under some conditions (AOR = 4.63; 95% CI =3.96 – 5.40, p-value = <.0001), and always allowing smoking (AOR = 5.37; 95% CI =4.08 – 7.08, p-value = <.0001) compared to never allowing smoking. Compared to never smokers, some days smokers when children are present had 2.3 times the odds of believing smoking should be allowed under some conditions (AOR = 2.31; 95% CI =1.69 - 3.15, p-value = <.0001) when compared to never being allowed.

Regression Results by Occupation Type

When Children are Present: Those who were in blue-collar occupations, when compared to those in white-collar occupations, had higher odds of believing that smoking should be allowed under some conditions (AOR = 1.36; 95% CI =1.15 – 1.61, p-value = .0005) but

lower odds of believing smoking should always be allowed (AOR = 0.62; 95% CI =0.40 – 0.95, p-value = .0273) when children were present compared to never be allowed.

When Others are Present: Compared to those who believed that smoking should never be allowed in multiunit housing, those who believed that smoking should be allowed in some apartments had higher odds of believing smoking should be allowed in a car when others are present both under some conditions (AOR = 3.53; 95% CI =3.33 – 3.73, p-value = <.0001) and always allowed (AOR = 3.14; 95% CI =2.76 -3.57, p-value = <.0001) compared to never be allowed when others were present in a car. Similarly when compared to those who believe that smoking should never be allowed in multiunit housing, those who believed that smoking should always be allowed in multiunit housing possessed higher odds of believing smoking should be allowed in a car when others are present both under some conditions (AOR = 3.50; 95% CI =3.27 -3.74, p-value = <.0001) and always allowed (AOR = 9.93; 95% CI = 8.74 -11.28, p-value = <.0001) compared to never be allowed when others were present in a car.

Regression Results by Smoking in Work Area

When Others are Present: Compared to those who did not have someone smoke in their area of work in the past two weeks, those that did have someone smoke in their area of work possessed higher odds of believing smoking should be allowed in a car when others are present both under some conditions (AOR = 1.54; 95% CI =1.26 – 2.03, p-value = <.0001) and always allowed (AOR = 1.60; 95% CI =1.37 – 1.73, p-value = .0001) compared to never be allowed when others were present in a car.

When Children are Present: Compared to those who did not have someone smoke in their area of work in the past two weeks, those that did have someone smoke in their area of work possessed higher odds of believing smoking should always be allowed in a car when children are present (AOR = 1.54; 95% CI =1.07 – 2.23, p-value = .0212) compared to never be allowed.

Table 36. Testing Global Null Hypothesis for Support for Smoking in a Car when Others are Present Multinomial Logistic Regression

Test	F Value	Num DF	Den DF	Pr > F
Likelihood Ratio	161.78	20.1129	3218.07	<.0001
Score	129.24	24	160	<.0001
Wald	132.34	24	160	<.0001
NOTE: Second-order Rao-Scott design correction 0.1933 applied to the Likelihood Ratio test.				

Table 37. Type 3 Analysis of Effects for Support for Smoking in a Car when Others are Present Multinomial Logistic Regression

Effect	F Value	Num DF	Den DF	Pr > F
Sex	93.53	2	160	<.0001
Race	32.31	4	160	<.0001
Education	9.98	4	160	<.0001
Smoking Status	321.36	6	160	<.0001
Occupation Type	1.44	4	160	.2240
Smoking Restricted at Work	9.23	2	160	.0002
Has Anyone Smoked at Work	32.67	2	160	<.0001

Table 38. Employed Adults' Support for Smoking in a Car when Others are Present Multinomial Logistic Regression

			When Others are Present (n=124,563)			
			Wgt Freq %	AOR	95% C.I.	P Value
Sex (*Referent = Female*)	Male	Never be Allowed (*Referent*)	78.3%			
		Be Allowed Under Some Conditions	18.9%	**1.339**	**1.273 - 1.410**	**<.0001*** **
		Always Be Allowed	2.8%	**1.695**	**1.511 - 1.901**	**<.0001*** **
Race (*Referent = White Only*)	Black Only	Never be Allowed (*Referent*)	78.7%			
		Be Allowed Under Some Conditions	17.9%	**0.785**	**0.715 - 0.862**	**<.0001*** **
		Always Be Allowed	3.4%	**0.780**	**0.621 - 0.980**	**0.0331***
	Asian/PI Only	Never be Allowed (*Referent*)	84.3%			
		Be Allowed Under Some Conditions	13.9%	**0.579**	**0.516 - 0.650**	**<.0001*** **
		Always Be Allowed	1.8%	**0.485**	**0.360 - 0.653**	**<.0001*** **
Education (Referent = 4 Year Degree or Higher)	Less Than HS	Never be Allowed (*Referent*)	78.4%			
		Be Allowed Under Some Conditions	18.4%	**0.656**	**0.556 - 0.775**	**<.0001*** **
		Always Be Allowed	3.1%	**0.600**	**0.442 - 0.816**	**0.0013****
	HS or GED	Never be Allowed (*Referent*)	73.7%			
		Be Allowed Under Some Conditions	22.5%	**0.904**	**0.850 - 0.962**	**0.0017****
		Always Be Allowed	3.8%	**0.814**	**0.719 - 0.921**	**0.0013****
Smoking Status (*Referent = Never*)	Former	Never be Allowed (*Referent*)	69.1%			
		Be Allowed Under Some Conditions	26.0%	**1.751**	**1.633 – 1.877**	**<.0001*** **
		Always Be Allowed	4.9%	**2.342**	**2.026 – 2.708**	**<.0001*** **
	Some Days	Never be Allowed (*Referent*)	54.7%			
		Be Allowed Under Some Conditions	39.0%	**3.440**	**2.971 – 3.983**	**<.0001*** **
		Always Be Allowed	6.4%	**3.943**	**2.883 – 5.392**	**<.0001*** **
	Every Day	Never be Allowed (*Referent*)	41.4%			
		Be Allowed Under Some Conditions	47.3%	**5.492**	**5.008 – 6.023**	**<.0001*** **
		Always Be Allowed	11.3%	**9.142**	**7.769 – 10.758**	**<.0001*** **
Occupation Type (*Referent = White Collar*)	Services	Never be Allowed (*Referent*)	71.9%			
		Be Allowed Under Some Conditions	23.7%	0.970	0.889 - 1.058	0.4885
		Always Be Allowed	4.4%	0.913	0.763 - 1.094	0.3218
	Blue Collar	Never be Allowed (*Referent*)	75.3%			
		Be Allowed Under Some Conditions	21.3%	1.081	0.994 - 1.177	0.0694
		Always Be Allowed	3.3%	0.930	0.764 - 1.132	0.4653
Smoking Restricted at Work (*Referent = Yes*)	No	Never be Allowed (*Referent*)	75.5%			
		Be Allowed Under Some Conditions	19.8%	**0.790**	**0.700 - 0.891**	**0.0002*****
		Always Be Allowed	4.7%	1.180	0.953 - 1.462	0.1284
Has Someone Smoked at Work? (*Referent = No*)	Yes	Never be Allowed (*Referent*)	75.4%			
		Be Allowed Under Some Conditions	21.3%	**1.539**	**1.260 - 2.032**	**<.0001*** **
		Always Be Allowed	3.3%	**1.600**	**1.373 - 1.726**	**0.0001*****

Controlled by Age
*p<0.05
**p<0.01
***p<0.001

Table 39. Testing Global Null Hypothesis for Support for Smoking in a Car when Children are Present Multinomial Logistic Regression

Test	F Value	Num DF	Den DF	Pr > F
Likelihood Ratio	33.42	20.5482	3287.71	<.0001
Score	20.57	24	160	<.0001
Wald	40.04	24	160	<.0001
NOTE: Second-order Rao-Scott design correction 0.1680 applied to the Likelihood Ratio test.				

Table 40. Type 3 Analysis of Effects for Support for Smoking in a Car when Children are Present Multinomial Logistic Regression

Effect	F Value	Num DF	Den DF	Pr > F
Sex	24.95	2	160	<.0001
Race	5.26	4	160	.0005
Education	2.79	4	160	.0284
Smoking Status	92.77	6	160	<.0001
Occupation Type	5.18	4	160	.0006
Smoking Restricted at Work	0.02	2	160	.9806
Has Anyone Smoked at Work	3.69	2	160	<.0001

Table 41. Employed Adults' Support for Smoking in a Car when Children are Present Multinomial Logistic Regression

			When Children are Present (n=124,563)			
			Wgt Freq %	AOR	95% C.I.	P Value
Sex (*Referent = Female*)	Male	Never be Allowed (*Referent*)	95.4%			
		Be Allowed Under Some Conditions	3.7%	**1.437**	**1.274 - 1.621**	**<.0001*****
		Always Be Allowed	0.9%	**1.457**	**1.162 - 1.827**	**0.0012****
Race (*Referent = White Only*)	Black Only	Never be Allowed (*Referent*)	96.6%			
		Be Allowed Under Some Conditions	2.8%	0.964	0.777 - 1.197	0.7405
		Always Be Allowed	0.6%	**0.535**	**0.296 - 0.969**	**0.0393***
	Asian/PI Only	Never be Allowed (*Referent*)	97.8%			
		Be Allowed Under Some Conditions	1.9%	**0.602**	**0.449 - 0.808**	**0.0008*****
		Always Be Allowed	0.3%	**0.361**	**0.162 - 0.805**	**0.0130***
Education (Referent = 4 Year Degree or Higher)	Less Than HS	Never be Allowed (*Referent*)	96.3%			
		Be Allowed Under Some Conditions	3.0%	**0.718**	**0.521 - 0.990**	**0.0433***
		Always Be Allowed	0.7%	0.490	0.225 - 1.064	0.0712
	HS or GED	Never be Allowed (*Referent*)	95.7%			
		Be Allowed Under Some Conditions	3.5%	0.918	0.805 - 1.047	0.2024
		Always Be Allowed	0.8%	**0.751**	**0.588 - 0.958**	**0.0217***
Smoking Status (*Referent = Never*)	Former	Never be Allowed (*Referent*)	95.4%			
		Be Allowed Under Some Conditions	3.7%	**1.628**	**1.393 – 1.902**	**<.0001*****
		Always Be Allowed	1.0%	**1.736**	**1.270 – 2.372**	**0.0006*****
	Some Days	Never be Allowed (*Referent*)	93.5%			
		Be Allowed Under Some Conditions	5.5%	**2.306**	**1.689 – 3.147**	**<.0001*****
		Always Be Allowed	1.1%	1.718	0.832 – 3.544	0.1422
	Every Day	Never be Allowed (*Referent*)	87.7%			
		Be Allowed Under Some Conditions	9.8%	**4.627**	**3.964 – 5.402**	**<.0001*****
		Always Be Allowed	2.5%	**5.374**	**4.079 – 7.081**	**<.0001*****
Occupation Type (*Referent = White Collar*)	Services	Never be Allowed (*Referent*)	95.2%			
		Be Allowed Under Some Conditions	3.8%	1.016	0.858 - 1.203	0.8537
		Always Be Allowed	1.0%	0.893	0.632 - 1.263	0.5215
	Blue Collar	Never be Allowed (*Referent*)	95.7%			
		Be Allowed Under Some Conditions	3.7%	**1.359**	**1.145 - 1.612**	**0.0005*****
		Always Be Allowed	0.6%	**0.616**	**0.401 - 0.947**	**0.0273***
Smoking Restricted at Work (*Referent = Yes*)	No	Never be Allowed (*Referent*)	96.0%			
		Be Allowed Under Some Conditions	3.2%	1.004	0.794 - 1.270	0.9707
		Always Be Allowed	0.8%	0.963	0.645 - 1.439	0.8535
Has Someone Smoked at Work? (*Referent = No*)	Yes	Never be Allowed (*Referent*)	94.3%			
		Be Allowed Under Some Conditions	4.5%	1.219	0.942 - 1.577	0.1321
		Always Be Allowed	1.2%	**1.541**	**1.068 - 2.226**	**0.0212***

Controlled by Age
*p<0.05
**p<0.01
***p<0.001

Discussion

This study found that there were socio-demographic characteristics among employed US adults associated with believing that smoking should be allowed under some conditions and always be allowed in a car both when others and when children are present. This analysis of those who were employed as a subsection of the overall TUS-CPS sample matched prior analysis of the 2018-2019 waves of the TUS-CPS with similar results when it comes to beliefs regarding smoking in a car both when others and children are present.

Blue-collar workers, when compared to white-collar workers, possessed higher odds of thinking that smoking should be allowed under some conditions when children were present compared to never allowed. A reason for this may be blue-collar workers' perceived effectiveness of methods of smoke reduction and elimination under some conditions such as rolling down windows or increasing ventilation in order to reduce the amount of smoke inside the car. However, blue-collar workers also had much lower odds of always allowing smoking in a car compared to white-collar workers. This difference between occupation types could be similar to differences found in educational attainment, where those with bachelor's degrees or higher when compared to those with lower educational attainment had higher odds of believing smoking should be allowed in a car when children were present. Oftentimes, white-collar jobs listed in the occupational appendices of the TUS-CPS require higher levels of education for employment when compared to service or blue-collar jobs. A larger sample size in future studies for more specific subgroups would further explain occupational differences.

The variable with the most consistent results was whether anyone had smoked in the participant's area of work within the past two weeks. Having someone smoke in their area increased the odds by 1.5 times of thinking that smoking should be allowed in a car both when others were present and when children were present when compared to never being allowed. Smoking norms may be reinforced in occupations where smoking in the area of work is viewed as more acceptable such as food service, construction, and extraction, further increasing disparities. This finding is consistent with a prior systematic review that exposure to secondhand smoke at the workplace among adults is associated with both smoking identity and smoking frequency [148]. One area potentially overlooked in workplace exposure to ETS however are work vehicles, which lacks current research regarding adherence to and coverage of non-smoking policies. While most employed US adults in this sample had some form of smoking

restriction at their place of work, the restriction did not account for increasing odds of believing smoking should not be allowed in a car. In fact, those without a smoking restriction compared to those with a restriction had lower odds of thinking smoking should be allowed in a car under some conditions compared to never allowed. One possibility to note is that presence of a smoking restriction may not be a complete restriction of smoking in the workplace. Additionally, smoking restriction at work does not guarantee adherence to the policy and requires compliance from not only the employees, but also any managers and customers. A study examining non-smoking compliance in businesses after a no-smoking law had been passed found that having a non-smoking manager was a predictor for having a workplace that complied with the law [149]. While workplace restrictions are an important component of tobacco control, they likely by themselves do not extend protections to the car as seen with its potential in assisting other areas such as increases in voluntary smoke-free homes, smoking quit intentions, and smoking quit attempts [108, 147]. Ensuring that intervention efforts are specific to certain areas of smoking and ETS exposure is an important step that should not be overlooked when conducting broad cessation efforts.

This study does possess some limitations. First, the CPS base survey reports that there are potential coverage differences when it comes to race/ethnicity and sex, with those who identify as Black and those who identify as male being less likely to be included in the study [135]. Additionally, cell counts for races not included in this study such as American Indian and multiracial, were too small for analysis and were removed from the model. Similarly, more specific categories of occupation were too small for analysis and were reduced into the three categories of occupation used in this study. This collapse of groups could group occupation categories that experience different rates of and opinions toward smoking. For example, workplace factors that can influence rates of smoking such as stress, lack of decision-making control, and low social and workplace support can vary between occupation types that are categorized together as blue or white-collar and service occupations [150]. There is also potential for selection bias of participants due to under-sampling from specific populations such as males and those who identify as Black, but weighting practices in the TUS-CPS reduce the impact of these differences by applying stronger weights to those groups [121]. Social desirability bias may be present in the items related to smoking in the presence of others and children and participants may under report their actual thoughts due to the stigma of smoking [128]. However, prior

research has shown that parents accurately disclose the amount of much smoke their children are exposed to [129]. The response of "be allowed under some conditions" may skew results away from participants' actual use patterns due to the broad meaning of "some conditions." For example, if a participant chooses "under some conditions" and considers their use as conditional due to smoke reduction methods such as rolling down windows or using air conditioning when smoking in their car when passengers are present, their passengers would still be exposed to ETS at unsafe levels [7].

Findings from this study highlight non-smoking restrictions in the workplace do not always translate to increases in smoking denormalization. Only putting a non-smoking workplace restriction into effect but not enforcing it does not provide benefits to specifically influencing beliefs towards reducing ETS exposure in other locations similar to how non-smoking policies at other locations provide. However, reduced exposure to ETS at work likely does provide a benefit not only for reducing normalization of smoking among working adults, but also has the potential to protect non-smokers in areas that are not directly being targeted, emphasizing the need for non-smoking areas in the workplace.

In conclusion, the workplace provides a unique and important setting to reduce the impact that ETS exposure in US working adults, but also those who are around them outside of the workplace.

Chapter VII: Conclusions

This series of studies concluded that there are specific groups that have higher likelihood of thinking that smoking inside a car when others and when children are present should be allowed. Those who identify as male, White, and are every day smokers are all more likely to think that smoking should be always and sometimes allowed in cars when both others and children are present. Additionally, while policies do not guarantee adherence to those policies, the presence of a statewide smokefree car policy when children are present is associated with lower odds of thinking that smoking should not be allowed in cars when children are present. Thinking that smoking should always, sometimes, and never be allowed in other locations like apartments, recreational areas, and indoor work areas were associated with also thinking that smoking should always, sometimes, and never be allowed in a car. Having others smoke in a person's area of work was associated with believing that smoking should under some conditions and always be allowed in a car when others were present. Lastly, blue-collar workers were more likely to think that smoking should be allowed under some conditions when children were present, but less likely to think that smoking should always be allowed.

Implications and Future Directions

Research

Findings from this study highlight several potential areas of research that should be expanded upon in future efforts to understand and reduce ETS exposure in cars. First, expanding on what "under some conditions" entails when it comes to smoking in cars should be a priority for health communication and interventions. While prior research has shown that different methods of mitigating smoke concentrations in a car such as rolling down windows and adjusting air conditioning can somewhat reduce air concentrations of ETS airborne products, no large scale studies have been done to examine biomarkers for ETS exposure comparing the differences between full, reduced, and no exposure to smoke in cars [7, 151]. Differences in smoking habits in a car specifically regarding "under some conditions" should consider the timing, weather conditions, passenger characteristics, and other factors related to when adults think that smoking should or should not be allowed. Additionally, research examining amount of time that children spend exposed to ETS in the private car should be conducted due to a lack of current research on this topic.

Regarding occupation types, potential future research would benefit from larger and more diverse samples in order to compare more specific occupational groupings instead of the broader categories utilized in this study. Other research areas utilizing the TUS-CPS have combined multiple years of waves to expand the sample size and could provide an opportunity for future research comparing occupations. Within this study, the difference between blue-collar workers' higher odds of thoughts towards allowing smoking under some conditions compared to their lower odds of thinking smoking should always be allowed highlights a potential area to explore.

Practice

A primary target population that this study highlights is the presence of those that think that smoking should be allowed under some conditions. This category could present a unique population group who could be more susceptible to health communication focused on reducing smoking in cars compared to those who think that smoking should be allowed. Additionally, demographic groups such as males, Whites, and non-Hispanic adults are specific segments that represent a large portion of the population with higher odds of thinking that smoking in a car should be allowed targeting these groups could help further reduce ETS exposure among vulnerable populations such as children. Lastly, finding ways of encouraging implementation of voluntary smokefree rules in homes and increasing support for smoke-free rules in a variety of locations such as apartments, workplaces, and recreation areas could provide extended protections towards the private car. This study also corroborates prior research that the presence of a smoke-free home policy is associated with smoke-free cars [108, 109].

Policy

This study highlights several needs that should be addressed when considering tobacco control. First, the lack of a national law restricting smoking in cars allows for geographic disparities regarding exposure to ETS in cars to between states that restrict smoking in cars with those that do not. Prior studies have shown that forms of smoke-free legislation restricting smoking in multiple location types such as the car, workplace, and restaurants have led to decreases in exposure among children and decreases in negative health outcomes such as asthma among children and cardiovascular and pulmonary conditions among adults [152, 153]. However, as seen in this study both in states with smoking in car restrictions as well as restrictions in other places like the home or workplace, presence of rules or legislation restricting smoking does not always guarantee adherence. Enforcement remains an important component of

any policy and if smokers are never reprimanded for smoking in their car when a child is present, they would likely not willingly follow any laws stopping smoking. Similar issues in lack of compliance arise when enforcement is not in effect in areas such as smoke-free college campuses, texting and driving, and seatbelt usage [114, 117, 154].

Additionally, findings from specifically Manuscript II highlight the need for more comprehensive legislation targeting children of all ages and not only under a specific age. While there could be geographic differences between states with an under 12 years of age restriction and those with higher age requirements, this study's results showing the difference in odds of thinking smoking in cars should be allowed when both others are present and specifically when children are present highlight the potential benefits of a more comprehensive policy.

Limitations

Some limitations exist for this series of studies. First, there may be some social desirability bias present related to thinking that smoking should be allowed in a car due to the stigmatization of smoking in the presence of others and specifically children, resulting in a potential movement from allowing smoking under some conditions or always to a more restrictive category. Additionally, the response of "be allowed under some conditions" may not reflect participants' actual use patterns due to the non-specific phrasing of the question. For example, if a participant selects "under some conditions" and considers their use as conditional due to behaviors such as rolling down windows or using air conditioning when smoking in their car when passengers are present, their passengers would be exposed to ETS at unsafe levels [7].

Conclusion

The private car is one of the few remaining locations where unnecessary ETS exposure can occur. While smokefree legislation banning smoking in cars would not only benefit children but also other adults, it is important to note that the implementation of a policy would likely not lead to improvements to health if it was not enforced or if its health benefits and purpose was not understood by the general population. Therefore, this study provides guidance on specific population groups who are at higher risk of thinking that smoking in a car is acceptable.

Appendices

Appendix I: Manuscript I-III Items

- **When others are present** (*TUS-CPS*: PEK6H) Inside a car, when there are other people present, do you think that smoking should… always be allowed, be allowed under some conditions, or never be allowed?
    - (-9) No Response
    - (-3) Refused
    - (-2) Don't Know
    - (-1) Not in Universe
    - **(1) Always be allowed**
    - **(2) Be allowed under some conditions**
    - **(3) Never be allowed**
- **When children are present** (*TUS-CPS*: PEK6H2) If children are present inside the car, do you think that smoking should… always be allowed, be allowed under some conditions, or never be allowed?
    - (-9) No Response
    - (-3) Refused
    - (-2) Don't Know
    - (-1) Not in Universe
    - **(1) Always be allowed**
    - **(2) Be allowed under some conditions**
    - **(3) Never be allowed (*including (PEK6H=3)*)**

Appendix II: Manuscript I Items:

Demographic Variables

- **Sex** (*TUS-CPS*: PESex) What is your sex? (CPS Item: SEX)
  - **(1) Male**
  - **(2) Female (Referent)**
- **Age** (*TUS-CPS*: PrtAge) What is your date of birth? (CPS Item: BIRTHD)
  - **00-79 Age in Years**
  - 80 80-84 Years Old
  - 85 85+ Years Old
- **Race** (*TUS-CPS*: PTDTRace) I am going to read you a list of five race categories. You may choose one or more races. For this survey, Hispanic origin is not a race. Are you White; Black or African American; American Indian or Alaska Native; Asian; or Native Hawaiian or other Pacific Islander? (CPS Item: Race)
  - **(1) White Only (Referent)**
  - **(2) Black Only**
  - (3) American Indian, Alaskan Native Only
  - **(4) Asian Only**
  - **(5) Hawaiian/Pacific Islander Only**
  - (6)-(26) Multiethnic combinations
- **Hispanic Origin** (*TUS-CPS*: PEHspNon) Are you of Hispanic, Latino, or Spanish origin? (CPS Item: HSPNON)
  - **(1) Hispanic**
  - **(2) Non-Hispanic (Referent)**
- **Highest Level of School Completed or Degree Received** (*TUS*-CPS: PEEDUCA) What is the highest level of school you have completed or the highest degree you have received? (CPS Item: EDUCA)
  - **(1) Less than a High School Diploma (PEEDUCA=31-38)**
  - **(2) High School Diploma or Equivalent (GED) (PEEDUCA=39-42)**
  - **(3) Four Year Degree or Higher (PEEDUCA=43-46) (Referent)**
    - (31) Less than 1st grade
    - (32) 1st, 2nd, 3rd or 4th grade
    - (33) 5th or 6th grade
    - (34) 7th or 8th grade
    - (35) 9th grade
    - (36) 10th grade
    - (37) 11th grade
    - (38) 12th grade no diploma
    - (39) High school grad-diploma or equiv(ged) (referent)
    - (40) Some college but no degree
    - (41) Associate degree-occupational/vocational
    - (42) Associate degree-academic program
    - (43) Bachelor's degree (ex: ba, ab, bs)
    - (44) Master's degree (ex: ma, ms, meng, med, msw)
    - (45) Professional school deg (ex: md, dds, dvm)
    - (46) Doctorate degree (ex: phd, edd)

Smoking Related Variables

- **Smoker Recode** (SMOKSTAT) made up of the subindented items
  - **(1) Never smoker (PEA1=2; PEA3=1,2,3) (Referent)**
  - **(2) Everyday smoker (PEA1=1; PEA3=1)**
  - **(3) Some days smoker (PEA1=1; PEA3=2)**
  - **(4) Former smoker (PEA1=1; PEA3=3)**
    - Have you smoked at least 100 cigarettes in your entire life? (PEA1)
      - (-9) no response
      - (-3) refused
      - (-2) don't know
      - (-1) not in universe
      - **(1) Yes**
      - **(2) No**
    - Do you now smoke cigarettes everyday, some days, or not at all? (PEA3)
      - (-9) no response
      - (-3) refused
      - (-2) don't know
      - (-1) not in universe
      - **(1) Everyday**
      - **(2) Some days**
      - **(3) Not at all (Referent)**

Appendix III: Manuscript II:

- **Home Smoking Rule** (*TUS-CPS*: PEK4) Which statement best describes the rules about smoking INSIDE YOUR HOME?
  - (-9) no response
  - (-3) refused
  - (-2) don't know
  - (-1) not in universe
  - **(1) No one is allowed to smoke anywhere INSIDE YOUR HOME (referent)**
  - **(2) Smoking is allowed in some places or at some times INSIDE YOUR HOME**
  - **(3) Smoking is permitted anywhere INSIDE YOUR HOME**
- **Opinion of MUH Smoking** (*TUS-CPS*: PEK5A) In buildings with MULTIPLE apartments or living areas, do you THINK that smoking should be… ALLOWED INSIDE ALL apartments or living areas, ALLOWED inside SOME apartments …., or NOT ALLOWED at ALL inside apartments?
  - (-9) no response
  - (-3) refused
  - (-2) don't know
  - (-1) not in universe
  - **(1) ALLOWED INSIDE ALL apartments or living areas**
  - **(2) ALLOWED inside SOME apartments**
  - **(3) NOT ALLOWED at ALL inside apartments (Referent)**
- **Opinion of Smoking in Recreation Areas** (*TUS-CPS*: PEK6b) In indoor work areas, do you THINK that smoking SHOULD be allowed in ALL areas, allowed in SOME areas, or NOT allowed at ALL?
  - (-9) no response
  - (-3) refused
  - (-2) don't know
  - (-1) not in universe
  - **(1) Allowed in ALL areas**
  - **(2) Allowed in SOME areas**
  - **(3) NOT Allowed at ALL (referent)**
- **Opinion of Smoking in Indoor Work Areas** (*TUS-CPS*: PEK6C) Inside bars, cocktail lounges, and clubs, do you THINK that smoking SHOULD be allowed in ALL areas, allowed in SOME areas, or NOT allowed at ALL?
  - (-9) no response
  - (-3) refused
  - (-2) don't know
  - (-1) not in universe
  - **(1) Allowed in ALL areas**
  - **(2) Allowed in SOME areas**
  - **(3) NOT Allowed at ALL (Referent)**

- **Car Law** Derived from State (*TUS*-CPS: GESTFIPS) Federal Information Processing Standards State Codes (CPS Item: EDUCA)
  - **(1) Lives in State with All Minors (U18) Present Car Ban (GESTFIPS=CA,OR)**
  - **(2) Lives in State with Teenagers (13-17) Present Car Ban (GESTFIPS=AR,LA,ME,UT)**
  - **(3) Lives in State with Children (12 and younger) Present Car Ban (GESTFIPS=VT,VA)**
  - **(4) Does not Live in State with Child Present Car Smoking Ban (GESTFIPS=All others) (Referent)**

Appendix IV: Manuscript III:

- **Smoking Restricted at Work** (*TUS*-CPS: PEK2A) Is smoking restricted in ANY WAY at your place of work?
  - (-9) no response
  - (-3) refused
  - (-2) don't know
  - (-1) not in universe
  - **(1) YES (referent)**
  - **(2) NO**
- **Has Anyone Smoked at Work?** (*TUS*-CPS: PEK3C) During the PAST TWO WEEKS, has anyone smoked in the area in which you work?
  - (-9) no response
  - (-3) refused
  - (-2) don't know
  - (-1) not in universe
  - **(1) YES**
  - **(2) NO (referent)**
- **Occupation Type** Derived from (*TUS*-CPS: PEIO1OCD)

(1)	**White-Collar**	
	Management	0010-0430
	Business and Financial Operations	0500-0950
	Computer and Mathematical	1005-1240
	Architecture and Engineering	1300-1560
	Life, Physical, and Social Science	1600-1965
	Legal	2100-2160
	Education, Training, and Library	2200-2550
	Arts, Design, Entertainment, Sports, and Media	2600-2920
	Healthcare Practitioners and Technical	3000-3540
	Sales and Related	4700-4965
	Office and Administrative Support	5000-5940
(2)	**Blue-Collar**	
	Construction Trades	6200-6765
	Extraction Workers	6800-6940
	Installation, Maintenance, and Repair Workers	7000-7630
	Production Occupations	7700-8965
	Transportation and Material Moving	9000-9750
(3)	**Services**	
	Healthcare Support	3600-3655
	Protective Service	3700-3955
	Food Preparation and Serving Related	4000-4150
	Building and Grounds Cleaning and Maintenance	4200-4250
	Personal Care and Service	4300-4650
(4)	*Dropped from Study*	
	Armed Forces	9840
	Farming, Fishing, and Forestry	6005-6130

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