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KATHERINE ALYSSA WHITE
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THE RELATIONSHIP BETWEEN TOBACCO 21 POLICIES AND RETAILER COMPLIANCE

A THESIS APPROVED FOR THE

DEPARTMENT OF HEALTH AND EXERCISE SCIENCE

BY THE COMMITTEE CONSISTING OF

Dr. Marshall Cheney, Chair

Dr. Page Dobbs

Dr. Sarah Maness

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Abstract

Introduction: Tobacco 21 policies raise the minimum legal sales age for tobacco in the United States, but in order for the policies to be effective, they must be observed by retailers. This study evaluated the relationship between local Tobacco 21 policies and retailer compliance across the United States.

Methods: Local policies included in this study (n = 271) were retrieved online through searches for local ordinances, municipal codes, or through the local clerk of each policy location. Municipality size was obtained from the United States Census, which was combined with retailer compliance data (violations, inspections, type of product sold during violations) from the FDA Compliance Check database. Violation rates before and after policy implementation were examined.

Results: Significant differences were found between groups' violation rates after policy implementation and population size ($F[5,248] = 3.97$, $p = 0.002$). Violation rates for locations with a population between 5,001-10,000 ($M = 0.03$, $SD = 0.05$) were significantly different from both locations with 50,001-150,000 people ($M = 0.08$, $SD = 0.07$, $p = 0.029$) and those with 150,001 or more people ($M = 0.11$, $SD = 0.08$, $p = 0.029$). Policies without suspension ($M = 0.09$, $SD = 0.08$) had significantly higher violation rates after policy implementation than those with suspension ($M = 0.05$, $SD = 0.06$), ($t(75.5) = 3.022$, $p = 0.003$). Additionally, policies without revocation ($M = 0.07$, $SD = 0.07$) had significantly higher violation rates after policy implementation than those with revocation ($M = 0.05$, $SD = 0.06$), ($t(180.26) = 2.12$, $p = 0.035$). Significant differences were also found among the product types sold during violations after policy implementation.

Conclusions: Although the raise in sales age is beneficial, having the recommended policy components, such as both monetary penalty structures and suspension/revocation of tobacco retailer licenses, is important in the success of Tobacco 21 policies at decreasing sales to minors.

Chapter I

Introduction

Background

The amount of literature concerning the negative health implications of tobacco product use is substantial; however, many individuals continue to use these products despite evidence of negative health effects. In the United States, tobacco use is ranked as the number one cause of preventable disease and premature death (Farber, Pakhale, and Neptune, 2016). This statistic is especially alarming due to the fact that the U.S. Department of Health and Human Services found that most smokers begin use before they reach adulthood (DHHS, 2012).

Although several factors could be attributed to the initiation of smoking, one contributing factor among adolescents is youth access, which is the availability of tobacco products to underage youth. Grucza et al. (2013) discussed that youth access policies were presumably created in order to avoid smoking progression during adolescence. This was to be accomplished by slowing the onset or decreasing smoking intensity among this population (Grucza et al., 2013). After examining certain components of youth access policies (e.g. identification requirements, penalties for violation, etc.) and adult smoking prevalence, the authors found that youth access restrictions had the potential to lead to decreased rates of smoking in adulthood (Grucza et al., 2013). This finding is important due to the fact that tobacco control policies can be implemented in states and localities across the United States.

Tobacco 21 policies are one approach to decreasing tobacco use among youth (Farber et al., 2016). Although typical youth access policies prohibit tobacco sales to those under the age of eighteen, Tobacco 21 policies raise the age of sale to 21 years old. While Tobacco 21 policies are relatively new forms of tobacco control, only beginning to emerge in the United States in 2005, several studies suggest that this method is successful at decreasing youth tobacco use (Farber et

al., 2016; Winickoff et al., 2014). However, the research is limited compared to other tobacco control methods.

In order for Tobacco 21 laws to be effective at reducing use among youth, the regulations and policies must be observed by retailers. Silver et al. (2015) found a decrease in identification checks in New York City following the passage of a citywide Tobacco 21 policy. Furthermore, the authors concluded that the success of the policies would largely be dependent on increased retailer compliance monitoring (Silver et al., 2015). Retailer compliance is one aspect of the success of tobacco control policies; however, the literature is relatively limited on rates of compliance of tobacco sales to minors when Tobacco 21 policies are in effect (Zhang et al., 2018). Furthermore, the existing literature that focused on the change in compliance rates pre and post Tobacco 21 is restricted to specific locations (Silver et al., 2015; Zhang et al., 2018). Therefore, it is important to broaden the scope and evaluate the relationship between Tobacco 21 policies and retailer compliance across the United States.

Purpose

The purpose of this study was to determine the relationship between the implementation of Tobacco 21 policies and rates of compliance at local levels across the United States using secondary data. It also allows for a deeper understanding of how covariates, such as the presence of suspension/revocation of tobacco retailer license, size of violation fine, municipality size, and product type sold during violation, impact the relationship between Tobacco 21 policies and violation rates. Finally, this study provides information about violation rates before and after the implementation of Tobacco 21 policies.

Research Questions

The research question for this study was:

Is there a relationship between Tobacco 21 policy implementation and violation rates?

Additionally, this study examined several sub questions:

1. Does the association between Tobacco 21 policy implementation and violation rates vary by municipality size?
2. Does the size of the violation fine in Tobacco 21 policies influence the relationship between Tobacco 21 policy implementation and violation rates?
3. Does the presence of suspension/revocation of tobacco retailer licenses in Tobacco 21 policies influence the relationship between Tobacco 21 policy implementation and violation rates?
4. Is the type of tobacco product sold during violations related to violation rates?

Null Hypotheses

1. There will be no relationship between Tobacco 21 policy implementation and violation rates.
2. Municipality size will not influence the relationship between Tobacco 21 policy implementation and violation rates.
3. The size of the violation fine in Tobacco 21 policies will not influence the relationship between Tobacco 21 policy implementation and violation rates.
4. The presence of suspension/revocation of tobacco retailer licenses in Tobacco 21 policies will not influence the relationship between Tobacco 21 policy implementation and violation rates.
5. The type of tobacco product sold during violations will not be related to violation rates.

Research Hypotheses

1. Rates of retailer compliance will increase after the implementation of Tobacco 21 policies.
2. Larger municipality populations will have decreased rates of retailer compliance.
3. Larger violation fines in Tobacco 21 policies will increase rates of retailer compliance.
4. The presence of suspension/revocation of tobacco retailer licenses in Tobacco 21 policies will increase rates of retailer compliance.
5. Rates of retailer compliance will be increased based upon the type of tobacco product sold during violations.

Significance of the Study

This study provides an overview of Tobacco 21 policies in the United States by examining their relationship with retailer compliance measured as violation rates. Tobacco control policies, such as Tobacco 21, can be implemented as state-wide policies or as local policies. According to Crosbie and Schmidt (2020), preemption is the concept that higher entities, such as states, have more authority over laws than lower entities, such as local governments; however, preemption is not used by all states for tobacco control regulations. In cities/towns that are not preempted by the state, these cities/towns are able to set stronger tobacco regulations than the state. Therefore, some states only have state level Tobacco 21 policies, some have only local level Tobacco 21 policies, some have no Tobacco 21 policies, and others have a combination of both local and state policies (in these cases, state regulations serve as the minimum). Based on this information, this study examined local level Tobacco 21 policies in states without preemption. As Tobacco 21 policies are becoming increasingly popular across the United States, this study provides useful insight into Tobacco 21 policy components (e.g.

tobacco retailer license suspension/revocation and violation fine sizes) and other variables, such as product type and municipality population, that impact retailer compliance. Additionally, this study provided information concerning violation rates before and after Tobacco 21 policy implementation (using datasets described below), which would contribute to the relatively small body of literature concerning Tobacco 21 policies and retailer compliance.

Delimitations

The delimitations for this study included:

- The policies included in this study were 271 local level Tobacco 21 policies in the United States with active state compliance contracts with the Food and Drug Administration (FDA).
- The policies included in this study became effective between October 1, 2012 and April 30, 2018.
- The policies included in this study were retrievable electronically.
- The policies included in this study define a minor to be an individual under the age of 21.

Limitations

The limitations for this study included:

- Policies from states with only state level Tobacco 21 policies or preemption for tobacco related policy were not included.
- Policies that became effective before October 1, 2012 or after April 30, 2018 and were not available electronically were not included in this study.
- This study is a document review of established policies, therefore cause and effect relationships could not be established.

Assumptions

The assumptions for this study include:

- No other programs or policies were implemented that would affect the rates of compliance.

Operational Definitions

- *Retailer Compliance:* For the purposes of this study, retailer compliance was defined as abiding by FDA regulations that are evaluated during compliance check inspections. Retailer compliance will be measured as violation rates before and after policy implementation. Higher rates of retailer compliance were characterized as decreased violation rates while lower rates of retailer compliance were characterized as increased violation rates.
- *E-cigarettes:* "Electronic cigarettes, also known as e-cigarettes, e-vaporizers, or electronic nicotine delivery systems, are battery-operated devices that people use to inhale an aerosol, which typically contains nicotine (though not always), flavorings, and other chemicals." (National Institute on Drug Abuse, 2018).
- *Youth Access:* For the purposes of this study, youth access was defined as the availability of tobacco products to youth.

Chapter II

Literature Review

The purpose of the present study is to explore the relationship between the presence of Tobacco 21 policies and the rates of compliance of tobacco sales to minors in several locations across the United States. The articles used in this review were retrieved from CINAHL, Medline (EBSCO), and PubMed, as well as through manual search by author name. Key words used in the article retrieval included "youth access", "youth product use", "tobacco control", "juvenile access", "retailer compliance", "e-cigarettes", and "Tobacco 21". The articles included in the following study were full text, peer reviewed, and published in the United States.

A Brief Summary of Tobacco Control Policy

Cigarette smoking was one trend that spread rapidly across the United States at the beginning of the twentieth century (Kluger, 1996). Although this was a widespread habit, many were resistant to smoking; however, this was not because of the health effects of smoking, but because of concerns of negative social and moral consequences (Best, 1979). This led to cigarettes becoming banned in several states and, in others, stronger restrictions were placed on advertising, as well as the locations individuals were able to smoke, such as in close proximity to schools (Tate, 1999). It was not until 1929 that the negative health impacts of smoking were brought forward by the Surgeon General (Burnham, 1989). By the end of the 1930s, smoking was publicly linked to shorter life expectancies (Pearl, 1938). Furthermore, research conducted in the 1940s and 1950s confirmed the association between smoking and lung cancer (Witschi, 2001). Although this information did lead to a slight decrease in smoking, the tobacco industry devised strategies, such as discrediting evidence of the harms of tobacco and marketing other "low risk" products, to undermine the research of the negative health effects of smoking and

divert public attention away from the scientific evidence (Brandt, 2007). Many government officials were hesitant to enact federal regulations on smoking; however, legislation was implemented in 1965 to place warning labels on all cigarette packages (DHHS, 2014). This was one of the first steps made by the government to educate consumers about the negative health consequences of smoking (DHHS, 2014). After this legislation, other initiatives were created, such as the removal of cigarette advertising from the airwaves, which occurred in 1971 (DHHS, 2014). Over the next several decades, additional smoking rules and regulations followed, such as smoke free buildings and flights (DHHS, 2006).

According to the U.S. Department of HHS (2014), there was a shift in tobacco product use from the early part of the 1900s to the present. Although chewing tobacco and cigars were the most popular in the early part of the twentieth century, cigarettes became the most popular tobacco product by the middle of the twentieth century (DHHS, 2000). In the U.S. Department of HHS (2014) report, it was noted that the last half of the twentieth century marked a shift from infectious to chronic diseases. Smoking has been linked to chronic diseases, such as atherosclerosis, cardiovascular disease, chronic obstructive pulmonary disease (COPD), cerebrovascular disease, cancer, and diabetes, among others (DHHS, 2014). The cost of smoking related illnesses was estimated to be greater than $300 billion per year in the United States (CDC, 2018). When it comes to preventable mortality, cigarette smoking remains the number one cause (DHHS, 2014).

Adult Tobacco Use

Based on data collected by the Centers for Disease Control and Prevention (CDC) (2019A), as of 2017, there were 34.3 million current smokers over the age of eighteen in the United States. In the same year, it was reported that 10.4% of young adults aged 18-24 were

current smokers (CDC, 2019A). In 2017 in the United States, the state with the lowest number of smokers had 8.9% while the state with the highest number of smokers had 26% (CDC, 2019A).

Youth Tobacco Use

One major finding of the U.S. Department of HHS (2012) was the fact that most individuals begin smoking before the age of eighteen. This was supported by the U.S. DHHS (2014) who found that among individuals who had been daily smokers, approximately 64.3% started smoking before the age of eighteen. Additionally, about 22.7% started smoking daily between the ages of 18-26. It was also mentioned that less than 1.5% of individuals began to smoke after the age of 26 (DHHS, 2014). This data relates to the findings from the CDC (2019B) who reported that every day approximately 2,000 youth in the United States try their first cigarette, and, as of 2018, 17.7% of middle school and 46.0% of high school students had used a tobacco product. Moreover, data collected in 2013 showed that 9.4% of middle school and 31.4% of high school students had used at least two products (CDC, 2019B). Additional data collection by the CDC (2019B) showed that 8.1% of high school students had smoked cigarettes within the past month and 20.8% of students of the same age had used an electronic cigarette within the same time frame. Though cigarette use has decreased, the rise in electronic cigarette use among youth is contributing to the current tobacco epidemic and is crucial to prevent (CDC, 2019B). The CDC provided a list of factors that were associated with tobacco use among youth and included in the list were the factors accessibility and availability (CDC, 2019B). These are two factors in particular that have been referenced in much of the literature regarding youth tobacco use.

Preventing Retailers from Selling to Youth

The Synar Amendment, which was enacted in 1992, is a federal effort intended to decrease access to tobacco among youth (SAMHSA, 2017). Under this amendment, states are required to prohibit tobacco products from being sold or distributed to minors through the use of laws and enforcement; however, if the states fail to comply with the amendment, the states will not receive the entirety of their Substance Abuse Prevention and Treatment Block Grant (SAMHSA, 2017). Included in the Synar Amendment are youth decoy inspections, prosecution of violators, and a minimum yearly eighty percent retailer compliance rate (Silver et al., 2015). There is a divide among researchers in regards to the success of the Synar Amendment in reducing youth smoking where some believe that policies of this nature have been unsuccessful and others believe that with proper enforcement that laws, such as the Synar Amendment, have resulted in decreased tobacco use among youth (Spivak and Monnat, 2015). For this reason, Spivak and Monnat (2015) used Synar violation rates from the United States to better understand the association between violation rates and smoking among youth, and the authors found a significant association between violation rates and higher rates of youth smoking. These findings provide convincing evidence that without enforcement, policies, such as the Synar Amendment, are unlikely to reduce youth smoking. This is supported by Difranza (2012) who found after a comprehensive review of the literature that without enforcement a law alone would be insufficient to reduce tobacco use among youth.

As previously mentioned, most smokers initiate use before the age of eighteen (DHHS, 2012). For this reason, youth access restrictions were created in order to delay the onset of smoking, which could subsequently deter progression during adulthood, or to reduce the amount of smoking among youth (Grucza et al., 2013). Grucza et al. (2013) also found that restrictive

youth access policies during adolescence could contribute to a decreased prevalence of smoking in young adulthood. Interestingly, the authors noted that their findings may not be generalizable to both genders as the policy-smoking associations were primarily found among women (Grucza et al., 2013).

Electronic Cigarettes

While there are a number of tobacco products sold by tobacco retailers, electronic cigarettes are one tobacco product that has become increasingly popular among youth and young adults (Gourdet, Chriqui, and Chaloupka, 2014). Electronic cigarettes have components, such as a cartridge, heating device, and battery that work together to heat the liquid inside of the electronic cigarette to a vapor that individuals inhale (Gourdet et al., 2014). Within state and local level tobacco control policies, certain tobacco products, such as electronic cigarettes, are regulated. Gourdet et al. (2014) examined state level laws with restrictions on youth access for a direct reference to electronic cigarettes or products that were containing/derived from nicotine or tobacco within their policies, and the authors discovered that over half of the United States had made the effort to regulate e-cigarettes at the time of their study (Gourdet et al., 2014), even though there were no current federal regulations on electronic cigarettes. Beginning in 2016, laws were established to allow the Federal Drug Administration (FDA) to regulate electronic cigarettes (Truth Initiative, 2018).

Tobacco Control Policy Components

Although youth access policies are aimed towards reducing tobacco use among youth, there are many necessary components of a policy needed to achieve this goal. DiFranza (2005) found that the states with the strongest rates of compliance had several essential components, such as state enforcement plans, merchant education, random enforcement inspections,

enforcement agencies, funding for inspections, legal recourse for offenders, and penalties for sales to minors. Another important policy component are tobacco retailer licenses, Astor et al. (2019) found locations with strong retail license restrictions (e.g., yearly renewal, penalty structures, suspension/revocation of license, etc.) had decreased odds of cigarette/e-cigarette use. In order to accomplish a reduction in tobacco use and initiation among youth, the CDC recommends several activities, such as an increased cost of products, smoke-free areas, media messages, community programs, school policies, and an increased legal sales age to twenty-one (CDC, 2019B).

Tobacco 21 Policy

Tobacco 21 policies are an increasingly popular method of tobacco control where the minimum legal sales age (MLSA) is raised to 21 years old (Berman, 2011). Currently, there are more than five hundred local policies, twenty-eight state level polices, as well as a national level policy in the United States (Preventing Tobacco Addiction Foundation, 2020) These regulations are aimed towards preventing youth tobacco product use and initiation at an age where they are at higher risk of addiction (Berman, 2011). According to Berman (2011), the first policy raising the age to 21 years old was established in Needham, Massachusetts in 2005 where the smoking rates among high school aged students were reduced by approximately 50% in the four years after the passage and implementation of the policy. Berman (2011) attributed the reduction in youth smoking rates to the fact that individuals who were old enough to purchase tobacco products after the policy implementation were no longer in the social circle of youth, and the legal age increase also made it more difficult for high school aged individuals to pass as twenty-one. This relates to the general premise of the Tobacco 21 laws, which is the fact that delaying

initiation of tobacco products through adolescence makes smoking initiation much less likely to occur in the future (Berman, 2011).

Public Support for Tobacco 21

Tobacco 21 policies are being implemented across the United States. Studies have been conducted to observe components of the law, such as retailer compliance; however, only a small number of studies have explored public support for the policies. Winickoff et al. (2016) were among the first to assess the national public support levels for the policies, and their findings indicated 70.5% of their respondents supported these policies which included individuals of almost all demographics and smoking statuses (Winickoff et al., 2016). Volinsky et al. (2018) also explored public support for raising purchasing age; however, their efforts were focused on individuals aged 13-25, and they found that 69.8% of respondents were in support of the change. A large majority of the respondents were nonsmokers; however, 49.8% of smokers stated their support for the policy (Volinsky et al., 2018). Similarly, Lee et al. (2016) found strong support for raising the purchasing age to 21 by a large portion of United States residents. Based on these findings, it is evident that youth tobacco use is an important topic that many feel can be addressed by increasing the purchasing age through the use of Tobacco 21 policies.

Compliance with Tobacco 21

According to Silver et al. (2015), New York City (NYC) was the first major United States city to implement a Tobacco 21 policy in 2014. The authors compared retailer compliance rates before and after the implementation of the new law in NYC where they used individuals of similar ages to the minimum legal sales age, before and after the policy was passed, in order to conduct compliance checks, and their results indicated that compliance with identification requirements and legal sales prices significantly declined after the implementation of the law

(Silver et al., 2015). Winickoff et al. (2018) noted that by the beginning of 2018, across nineteen states, there were almost three hundred effective Tobacco 21 laws. The authors also mentioned that the Tobacco 21 policy in New York City resulted in slight decreases of tobacco use among youth following implementation; although, the state of New York and four other Florida cities experienced greater declines in youth tobacco use as a result of the policies (Winickoff, 2018).

The most recent study concerning Tobacco 21 policies was conducted in California by Zhang et al. (2018) where the authors found that the retailer violation rates were statistically lower after the passage of the new policy, which is a contrast to the findings of Silver et al. (2015). These contradicting findings could be attributed to increased policy awareness and support that was mentioned to be present in the study by Zhang et al. (2018), but was lacking in the study by Silver et al. (2015) who mentioned that some retailers may not have been aware of the new policy changes. Due to the decline in compliance found by Silver et al. (2015), the authors suggested that without strict compliance enforcement that tobacco control initiatives are unable to achieve their goal of decreasing youth access. Not only did the authors list awareness among their explanation of results, but they also noted that compliance checks for any given retailer are not typically conducted more than once a year (Silver et al., 2015). This leaves a remaining question of how retailer compliance varies in localities across the United States before and after implementation as most of the previous literature has focused on specific locations and time points. Lastly, retailer compliance to Tobacco 21 policies appears to be affected by other variables, such as awareness and support; however, little to no research exists on other policy components, such as fine size and the presence of suspension/revocation of tobacco retailer licenses, and how those variables affect compliance when Tobacco 21 policies are in effect.

Summary

As mentioned by the U.S. Department of HHS (2014), cigarette smoking remains the leader in preventable mortality and adverse health effects. This information is alarming due to the fact that in 2017, 34.3 million adults and 10.4% of young adults identified as smokers (CDC, 2019A). Furthermore, the CDC observed that e-cigarette use had risen from 2.1 million to 3.6 million from 2017 to 2018. Since almost 90% of smokers have smoked before the age of 26, it can be concluded that most tobacco use is initiated and established during adolescence (CDC, 2019B). This trend occurs for a number of reasons; however, violations of youth access policies are a major source of the problem. In the previously mentioned article by Spivak and Monnat (2015), the authors found a significant association among increased numbers of violations and increased rates of youth smoking. One approach to youth access restrictions is the implementation of Tobacco 21 policies, which Winickoff (2018) mentioned to be successful at decreasing youth tobacco use across the state of New York and in four Florida cities. Currently, several cities and states have established Tobacco 21 policies as part of their tobacco control initiatives; however, the success of Tobacco 21 laws appear to be largely dependent on the regulations being observed by the retailers, as well as the public. For this reason, the present study aimed to better understand the relationship between Tobacco 21 policies and retailer compliance at local levels across the United States.

Chapter III

Methodology

Tobacco 21 policies have become a popular method of tobacco control (Farber, 2016; Winickoff, 2018). This tobacco control method is important because approximately 90% of current smokers in the United States initiated use before eighteen years of age (Farber, 2016). A recent study examined retailer compliance before and after the implementation of a Tobacco 21 policy in New York City and found retailer compliance had declined after passage; therefore, the authors concluded that in order for the policies to be effective, retailer compliance needed to be more stringently monitored (Silver et al., 2015). Although there is an abundance of research on other methods of tobacco control, there has been little research on the relationship between retailer compliance, local-level Tobacco 21 policies, and the different components of policy language within each policy. For this reason, the purpose of the following study was to examine the relationship between local-level Tobacco 21 policy components and retailer compliance. This chapter will describe the methodology of this study, such as the research design, inclusion/exclusion criteria of the policies, policy retrieval, tool development, retailer compliance inspections, data collection, and data analysis.

Research Design

This study utilized a document review process to gather qualitative and quantitative data about two hundred and seventy-one local level Tobacco 21 policies in the United States for penalty structures and the presence of suspension/revocation of tobacco retail licenses within the policy language. Each policy was coded for policy language components between September 1, 2018 and February 10, 2020 (policy coding described below).

Research Questions

- Is there a relationship between Tobacco 21 policy implementation and violation rates?
- Does the association between Tobacco 21 policy implementation and violation rates vary by municipality size?
- Does the size of the violation fine in Tobacco 21 policies influence the relationship between Tobacco 21 policy implementation and violation rates?
- Does the presence of suspension/revocation of tobacco retailer licenses in Tobacco 21 policies influence the relationship between Tobacco 21 policy implementation and violation rates?
- Is the type of tobacco product sold during violations related to violation rates?

Inclusion and Exclusion Criteria

The policies in this study included municipalities within the United States with local level Tobacco 21 policies that became effective between October 1, 2012 and April 30, 2018. Additionally, the included locations had active compliance contracts with the United States Food and Drug Administration (FDA). These locations were chosen because, at the time of the study, they were the only locations with compliance data that could be retrieved two years before and one to two years after the policies went into effect. The included policies were collected in a study by Dobbs et al. (in progress) where the policies were retrieved by researchers electronically, if available online, or from the local clerk of each policy location if the policy could not be found.

The inclusion criteria included:

- Policies that prohibited the sale of tobacco products to those under the age of 21.

- Local level (governmental divisions below the state level, including city, village, township) Tobacco 21 policies in the United States with active compliance contracts with the FDA.
- Local level Tobacco 21 policies that became effective between October 1, 2012 and April 30, 2018.
- Policies that defined a minor as an individual under the age of 21.
- Policies that were retrievable electronically (see below).

The exclusion criteria included:

- Policies from locations in the United States with only a state level Tobacco 21 policy.
- Policies from locations in the United States who had preemption for tobacco-related policy.
- Policies from locations with no compliance contracts with the FDA.
- Policies that were put into effect after April 30, 2018 or before October 1, 2012.

Instrumentation

The "Tobacco 21 Policy Assessment Tool" was developed by Dobbs et al. (2019) to assess Tobacco 21 policy components. The development of the tool required several steps, beginning with a "Tobacco 21 Summit" where experts in the field of Tobacco 21 policies gathered to identify the necessary components of strong Tobacco 21 policies. Next, a literature review and a review of current Tobacco 21 policies was used to examine potential recommendations and terminology for policy language. For the literature review, literature from law, tobacco control, and public policy were examined in order to further identify important aspects of Tobacco 21 policies, such as policy language and enforcement methods, as well as policy recommendations. The literature review findings and the expert recommendations made

during the Tobacco 21 Summit were compared to the identified policies and the authors identified those with the strongest regulations and language (Dobbs et al., 2019).

Based upon the Tobacco 21 Summit, literature review, and input from legal and community-based Tobacco 21 experts, a tool was drafted. This instrument was sent to a panel of experts for revisions and recommendations. Following this series of steps, the completed tool was input into Qualtrics and used to code 16 state policies (Dobbs et al., 2019). The Tobacco 21 Policy Assessment Tool was used in the present study to determine if local-level Tobacco 21 policies included a retail penalty structure and if the structure included the suspension and/or revocation of the retailers' tobacco retail licenses for repeated violations of the policy.

Retailer Compliance Violations

The retailer compliance violations and type of tobacco products sold during violations of the selected locations were gathered from the FDA's online database (https://www.accessdata.fda.gov/scripts/oce/inspections/oce_insp_searching.cfm) from March 18, 2020 until May 12, 2020. According to the FDA (2018a), states in the United States are able to establish a contract with the FDA for the compliance check inspections of the tobacco retailers in their state. Although not all states have a contract with the FDA, the FDA has established contracts with third-party agencies to conduct the inspections when a contract is unable to be established with the state agencies and in some cases, the FDA personnel will complete their own inspections (FDA, 2018a). According to the FDA (2018b), once a contract has been established, inspections will be conducted to monitor retailer compliance with federal laws, as well as the regulations of the FDA. The multi-step inspection process is carried out by an inspector and a trained minor (FDA, 2018b) (see figure 1). The inspections are randomly

conducted at different retailers; therefore, it is important to mention that not all retailers are inspected every year.

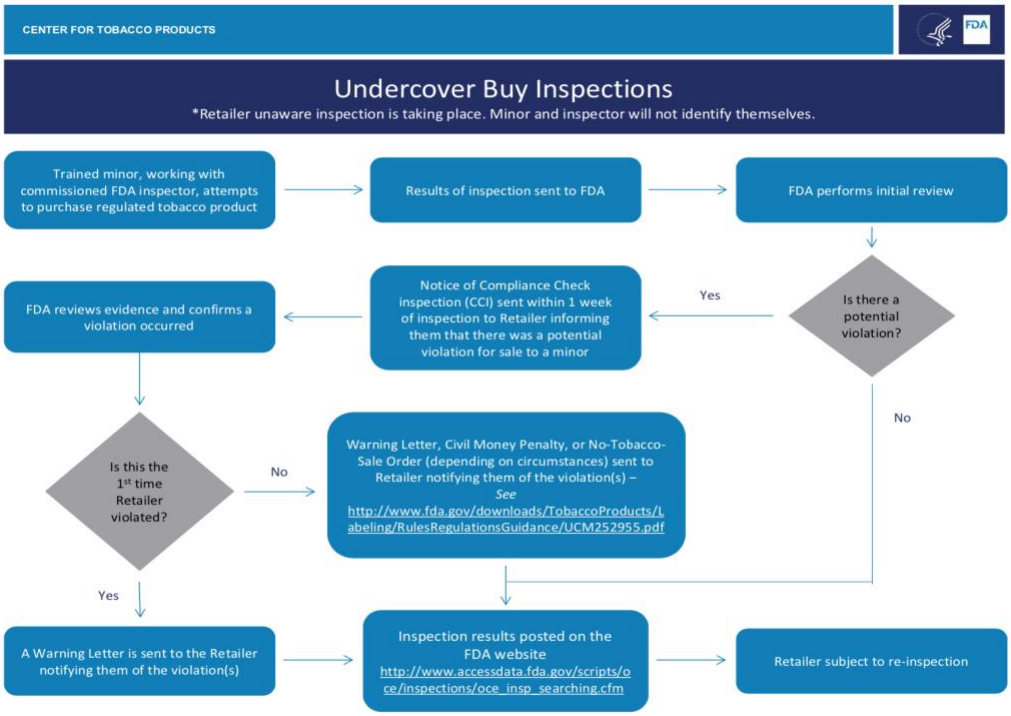

Figure 1. Food and Drug Administration. (2018b, June 13). CTP Compliance & Enforcement. Retrieved from https://www.fda.gov/tobacco-products/compliance-enforcement-training/ctp-compliance-enforcement

Data Collection

Sampling Method. Purposive sampling is used when a specific sample could provide particularly useful insight into the problem; therefore, the sample is not being generalized to the population, but is offering information about the topic being researched (Patton, 2015). Due to the fact that the present study was aiming to better understand Tobacco 21 policies, policies included in this study were purposively sampled from locations with Tobacco 21 policies that became effective between October 1, 2012 and April 30, 2018 with active contracts with the FDA for compliance check inspections.

Policy Retrieval. Four hundred and seventy-seven local Tobacco 21 policies that were passed before July 1, 2019 were retrieved by two graduate student research assistants, one from the University of Missouri-Columbia and the other from Illinois State University, for a recent study conducted Dobbs et al. (in progress). The search began with a list of the cities/counties/states who had effective Tobacco 21 policies and the date those policies became effective. Once the list was developed, the name of the location with the effective policy was searched in a search engine where the researchers tried to identify the city/county/state website or local news articles for mention of the Tobacco 21 policy in order to find a copy of the ordinance/article/local law. If the researchers were unable to retrieve the policies in this manner, the Municipal Code of the cities/counties/states was searched for either the ordinance number mentioned in the previous search or for the word "tobacco". The sections of the Municipal Code pertaining to the search were reviewed and cross-referenced with the effective dates provided in the original list. While most of the policies were available through these searches, some of the Tobacco 21 policies had to be obtained by contacting the local clerk to have the most updated tobacco policies emailed to the researchers. Of the four hundred and seventy-seven policies retrieved by the researchers, only two hundred and seventy-one policies were included in the present study based on the inclusion/exclusion criteria. Due to the fact that only a subsample of policies from across the Unites States were included, it is important to mention that the results may not be generalizable to all locations in the United States.

Policy Coding. The policies included in a recent study by Dobbs et al. (in progress) as well as in the present study, were coded independently, using the "Tobacco 21 Policy Assessment Tool", by two graduate research assistants from the University of Oklahoma between September 1, 2018 and February 10, 2020; however, before the two researchers began

coding independently, three teams of two researchers coded a small portion of the policies. The responses of all coders were recorded and stored using the assessment tool in Qualtrics. After the policies were coded, two student researchers reviewed the coded policies and identified any coding discrepancies. The discrepancies were discussed until a consensus was reached on the final code. Any discrepancies where consensus was unable to be reached was reviewed by a third researcher.

The final coded version of the policies was transferred from Qualtrics to Excel where the policies that did not meet the inclusion/exclusion criteria of this study were removed. The included policies with the variables of suspension/revocation of tobacco retailer licenses and violation fine structures were linked by municipality name to the retailer compliance violation data retrieved from the FDA database and transferred into SPSS Version 26 for data analysis (IBM SPSS, 2019)(see Appendix A).

Covariates. Retailer compliance could be affected by a number of factors, such as the presence of a tobacco retail license suspension and/or revocation in the policy, municipality population, policy jurisdiction (state, county, city/village/township), size of the fine for violations of the policy, type of inspector completing the inspections, as well as the product type sold during the violation (see Table 1).

Table 1. List of study variables

Variable Name	Measurement	Defined as	Type of Data
Retailer compliance violations	FDA Compliance Check Inspections of Tobacco Retailers (Online database information input into Qualtrics)	Violations observed during FDA compliance check inspections, such as the sale of tobacco products to minors. Retailer compliance will be measured as violation rates before	Numerical

		and after policy implementation.	
Covariates/Other variables			
Size of fine	Tobacco 21 Policy Assessment Tool (Qualtrics survey)	The fine structure present in each policy for tobacco sales to minors.	Numerical
Suspension/revocation of tobacco retailer license	Tobacco 21 Policy Assessment Tool (Qualtrics survey)	The presence/absence of suspension or revocation of tobacco retailer licenses for tobacco sales to minors.	Categorical
Municipality population	United States Census	The estimated number of individuals residing in each location.	Numerical
Product type	FDA Compliance Check Inspections of Tobacco Retailers (Online database information input into Qualtrics)	The type of product sold during each FDA compliance check violation, such as cigarettes, cigars, electronic nicotine delivery systems, etc.	Numerical

Data Management and Analysis

A Qualtrics survey was created to organize the population data from the Census, as well as the retailer compliance data from the FDA database for each policy location included in this study. The compliance variables and the census data from each policy location were matched with the dataset containing the presence of suspension/revocation of tobacco retail licenses and violation penalty structures for each policy location and combined into one SPSS file. The data analysis approach is described by research question.

Research Question 1: *Is there a relationship between Tobacco 21 policy implementation and violation rates?*

In order to examine the relationship between Tobacco 21 policy implementation and violation rates, the number of violations and inspections were collected from the FDA database for each policy location included in this study before and after each policy became effective. This data was entered into a Qualtrics survey and grouped by year into six categories: two years before, one year before, months before, months after, one year after, and two years after. The violations before policy implementation were summed into the variable "violations before", and the inspections before policy implementation were summed into the variable "inspections before". Additionally, the violations after policy implementation were summed into the variable "violations after", and the inspections after policy implementation were summed into the variable "inspections after". In order to account for the varying amount of inspections and violations, two variables were created, "violation rates before" and "violation rates after". The variable "violation rates before" was formed by dividing "violations before" by "inspections before", and the variable "violation rates after" was formed by dividing "violations after" by "inspections after". This equation was used because violations are dependent on the number of inspections conducted. Furthermore, a similar equation was used in a recent study by Henriksen et al. (2019). Using the equations for retailer compliance, frequencies of the data were conducted, the data was checked for any violations of the assumptions of a dependent t-test, and was analyzed using a dependent t-test to compare the means of the "violation rates before" to the "violation rates after".

Research Question 2: *Does the association between Tobacco 21 policy implementation and violation rates vary by municipality size?*

Populations from the 2010 Census and 2018 population estimates were gathered for each policy location included in this dataset. The populations were categorized into six groups for both the 2010 data and 2018 data: “5,000 and under”, “5,001 to 10,000”, “10,001 to 20,000”, “20,001 to 50,000”, “50,001 to 150,000”, and “150,001 and higher”. As previously mentioned, two new variables were formed, “violation rates before” and “violation rates after”, that accounted for the rate of violations per inspections before and after policy implementation. In order to determine the association between the population groups and violation rates, two one-way ANOVAs were conducted. The first included 2010 population groups and violation rates before and the second included 2018 population groups and violation rates after. This was done because the violations and inspections that occurred before policy implementation would have likely occurred near 2010 and the violations and inspections that occurred after policy implementation would have likely occurred near 2018. The first ANOVA did not violate the homogeneity of variance assumption; however, the second ANOVA did violate this assumption. For this reason, the Brown-Forsythe and Welch Tests were conducted, as well as the Games-Howell Post Hoc Test to determine any between group differences.

Research Question 3: *Does the size of the violation fine in Tobacco 21 policies influence the relationship between Tobacco 21 policy implementation and violation rates?*

To determine the size of the violation fine present in each Tobacco 21 policy included in this study, each policy was analyzed for its penalty structure that occurs when tobacco products are sold to individuals under the age of 21. If a penalty structure was present within the policies, they were categorized as “first violation fines”, “second violation fines”, “third violation fines”,

and “continued subsequent fines”, which would include fourth violations and beyond. The violation rates after policy implementation, not before, were compared to the fine sizes because the tobacco regulations in place before the Tobacco 21 policy could have included a different penalty structure. Two categories were created for policies with penalty structures that included minimum and maximum values. A policy was considered to have a minimum fine if the penalty structure had phrasing, such as “at least”, “not less than”, or “a fine between”, and a policy was considered to have a maximum fine if the penalty structure had phrasing, such as “not more than”, “up to”, “not to exceed”, “not in excess of”, “a fine between”, or “less than”. These categories were examined using descriptive statistics, which provided the amount of policies in the data set that included this language. In order to determine the relationship between fine sizes and violation rates, it was proposed that a multiple linear regression would be conducted between the fine categories and the violation rates after the policy became effective. However, the second violation fine, third violation fine, and fourth violation fine violated multicollinearity; the first violation fine did not violate multicollinearity. For this reason, a bivariate linear regression was used with only the first violation fines and violation rates after policy implementation.

Research Question 4: *Does the presence of suspension/revocation of tobacco retailer licenses in Tobacco 21 policies influence the relationship between Tobacco 21 policy implementation and violation rates?*

In order to determine the relationship between the presence of suspension/revocation for a retailer’s tobacco retail license and violation rates, two independent t-tests were conducted. The first independent t-test examined the differences between violation rates of those with/without the presence of suspension, while the second independent t-test examined the differences between violation rates of those with/without the presence of revocation. The violation rates

after, and not before policy implementation, were chosen because violations and inspections that occurred prior to Tobacco 21 policies being implemented could have included a different set of policy language.

Research Question 5: *Is the type of tobacco product sold during violations related to violation rates?*

The FDA online database includes eight categories for the types of products sold to minors during compliance check inspections: “cigar(s)”, “cigarette tobacco”, “cigarettes in a package”, “ENDS/E-liquid”, “hookah tobacco”, “roll-your-own tobacco”, “single cigarette”, and “smokeless tobacco”. It is important to mention that “cigarettes in a package” are packages of cigarettes rather than the number of cigarettes in each package. These categories were used in the Qualtrics survey during the retrieval of the inspection and violation data from the online database, along with the addition of two categories: “other” and “not given”. The two additional categories were added in case any other unlisted products were sold during the time of a violation, or if the product information was not available for the violation. Since the violation data and subsequent product types sold during violations were collected by year, each of the product type categories were summed to create new variables. The products sold during violations before policy implementation were created into ten new variables: “cigar(s) before”, “cigarette tobacco before”, “cigarettes in a package before”, “ENDS/E-liquid before”, “hookah tobacco before”, “roll-your-own tobacco before”, “single cigarette before”, “smokeless tobacco before”, “other before”, and “not given before”. The new variables were formed by summing the number of each product that was sold before the policy was implemented. Similarly, the products sold during violations after policy implementation were created into ten new variables: “cigar(s) after”, “cigarette tobacco after”, “cigarettes in a package after”, “ENDS/E-liquid after”, “hookah

tobacco after", "roll-your-own tobacco after", "single cigarette after", "smokeless tobacco after", "other after", and "not given after". This was also done by summing the number of each product that was sold; however, these products were sold after the policy was implemented. A dependent t-test was chosen to compare each of the products before to their matching product after; however, the data violated the assumption of normality. Therefore, a non-parametric version, the Wilcoxon Signed Ranks Test, was chosen to accommodate for the non-normal distribution of the data and determine if there was a difference in means of the tobacco products sold before and after policy implementation.

Chapter IV

Results

Two hundred and seventy-one local policies from across the United States were included in this study. The policies included were retrieved from 16 states where 59% of the policies were from Massachusetts (see table 2).

Table 2. Sample characteristics

State Name	Number (N)	Percentage (%)
Arizona	2	0.74
Arkansas	1	0.37
California	6	2.21
Colorado	2	0.74
D.C.	1	0.37
Illinois	20	7.38
Kansas	14	5.18
Massachusetts	160	59.04
Maine	1	0.37
Michigan	1	0.37
Missouri	15	5.54
Minnesota	2	0.74
New Jersey	27	9.96
New York	8	2.95
Ohio	10	3.69
Rhode Island	1	0.37

Research Question 1: *Is there a relationship between Tobacco 21 policy implementation and violation rates?*

To determine the relationship between Tobacco 21 policy implementation and violation rates, a dependent t-test was used. The means of the violation rates before policy implementation ($M = 0.07$, $SD = 0.08$) versus the violation rates after policy implementation ($M = 0.06$, $SD = 0.07$) (see table 3) did not yield a statistically significant difference ($p = 0.213$, $t\ (248) = 1.247$).

Table 3. Violation and inspection frequencies

Variables	Mean	SD	Minimum	Maximum
Inspections Before	64.51	132.24	0.00	1031.00
Inspections After	75.80	177.31	0.00	1809.00
Violations Before	6.36	22.40	0.00	246.00
Violations After	6.65	21.23	0.00	180.00
Violation Rate Before	0.07	0.08	0.00	0.33
Violation Rate After	0.06	0.07	0.00	0.30

Note. The violation rates before (Skewness = 1.28, Kurtosis = 1.27) and violation rates after (Skewness = 1.24, Kurtosis = 1.31) were not normally distributed; however, the data was within an acceptable range to proceed with the analysis.

Research Question 2: *Does the association between Tobacco 21 policy implementation and violation rates vary by municipality size?*

There was no statistically significant difference between groups' ($F[5,247] = 1.70$, $p = 0.136$) violations rates before policy implementation and the six population groups (see table 4). There were significant differences between the population groups' violation rates after policy implementation ($F[5, 248] = 3.97$, $p = 0.002$) (see table 5), but the homogeneity of variance was violated ($p = 0.027$). The Welch ($F[5, 71.83] = 3.76$, $p = 0.004$) and Brown-Forsythe ($F[5, 107.90] = 3.31$, $p = 0.008$) tests (non-parametric tests often employed when continuous variables violate assumptions of homogeneity) confirmed the violation rates of the six population groups were significantly different, and the Games-Howell post hoc test yielded significant between group differences (see table 6).

The violation rates after policy implementation were significantly different between the 5,001-10,000 population group (M = 0.03, SD = 0.05) and the 50,001-150,000 population group (M = 0.08, SD = 0.07)(p = 0.029), as well as between the 5,001-10,000 population group (M = 0.03, SD = 0.05) and the 150,001 and higher population group (M = 0.11, SD = 0.08) (p=0.029).

Table 4. Population groups with violation rates before policy implementation

Groups	N	Mean	SD
5,000 and Under	24	0.07	0.11
5,001-10,000	44	0.05	0.08
10,001-20,000	59	0.07	0.07
20,001-50,000	83	0.07	0.07
50,001-150,000	29	0.07	0.07
150,001 and Higher	14	0.12	0.08

Table 5. Population groups with violation rates after policy implementation

Groups	N	Mean	SD
5,000 and Under	24	0.06	0.09
5,001-10,000	44	0.03	0.05
10,001-20,000	58	0.06	0.06
20,001-50,000	82	0.06	0.06
50,001-150,000	31	0.08	0.07
150,001 and Higher	15	0.11	0.08

Table 6. Post hoc between group differences

Population Groups		Mean Difference	Std. Error	Sig.
5,000 and under	5,001-10,000	0.02963	0.01948	0.654
	10,001-20,000	-0.00089	0.01958	1.000
	20,001-50,000	0.00023	0.01879	1.000
	50,001-150,000	-0.01671	0.02144	0.970
	150,001 and higher	-0.04888	0.02767	0.501
5,001-10,000	5,000 and under	-0.02963	0.01948	0.654
	10,001-20,000	-0.03052	0.01177	0.109
	20,001-50,000	-0.02940	0.01041	0.062
	50,001-150,000	-0.04634	0.01467	0.029*
	150,001 and higher	-0.07851	0.02282	0.029*
10,001-20,000	5,000 and under	0.00089	0.01958	1.000
	5,001-10,000	0.03052	0.01177	0.109
	20,001-50,000	0.00112	0.01059	1.000
	50,001-150,000	-0.01582	0.01480	0.892
	150,001 and higher	-0.04799	0.02290	0.331
20,001-50,000	5,000 and under	-0.00023	0.01879	1.000
	5,001-10,000	0.02940	0.01041	0.062
	10,001-20,000	-0.00112	0.01059	1.000
	50,001-150,000	-0.01694	0.01374	0.818
	150,001 and higher	-0.04911	0.02223	0.285
50,001-150,000	5,000 and under	0.01671	0.02144	0.970
	5,001-10,000	0.04634	0.01467	0.029*
	10,001-20,000	0.01582	0.01480	0.892
	20,001-50,000	0.01694	0.01374	0.818
	150,001 and higher	-0.03217	0.02451	0.776
150,001 and higher	5,000 and under	0.04888	0.02767	0.501
	5,001-10,000	0.07851	0.02282	0.029*
	10,001-20,000	0.04799	0.02290	0.331
	20,001-50,000	0.04911	0.02223	0.285
	50,001-150,000	0.03217	0.02451	0.776

Note. * $p < 0.05$ indicates significance

Research Question 3: *Does the size of the violation fine in Tobacco 21 policies influence the relationship between Tobacco 21 policy implementation and violation rates?*

The results of the bivariate linear regression indicated that there was a non-significant ($p = 0.241$) correlation ($r = 0.05$) between violation rates after policy implementation and the first violation fine sizes, and only a small amount of the variance of the violation rates were explained by the size of the first violation fine ($R_2 = 0.002$). Furthermore, the association between the first violation fine sizes and the violation rates after policy implementation, using the standardized coefficient, was not significant ($B = 0.046$, $p = 0.481$).

Research Question 4: *Does the presence of suspension/revocation of tobacco retailer licenses in Tobacco 21 policies influence the relationship between Tobacco 21 policy implementation and violation rates?*

Policies that did not include Tobacco Retail License (TRL) suspension ($M = 0.09$, $SD = 0.08$) were found to have significantly higher violation rates than policies that included TRL suspension ($M = 0.05$, $SD = 0.06$), ($t(75.5) = 3.022$, $p = 0.003$). Levene's test indicated unequal variances ($F = 14.74$, $p < 0.001$); thus, the degrees of freedom were adjusted from 252 to 75.5. Similarly, policies that did not include TRL revocation ($M = 0.07$, $SD = 0.07$) were found to have significantly higher violation rates than policies that included TRL revocation ($M = 0.05$, $SD = 0.06$), ($t(180.26) = 2.12$, $p = 0.035$). Furthermore, Levene's test indicated unequal variances ($F = 8.80$, $p = 0.003$); therefore, the degrees of freedom were adjusted from 252 to 180.26.

Research Question 5: *Is the type of tobacco product sold during violations related to violation rates?*

The results of the Wilcoxon signed rank test indicated significant differences between the means of several products sold before and after policy implementation (see table 7 and 8). The average number of cigars sold before policy implementation was significantly lower than the average number of cigars sold after policy implementation ($Z = -5.389$, $p = 0.001$). However, the average number of cigarettes in a package sold before policy implementation were significantly higher than the average number sold after ($Z = -4.459$, $p = 0.001$). The average amount of ENDS/E-liquid sold before policy implementation was lower than the average amount sold after policy implementation ($Z = -6.526$, $p = 0.001$). Additionally, the average number of smokeless tobacco sold before policy implementation was higher than after policy implementation ($Z = -2.569$, $p = 0.010$). Lastly, the average amount of products that were "not given" were higher before policy implementation than after ($Z = -2.786$, $p = 0.005$). There was not a significant difference between all other types of tobacco products sold before and after policy implementation.

Table 7. Tobacco products sold during violations before policy implementation

Type of Product	Mean	SD	Minimum	Maximum
Cigar(s) Before	0.34	1.25	0.00	11.00
Cigarette Tobacco Before	0.04	0.25	0.00	2.00
Cigarettes in a Package Before	8.35	24.97	0.00	240.00
ENDS/E-Liquid Before	0.13	0.72	0.00	8.00
Hookah Tobacco Before	0.00	0.00	0.00	0.00
RYO Tobacco Before	0.00	0.00	0.00	0.00
Single Cigarette Before	0.22	1.52	0.00	15.00
Smokeless Tobacco Before	0.68	2.57	0.00	20.00
Other Before	0.00	0.00	0.00	0.00

Not Given Before	0.32	1.32	0.00	13.00

Table 8. Tobacco products sold during violations after policy implementation

Type of Product	Mean	SD	Minimum	Maximum
Cigar After	3.40	13.07	0.00	107.00
Cigarette Tobacco After	0.03	0.39	0.00	5.00
Cigarettes in a Package After	5.26	12.97	0.00	96.00
ENDS/E-Liquid After	1.32	3.59	0.00	42.00
Hookah Tobacco After	0.00	0.00	0.00	0.00
RYO Tobacco After	0.00	0.00	0.00	0.00
Single Cigarette After	0.13	1.00	0.00	10.00
Smokeless Tobacco After	0.24	1.28	0.00	15.00
Other After	0.00	0.00	0.00	0.00
Not Given After	0.10	0.47	0.00	4.00

Chapter V

Discussion

This study examined the association between Tobacco 21 policies and rates of retailer compliance. Furthermore, this study was conducted to expand the literature on how policy components, such as monetary penalty structures and suspension/revocation of tobacco retailer licenses, municipality size, and product type sold during violations are associated with violation rates. No significant differences were observed between the violation rates before and after policy implementation, as well as for the size of the violation fine and violation rates after policy implementation. However, significant differences were observed between certain population groups and violation rates after policy implementation, between the presence of suspension and revocation and violation rates after policy implementation, as well as between certain tobacco products sold before and after policy implementation. The following chapter will provide context to the findings of this study, as well as what has been discovered in past literature, and recommendations for tobacco policy and practice.

Tobacco 21 Policy Implementation and Violation Rates

The findings of this study indicated no significant difference between violation rates before policy implementation and violation rates after policy implementation; therefore, we fail to reject the null hypothesis of this study that retailer compliance would increase after the passage and implementation of Tobacco 21 policies. Furthermore, this differs from the findings of Zhang et al. (2018) who observed a decrease in retailer violation rates after the implementation of California's state Tobacco 21 law. The authors attributed their findings to the high levels of policy support and awareness (Zhang et al., 2018), which could have been less pronounced in the local policies included in this study as they were retrieved from 16 different

states in the United States. Other literature focused on compliance with identification checks, such as Silver et al. (2015) who found that compliance decreased significantly after the passage of the Tobacco 21 policy in New York City. The authors suggested these findings could be because of the delay in retailer awareness of the policy and the low frequency of inspections per year that could cause retailers to feel less concerned with violations (Silver et al., 2015). The findings of this study, which are in contrast to the findings of Silver et al. (2015), could be attributable to a higher amount of policy awareness in the locations included in this study. The population eligible to purchase tobacco products decreased when the tobacco sales age was raised from 18 to 21, which is noteworthy because the violation rates after policy implementation did not increase. This could be attributable to several factors, such as retailer education on the tobacco policy or the strength of fines and penalties associated with violations, which are supported by Difranza (2005) who found penalties for violation and retailer education as essential components for the compliance of tobacco policies.

Based on the findings of this study, as well as the findings of past literature, it is clear that further research is needed on violation rates before and after the implementation of Tobacco 21 policies, such as the factors that impact violation rates. Specifically, future research should be conducted on the delay in policy awareness of retailers and what steps could be taken to eliminate this delay as this could serve as a major contributor to violations that occur after policy implementation.

Municipality Size

Although there were no statistically significant differences between groups' violation rates before policy implementation and population size, there were significant differences between groups' violation rates after policy implementation and population size. While the past

literature is limited on the differences in municipality size and violation rates, the between group differences could be the result of several factors with the first being the large differences in city size of the locations included within this study. Since the number of violations are dependent on the number of inspections, the violation rate would likely differ when comparing a location with a population of less than 5,000 to a location with a population of more than 150,000 because of the number of inspections conducted in each location. Secondly, larger municipalities would likely have a greater number of tobacco retailers, and thus more locations to inspect, than smaller municipalities. Based on these factors, in order to standardize for the variation of retailers and inspections conducted in smaller and larger municipalities, a consideration for future compliance checks could be the establishment of a predetermined percentage of retailers to be inspected for all municipality sizes. This ideology is similar to a recommendation made by Dobbs et al. (2019) who suggested that including policy language to indicate the frequency of compliance checks was a "positive component" that would aid in the enforcement of the policies. Furthermore, Silver et al. (2015) mentioned that retailers could feel less risk for violation with a smaller frequency of inspections. Therefore, conducting more inspections could be a method to consider to help counteract this effect.

Monetary Penalty Amount

There was not a significant relationship between the first violation fine size and the violation rates after policy implementation. Previous research suggests the inclusion of monetary penalties for selling tobacco products to minors increases retailer compliance; however, the author also pointed out that the size of the fine (high or low) was not related to retailer compliance (DiFranza, 2005). The lack of relationship between fine size and violation rates after policy implementation could be attributable to retailers receiving less consequences when paying

violations than when a retailers' TRL is suspended and/or revoked, which could result in a much greater financial loss. While the inclusion of a penalty structure is suggested for reducing sales to minors, and is regarded as a "positive component" by Dobbs et al. (2019), another method of tobacco control that could be paired with the monetary penalty structure in the policy language to achieve a greater amount of retailer compliance is the inclusion of suspension and revocation of tobacco retailer licenses.

Tobacco Retail License Suspension/Revocation

Violation rates after policy implementation were significantly lower among communities that included a TRL suspension and revocation within their policy language. Therefore, we reject the null hypothesis which suggested the presence of these policy components would not impact retailer compliance. These findings are noteworthy because of the lack of relationship between violation rates after policy implementation and the size of the violation fine, which indicates that stronger restrictions, such as the suspension and/or revocation of TRL, are likely more effective at decreasing tobacco sales to minors. This could be attributed to the financial loss that occurs that would likely be lower when paying a violation fine versus the amount of revenue lost that results from a license suspension/revocation. Although the majority of policies included in this study had suspension (75.3%), just over half of the policies included revocation (59.4%) of tobacco retailer licenses. Although these values cannot be generalized to all of the Tobacco 21 policies across the United States, these findings suggest there are still a number of age-restriction policies that do not include the policy language recommended by researchers and public health officials (DiFranza, 2005; Dobbs et al., 2019).

The findings of this study indicated the presence of suspension/revocation were related to decreased violation rates. Additionally, Astor et al. (2019) found that localities with more

restrictive TRL policies (e.g. graduated penalty structures, suspension/revocation, yearly license fees, and license renewal) could decrease product use. Therefore, components, such as the suspension and revocation of tobacco retailer licenses and the components mentioned in the study by Astor et al. (2019), should be considered for inclusion in future policy language to achieve a greater level of retailer compliance and decrease sales of tobacco products to minors. Furthermore, future research on Tobacco 21 policies should consider how other policy components, not mentioned in this study, affect violation rates.

Product Type

Although not all categories of tobacco products sold during violations had differences from before policy implementation to after policy implementation, the average number of cigars sold was significantly higher after policy implementation, the average number of cigarettes in a package (package of cigarettes) sold was lower after policy implementation, the average amount of ENDS/E-liquid sold was higher after policy implementation, the average amount of smokeless tobacco was lower after policy implementation, and the average amount of not given products were lower after policy implementation. These findings indicate that traditional tobacco products (cigarettes in a package and smokeless tobacco) were sold less after policy implementation, with the exception of cigars. Additionally, newer products, such as ENDS/E-liquid were sold more frequently after policy implementation. This finding was not surprising as the amount of high school aged individuals that had used cigarettes in the past month was 5.8% while 27.5% had used e-cigarettes according to 2019 data from the CDC (2019B). There were no significant differences in violation rates before and after policy implementation, which differs from Levinson et al. (2020) who found violations occurred more frequently with the purchase of vaping products than cigarettes. Therefore, product types sold during violations should be further

explored by researchers and should be considered by tobacco retailers as individuals under the legal sales age could gravitate towards the purchase of new and emerging products.

Policy

Shipan and Volden (2006) explored the concept of policy diffusion on three levels: "local-to-state", "state-to-state", and "national-to-state". The authors found when observing antismoking policies that there were notable patterns of diffusion in the "state-to-state" and "national-to-state" levels (Shipan and Volden, 2006). While the diffusion from the local to state level can occur, the authors observed that it is largely dependent on factors, such as the legislatures and advocates present within each state; therefore, the authors suggested that the push for local policies is most successful where the local policies would be supported by legislators and advocates, but would otherwise be less successful at passing on a state level if not in this environment (Shipan and Volden, 2006). Additionally, Cox, Barry, and Glantz (2016) found extreme lobbying from cigarette companies to interfere with the passage of state laws; however, the authors suggested pursuing local policies to avoid this interference.

These findings are relevant to the current study in that local Tobacco 21 policies diffused quickly across the United States (Ribisl and Mills, 2019). Due to the fact that local policies can be used as a framework for state policies (Shipan and Volden, 2006), it is important to look closely at the policy language being spread. This study examined policy components, such as tobacco retail license suspension/revocation, as well as violation fine sizes, and found that the presence of suspension and revocation significantly decreased violation rates after policy implementation. However, future research should focus on how other policy components impact violation rates in an effort to identify the most effective components at decreasing sales to minors. Although the recently enacted national level Tobacco 21 policy has the ability to impact

the greatest number of people, additional policy components, other than solely the age raise to 21, are needed to reduce sales of tobacco products to minors.

Limitations

There were several limitations of this study. First, the sample of this study did not include all of the local level Tobacco 21 policies in the United States because of the inclusion/exclusion criteria that only included policies that became effective between October 1, 2012 and April 30, 2018. Secondly, dates for the inspection and violation data from the FDA online database were for the decision date rather than the date of inspection. The FDA was contacted through a telephone interview where it was clarified that the decision date is approximately four to six weeks after the date of inspection. This is important to mention as it could have caused inspections and violations near the policy effective date to have improperly fallen in the before or after policy implementation categories, thus impacting violation rates. Thirdly, the policies gathered for each location could have had amendments to the policy language that occurred after the policy retrieval. Lastly, 59% of the policies included in this study were from Massachusetts and may not be representative of other age-restriction policies across the US.

Conclusions

Although there was not a significant difference between the violation rates before and after policy implementation, it is important to mention that, despite the increase in individuals who were ineligible to purchase tobacco products, the violation rates did not increase after policy implementation. However, between some population groups, the violation rates increased from the smaller to larger municipalities. The first fine size did not yield a significant difference in violation rates; although, the presence of suspension and revocation of retailer licenses significantly decreased violation rates after policy implementation. Additionally, the tobacco

products sold during violations appeared to shift from before to after policy implementation to newer products, such as ENDS/E-liquid. All of these findings suggest that although the raise of the sales age is beneficial, the language of the policies themselves are among the most important components. Furthermore, having comprehensive policy language in all levels of tobacco policy (local, state, and national) are encouraged to better enforcement methods, decrease violation rates, and reduce youth use of tobacco products.

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Appendix A: Summary of Methodology

