The Impact of Safety Through Seat Belt Enforcement Laws

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ABSTRACT

The United States depends significantly on vehicles as a major aspect of transportation. Passenger vehicle occupants were involved in nearly 24,000 unrestrained fatal crashes, which accounted for almost half of those who died. While many citizens use their seat belts, some refuse to buckle up. Research indicates that states that switch their seat belt law from secondary to primary see seat belt usage increase by 10%. One research gap is the motivation of at-risk populations regarding restraint use. The primary purpose of this research is to analyze seat belt use, social vulnerability, and crash outcomes. One unique aspect of this study is that it integrates the Social Vulnerability Index (SVI) data from the CDC by combining SVI and county-level crash data using predictor variables from traffic crashes. The research uses the following analyses: descriptive comparisons, inferential statistics (χ^2, *t* tests, logistic regression), overlaying SVI data, and economic calculations. Deterrence theory provides how the certainty, swiftness, and severity of enforcement impact seat belt use compliance. The use of social learning theory helps explain why people choose to wear or not wear seat belts. Understanding the differences in these laws and their impacts across demographics explains how they affect whether someone buckles up.

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DEDICATION

This dissertation is dedicated to my family: my wife, Kristin, and my daughters, Brianna and Ciara. They have sacrificed much and have been supportive in my journey. I want to thank my dad for always believing in me. Finally, I want to thank God for helping me get through this all.

Chapter I

Introduction to the Study

The United States relies heavily on motor vehicles as a critical aspect of transportation. The miles traveled for work and play increase the traveling public's lifetime risk of being involved in a motor vehicle accident by 3 to 4 times (Toups, 2011). Since the first motor vehicle crash in 1869, which involved a Ms. Mary Ward, who was run over by the wheels of an experimental steam car (Fallon & O'Neill, 2005), there have been improvements to highway safety by the addition of seat belts, airbags, advanced braking, and stability control, as well as other passive restraint systems to the motor vehicle, making them much safer. These improvements to the automobile have enabled people to walk away from car crashes that would otherwise have resulted in serious injuries or even death.

While many citizens use their seat belts, a portion of the population simply refuses to buckle up (Shults et al., 2004). These individuals are usually made up of risk-taking young adult males (age 18 to 34) who account for 61% of all unrestrained fatalities (National Center for Statistics and Analysis [NCSA], 2025a). The data also shows that males make up a greater amount of non-users who die in motor vehicle crashes at 53% compared to females at 41% (NCSA, 2025a).

These non-belt users are often involved in fatal crashes that occur in both rural and urban environments and at night. Non-seat belt users represent many socioeconomic backgrounds. Policymakers have to consider developing effective seat belt use strategies and countermeasures targeting these groups. These partners and stakeholders could adopt additional strategies and countermeasures to help save lives.

One of these important safety improvements, designed to protect vehicle occupants, was the introduction of seat belts. Seat belts allow the passenger to maintain their original seating position (or close to it) and "ride down" the crash (Kahane, 2015). Seat belts were introduced in the United States in 1968, as a law requiring standard-issue safety equipment in new vehicles (Strine et al., 2012). Seat belts have saved an estimated 14,955 lives in 2017 (NCSA, 2019). Additionally, when using both a lap and a shoulder belt while driving, the risk of fatal injury to occupants of passenger vehicles is reduced by 45%, and that of moderate-to-critical injury by 50% (Kahane, 2015). The use of this life-saving device is critical in preventing needless death on roadways.

There are two main types of seat belt laws in the United States: primary and secondary laws. A primary law allows law enforcement to pull over and issue a citation for any offense. In contrast, a secondary law only allows law enforcement to pull over for a primary offense violation to issue a secondary one (NCSA, 2019). Currently, 35 of the 50 states in the United States have primary seat belt laws (NCSA, 2025b). Research indicates that states that switch their seat belt law from secondary to primary see seat belt use increase by 10 percent. Research also indicated that for every 1% increase in seat belt usage, these states saw a 13.6% decrease in fatalities (Houston & Richardson, 2006).

Background

The need for effective strategies and countermeasures for law enforcement is an important step toward addressing non-seat belt use. Policymakers enact seat belt laws with the hope that they will allow law enforcement to modify undesired behavior through enforcement, thereby achieving public safety. The goal of a law is to persuade individuals to conform to it, either voluntarily or by fear of punishment (Bilz & Nadler, 2014). Theories help explain how specific policy-related activities or services are expected to affect their intended outcomes (Mears, 2010). Social control theories provide additional understanding as to why people conform to laws or fail to follow them (Williams & McShane, 2010). Policymakers use this information to inform decisions on which strategies and countermeasures to implement to achieve behavior change.

Today, deterrence theory influences many of the laws. Deterrence theory has its roots in classical criminology and has served as the foundation for criminal justice policies and practices for much of American History (Pratt et al., 2006). Theorists revived it in the 1970s to explain why people commit crimes and find a solution to the crime problem (Pratt et al., 2006). The theory focuses on choice and the idea that potential offenders evaluate the benefits and costs of crime (Nagin, 2013). These punishments, fines, and jail time, enacted for violating laws, are only as valid as the notion of deterrence. Deterrence must be certain, swift, and severe to impact people's decisions about whether to commit a crime (Tibbetts & Hemmens, 2015). The highway safety community uses deterrence theory, especially regarding the implementation of seat belt laws.

The very first step in increasing seat belt use is a law that will be in effect to deter. People obey laws out of fear of reprisal from those who control the formal mechanisms of power and punishment. Public policymakers feel they can achieve greater compliance through manipulating the severity, certainty, and swiftness of formal legal sanctions (Papachristos et al., 2012). Deterrence influences citizens' behavior when they witness violators receiving citations for noncompliance. In the United States and other countries, the best way to increase seat belt use is to conduct and maintain highly publicized, high-visibility enforcement (HVE) of strong seat belt laws (Nichols & Ledingham, 2008). HVE is a universal traffic safety approach designed to deter unlawful traffic behaviors (National Highway Traffic Safety Administration [NHTSA], 2025c). HVE is a universal traffic safety approach that incorporates laws, enforcement, and public education to target undesired driver behaviors (NHTSA, 2025c). HVE components, when integrated, achieve and maintain effectiveness (Nichols & Ledingham, 2008). The use of HVE tactics has become a standard requirement of the NHTSA and its state partners within highway safety offices.

HVE strategies have helped reduce traffic-related violations by creating general deterrence and encouraging voluntary compliance with traffic laws (NHTSA, 2025c). Researchers have explicitly applied general deterrence approaches to impaired driving problems for decades. For example, sobriety checkpoints are a familiar practice that aims to achieve general deterrence in the United States (used by 38 states and the District of Columbia). These sobriety checkpoints use the three HVE tactics to raise public awareness at the community level (Goodwin et al., 2005). Sobriety checkpoints increase the perceived risk of detection and arrest for individuals who might otherwise decide to engage in unsafe driving behavior (Morrison et al., 2023). Law enforcement agencies throughout the United States have used these HVE models to increase the likelihood of apprehending individuals for non-seat belt use. HVE strategies use seat belt enforcement zones and checkpoints to increase public awareness and warnings about buckling up (Williams & Wells, 2004). Warnings are an element of deterrence because police enforcement on the roadside and safety media messaging deter violators.

In the field of traffic safety research, evaluation has focused on how enforcement and deterrence-based publicity influence public compliance with the law. This research puts a greater emphasis on how seat belt enforcement during late-night hours, is accompanied with alcohol laws, can increase additional seat belt use and injury reduction (Nichols & Ledingham, 2008). Research on high-visibility models indicates that violators who engage in risky behaviors, such as impaired driving and speeding, are less likely to buckle up (Kirley et al., 2023).

One project in the State of Washington focused on nighttime enforcement to increase seat belt use via general deterrence. This program examined how to gauge nighttime-focused enforcement of seat belt laws and how this might affect drivers' behavior. An evaluation of this program found that when HVE and paid and earned media provided by the program were combined, there was an increase in observed nighttime belt use (from 94.6% to 95.7%) without a decrease in daytime belt use (Thomas et al., 2017). Public awareness surveys showed that 70% of Washington motorists had heard of, read about, or seen the program. It also showed that the message reached its intended group, which consists of 18- to 34-year-old male drivers (Thomas et al., 2017).

Another general deterrence tool used across the United States is sobriety checkpoints. Checkpoints are among the most effective general deterrence measures (Bergen et al., 2014). Sobriety checkpoints aim to reduce impaired driving by increasing the perceived risk of arrest by highly visible, well-publicized, and regularly conducted checkpoints (Fell et al., 2008). General deterrence increases public perception of the likelihood of detection and apprehension for impaired drivers. Researchers have evaluated sobriety checkpoints as being an effective way to reduce alcohol-impaired driving and crashes by 20% (Ferguson, 2012).

Sobriety checkpoints continue to serve as a model for seat belt zones and seat belt checkpoints. The use of these strategies by law enforcement continues to serve as a means of employing general deterrence toward the motoring public (Kirley et al., 2023). Most enforcement in the U.S. has a specific deterrence effect on both the violator and the public. This traditional enforcement approach involves the violator interacting with the officer. The violator will likely go home and discuss their interaction with law enforcement with their family and friends. However, communities will receive the message rather than just individual drivers. This will help deliver general deterrence to the community (NHTSA, 2025c).

Problem Statement

In the United States, daytime seat belt use is currently 91.2% (NCSA, 2025a). The nation has experienced a significant growth in seat belt usage since the initial seat belt survey conducted in 1982. This initial seat belt survey of 19 cities documented use at 11%, a significant shift from current levels (Williams & Wells, 2004). However, there has been tremendous progress in the reduction of fatalities and the unrestrained use in the United States.

According to NHTSA, in 2023, passenger vehicle occupants were involved in nearly 24,000 unrestrained fatal crashes, which accounted for almost half of those who died (NCSA, 2025a). There has been significant progress in reducing fatalities and the unrestrained use in the United States. Looking back almost four decades, motor vehicle fatalities in the United States were over 43,000. Out of those fatalities, over 23,500 were unrestrained occupants, accounting for nearly 80% of individuals who died in passenger fatalities (NCSA, 2019). Today, unrestrained seat belt fatalities continue to remain a large part of the highway safety problem in the United States.

Purpose of the Study

The purpose of this study is to explore differences (sociodemographic, contextual, situational) between two states with different seat belt laws (Illinois and Ohio). The previous chapter presented the study’s data analysis results. This research collected crash statistics from

2014 to 2023. These results indicate the effectiveness of seat belt use and fewer fatalities. It will investigate the impact of the independent variable on the dependent variables, which include unrestrained passenger vehicle occupant-related fatalities, daytime observed seat belt use percentages, and the economic cost associated with non-seat belt use. The study will use disaggregated fatality data across various predictor variables. These variables will consist of gender, occupant role, age groups, rural and urban areas, time of day, season, vehicle type, and county-level social vulnerability data. SVI will use overlay crash data from 2014 and 2022.

This study contributes to the field of traffic safety by comparing neighboring states that differ in enforcement type but share similar characteristics. This variation makes Illinois and Ohio ideal for reviewing and assessing policy impact while controlling for contextual differences. These differences make Illinois and Ohio ideal for reviewing and assessing policy impacts while governing for context. One of the unique aspects of this study is that it integrates the Social Vulnerability Index (SVI) data from the CDC by combining SVI and county-level crash data using multiple predictor variables from traffic crashes. This study builds on previously mentioned research and fills gaps by examining sociodemographic factors alongside the effectiveness of the law type and linking SVI data.

Prior research focused on seat belts, as in this study. However, theirs were much narrower in scope. The first study examined the effectiveness of primary and secondary seat belt laws (Rivara et al., 1999). The second examined how associations between sociodemographic and seat belt use in states with and without primary enforcement laws (Beck et al., 2007). The third and final study focused on variation in drivers' seat belt use by indicators of community-level vulnerability (Sartin et al., 2023).

Research Question and Hypothesis

These research questions examine whether a primary seat belt law has affected seat belt use, restrained and unrestrained fatalities, and economic costs relative to a secondary seat belt law, while controlling for non-seat belt use-related variables. The researcher will conduct the study in Illinois, a state with a primary seat belt law, and Ohio, a state with a secondary seat belt law.

1. Passenger vehicle occupants will have a lower share of being unrestrained in a fatal crash across all subgroups (male vs. female, driver vs. passenger, rural vs. urban, day vs. night, seasons, and vehicle types) in Illinois than those in Ohio due to Illinois' primary law. If this is true, primary seat belt enforcement may be more effective in increasing seat belt use and decreasing unrestrained fatalities across all subgroups.
2. Passenger vehicle occupants will have lower odds of being unrestrained in a fatal crash in Illinois than in Ohio when controlling for situational and demographic factors. If this is true, it may indicate that primary enforcement increases seat belt compliance even accounting for predictor variables.
3. Passenger vehicle occupants will have lower unrestrained fatality in crashes when factoring in contextual and environmental factors, such as nighttime, rural and urban roadways, seasons, and vehicle types, in Illinois compared to Ohio. A positive response to this question may indicate that the type of enforcement can influence seat use behavior, even when considering contextual and environmental factors.
4. Passenger vehicle occupants in counties with higher social vulnerability (SVI Q4) will show significantly higher unrestrained use in fatal crashes compared to those in lower vulnerability counties (SVI Q1). These SVI disparities will interact with

passenger vehicle occupant subgroups and state enforcement policies, resulting in larger differences in Ohio than in Illinois. If this is true, it may indicate that enforcement type and social influences can affect the seat belt use of vulnerable populations.

Methodology Premises

This research will compare two states by varying the law types (primary and secondary). The research will use the following analyses: descriptive comparisons, inferential statistics (χ^2, *t*-tests, and logistic regression), overlaying SVI data, and economic calculations. The dependent variables will include an observational daytime seat belt survey, an unrestrained passenger vehicle occupant-related fatality rate per 100 MVMT, attitudinal awareness surveys, economic costs associated with non-seat belt use, and overlaying SVI data. The descriptive analysis section will provide the foundation for a more complex statistical analysis.

Theoretical Premises

This study will use the following theories to understand how motivation, beliefs, and social norms impact seat belt use. Deterrence theory will provide how the certainty, swiftness, and severity of enforcement impact seat belt use compliance. The use of social learning theory will help explain why people choose to wear or not wear seat belts. Fatalism reduces perceived behavioral control, weakening motivation to comply with safety laws.

Significance of the Study

Understanding the difference in these laws and their impact across demographics will explain how the law affects whether someone buckles up, leading to consequences such as unrestrained fatalities and economic costs to society. These findings emphasize the fiscal and human impacts that continuing with a secondary law would lead to, including continued loss of life. This research offers key findings on how policymakers can implement and influence seat belt use. The transition from secondary to primary seat belt use is critical to increasing seat belt use and reducing fatalities.

Chapter Summary

This research has helped validate the differences in seat belt use and in reducing loss between primary law and non-primary law. It will contribute to the field of traffic safety by providing additional research on the impact of non-seat belt use. The SVI overlay data, used to better understand the most vulnerable populations, can inform. Each life saved will help validate the reform of switching laws for the sake of public safety.

Chapter II

Review of Literature

Seat belt laws are an important aspect of safety. Today, laws like seat belt requirements impact order and safety, ensuring that citizens can live safely within the community. The enforcement branch of government ensures that laws established by the government are carried out and not broken. These laws establish public safety by intervening in behavior that society views as negative. Policymakers must consider various divergent interests when developing new laws and regulations.

In a law-abiding society, there must be some social control to deter those who might violate the law. Without these controls, society would be rife with lawlessness and selfishness. In comparison, many individuals obey laws simply because they exist. Others obey the law out of habit or a sense of its legitimacy. There are specific segments of our society that will not obey the law solely because a law exists, without legal sanctions (Brown et al., 2015; McAdams, 2015). Policymakers may need to implement programs that address seat belt use through enforcement grants.

Often, policymakers encounter challenges when attempting to implement traffic safety programs or to seek legislative changes from their constituents and politicians. They must weigh the needs for safety against individual rights that the law may impact, which makes the process complex. Enacting laws is never a simple task, and enacting primary laws is a strategic approach. When lawmakers draft laws that are preventative in nature, they must often weigh the benefit that will result. These preventative laws will help citizens from harming themselves or others by engaging in perceived risky behavior. Implementing critical safety laws can impact the safety and welfare of citizens by preventing this undesired behavior. Their health and well-being are often of chief concern in developing these rules. For instance, it may be the need to safeguard its citizens, leading them to create a system for free travel within its borders. This analysis uses problem-solving strategies that draw on various theories, methods, and social sciences to determine what is deemed acceptable (Dunn, 2004).

Seat Belt Use: Community Health Issues

Seat belt policies remain a difficult challenge for policymakers. The establishment of these laws encounters competing differences of opinions, beliefs, and cultures. Public policymakers must consider the needs of the majority of their citizens before enacting laws that affect society. Before enactment, laws should undergo a cost-benefit analysis to determine the impact the proposed law will have on society, to address undesired behavior or a public health issue. The introduction of laws such as seat belt requirements has, for the most part, been widely accepted. Once the majority of citizens see the benefits the new law offers society and recognize the long-term benefits of wearing a seat belt, it will be adopted. When society accepts these laws, their benefits save lives, and the law gains majoritarian support among most politicians and is more widely adopted (Wilson, 1980). This results in citizens investing in these laws through compliance. This acceptance allows the government to ensure that those who might violate such rules are dealt with. Society can expect some semblance of order and responsibility from its citizens in return (Portis, 2008).

Even with the public health impacts associated with non-seat belt use, majoritarian acceptance explains in part why seat belt laws often encounter resistance. However, seat belt laws still encounter resistance in being enacted. Portions of our population view this action as over-governance and as such, an intrusion on citizens' daily lives (St. Louis et al., 2011). Initially, when establishing seat belt laws, they were often developed with limited enforcement. These limitations included dulled-down laws with various restrictions on enforcement, such as secondary enforcement. There was no more than an honor code among its citizens to wear the belts. These initial laws also put limitations, such as restrictions on where law enforcement could enforce the law, such as specific seating positions, front seat only, and age restrictions, enforceable only for those under 18, which affect the law's ability to enforce these regulations (St. Louis et al., 2011).

In the United States, the first seat belt law that was enacted occurred in 1968. As a result, the law's provisions required that seat belts be installed in the front outboard seating positions of all future production of motor vehicles (National Highway Traffic Safety Administration [NHTSA], 2025b). There has still been no effort to establish a national seat belt law mandating its use nationwide. Instead, the role of establishing laws requiring seat belt use has been left mainly to the states to adopt (NHTSA, 2025b). The Federal government's focus was on establishing seat belt enforcement programs to get more people to buckle up and on implementing legislative incentives to promote the adoption of these laws (NHTSA, 2025b).

Seat Belt Policy Enactment

Seat belt use has increased sharply over the past decade. In 2008, seat belt use nationwide was at 84.0%. It increased to 90.7% in 2019, a 6.7 percentage point increase (NCSA, 2019). This increase in use can be attributed to the rise in states with primary seat belt laws and the accompanying high-visibility enforcement (HVE), such as the Click It or Ticket (CIOT) program (Nichols et al., 2014). Despite this increase in seat belt use in the United States, many continue to die from not wearing their seat belt. In fact, in 2023, nearly 24,000 passenger vehicle occupants were involved in fatal crashes, and nearly half were unbuckled (NCSA, 2025a). Today, unrestrained seat belt fatalities continue to remain a large part of the highway safety problem in the United States.

A considerable amount of research has examined seat belt use. The vast majority of seat belt research conducted over the past decade in the field of highway safety has focused on the impact of seat belt legislation, seat belt use, seat belt enforcement, and media communications supporting seat belt use (Kirley et al., 2023). One research gap is the motivation of at-risk populations regarding restraint use. These at-risk populations should be given attention, and effective approaches to improve seat belt use among them should be identified, as this is an untapped area for research (Beck et al., 2019). Understanding what motivates at-risk populations that fail to buckle up is an untapped area of research that warrants focus.

Seat belts were required in all new vehicles beginning in the 1960s (NHTSA, 2025b). However, this life-saving device, now required to be in vehicles, was not widely worn by many people. In 1984, New York enacted the nation's first seat belt use law. Since then, all states except New Hampshire have adopted seat belt laws requiring their use for both the driver and the front passenger in an occupied vehicle (NCSA, 2025b). The gradual adoption of seat belt laws over 32 years resulted in two main legislative camps. The adoption of primary seat belt laws or secondary laws. In the past decade, many states have upgraded their secondary laws to primary (NCSA, 2025b). Thirty-five states have a primary seat belt law, and fifteen states have a secondary seat belt law (NCSA, 2025b). Much research has specifically examined the differences in both primary and secondary seat belt law usage and unrestrained fatalities. There is still more to learn about the two types of seat belt laws. The way in which each state implements its various programs, law enforcement efforts, and how its citizens accept the law. Understanding the differences and issues will help develop new intervention methods to get more people to buckle up.

When studying seat belt laws, the focus has primarily been on the benefits of adopting or strengthening them. Research has found that seat belt laws are effective in promoting seat belt use (Strine et al., 2012). The adoption of primary seat belt laws has had greater benefits than secondary laws, with higher seat belt usage and a reduction in unrestrained passenger vehicle occupant fatalities following their passage (Houston & Richardson, 2006). On average, states that upgraded to primary seat belt laws saw a 10% increase in their seat belt usage (Houston & Richardson, 2006). The increase in seat belt use ultimately translates to lives saved

Upgrading seat belt laws increases seat belt usage. There are also other measures attached to passing laws that affect seat belt usage. Seat belt fines in the United States vary from $10 in a number of states, such as Oregon, which has a fine of up to $250 (NHTSA, 2018). Data show that for every $10 increase in seat belt fines, there is a 1.35% increase in seat belt use (Houston & Richardson, 2006). Even a secondary state may increase seat belt usage with fines. For example, one study on seat belts reports that an increase of 12-15 percentage points in seat belt use was observed following an increase in the fine (Houston & Richardson, 2006). North Carolina surveyed citizens' attitudes toward seat belts and found that non-users would use their seat belts if fines were doubled to $50 (Williams & Wells, 2004). However, it was found that fines exceeding $100 had no additional effect on seat belt use (Centers for Disease Control and Prevention [CDC], 2020). It should be noted that some limitations were identified in raising seat belt fines. It became evident that if penalties were low, there was little effect. If the penalties were too high, police became reluctant to issue citations, and judges would often toss out the violations in court (Nichols et al., 2014). While increasing fines for non-use of seat belts shows an impact on greater seat belt use, one should proceed with caution and note the limitations of such an approach. As noted previously, they will eventually level off.

When upgrading existing laws from secondary to primary, certain obstacles often become the focal point of the debate for change. The first were citizens who felt government intrusion into personal freedoms. Racial profiling can also occur (St. Louis et al., 2011). Racial profiling is a social critical element that is often of chief concern when states look to change their traffic laws to primary laws. The NHTSA has conducted research examining thirteen states that changed their laws from secondary to primary enforcement between 2000 and 2009. They discovered that, of these thirteen states, seven experienced a decrease in fatalities among front passenger occupants. These data indicated that drops occurred by 8% overall, 7% for Caucasians, and 11% for minorities.

Additionally, this research found that, among the 13 states, four showed that the percentage of tickets issued to minorities either stayed the same or decreased slightly after the law was changed. This research found that following changes in the law, seat belt use increased without evidence of racial profiling (Tison et al., 2011). Additionally, challenges can come from those in leadership, including legislators who introduce legislation. In many instances, legislators can be a significant factor in hindering the passage of laws because of their personal beliefs that seat belt laws are unnecessary. In addition, resistance to seat belt laws can also come from another source, such as the alcohol industry. One of the main reasons given was that it would negatively impact their business. They believe that if their customers are pulled over for a seat belt violation, they might also be given a DUI (St. Louis et al., 2011). These challenges are often a contributing factor to why many of these secondary states do not have a primary seat belt law in effect today.

The ability to enforce the law is crucial for law enforcement to have an impact on seat belt usage and unrestrained fatalities. One of the major annual enforcement campaigns run by the Federal Government and its state stakeholders is CIOT. CIOT is a high-visibility seat belt enforcement campaign focused on seat belt use. This two-week event, which originated in 1993 in North Carolina, occurs in late May (Starting near Memorial Day weekend) through the first week of June (Reinfurt, 2004). This event combines enforcement with highly publicized media and uses of seat belt zones, checkpoints, and saturated patrols. In 2008, when comparing 16 states with high seat belt use rates to 15 states with low seat belt use, the most significant factor was enforcement's impact on seat belt use (Hedlund et al., 2008).

There is a clear difference in the amount of enforcement conducted in primary seat belt law states compared to secondary seat belt law states. An evaluation of the 2013 CIOT mobilization found that primary states issued significantly more seat belt tickets during the 2013 campaigns compared to secondary states (Nichols et al., 2016). In a CDC review of 15 high-quality studies, this research found that during short-term high-visibility enforcement (HVE), seat belt use increased by 16 percentage points (Dinh-Zarr et al., 2001; Shults et al., 2004).

Integrated nighttime seat belt enforcement is another method that law enforcement can use to enforce seat belt laws. Integrated nighttime seat belt enforcement, although not a new concept, is relatively recent in the broader use of strategies within the United States. It is unclear how often seat belt enforcement occurs at night because no national analysis has identified programs that focus on nighttime enforcement (Hedlund et al., 2008). However, seat belt use at night remains an issue that data shows is worth addressing. In fact, unbelted occupants at night represent a higher proportion than during the day (NHTSA, 2010).

There has been some success in measuring the effectiveness of nighttime seat belt enforcement. A NHTSA study evaluating an HVE nighttime seat belt enforcement program in Maryland found that drivers' records of those cited for seat belt violations were eight times more likely to have prior seat belt violations (Retting et al., 2018). Additionally, after five waves of enforcement, statistically significant pre-post increases (occurring in three out of the five waves) were observed in nighttime seat belt use (Retting et al., 2018). Research indicates that combining nighttime seat belt enforcement with DUI law enforcement can increase seat belt use and reduce injuries (Nichols & Ledingham, 2008).

Sustained enforcement is another key element to consider that affects higher seat belt use. Sustained enforcement, unlike short-term HVE efforts, typically spans one year. Many high-use states conduct sustained enforcement efforts, and as a result, have seen their seat belt use rates climb (Chen & Webb, 2016). Little research has evaluated the effectiveness of sustained seat belt enforcement. Nonetheless, the data look promising, but further research may be needed to determine whether such an action can increase seat belt use.

The main seat belt message in the United States has been CIOT since 2003 (Nichols et al., 2016). CIOT has become a household name that, in many cases, brings up awareness of wearing a belt. While many Americans connect with this message, the media industry is ever-evolving. As different media emerge, it may become necessary to revisit the evaluation of CIOT's current reach. Scholars report that seat belt use has increased as a result of this CIOT media campaign.

In 2002, when CIOT was a demonstration project, one of the areas evaluated was the impact of media on seat belt usage. The data showed that seat belt use increased by 8.6 percentage points across the 10 states that used paid media. The May 2002 CIOT campaign evaluation demonstrated the effect of earned and paid media strategies. Belt use increased by 8.6 percentage points across 10 States that used paid advertising extensively in their campaigns. Seat belt use only increased by 2.7 percentage points in the four states that used limited paid media and only 0.5 percentage points across the last four states that used no paid advertising (Solomon et al., 2002). Developing a marketable and noteworthy program helped CIOT drive the national seat belt program for nearly two decades.

The media has a tremendous impact on the general population of the United States. The methods of reaching intended audiences have changed from the days of radio to being placed in gaming platforms as we enjoy our latest games. Getting people to buckle up through media messages is a main staple in the Federal and State governments in the United States. Additionally, these entities have been using social networking sites to reach the general public with messages concerning seat belt use.

While social media is a powerful tool, the main drawback is that social media applications are more observable than measurable (Lenhart, 2015). Using traditional methods to collect data may encounter issues, as there is no way to confirm the identity, gender, age, and ethnicity of those who like a post (Drake et al., 2017). The use of different media is a mainstay of highway safety media programs, which aim to raise awareness of the importance of seat belt use. It is essential to note that these new technologies, which are being used, still require formal evaluations to assess their impact and reach in changing behavior.

It is essential to measure public perception of seat belt laws in order to gauge support. Research has shown that the public's perception of seat belt laws is generally favorable and supportive (NHTSA, 2008). The NHTSA conducted a national sample survey on attitudes regarding occupant protection and found that 64% of respondents believed law enforcement officers should be allowed to stop a vehicle if they observe a seat belt violation. In primary states, the public support for seat belt enforcement was 71%, and in secondary states, it was 56% (NHTSA, 2008).

When the state of Maine upgraded its seat belt law to primary enforcement in 2007, research was conducted to assess the law's impact through awareness surveys. The data collected in this research showed that awareness concerning the seat belt law increased after each subsequent wave of enforcement (Chaudhary et al., 2010). Individuals surveyed indicated that their belief that police could only issue a ticket if they were stopped for something else decreased from 21% to 10% after the third wave of enforcement (Chaudhary et al., 2010). This survey measured the impact of the new primary law, as secondary laws required some other violation as a trigger for the stop. Respondents who felt that police could now issue a ticket whenever they saw someone not wearing a seat belt increased from 78% to 87% after the third wave of enforcement (Chaudhary et al., 2010).

Group Seat Belt Behavior

When individuals start their vehicles, one of the most important steps in getting from one place to another safely should be an easy choice. However, there is a significant gap in the literature on what motivates people to choose a device that can be put on in only seconds. It is essential to understand the makeup of these risk takers who fail to buckle up. Data shows that groups with lower seat belt use tend to be young males aged 18-34 years. They are often risk takers, either through habits or poor choices, such as obese individuals, people who engage in high-risk health behaviors, rear-seat passengers, and rural residents who fail to buckle up (Beck et al., 2019; Strine et al., 2012).

Research indicated that risky seat belt habits impact different groups. This is the result of many circumstances, environments, and developed habits over the years. Data showed that Older drivers had higher seat belt use than younger drivers; married drivers, especially those with children, compared to unmarried; women, compared to men; higher socioeconomic status, based on education and income, compared to lower socioeconomic status; owners of newer and more expensive vehicles, compared to owners of older and less expensive vehicles; Whites, compared to Blacks and Hispanics; passenger car drivers, compared to pickup truck drivers; alcohol abstainers or moderate drinkers, compared to heavier drinkers; nonsmokers, compared to smokers; and low-crash and crash-free drivers compared to high-crash drivers (Shinar, 2017). These behavioral habits of non-seat belt use are illustrated in Table 1 below. Strine et al. (2012) found that men and women who engaged in smoking, binge drinking, or heavy drinking, were physically inactive, or were obese, were less likely to wear a belt compared to those who did not exhibit these behaviors. Future research is necessary to explore the relationship between beliefs and behavior, and to identify interventions that may improve seat belt use (Beck et al., 2019).

Table 1

Seat Belt Habits Involving Risky Drivers

HIGHER SEAT BELT USE	LOWER SEAT BELT USE
Older Drivers	Younger Drivers
Drivers Married with Kids	Single Drivers
Female Drivers	Male Drivers
Drivers with Expensive Vehicles	Drivers with Less Expensive Vehicles
Drivers who Abstain from Alcohol	Drivers who Drink Alcohol
Drivers who do not Smoke	Drivers who Smoke
Car Drivers	Pickup Drivers

Note. Adapted from Shinar (2017).

It is important to understand the psychological factors underlying seat belt use to develop effective countermeasures that increase seat belt use. This human behavior plays a significant role in non-seat belt use, speeding, not wearing a motorcycle helmet, and many other hazardous driving behaviors, all of which require additional thought to be effective. According to Sullman and Dorn (2019), risk-takers seek thrills and often exhibit personality traits associated with individuals willing to take risks and live on the edge. This behavior of the risk-takers shows their constant seeking sensation, which defines individuals seeking varied, novel, complex, and intense feelings and experiences; and who are willing to take physical, social, legal, and financial risk for such an experience, which makes the risk a means to an end for the excitement and lifestyle (Malik, 2024).

These thrill-seeking individuals consistently disregard laws, such as speeding, drinking and driving, and failing to use a seat belt and motorcycle helmet while operating motor vehicles, as well as not wearing a helmet while riding motorcycles. This thrill-seeking trait is more prevalent when specific laws that reduce risky behavior are not strictly enforced, such as speeding, non-seat belt use, and helmet use (Sullman & Dorn, 2019). It is important to note that unenforceable laws, such as secondary laws, are rarely enforced by law enforcement. These laws are viewed as less important and should be minimally enforced; otherwise, law enforcement could use the secondary law as a pretext for unnecessary traffic stops. Lawmakers must write laws that are enforceable and effective. If not, the laws become nothing more than paper, with no teeth to change behavior.

While seat belt use has received considerable attention in research, there is still room to learn ways to increase its usage. As the research highlights the critical shift from secondary to primary seat belt laws, it remains essential to evaluate the success states have achieved critically.

Seeing the impact that has been made and understanding what leads to success in a state, as well as where states struggle, can only improve interventions to increase seat belt use and decrease unrestrained fatalities.

Deterrence Theory

While enacting a seat belt law, the very first step to impacting behavior is through enforcement. To modify compliance, it is necessary to consider the factors that influence whether someone buckles up. This enforcement is important in influencing behavior and getting people to buckle up. Without enforcement of the law and some form of punishment, the undesired behavior is unlikely to change. Seat belt laws, as mentioned earlier, are either primary or secondary laws. The need for law enforcement to pull over a violator for a seat belt violation alone is a critical aspect that demonstrates to the public that non-seat belt use will not be tolerated, and certain punishment will result. This perceived risk must be real and enforceable to have the desired deterrence. Seat belt laws, along with other laws, such as impaired driving laws, rely on the deterrence of crimes by enforcement activities and, in the end, certainty of some punishment (Kirley et al., 2023). Deterrence theory provides a foundation for why people obey the law by fearing the consequences, thereby deterring them from committing violations. As a result, the individual's fear of reprisal from those who control the formal mechanisms of power and punishment, such as law enforcement, alters their behavior (Papachristos et al., 2012).

When laws are drafted, lawmakers should ensure to include sanctions and/or penalties to ensure compliance. Including sanctions and penalties serves as a deterrence to get citizens to comply with the law. Without such deterrence in the laws, interventions become weak and often not enforced. As a result, the laws often have minimal impact on the undesired behavior. This minimal impact stems from the potential offender's contemplation of committing a crime. He or she conducts an internal cost-benefit analysis to determine whether committing a crime is worth the risk of apprehension (Nagin, 2013). When an offender contemplates violating such a law, they evaluate whether committing a crime will result in little punishment or a high likelihood of getting caught. The potential offenders must weigh the possibility of sanctions or punishment as adequate to deter their own undesired behavior.

The need to effectively communicate this deterrence message is crucial and a fundamental way to convey information directly to those who might violate the law. This deterrence is accomplished by discouraging potential law violations through communication of the sanctions that might be imposed upon individuals who fail to conform to accepted behavior (Apel, 2013). When individuals receive this threat and view the risk, deviant behavior can occur. The mass media broadcasting of relevant messages poses a communication threat. The message can be highlighted by describing that police will be out in force and will detect and apprehend suspects who violate the targeted law (Kirley et al., 2023). The message is further communicated to the community through the visual or verbal announcements of the arrests, prosecution, and sentencing of the violator (Apel, 2013). This process helps produce a deterrent message for the public. Through visual and audio communication, it conveys the certainty of sanctions.

The need to utilize existing legislation or modify it to increase the severity of punishment through enforcement action is important. Police will publicly enforce the enacted sanction in a highly visible manner. The result of enforcement will then be implemented through arrest, adjudication, and jail time (Apel, 2013). As a result, individuals will then evaluate their risk perception to avoid criminal action based on deterrence through the avoidance of punishment or the avoidance of future punishment due to previous experience. Therefore, upgrading secondary seat belt laws to primary seat belt laws increases the perceived risk of enforcement and certainty of being issued a citation. Typically, secondary laws are limited in their ability to deter. Therefore, violators do not think they will be caught or punished.

One of the critical components of deterrence theory is the severity of punishment. However, punishment alone cannot deter undesired behavior. Sanctions need to be imposed on the violator (Mendes, 2004). Even if strict laws are on the books, if there is no certainty that the violator will receive punishment or that the violator will be caught, these actions are just hollow threats, and they will ignore them. For individuals to comply with laws, law enforcement must cite or apprehend violators; if law enforcement fails to detect and apprehend violators, there will be no convictions or punishments to deter future violations (Nagin, 2013). The combination of relevant actors and parts of the justice system plays an important role in the effectiveness of deterrence. The last aspect of successful punishment, swiftness, is hard to gauge. The criminal justice system can be a burdensome process, and swiftness is often in the eye of the beholder. The use of seat belt punishment, such as receiving a ticket and promptly paying the fine, may add some swiftness and enhance deterrence for seat belt enforcement, which has a distinct advantage over impaired driving laws. Those arrested for DUI can often expect a more extended period of time to have their day in court than seat belt violators, as the DUI laws are more complex and are viewed as a more serious violation (Kirley et al., 2023).

In secondary law states, there is often an opposite reaction by the public and law enforcement to seat belt laws compared to primary-enforced states. Research has found that the public tends to disregard non-primary laws because they lack confidence in being issued a ticket for non-seat belt use (Kirley et al., 2023). Law enforcement officers in secondary enforcement states often hesitate to pull over individuals for primary violations to obtain a secondary violation, such as a seat belt offense (Kirley et al., 2023). Attitudinal surveys that are completed by law enforcement found that they consistently prefer primary laws to secondary laws. This preference often serves as a deterrent to issuing citations (NHTSA, 2008). Since law enforcement will not be as aggressive in enforcing secondary laws, detection or arrest is unlikely. Therefore, violators in this scenario are unlikely to follow the law (Houston & Richardson, 2006). The lack of deterrence experience in secondary states ultimately harms seat belt use. As stated earlier, states with secondary laws tend to enforce them less. Research suggests that primary seat belt laws will have a greater deterrent effect, thereby increasing seat belt usage and decreasing unrestrained fatalities. Deterrence theory plays a strong role in addressing the effectiveness of seat belt laws.

Seat belt laws are not alone in facing specific challenges in their enforcement. Using cell phones while driving poses comparable challenges. Both seat belt and cell phone usage while driving require law enforcement officers to observe the infraction(s). Both of these laws are either primary or secondary in nature and face similar enforcement issues. Research on cell phone use while driving found that enforcement of these laws was critical to deterrence. Enforcement was more likely to occur when laws could be effectively enforced (Rudisill, 2020). Many police officers believed the law's language needed to be revised and clarified to enable them to enforce it effectively. Additionally, officers felt that the laws should be made easier to enforce (Rudisill et al., 2019). Finally, it was discovered that traffic laws with fewer barriers to enforcement were more likely to be enforced by the police (Rudisill, 2020).

Additional studies have examined punishment avoidance, deterrence, defiance, and the influence of informal factors on decision-making (Tomlinson, 2016). The examination of whether deterrence works for some people and not others needs to be considered. As many have studied, some people are not deterrable (Jacobs, 2010). Empirical evidence suggests that legal sanctions have a marginal deterrence effect; it is difficult to understand the impact and deterrence strength of sanctions on the criminal justice system (Paternoster, 2010). Additional findings on deterrence theory suggest that deterrence is a dynamic process in which an individual's perception changes (Truelove et al., 2020). Deterrence theory has provided policymakers with a sound understanding of how to implement enforcement programs and laws for a decade. As with any theory, it may be necessary to revise or revisit the theory to ensure it continues to have an impact on criminal behavior.

General and Specific Deterrence

It is important that enforcement can impact undesired behavior. Often, this can just be the presence of them being visible to the public. There is a need to deter undesired behavior at both the micro and macro levels. These two versions of deterrence are general and specific deterrence. General deterrence seeks to motivate the community through the prescribed punishment, made public through various media, by making law enforcement visible, and by showing that sanctions are in place should one violate a law. These sanctions can include a citation for not wearing a seat belt or an arrest for driving under the influence (DUI). Deterrence is achieved through several means, including enacting laws requiring seat belt use, publicizing, and enforcing those laws, and issuing citations to violators. These are all a part of showing the public the certainty of punishment, which should change behavior through the fear of apprehension when individuals encounter law enforcement.

For deterrence to have the desired effect, the driver must feel that not wearing a seat belt will result in a citation or the accumulation of points on their license. (Kirley et al., 2023). This enforcement activity is accompanied by highly publicized media, including paid and earned media, from community highway safety programs. For the general deterrence effect to occur, public media messages indicating the consequences of not wearing a seat belt must be shown during enforcement. This happens when the public hears and sees the messages to buckle up on signs, TV, and radio. They will then see law enforcement officers enforcing the seat belt law, issuing tickets, or operating in a seat belt enforcement zone. These actions will help reinforce general deterrence. As a result of these interventions, citizens will fear the public shame and stigma associated with being pulled over and issued a citation (Stuster, 2005). Therefore, general deterrence has a broad impact on the community due to a multiplier effect. The more people who see the CIOT advertisement and HVE by the police, the broader the impact, encouraging them to buckle up.

The second type of deterrence is called specific deterrence, which seeks to keep the offender from continuing to violate the law by instilling fear of future punishment and sanctions, such as receiving a ticket or being arrested (Stuster, 2005). Specific deterrence helps to influence those who violate the law. The main difference between specific deterrence and general deterrence is that specific deterrence effect is limited to the offender and those in their immediate circle of friends and family, with a limited impact on the community (NHTSA, 2025a). Those affected by the sanctions and actions may be limited to family and friends, unlike the community-wide reach of general deterrence, which deters individuals from violating a particular law (NHTSA, 2025a).

Previous research has examined the validity of both types of deterrence. One of the impactful studies on general and specific deterrence comes from Stafford and Warr. Their research looks at the reconceptualization of general and specific deterrence. They believed that deterrence was influenced by a combination of personal and vicarious experiences with punishment and its avoidance that affect behavior (Stafford & Warr, 1993). In fact, Stafford and

Warr (1993) believed that both general and specific deterrence could operate in any given environment. For example, a person could be affected by both general and specific deterrence through indirect experiences. They receive exposure from them, either through a ticket at a checkpoint or through specific deterrence. Then they either hear or see it on the news or from a friend at work sharing their experiences, which creates general deterrence (Piquero & Paternoster, 1998).

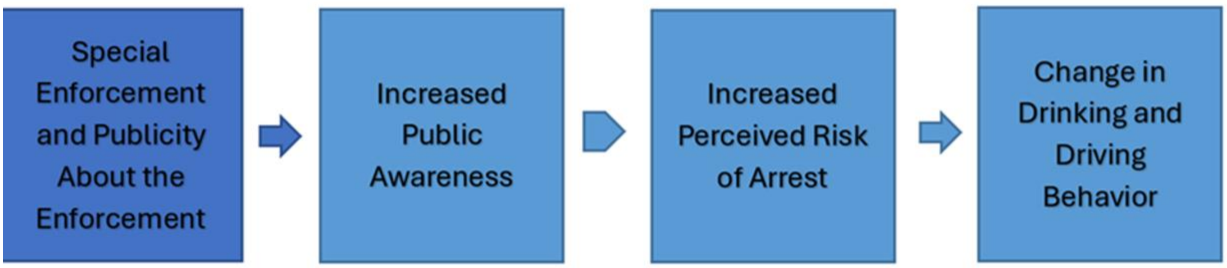
Secondly, an individual may avoid punishment out of deterrence itself, as punishments imposed or avoided may be felt directly through personal experience or indirectly through the experiences of others. (Stafford & Warr, 1993). The final aspect of this research looked at the compatibility of general and specific deterrence with learning theory. General deterrence uses vicarious experiences, while specific deterrence examines how personal experiences affect the subject's perceptions of the threat of punishment for violating the law (Piquero & Paternoster, 1998).

One issue with this conceptualization is that general and specific deterrence have distinct reaches and impacts on individuals and communities (Piquero & Paternoster, 1998). This research went further in examining this question and presented an instance in which general and specific distinctions could be separate. They found that individuals' thoughts about whether to drink and drive were affected by personal and vicarious experiences, and as such, would cause punishment avoidance because of the strong certainty that they would get caught and receive punishment. These experiences could support the need to keep the two theories separate. However, for highway safety enforcement projects, both theories have specific applications.

The NHTSA and its state partners utilize the general deterrence model (see Figure 1). The use of this model attempts to produce an awareness by highlighting the non-desired behavior, especially those involving impaired driving or non-seat belt use, when an individual perceives a risk that is high enough to deter and alter the impaired driving or non-seat belt use through the creation of perceived risk as a result of the intervention of this model (Stuster, 2005).

Figure 1

General Deterrence Model



Note. Adapted from NHTSA (2025a).

The impact of this activity and awareness is often felt by the community, which is motivated to change its behavior in response to what it hears, sees, or reads, leading to positive behavioral change (NHTSA, 2025a). The general deterrence model used by NHTSA begins by targeting a specific violation through special enforcement; this enforcement is publicly announced through paid and earned media, which increases public awareness and perceived risk of arrest, ultimately leading to a change in behavior (NHTSA, 2025a). General deterrence approaches have been used with impaired driving for decades. Jurisdictions around the country have sought to increase apprehension by applying general deterrence strategies to deter impaired drivers (Stuster, 2005). While there are limitations to its use across all enforcement efforts, it has been successful in some cases. It is essential to recognize general deterrence theory, which is often not applied to seat belt enforcement (or emerging issues such as distracted driving enforcement), but it has merit.

Law enforcement uses a variety of tools to deter crime, none more effective than sobriety checkpoints. Sobriety checkpoints are among the most effective general deterrence measures in the United States (Morrison et al., 2023). Sobriety checkpoints aim to reduce impaired driving by increasing the perceived risk of arrest through highly visible, well-publicized, and regularly conducted checkpoints (Kirley et al., 2023). Sobriety checkpoints increase general deterrence through increased awareness, enforcement action, and additional public perception that there is a high probability of detection and apprehension when driving impaired. The apprehension of these offenders should be followed by swift and certain punishment (Ferguson, 2012). Sobriety checkpoints are an effective way to reduce alcohol-impaired driving and crashes and have been found to reduce these crashes by 20% (Ferguson, 2012). This reduction is an important aspect, as seat belt zones and seat belt checkpoints use similar deployment methods. These reductions suggest that employing these types of law enforcement operations would have a similar impact on seat belt usage and unrestrained fatalities.

Additional innovative strategies are necessary to achieve both general and specific deterrence, reaching those who ignore that this can happen to them. One such strategy that has had an impact in Australia is the use of Roadside Breath Testing (RBT) laws. In Australia, the use of roadside breath testing (RBT) laws has been one such innovative countermeasure that addresses both general and specific deterrence. It was found that mobile RBTs, where drivers are stopped in a vehicle, typically at checkpoints, had a more specific impact on drunk drivers, with a specific deterrent effect. As motorists passed through these RBT checkpoints, they witnessed the enforcement activity firsthand, which led to a general deterrence effect.

When incorporating media alerts alongside enforcement, general deterrence was able to impact a greater portion of the community (Terer & Brown, 2014). As with checkpoints, the primary goal of RBTs is to deter impaired driving through general deterrence, and detection is a secondary aim. This results in perceived risk increasing apprehension and, as a result, the offender is deterred (Terer & Brown, 2014). Research studied the relationship between Western Australia's RBT programs and traffic enforcement outcomes. It found that Western Australia's RBT program was effective in providing general deterrence and in combating DUI through its enforcement efforts (Parmar et al., 2020).

Additionally, the Western Australia RBT program was found to have the most significant reduction in alcohol-related traffic crashes (Parmar et al., 2020). The use of RBTs has shown promise in impacting impaired driving and contributing to both general and specific deterrence. This approach has shown that when the public perceives certainty and punishment for failing to comply with established laws, it is more likely to comply. However, incorporating them into U.S. law might be challenging, as many states do not allow sobriety checkpoints.

Most research conducted on seat belt laws has focused heavily on comparing primary and secondary laws. They often examine the outcomes of each law on seat belt use and unrestrained fatalities. Research has shown that primary seat belt laws result in higher seat belt use than secondary seat belt laws (NCSA, 2020). Over a quarter of states still lack primary seat belt laws. Understanding the impact of these laws on crash data is critical information that policymakers can use to develop or update current laws. The need for primary seat belt laws, as well as other sanctions and programs, is crucial for increasing deterrence and impacting the behavior of non-users. This includes examining the effective seat belt enforcement strategies used by states that have achieved positive results in seat belt use and unrestrained fatality rates. Both general and specific deterrence effects impact those who encounter law enforcement directly or indirectly through their presence. Both general and specific deterrence lead to the changes necessary to reduce crashes, injuries, and fatalities on the nation's roadways.

Social Learning Theory

Seat belt use is a learned habit formed from consistent use. It is important to learn how to adopt and retain habits. Social learning theory posits that learning occurs through social interactions. This learning happens through observation and imitation. This is often from someone considered significant or influential, and is reinforced through rewards or punishments (Akers, 1973; Bandura, 1977). Seat belt use is a learned behavior that, through differential association, begins at a young age, follows a life cycle, and becomes a developing habit influenced by family, friends, peers, and society (Beck et al., 2019; Litt et al., 2014).

Seat belt use can be influenced in many ways by social learning theory, such as through definitions that shape one's beliefs and attitudes. Seat belt use can be influenced through rewards and punishments (differential reinforcement). This can occur when individuals receive a citation or are rewarded for buckling up with a coupon; it can influence future use (Akers, 1973; Bandura, 1977). Consistent with social learning theory, research found that passenger seat belt habits are influenced by the driver's seat belt habits (Beck et al., 2019). Social learning theory explains how definitions and differential association influence seat belt habits, driver model norms, and the norms that passengers adopt (And et al., 1983). Social learning theory applies well to other traffic safety behaviors, such as speeding, distracted driving, and impaired driving, which are influenced by definitions, differential association, and imitation and modeling (Tontodonato & Drinkard, 2020).

However, individuals often undervalue long-term safety relative to short-term convenience, due to the hassles of buckling up (Kahneman & Tversky, 2013; Malekpour et al., 2021). Seat belt use is influenced by peers, family, or friends, who impact individuals' habits (Malekpour et al., 2021). When seat belt use serves as a positive role model, and norms are present, it leads to increased seat belt use. This differential association is illustrated when children imitate their parents' seat belt use (Maron et al., 1986).

When considering other theories and their impact on social learning theory, they are crucial for understanding the effects of contextual and situational variables on usage (Ajzen, 1991; Litt et al., 2014). According to social learning theory, individuals who receive positive modeling of seat belt use reduce the influence of fatalistic beliefs by showing that seat belt use is both common and effective (Rimal & Real, 2003). An example of this is consistent seat belt use by influential family members or friends. When influential individuals fail to model seat belt use correctly, they only reinforce these attitudes towards its use (Esparza-Del Villar et al., 2015).

When a passenger of a vehicle witnesses a family member being pulled over and receiving a citation for not wearing a seat belt, social learning theory allows the passenger to mimic the behavior to a preventive one to avoid punishment (Stafford & Warr, 1993). Social learning theory aligns with the punishment-avoidance approach, which supports deterrence (Stafford & Warr, 1993). Social learning theory, along with other theories, supports this research by explaining how individuals learn habits and how learned behaviors, such as seat belt use, are acquired through differential association, definitions, differential reinforcement, imitation, and modeling.

Fatalism Theory

It is important to gather beliefs that individuals might have about their seat belt use. Fatalism is a vital theory for gathering information to design effective strategies to combat unrestrained fatalities. Fatalism is an outlook that holds that external forces control events and that humans are powerless to influence them (Joshanloo, 2022). Fatalistic beliefs are found across many groups, including older age groups, lower levels of education, and lower economic status (Kayani et al., 2012).

Many individuals who are in lower education, lower economic, less developed, and rural areas often hold fatalistic beliefs, and their failure to wear a seat belt may be influenced by fatalism, the belief that all events are predetermined and inevitable (Özkan & Lajunen, 2005). Individuals who consider themselves at the bottom of the economic class tend to be more fatalistic (Ruiu, 2013). From a fatalistic viewpoint, many see the conclusions people draw as governed by fate, destiny, or external forces rather than by personal choice or behavior (Ajzen, 2002; Kayani et al., 2012). Beliefs reduce perceived behavioral control, weakening motivation to comply with safety laws (Nordfjærn et al., 2011).

For example, in traffic safety research, individuals in motor vehicle crashes with fatalistic beliefs may think, "If it is my fate to have an accident, it will happen no matter how I drive." Such beliefs can reduce motivation to engage in preventive or cautious behavior (Nordfjærn & Rundmo, 2010). This reflects low self-efficacy (Ajzen, 2002; Ruiu, 2013). Often, when people are in crashes and hold fatalistic beliefs, they rationalize adverse events in their lives to overcome their grief, accept the outcome, and also use post-crash justification to avoid responsibility (Kayani et al., 2012). This acceptance may lead a person to engage in risky driving and to rationalize past crashes, thereby normalizing future dangerous behavior (Kayani et al., 2012).

Research suggests that it is critical to understand that they often view the beliefs of non-seat belt users as invincible (Sullman & Dorn, 2019). This group believes they are skilled drivers, invincible, and need to be protected from other drivers (Kouabenan, 2007). They often fail to admit that they are the driver who makes poor decisions behind the wheel (Kouabenan, 2007). Understanding what motivates non-seat belt users will support the critical need to buckle up and to implement effective interventions and laws (Girasek, 2001; Sullman & Dorn, 2019). As fatalism and social learning theories intersect, they show how each theory affects the other. It explains how fatalistic beliefs can be transmitted through observing behavior in group interactions, and how deterrence can affect environments that challenge fatalistic norms (Akers, 1990). While fatalism explains how one's beliefs are interconnected with certain environmental factors, social learning theory describes how beliefs are either adopted or influenced through group interactions (Kayani et al., 2012). If the behavior is consistently modeled within the community, this can eventually weaken fatalistic attitudes towards safety behavior (Akers, 1990; Kouabenan, 2007).

Research indicates that individuals in lower socioeconomic groups may view traffic safety more fatalistically, invest less in preventive behaviors, and model parental behaviors characterized by low seat belt use (Becker, 2007; Girasek, 2001; Shin et al., 1999). Fatalism can be culturally transmitted from one generation to the next (Ruiu, 2013). These belief systems can reduce perceived control and weaken motivation to engage in traffic safety behaviors such as buckling up (Kouabenan, 2007). However, evidence also shows that individuals from lower socioeconomic groups respond strongly to primary seat belt laws. When these individuals perceive enforcement as certain and the citation as a sanction, primary laws significantly increase seat belt use and reduce socioeconomic disparities by approximately 15-25 percentage points (Harper et al., 2014).

Research shown in this section has been clear that seat belt use can be affected by fatalism (Kayani et al., 2012; Özkan & Lajunen, 2005). There is a need for a better understanding of the causes of fatalistic belief formation, which may be crucial for a policymaker. Policymakers must find ways to incorporate model seat belt laws and programs like HVE to ensure consistent enforcement. This study will use fatalism, along with other theories, to help determine the impact of fatalistic beliefs on seat belt use.

Behavioral Economics

Getting everyone to use their seat belt cannot be a one-size-fits-all solution. People are motivated by all sorts of things. Looking for solutions to seat belt use will need to factor in behavioral economics, the study of why people make decisions, which combines insights from psychology, economics, and neuroscience to understand why people make decisions (Thaler & Sunstein, 2009). Behavioral economics informs targeted psychological interventions to help reduce unrestrained fatalities and the associated economic losses. As previously stated, Ohio had experienced greater economic losses alongside rural disparities. Ohio experiences less deterrence as a result of its secondary law, making seat belt use a short-term issue rather than culturally or economically impactful (Byrd et al., 1999). Crash fatalities, by themselves, do not offer persuasion to use a seat belt (Sullman & Dorn, 2019; Thaler & Sunstein, 2009).

Other factors can influence compliance with safety laws (Thaler & Sunstein, 2009). As previously discussed, deterrence offers society a choice: either buckle up, or you will get pulled over and ticketed. The difference is that deterrence focuses on external punishment, while behavioral economics focuses on internal cognitive processes and biases. However, that alone is not enough to change behavior; many competing factors explain why its citizens choose not to buckle up (Sullman & Dorn, 2019; Thaler & Sunstein, 2009). While changing secondary laws to primary is the goal of lawmakers. They need to do research and find data and information that supports this change such as presenting economic factors influencing one's decision to wear a belt, along with the costs borne by society (medical expenses, higher insurance premiums, loss of life) if the public (including policymakers) is informed that the unexpected loss and associated economic costs will influence whether such a law might be accepted (Dardis, 1983).

Research indicates that, to impact communities at risk without protective laws, they must influence their beliefs and equate the costs and the lives potentially saved by adopting such laws. Consumer risk can be influenced by the degree of protection this intervention (law) provides, in the form of reduced taxes, insurance, and medical costs, upon its implementation and when consumers are well-informed, which would equate to some media campaign (Dardis, 1983; Elder et al., 2004).

Different alternatives to encourage seat belt use need to be investigated. The use of behavioral nudges can help reach resistant seat belt users. Behavioral nudges might take the form of a message like "Most people buckle up," or a seat belt ignition interlock that alerts them to buckle up. These nudges align with social learning theory. Nudges help to model peer conformity and differential reinforcement, which help change seat belt behavior (Zadka-Peer & Rosenbloom, 2024). Behavioral nudges help reach those who want the freedom to choose whether to buckle up. Nudges aimed at traffic safety could make roadways safer through non-mandated laws or programs. Instead, the behavioral nudge could take the form of warning signs, feedback, and reminders to target safe behaviors (Zadka-Peer & Rosenbloom, 2024).

Often, individuals might have issues buckling up, such as in winter with large coats, or when I am just going down the street to get a loaf of bread (habit and friction cost bias). Behavioral nudges, such as seat belt ignition interlocks, can effectively remind us to buckle up. Behavioral nudges are important to traffic safety as they help build successful habits through repetition (hearing the seat belt interlock remind them to buckle up), creating successful norms (especially helpful in rural areas to break through the cultural barriers), and impact long term cultural shifts (changing it was always done this way and we do not need change).

Unfortunately, society needs many different types of interventions to achieve compliance with specific laws (Elder et al., 2004). The need for seat belt interventions stems from behavioral biases (present bias) that seem to contradict common sense, such as failing to wear a seat belt as a short-term inconvenience and overlooking long-term benefits (staying alive, reducing economic costs, etc.) (Thaler & Sunstein, 2009). Cost-benefit analysis can influence many people's positive behaviors related to traffic safety (Thaler & Sunstein, 2009). Incentives could be an economic factor that could help some buckle up. Research has found that education, personalized tips, and planning exercises without incentives did not significantly increase buckling up. While giving money directly toward buckling up might be cost-prohibitive, adding an insurance-based incentive or reducing another cost might be persuasive and could encourage restrained use (Thaler & Sunstein, 2009).

In rural areas, the population is usually composed of lower-income residents, who are influenced by a reduced focus on long-term risks (status quo bias). The residents live for the day (optimism bias) rather than worrying about the repercussions of not using a seat belt, thinking either "I am a good driver" or "it will not happen to me" (affect heuristic and optimism biases) (Thaler & Sunstein, 2009). Rural residents tend to have lower levels of education, which muddles their understanding of risk. This lack of comprehension affects their understanding of crash probabilities and cost implications (Byrd et al., 1999). There are broad, systematic disparities in many aspects of their daily lives, from reliable transportation to community infrastructure and access to healthcare (Byrd et al., 1999). Adding behavioral nudges, which create a choice structure that alters people's behavior predictably without forbidding any options or significantly changing their economic incentives, can encourage safer behavior, such as buckling up (Thaler & Sunstein, 2009).

This research suggests that behavioral nudges should be integrated with seat belt efforts and community-based safety programs to improve seat belt use (Elder et al., 2004; NCSA, 2025a). This alternative solution would be helpful to policymakers, as governments can use behavioral nudges to improve outcomes in health, finance, and the environment without restricting freedom (Thaler & Sunstein, 2009). Behavioral economics will be incorporated into this study to help understand what alternative methods other than changing a law from secondary to primary might look like.

Social Vulnerability Index (SVI)

Understanding why people buckle up and what influences their decisions is important. The use of SVI overlay data is a relatively new method for measuring the link between social vulnerability and traffic-safety fatalities (Kasha et al., 2025). Social vulnerability provides us insight into an individual or community's susceptibility to harm and to the influence of inequities in resources, opportunities, and social conditions (Cutter, 2024). The SVI was developed by the CDC, which uses 15 census variables grouped into four themes, to rank communities from least to most vulnerable (Cutter, 2024). FARS fatality data at the county level is then linked with SVI data, where crash victims are found to be overrepresented and from underserved groups (Kasha et al., 2025). Policymakers have recently been looking at SVI indices as factors that provide percentile ranks from the least vulnerable to the most vulnerable counties at risk of involvement in fatal crashes. Research has found that high social vulnerability is associated with greater adverse outcomes (Cutter, 2024).

Social indicators have been used since the 1960s; their primary role in natural disasters has been incorporated into indices such as health, education, public safety, standard of living, and leisure time (Cutter, 2024). While very little research is being conducted specifically in the field of traffic safety with SVI, the CDC has conducted some studies on pedestrian injuries and fatalities. The Georgia Governor's Office of Highway Safety (GOHS) uses this information to create a cluster heat map to identify areas of risk within the state (Georgia Crash Outcomes Data Evaluation System, 2023). This information provides a quantitative analysis of how communities are disproportionately socially vulnerable to traffic-safety-related issues. Recent research found that motor vehicle crashes were strongly associated with the racial and minority theme, while suburban and rural areas were strongly associated with the socioeconomic status theme (Kasha et al., 2025).

Many policymakers, especially those in the traffic safety discipline, do not widely use SVI data alongside crash data to examine issues such as seat belt use. This gap in the research is evident, as there is limited research implementing SVI data with seat belt analysis. Seat belt use is often lower among vulnerable populations. Sociodemographic groups, especially those from vulnerable populations, are most at risk for lower seat belt use (Beck et al., 2007). The use of SVI data and spatial mapping could provide policymakers with valuable insights into implementing traffic safety programs in at-risk communities. This research will use SVI-overlaid data to compare the impact of unrestrained seat belt use across various predictors in Illinois and Ohio. This analysis will provide data to show if there is a link between seat belt use and how it may influence both less vulnerable and highly vulnerable counties.

COVID-19 Pandemic Impact

One limitation on highway safety research and literature recently stemmed from the COVID-19 pandemic lockdowns. During the pandemic, Americans drove less. However, fatalities saw the most significant increase since 2007 at almost 39,000 fatalities (NCSA, 2020). The NHTSA found that risky behavior was a leading cause contributing to this increase in fatalities (Office of Behavioral Safety Research [OBSR], 2021). This increase in fatalities was a contribution of associated lockdowns, driving patterns and behaviors changed significantly, and drivers who remained on the roads engaged in more risky behaviors, including speeding, failing to wear seat belts, and driving under the influence of drugs or alcohol (OBSR, 2021).

The pandemic altered driver behavior due to living under these conditions. Data indicate that average speeds increased, while extreme speeds became more prevalent, and fewer people wore their seat belts (NCSA, 2022). Research found that people self-reported decreasing their speed during this period; however, objective data obtained from phone apps and other sources revealed that, in fact, driving speed and extreme speeding increased (Miller, 2021). Research also indicated that increased phone use under harsh acceleration and braking events occurred more frequently (Miller, 2021).

During the pandemic, highway safety research slowed down tremendously. Many agencies that once conducted surveys and research closed their doors. This lack of data collection and research was a result of the lockdowns and the inability to collect the data in person. The lockdown also affected data collection from the state highway safety office, who conduct the annual seat belt surveys. Some states chose to waive conducting their annual survey in 2020 and 2021 (NHTSA, 2025d). This lack of data collection left a hole in the consistency of future research that will need to be addressed in seat belt surveys. In 2022, states resumed seat belt survey collection. The data collected will provide clues into the impact of seat belt use during the pandemic.

Synthesis and Gaps

After reviewing the literature in this field of research, gaps were identified. The following are gaps that could help improve this topic and future research by providing a more robust review. One such area where a gap was identified was the motivation of at-risk populations to buckle up. Gathering this data and adding it to the research used in the field of traffic safety would be invaluable. Additional research is needed to examine the relationship between beliefs and behavior, and to identify interventions that may improve seat belt use.

This study found that prior research focused solely on how sociodemographic factors influence seat belt use in primary and secondary enforcement states (Sartin et al., 2023). Prior research has also, evaluated the relative effectiveness of primary versus secondary seat belt enforcement laws by comparing their impact on seat belt use rates, crash-related injuries, and fatalities across different jurisdictions (Rivara et al., 1999). Lastly, prior studies have only explored how socioeconomic and sociodemographic factors relate to community-level resiliency (Beck et al., 2007). Additionally, gaps were found that seat belt surveys provide a daytime snapshot but do not address nighttime issues, leaving a broad section of the population out. This population is among the most at-risk, and it is important to gather and research this information.

This study contributes to the field of traffic safety by comparing neighboring states that differ in enforcement type but share similar regional demographic and economic characteristics. One of the unique aspects of their study is that it integrates the Social Vulnerability Indicators (SVI) data from the CDC by combining SVI and county-level crash data using multiple-predictor variables from traffic crashes.

Chapter Summary

This chapter reviewed literature and research on seat belt use from different types of laws (primary and secondary). This research focused on enforcement efforts to address seat belt use, group behavior, and multiple theories to understand why people do not buckle up and what works to change this behavior. The key findings in this research show that there continues to be a need to address unrestrained fatalities, especially when in high-risk or vulnerable groups and communities.

Seat belt laws help improve public health and serve as a policy tool for developing policies and programs. In the United States, there has been a progression of adoption of seat belt laws. Since the first enactment in 1968, the requirement to wear seat belts has transformed. The laws have gone from requiring a seat belt to be in a vehicle to allowing specific enforcement (secondary and primary laws). Primary laws can issue a citation just on the violation, while secondary laws need a primary offense before a citation can be issued. Secondary laws are at a distinct disadvantage for several reasons.

One notable disadvantage is that law enforcement is reluctant to pull over individuals. Law enforcement may view this pullover as unimportant or too difficult to address. If the law were important, they would have made it easy to implement. Other programs, such as HVE campaigns like CIOT, have contributed to increased seat belt use. Media and awareness have contributed to the enforcement of implementing general and specific deterrence to impact non-use.

The research pointed to various groups that were often overrepresented in unrestrained fatalities. It was found that younger males, individuals who speed, drink, smoke, live in rural areas, are pickup drivers, or are of a lower socioeconomic status. Many of these studies state that habits, environment, risk-taking, and social context impact seat belt use. The literature in these areas of study needs more research on the motivation and beliefs of these at-risk populations.

Research found that theories and economic factors help explain the motivation, beliefs, and social norms that affect seat belt use. The use of deterrence theory in traffic safety has been in place for decades, and it fits well, as individuals must know that enforcement will be specific. If they fail to buckle up, there will be sanctions (punishment) in the form of a citation for non-compliance and swiftness in adjudication. Social learning theory has been important in establishing how habits are learned over a lifetime, including seat belt use. They can be influenced by fatalistic beliefs (fatalism theory) to give up on using a seat belt because it is inevitable that they will die one way or another.

These theories often intersect and can be linked. This linkage can be positive or negative for seat belt use. Seat belt use is not a one-size-fits-all problem; behavioral economics can explore ways to increase compliance through cognitive persuasion. Examining biases that affect non-use behavioral nudges can help achieve voluntary compliance through various means. These can be as simple as a seat belt interlock device that reminds you to buckle up. The behaviors make great examples since they rely on freedom of choice, which the country significantly influences.

Research has shown that SVI is linked to social vulnerability and is a powerful tool for identifying locations. These locations can provide information on groups that are underserved and overrepresented in unrestrained fatalities. Studies found that there has been minimal research conducted on SVI and traffic safety. SVI has a clear gap in the literature that this study aims to address.

The COVID-19 pandemic greatly impacted traffic safety. This data from the pandemic has gradually emerged in the research, highlighting that holes may exist and examining how risky behaviors contributed to some of the most significant spikes in unrestrained fatalities. There will be limitations and gaps in the literature due to reduced data collection.

This research has identified some gaps in this type of research on seat belt use. There needs to be further studies that address how motivation and beliefs impact seat belt use. This key ingredient can help forge new strategies for selecting and delivering effective programs. Behavioral economics research will be important, especially in showing the impact on economic costs in insurance, healthcare, and taxes that affect just about everyone in society. Alternative solutions to address seat belt use would allow policymakers to demonstrate real-life impacts to promote seat belt use.

Understanding how communities interact with different behavioral nudges could lead to more effective nudges. These nudges could then help people voluntarily change. Using norm-based advertising and addressing issues specific to the particular population or environment will go a long way toward boosting seat belt use. SVI research and its application to seat belt use are critical; currently, this research is among the few studies addressing both issues.

Secondary versus primary environments will definitely benefit from the additional research on these particular topics examined. Innovation and the use of non-traditional methods such as SVI, behavioral nudges, social economics, and other behavior-based countermeasures are needed to make inroads with this last group of non-users, who are among the most difficult to persuade. This next chapter will outline the methodology for assessing the impacts of law types on social, situational, and demographic contexts and for overlaying SVI data. The focus will lead to the effects of seat belt use in vulnerable and non-vulnerable locations. Finding the motivation and identifying the areas to focus on to change seat belt behavior.

Chapter III

Method

The main purpose of this research was to conduct a data analysis on seat belt use and awareness of seat belt enforcement in a state with a primary seat belt law (Illinois) and a state with a secondary seat belt law (Ohio). The study investigated the influence that the independent variable had on the dependent variables, including restrained and unrestrained fatalities, daytime observed seat belt usage, and economic costs associated with unrestrained use. The research used the following analysis to assess the impact of state laws on seat belt use: descriptive comparison (using normalized data) of control variables (age group, gender, occupant roles, time of day, rural and urban areas, season, and vehicle type) against the dependent variables, inferential statistics (χ^2, *t* tests, and logistic regression), overlaying Social Vulnerability Index (SVI) data, and economic calculations. The study analyzed data collected from attitudinal awareness surveys gauging the public's perception of seat belt enforcement in both states. Conducting this analysis provided additional insight into the impact of seat belt laws, specifically in Illinois and Ohio. This analysis examined secondary data from the NHTSA's National Center for Statistical Analysis (NCSA), the Centers for Disease Control and Prevention (CDC), the Federal Highway Administration (FHWA), and Illinois and Ohio (see Appendix A).

This research compared two states by varying the law types (primary and secondary). The selection process considered several factors in choosing the two states. This criterion included similar population counts, with one state having a primary seat belt law and one state having a secondary seat belt law, both states conducting seat belt surveys, and a ten-year data period

(2014-2023). The selected states must have conducted attitudinal awareness surveys. These surveys determined the effects of deterrence on the public by measuring awareness of seat belt enforcement and citizens' perceptions of enforcement in the states. Illinois and Ohio were selected based on meeting the established requirements. Illinois has a primary seat belt law, while Ohio has a secondary seat belt law. The selection process took other factors into account; both Illinois and Ohio have similar rural and urban settings, comparable demographics, and are within the same geographic area (the Midwest) and climate zones.

There was no perfect match between the two states in demographics. Additionally, seat belt surveys provide a daytime snapshot of seat belt use and do not address nighttime issues related to it. Finally, awareness surveys have an inherent potential for bias as individuals enter information without any separate verification, which is often the case with self-reported data (Remler & Van Ryzin, 2011). While the selection of these two particular states was based on the aforementioned criteria, this study has some limitations.

Variables of Interest

This research looked at the independent variable (Illinois' primary seat belt law and Ohio's secondary seat belt law) by comparing the dependent variables of seat belt usage, unrestrained passenger vehicle occupant-related fatality rates (normalized by vehicle miles traveled), attitudinal awareness surveys related to seat belt use and perceived enforcement, SVI data associated with unrestrained passenger vehicle occupant-related fatality by quartile, and economic costs for unrestrained passenger vehicle occupant-related fatalities. This research controlled for the following variables: age group, gender, occupant role, rural and urban areas, time of day, season, vehicle type, and year.

Independent Variables

The two independent variables examined in this analysis are Illinois' primary seat belt law and Ohio's secondary seat belt law. To determine the effect of the cause (independent variable) on specifically selected measurable dependent variables, the researcher operationalized the data in the section below.

Dependent Variables

The dependent variables measured the effect of the independent variable. This information was derived from secondary statistical data extracted from the NHTSA Fatality Analysis Reporting System (FARS), utilizing the Fatality and Injury Reporting System Tool (FIRST), and state attitudinal awareness surveys from Illinois and Ohio. Economic cost data were drawn from NHTSA and were obtained from the CDC SVI. The dependent variables produced direct measurable outcomes through the following statistical analyses. The outcomes included fatality rates, odds of being unrestrained, SVI-based risk differences, observational compliance rates, and survey-based attitudinal indicators. The dependent variables included an observational daytime seat belt survey, the unrestrained passenger vehicle occupant-related fatality rate per 100 million vehicle miles traveled (MVMT), attitudinal awareness surveys, economic costs associated with non-seat belt use, and overlaying SVI data.

Observational Daytime Seat Belt Survey

This variable was captured and measured through seat belt use in both Illinois and Ohio. On an annual basis, all states in the United States conduct seat belt surveys to receive highway safety funds from the federal government. This study collected data from seat belt surveys conducted in Illinois and Ohio for the calendar years 2015-2024. A calculation of Illinois' and

Ohio's seat belt use means examined the average usage during the analyzed period and seat belt usage trends over the ten years between the two states.

Unrestrained Passenger Vehicle Occupant-Related Fatality Per 100 MVMT Rate

This variable captured and measured seat belt usage among individuals who die in motor vehicle crashes on Illinois and Ohio roadways during the calendar years 2014-2023. This variable showed those who were not wearing a seat belt at the time of their death. Data from Illinois and Ohio on unrestrained fatalities were normalized to conduct a descriptive analysis using a per-100-MVMT rate. The researcher collected normalization data from 2014 to 2023, and the mean values were compared between the two states, providing the differences over this period.

This study conducted inferential statistical tests over the same period (2014-2023). The study compared the likelihood of being unrestrained between the two states, with the analyses weighted by the number of fatalities. The *t* test showed whether there were statistically significant differences in restrained and unrestrained use between Illinois and Ohio. The study used a logistic regression model to show, for each coefficient, the shift in the odds of being unrestrained in Illinois relative to Ohio. A positive value indicates higher odds, while a negative value indicates lower odds. This multivariable logistic regression analysis provides a direct way to quantify the combined effects of differences in seat belt laws and subgroup characteristics. By doing this, it extends the analysis beyond the one-variable contrasts.

Attitudinal Seat Belt Awareness Survey Results

This study utilized information from attitudinal awareness surveys conducted in Illinois and Ohio in 2016. These attitudinal awareness surveys are the most recent surveys available by the two states, as many states, including both Illinois and Ohio, have since stopped conducting them. These surveys examine multiple variables derived from survey questions and compare them descriptively. The surveys specifically examine the public's perceptions of seat belt laws and enforcement in their respective states. The survey specifically examines perceptions of enforcement, the visibility of Click It or Ticket (CIOT), understanding of seat belt law types, and awareness of enforcement messages. The Ohio Department of Public Safety and the Illinois Department of Transportation completed these surveys, and they are secondary state data.

Economic Costs Associated with Unrestrained Fatalities

This study translated fatality counts into economic losses to show the broader impact on states and communities. A descriptive analysis revealed the combined impact of unrestrained fatalities in Illinois and Ohio in 2023, along with their associated economic costs. The costs were based on an estimated economic cost method using NHTSA's value of $1.7 million per fatality inflation-adjusted from 2019 (Blincoe et al., 2023). The costs showed the potential benefits of implementing cost-selected seat belt interventions (see Appendix C).

Control Variables

This study focused on adjustments based on person-level and crash-level characteristics, including gender (male or female), age group, occupant role (driver or passenger), time of day (day or night), rural versus urban roadway, and vehicle type. The initial analysis was descriptive of the relationship between these predictor variables and the dependent variable of unrestrained passenger vehicle occupant-related fatalities, which were normalized by VMTs. The proxy was the proportion of unrestrained passenger vehicle occupant fatalities-related fatality per vehicle miles traveled (VMT) to normalize rates for exposure. This comparison was across the two states and years (2013-2024).

As indicated earlier in this section, the study conducted inferential statistical testing, including *t* tests and logistic regression, to determine the likelihood of being unrestrained across the two states and to show the shift in odds of being unrestrained in Illinois relative to Ohio for each coefficient. This multivariable logistic regression analysis provides a direct way to quantify the combined effects of differences in seat belt laws and these subgroup characteristics.

SVI Categories to Compare to Outcome Variables

This study examined the relationships among seat belt use, social vulnerability, and crash outcomes by comparing descriptive data on fatalities in Illinois and Ohio. This study examined how unrestrained use is distributed across SVI quartiles while accounting for key predictor variables. This analysis created a descriptive baseline design that provides important context for understanding whether higher social vulnerability corresponds to elevated unrestrained use.

The study assessed the significance of relationships between restraint use and key predictors; the researcher conducted a χ^2 test of independence separately for Illinois and Ohio. These analyses evaluated whether differences in restraint use are thoroughly associated with demographic (male and female, driver and passenger), situational (day and night, rural and urban, seasons), and crash-related factors (vehicle type). The results provided a better understanding of which variables demonstrate meaningful associations with seat belt unrestrained usage across the two states. Additionally, this research included Cramer's *V* as a measurement. Cramer's *V* is a measure of the association between two categorical variables.

The study used a logistic regression model to look at how states' seat belt laws influence unrestrained use across demographic and situational subgroups by overlaying SVI. The SVI is a composite measure of county-level socioeconomic and structural disadvantage, with traffic crash data (CDC/ Agency for Toxic Substances and Disease Registry [ATSDR], 2014, 2022). Adding these factors to this research helps further shape restraint outcomes to understand the effect of unrestrained use on the socially vulnerable. The models evaluated whether occupants in the most vulnerable counties (Q4) face elevated odds of being unrestrained in fatal crashes. Then the model compared those results to the least variable counties (Q1). This analysis allowed the identification of differences that emerge or increase over time, linking seat belt use to broader social factors that influence health. In doing so, the SVI logistic regression models extend the individual-level analysis by showing how state policy, demographic risk, and community context intersect to shape non-seat belt use.

Hypotheses

These research questions explore whether a primary seat belt law in Illinois has had an impact on seat belt usage, unrestrained passenger vehicle occupant-related fatalities, and economic costs, across the control variables, associated with non-seat belt use compared to a secondary seat belt law in Ohio.

1. Passenger vehicle occupants will have a lower share of being unrestrained in a fatal crash across all subgroups (male vs. female, driver vs. passenger, rural vs. urban, day vs. night, seasons, and vehicle types) in Illinois than those in Ohio due to Illinois' primary law. If this is true, primary seat belt enforcement may be more effective in increasing seat belt use and decreasing unrestrained fatalities across all subgroups.
2. Passenger vehicle occupants will have lower odds of being unrestrained in a fatal crash in Illinois than in Ohio when controlling for situational and demographic factors. If this is true, it may indicate that primary enforcement increases seat belt compliance even accounting for predictor variables.

3. Passenger vehicle occupants will have lower unrestrained fatality in crashes when factoring in contextual and environmental factors, such as nighttime, rural and urban roadways, seasons, and vehicle types, in Illinois compared to Ohio. If this is true, it may indicate that the type of enforcement can influence seat use behavior, even when considering contextual and environmental factors.
4. Passenger vehicle occupants in counties with higher social vulnerability (SVI Q4) will show significantly higher unrestrained use in fatal crashes compared to those in lower vulnerability counties (SVI Q1). These SVI disparities will interact with passenger vehicle occupant subgroups and state enforcement policies, resulting in larger differences in Ohio than in Illinois. If this is true, it may indicate that enforcement type and social influences can affect the seat belt use of vulnerable populations.

Data Analysis Plan

Several analyses were employed to examine the four hypotheses of this research. The analysis followed the data analysis plan. This study analysis consisted of four distinct analyses examining factors that affect seat belt usage.

The first portion of this analysis focused on the individual-level and crash-level analysis which focused on seat belt usage (percentages), unrestrained fatality rates (VMT normalized), subgroup differences (gender, occupant roles, age group, rural and urban roadways, time of day, season, and vehicle type), *t* tests, logistic regression analysis, and as a result comparison between primary and secondary laws (2014-2024)(see Appendix B).

The second portion conducted a comparative descriptive analysis of the two states using their seat belt survey data (2015-2024). Attitudinal survey comparative analysis of their most recent attitudinal awareness survey (2016), the analysis looked at the following information: seat belt survey comparisons, attitudinal awareness (perceived risk to receive a ticket, seeing police presence, seat belt effectiveness, and support for the seat belt law), and cross-state comparison of public perception.

In the third part of this analysis, the study conducted a community-level social vulnerability analysis, which included a descriptive analysis comparing SVI quartiles (Q1-Q4), χ^2, differences in unrestrained usage across vulnerability levels, logistic regression including SVI interactions, and State x SVI x Year analysis (2014, 2022). The fourth and final section of this study conducted an economic impact analysis, looking at the economic costs of non-seat belt use, comparing costs between Illinois and Ohio, and linking these costs to unrestrained fatality and crash outcomes (2023).

Institutional Review Board

This study has been exempted from full IRB review, as it evaluated publicly released secondary data and did not contain any sensitive information. The study limited the data review to the state level and will not include any personal identifiers (see Appendix D).

Chapter Summary

This chapter's purpose is to describe the study's research methodology, including the design, data, and methods. This study used quantitative secondary data analysis to examine differences between two seat belt law types (Illinois and Ohio). The study used data from the NHTSA FARS/FIRST, daytime seat belt observation surveys, attitudinal awareness survey data, CDC SVI, and NHTSA economic cost data. The study used this data and the following analytic techniques to draw various statistical conclusions, descriptive statistics, χ^2, *t* tests, logistic regression, SVI comparisons, and economic cost calculations. Chapter 4 presents the results from Chapter 3, providing the reader with the findings.

Chapter IV

Results and Analysis

The purpose of this chapter is to present the results of the analysis, which looked at the relationship of unrestrained usage in fatal passenger vehicle crashes across Ohio and Illinois from 2014 through 2023. Incorporating the methodological section plan in Chapter 3, the results provide insight into how individual, contextual, and policy-level variables influence the likelihood of being unrestrained in passenger vehicles at the time of a fatal crash. Given the different enforcement laws between Ohio (secondary) and Illinois (primary), these analyses are designed to capture both broad trends and state-specific variations in unrestrained use.

Seat belt use is among the most effective protections against fatal injuries in motor vehicle crashes (Acosta-Rodriguez et al., 2020). Unrestrained seat belt use varies across predictor variables. This analysis looks at Ohio and Illinois from 2014 to 2023, using fatality data normalized by vehicle miles traveled (VMT) to account for exposure differences. The year effects are included to control for broad, time-specific influences that affect both states. Individual and crash-level factors are incorporated to adjust for differences in who is involved in crashes and under what conditions. Standard errors were adjusted for reliable inference but are not clustered in the baseline models.

In addition, the analysis incorporated the Social Vulnerability Index (SVI) by overlaying it with 2014 and 2022 county-level crash data to provide contextual background on how community-level vulnerability relates to unrestrained seat belt use in fatal crashes. Standard errors for the SVI models are clustered at the county level to account for shared conditions within counties. Data throughout Chapter 4 are gathered from the Fatality Analysis Reporting System (FARS) and the Fatality Injury Reporting System Tool (FIRST), both maintained by the National Highway Traffic Safety Administration (NHTSA), from the SVI data provided by the Centers for Disease Control and Prevention (CDC), and from the annual Highway Statistics publication from Federal Highway Administration (FHWA).

Additionally, the analysis translated fatality counts into economic losses to show the broader impact on states and communities. Furthermore, this research presents a descriptive and economic analysis of passenger vehicle occupant unrestrained-related fatalities in Illinois and Ohio for 2023. The findings are organized by gender, age group, and rural and urban areas, with estimated economic costs based on NHTSA's value of $1.7 million per fatality (inflation-adjusted from 2019).

Social Vulnerability Index (SVI)

Social vulnerability refers to the susceptibility of individuals or communities to harm and is influenced by inequities in resources, opportunities, and social conditions (Kasha et al., 2025). The CDC's SVI ranks counties on a percentile scale, combining indicators such as poverty, unemployment, educational attainment, minority status, language proficiency, housing, and transportation access (CDC, 2022). In this analysis, SVI was divided into quartiles (1 = lowest vulnerability, 4 = highest vulnerability) to examine its relationship with restrained and unrestrained fatalities in Illinois and Ohio in 2014 and 2022. SVI results were presented descriptively in dedicated subsections, including logistic regression contrasts, interactive and trend analyses, and theme-level models. 2022 maps of SVI within both states and unrestrained fatalities are provided to offer additional support for the core driver-focused models (CDC, 2022).

Objectives and Research Questions

This research looked at the following four research questions: (1) How does Illinois (primary law) and Ohio (secondary law) compare to the share of fatally injured occupants who were unrestrained, both overall and across key subgroups (male vs. female, driver vs. passenger, rural vs. urban, day vs. night, seasons, and vehicle types)? (2) When controlling for demographic and situational factors, is primary law (Illinois) associated with lower odds of being unrestrained compared to secondary law (Ohio)? (3) Which situational contexts, rural vs. urban, day vs. night, season, and vehicle types are most strongly associated with unrestrained usage? (4) How does the unrestrained differ across levels of social vulnerability, and how does SVI disparities interact with occupant subgroups and state enforcement policies?

Descriptive Comparison Analysis

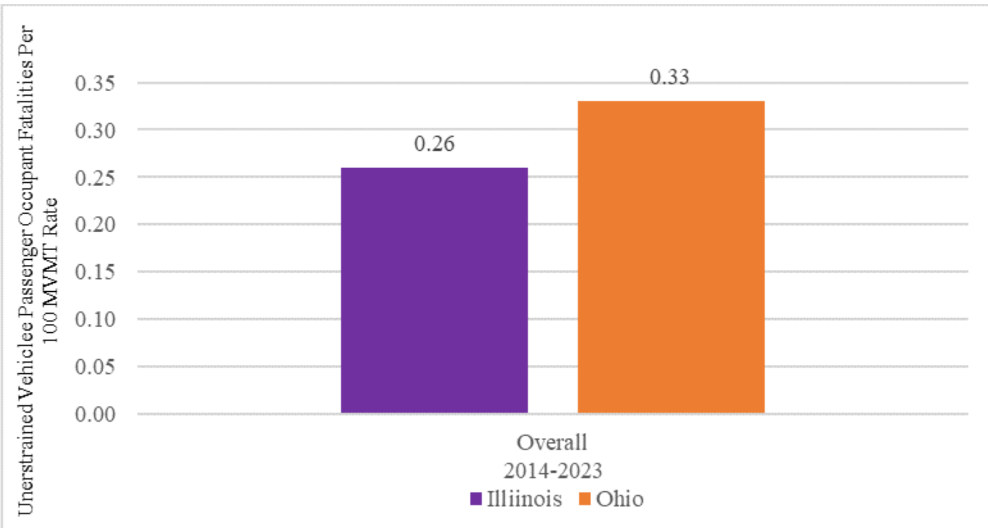
To interpret the relationship between seat belt usage and crash outcomes, it is necessary to examine descriptive comparisons of fatalities between Illinois and Ohio. This descriptive analysis section describes how non-seat belt use varies across specific factors, including overall seat belt usage, gender, occupant role, age group, time of day, rural and urban areas, season, and vehicle type. In doing so, this descriptive analysis section will provide the foundation for a more complex statistical analysis later in this chapter.

Overall State Unrestrained Passenger Vehicle Occupant-Related Fatalities Per 100 MVMT Rate

Ohio has an overall higher reported unrestrained passenger vehicle occupant-related fatality per 100 MVMT rate of 0.33. This rate was 23.7% higher than Illinois' rate of 0.26. This shows that unrestrained passenger occupant vehicle-related fatalities occur more frequently in Ohio from 2014 to 2023 (see Figure 2).

Figure 2

Overall Unrestrained Passenger Vehicle Occupant-Related Fatalities per 100 MVMT Rate for Illinois and Ohio, 2014-2023.



Note. The National Highway Traffic Safety Administration (NHTSA) (2023); Federal Highway Traffic Administration (FHWA) (2023).

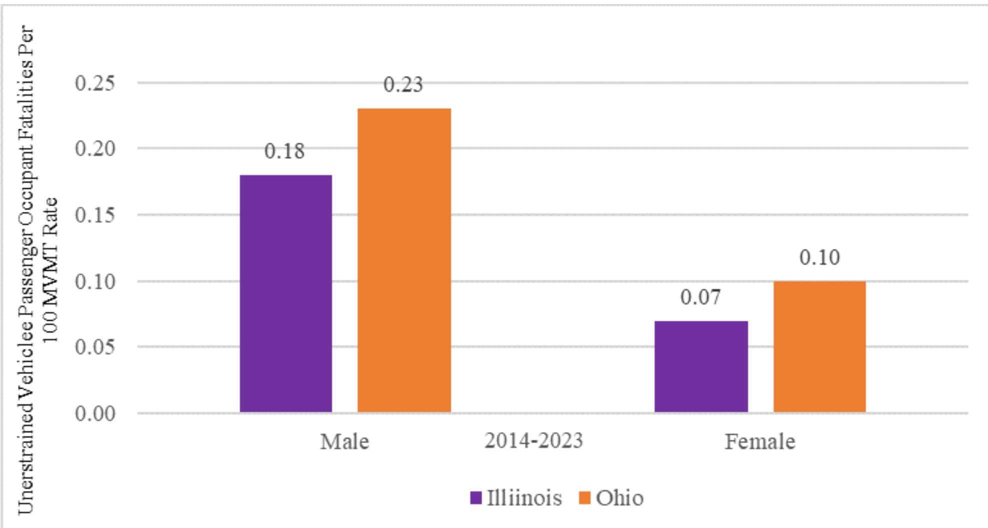
Male and Female Unrestrained Passenger Vehicle Occupants-Related Fatalities Per 100 MVMT Rate

In Ohio, male unrestrained passenger vehicle occupant-related fatalities per 100 MVMT rate were 0.23. At the same time, females had a rate of 0.10. In contrast, Illinois had lower rates for both groups: 0.18 for males and 0.07 for females. The fact that Ohio's rates for males are 27.8% higher and for females 42.9% higher reveals the disparity in gender usage between the two states.

Across both states, the unrestrained rate for male occupants was approximately 141% higher than for female occupants, males in Ohio showing the greatest difference. These differences suggest continued gender disparities in seat belt use, particularly in Ohio (see Figure 3).

Figure 3

Male and Female Unrestrained Passenger Vehicle Occupant-Related Fatalities per 100 MVMT Rate for Illinois and Ohio, 2014-2023



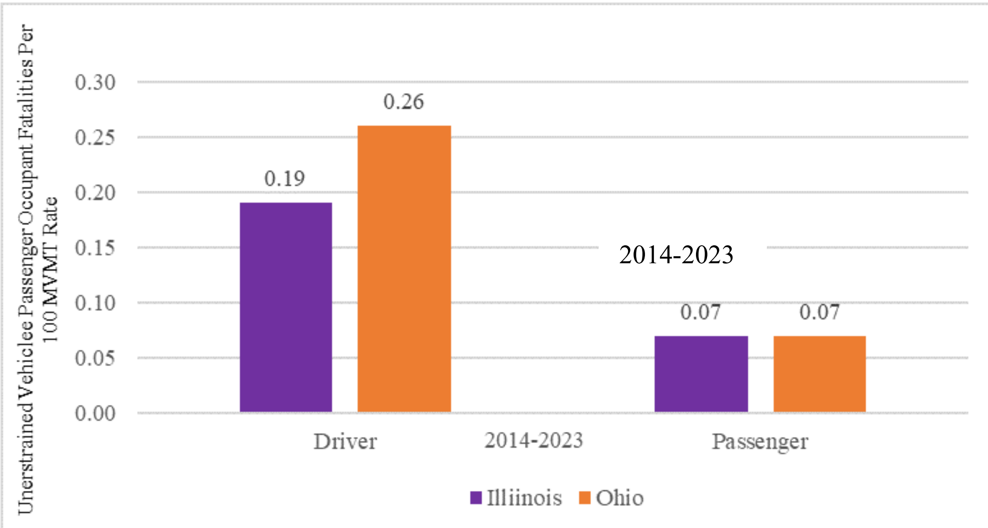
Note. NHTSA (2023); FHWA (2023).

Unrestrained Passenger Vehicle Occupant-Related Fatalities by Occupant Role (Driver and Passenger) Per 100 MVMT Rate

Drivers and passengers in Ohio experienced a higher rate of unrestrained passenger vehicle occupant-related fatalities, seeing a rate of 0.26 per 100 MVMT for its drivers and a rate of 0.07 per 100 MVMT for its passengers. The rate for drivers in Ohio was over 36.8% higher than that of Illinois drivers. Illinois experienced a rate of 0.19 for its drivers and 0.07 for its passengers. Drivers in both states had a higher risk of being involved in a fatality by non-seat belt use compared to their passengers (see Figure 4).

Figure 4

Unrestrained Passenger Vehicle Occupant Related Fatalities by Occupant Role (Driver and Passenger) per 100 MVMT rate for Illinois and Ohio, 2014-2023



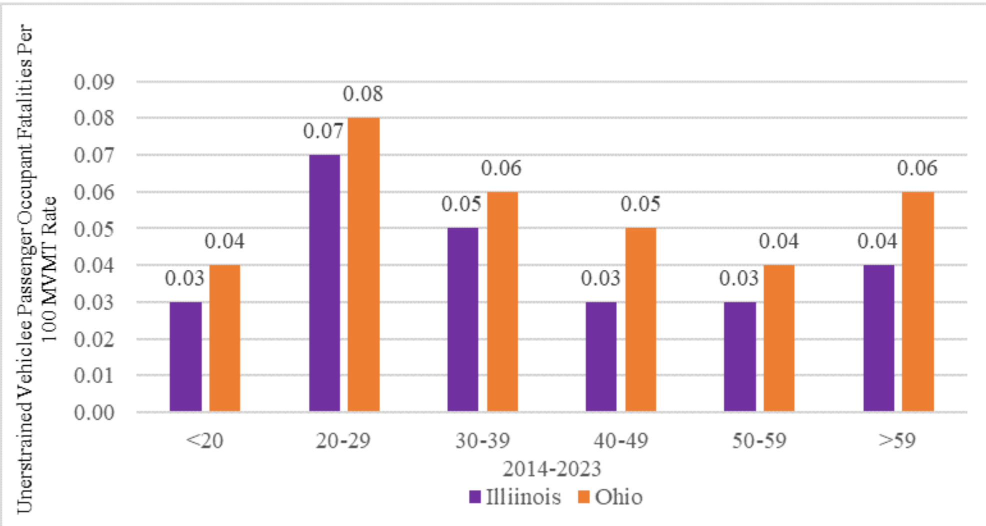
Note. NHTSA (2023); FHWA (2023).

Unrestrained Passenger Vehicle Occupant -Related Fatalities Per 100 MVMT Rate by Age Group

Ohio consistently showed higher rates of unrestrained use than Illinois across age groups. Unrestrained passenger vehicle occupant-related fatality rates peaked among young adults (ages 20–39) in Ohio and Illinois. Ohio experienced a rate of 0.15 per 100 MVMT. At the same time, Illinois had a rate of 0.14 per 100 MVMT. Ohio's rate was 7.1% higher for this age group. The lowest use rate is among the subgroup aged 20 or younger in Illinois (see Figure 5). This particular finding is surprising, since younger drivers are often new to driving and are the focus of many educational programs aimed at reducing their involvement in risky driving behavior.

Figure 5

Unrestrained Passenger Vehicle Occupant Related Fatalities per 100 MVMT by Age Group in Illinois and Ohio, 2014–2023



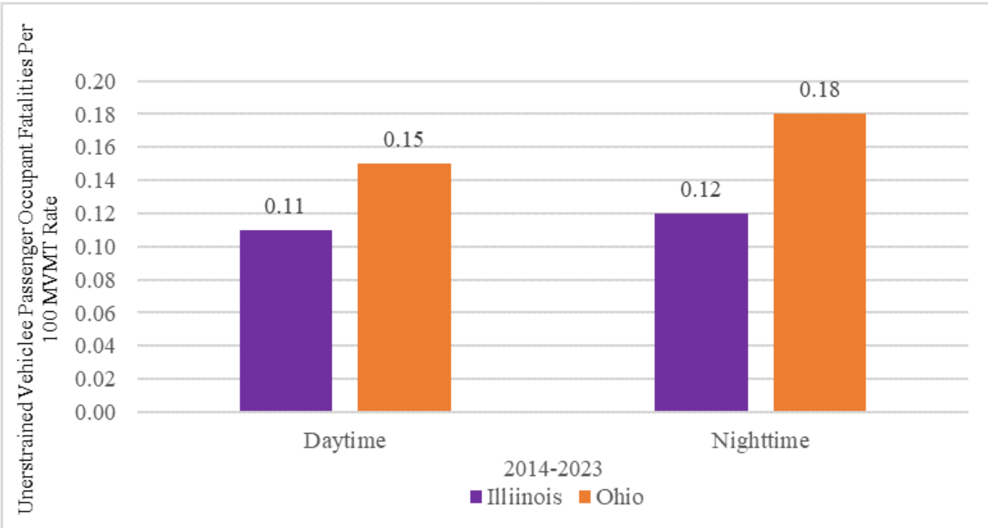
Note. NHTSA (2023); FHWA (2023).

Unrestrained Passenger Vehicle Occupant-Related Fatalities Per 100 MVMT Rate by Time of Day (Day and Night)

Driving at night in Ohio was extremely dangerous compared to daytime travel. Ohio's unrestrained passenger vehicle occupant-related fatalities per 100 MVMT rate was at 0.15 compared to a nighttime exposure rate of 0.18. In contrast, Illinois' rates remained lower at 0.11 during the day and 0.12 at night. Nighttime fatal crashes involving passenger vehicle occupants experienced higher rates of fatalities (see Figure 6) by an average of over 15 % than daytime non-use rates between the states. Ohio had a much higher exposure to risk during both time periods (day and nighttime), especially during nighttime, which was 50% higher.

Figure 6

Passenger Vehicle Occupant Unrestrained-Related Fatalities Per 100 MVMT Rate by Day and Nighttime for Illinois and Ohio, 2014-2023



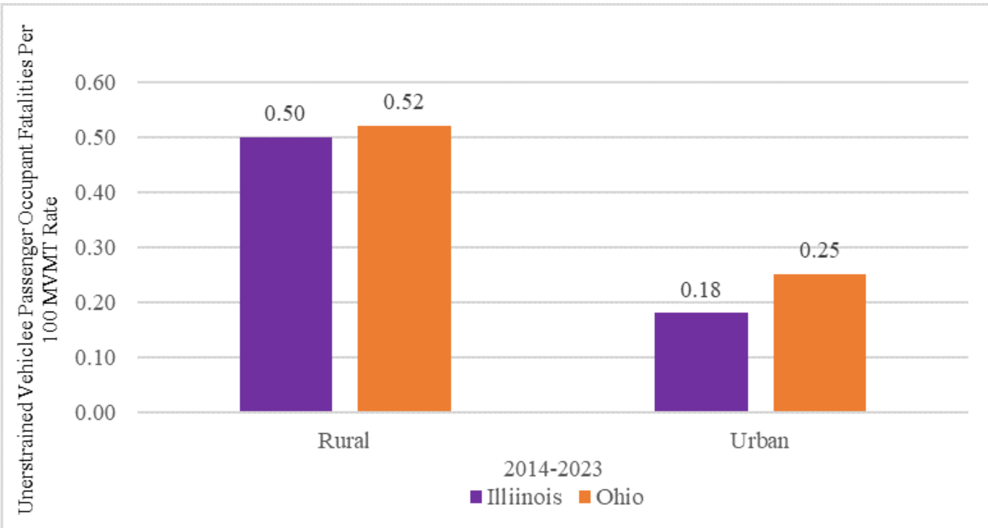
Note. NHTSA (2023); FHWA (2023).

Unrestrained Passenger Vehicle Occupant-Related Per 100 MVMT by Rural and Urban Areas

While driving through rural areas in both states, occupants experienced a much higher rate of unrestrained passenger vehicle-related fatalities than in urban areas. Ohio's rural areas showed a rate of 0.52 per 100 MVMT and 0.25 per 100 MVMT for urban areas. While in Illinois, rural and urban areas remained lower, at 0.50 per 100 MVMT for rural areas and 0.18 per 100 MVMT for its urban areas. Rural and urban areas exhibited the most significant disparities in this comparative study section, with an average difference of over 137% (see Figure 7).

Figure 7

Unrestrained Passenger Vehicle Occupant-Related Fatalities Per 100 MVMT Rate by Rural and Urban Areas for Illinois and Ohio, 2014-2023



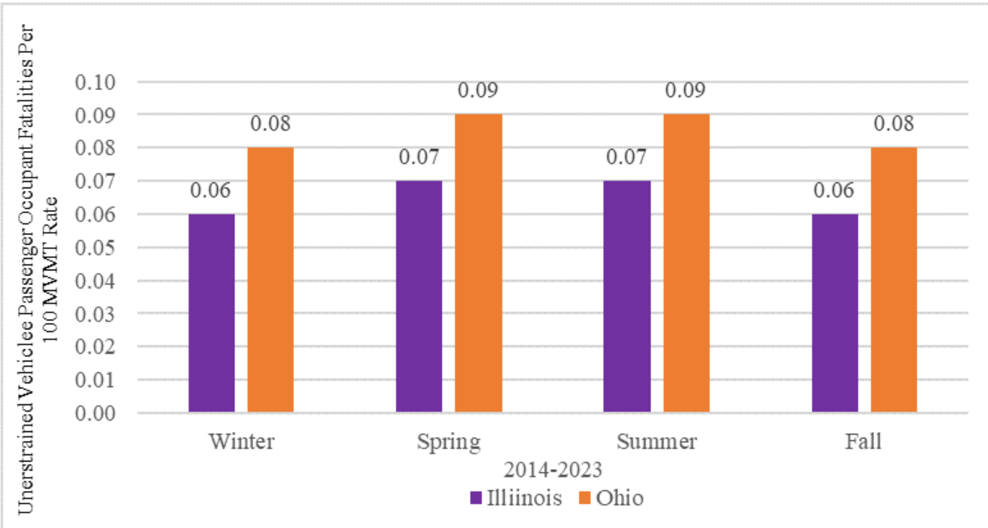
Note. NHTSA (2023); FHWA (2023).

Unrestrained Passenger Vehicle Occupant-Related Fatalities Per 100 MVMT by Season

When controlling for seasonal changes, Ohio's passenger vehicle occupant unrestrained-related fatalities per 100 MVMT rate ranged from 0.08 to 0.09. In contrast, Illinois' rate remained consistently lower, at 0.06 to 0.07 per 100 MVMT throughout the year (see Figure 8).

Figure 8

Unrestrained Passenger Vehicle Occupant-Related Fatalities Per 100 MVMT by Season for Illinois and Ohio, 2014-2023



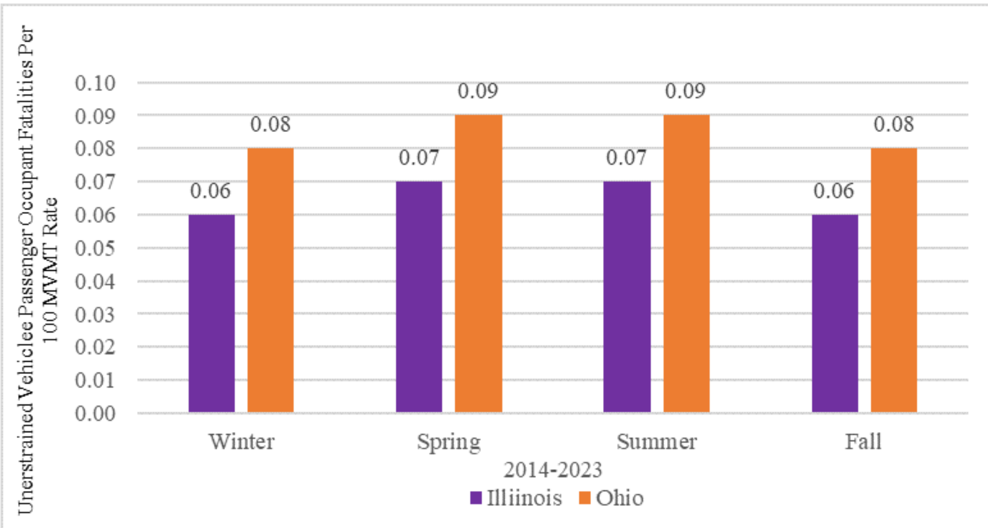
Note. NHTSA (2023); FHWA (2023).

Unrestrained Passenger Vehicle Occupant-Related Fatalities Per 100 MVMT Rate by Vehicle Type

In Ohio, unrestrained passenger vehicle-related fatalities were highest among passenger cars at 0.19, followed by SUVs at 0.19, and pickup trucks at 0.05. Illinois showed lower unrestrained fatalities across all vehicle types, ranging from 0.14 to 0.01 (see Figure 9). The Ohio passenger car rate was 35.7% higher, and the pickup truck rate was 25% higher than in Illinois.

Figure 9

Passenger Vehicle Occupant Unrestrained-Related Fatalities Per 100 MVMT Rate by Vehicle Type for Illinois and Ohio, 2014-2023



Note. NHTSA (2023); FHWA (2023).

Section Summary

The descriptive analysis helped establish a preliminary picture of the differences in unrestrained passenger vehicle occupant-related fatalities between Ohio and Illinois during the period 2014 to 2023. Across all subgroups: male and female, driver and passenger, age group, day and nighttime, rural and urban, seasons, and vehicle type, Ohio displayed higher rates of unrestrained occupants, reflecting the impact of its secondary law. Out of these predictor variables, males, young adults, nighttime crashes, and passenger cars were the most overrepresented of unrestrained fatalities (passenger vehicle occupants).

Having now established a baseline fatality example, the following section examines observational and attitudinal surveys to contextualize these results with reported seat-belt behaviors and perceptions among Illinois and Ohio motorists.

Seat Belt Survey Analysis

To enhance the fatality-based findings, analyzing vehicle occupants' behavior is important. This can be done through reviewing both states' annual seat belt observation surveys. These two surveys capture a snapshot of daytime seat belt usage. Understanding differences in seat belt use between Illinois and Ohio provides insight into variations in the two states' seat belt laws. (Illinois Department of Transportation [IDOT], 2024).

After examining both Illinois' and Ohio's 2024 observation seat belt surveys, there was an apparent difference between the two states. Looking at the surveys regionally, Illinois showed higher seat belt use across its urban and downstate areas. In contrast, Ohio showed a more widespread range of seat belt use across its regions, as shown in Table 2, with usage ranging from 62.0% to 99.7%. These variations showed that Illinois' seat belt law had an advantage over Ohio's, which had lower overall compliance, affecting seat belt usage.

Table 2

Seat Belt Use in Illinois and Ohio (2024 Observational Surveys)

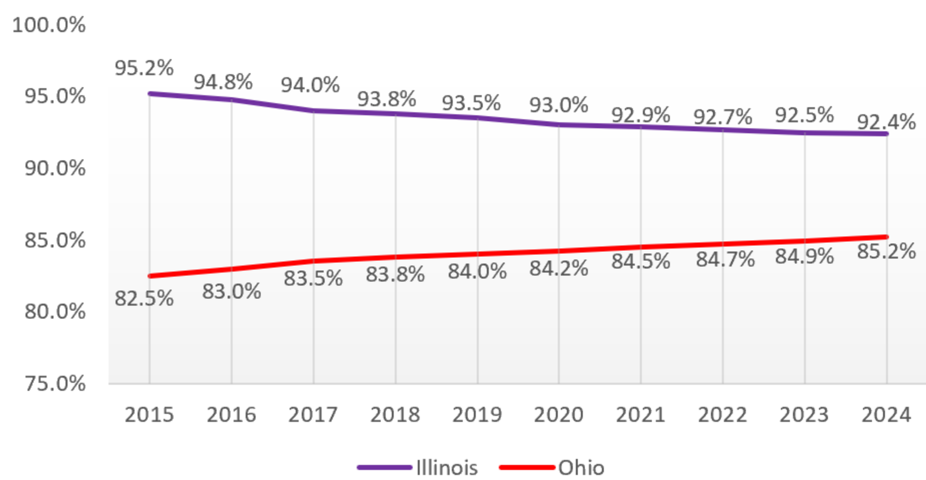
	Illinois (2024)	**Ohio (2024)**
Overall Compliance	92.4%	85.2%
Regional	Chicago 79.9%, Collar 93.7%, Cook 92.7%, and Downstate 89.7%	Champaign 62% to Montgomery 99.7%
Road Type	Interstates 93.9%, Highways 93.5%, Residential 90.8%	Primary 90.0%, Secondary 87.5%,

Note. Illinois Department of Transportation (IDOT), (2024); Schneider and Ackerman (2024).

Taken together, the comparative trends from 2015 through 2024 (see Figure 10) showed that both states have made progress in seat belt use over the past decade. However, Illinois' seat belt law has sustained higher and more consistent seat belt usage than Ohio's, which still lags behind Illinois (see Figure 10). Illinois had a mean of 93.5% during the period from 2015 to 2024, while Ohio had 84.0%, a 9.5 percentage point advantage (IDOT, 2024; Schneider & Ackerman, 2024).

Figure 10

Seat Belt Use Trend: Ohio vs Illinois (2015–2024)



Note. IDOT (2024); Schneider and Ackerman (2024).

Attitudinal Awareness Survey on Seat Belt Use

This research utilized both Illinois' and Ohio's observational and attitudinal surveys, which revealed individuals' behavior and perceptions. Examining Ohio's 2016 statewide telephone survey alongside Illinois' 2016 Click It or Ticket evaluation provides an opportunity to analyze vehicle occupants' attitudes toward enforcement and seat belt use. Participants in these attitudinal awareness surveys provided explanations for why they use or do not use a seat belt (see Table 3). These surveys offer context in the difference between the two states. Providing an explanation of underlying motivations and barriers, offering context for why differences between the two states persist despite ongoing enforcement and education efforts.

Table 3

Comparison of Attitudinal Awareness Survey on Seat Belt Use and Perceptions (Ohio vs. Illinois 2016) Key differences

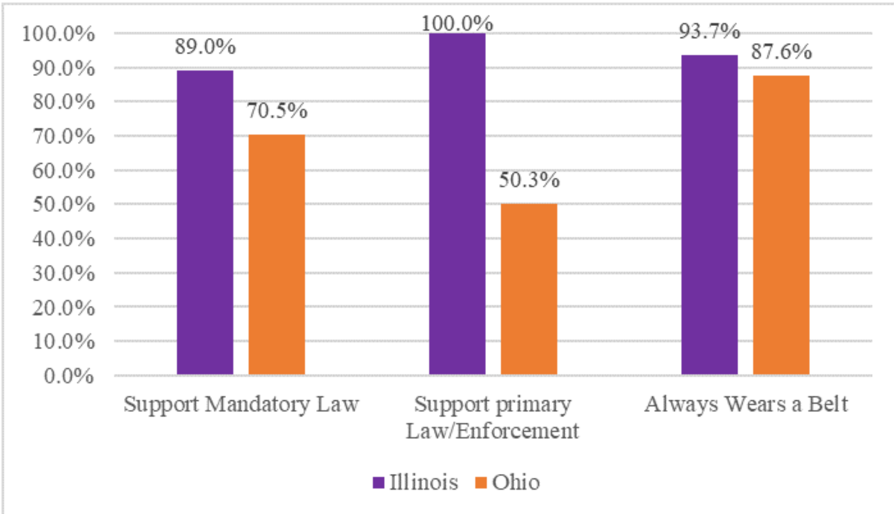
	Ohio (2016)	**Illinois (2016)**
Self-reported "always use"	87.6%	93.7%
Support for mandatory laws	70.5%	89% agree enforcement important
Support for primary law	50.3% would vote yes	Already primary law
Perceived as likely to get a ticket	19.4%	23.8% saw more enforcement
Regional disparity	Rural 46% respondents	Chicago 82.3% to 87.8%

Note. IDOT (2017); Seufert and Walton (2017).

These two attitudinal awareness surveys revealed insights into residents' perceptions of seat belt use. Illinois residents reported higher seat belt compliance than and showed overwhelming support for enforcement in line with Ohio's seat belt law (see Figure 11). Ohio residents expressed support for enforcing seat belt laws in this survey. In addition, Ohio indicated strong support for a mandatory seat belt law, but only half said they would vote for a primary law. Ohio residents believed that police enforcement efforts were weak. Ohio residents felt that they would not receive a ticket from the police for not wearing their seat belts. Even fewer remember which seat belt enforcement campaigns were underway in the state (Seufert & Walton, 2017).

Figure 11

Support for Seat Belt Laws and Enforcement



Note. IDOT (2017); Seufert and Walton (2017)

Section Summary

This study found that Illinois' and Ohio's seat belt and attitudinal awareness surveys highlight a distinct difference between the two states' seat belt laws. The occupants in Illinois continue to have a higher seat belt use rate than those in Ohio, highlighting a greater variation in seat belt use across the state (see Table 11). These two previous sections, descriptive, survey-based data, provide the foundation for the research, which will now examine demographic, contextual, and situational details. This inferential statistical analysis section, coming up, will help provide additional understanding of how the enforcement of these seat belt laws, through primary and secondary laws, affects the various predictor variables associated with unrestrained outcomes.

Inferential Statistics

While the descriptive analyses established a clear pattern of non-seat belt use across states, subgroups, and contexts, it is important to test whether these differences in seat belt use are statistically significant. To further understand differences in seat belt use between Illinois and Ohio, this study used an independent t-test across multiple subgroups, based on 2014-2023 data from NHTSA's FIRST system (NHTSA, 2023).

The *t*-test compared the likelihood of being unrestrained across the two states, weighting the analyses by fatality counts. The analysis factors in subgroups including male and female, driver and passenger, age group, day and night, rural and urban, seasons, and vehicle type. The *t*-tests will show any statistically significant differences in unrestrained use between Illinois and Ohio.

When *t*-tests were run, the results revealed significant differences between Ohio and Illinois in most categories. Ohio was consistently higher across most subgroups, with the most significant differences among males, younger adult occupants, nighttime occupants, all seasons, and fatalities that occurred in urban areas (see Table 4). Illinois showed a significantly lower unrestrained usage across most predictors. The probability of reduced unrestrained use was higher within most subgroups that are directly influenced by their state's law (IDOT, 2024; Schneider & Ackerman, 2024).

Table 4

Independent Sample t test Comp*aring Ohio and Illinois Unrestrained Use, Factoring in Subgroups 2014-2023*

	Ohio Mean	Illinois Mean	*T*	*p*	*N* (OH)	*N* (IL)
Male	0.60	0.50	8.36	< .001	4,398	3,767
Female	0.46	0.37	5.88	< .001	2,481	2,094
Rural	0.51	0.46	4.61	< .001	3,458	2,698
Urban	0.58	0.46	9.78	< .001	3,421	3,163
Driver	0.56	0.45	9.96	< .001	5,289	4,426
Day	0.46	0.37	7.53	< .001	3,728	3,093
Night	0.65	0.55	7.44	< .001	3,151	2,768
Age 20–29	0.67	0.59	4.19	< .001	1,377	1,295
Age 30–39	0.67	0.58	4.18	< .001	1,060	939
Age 40–49	0.60	0.49	4.36	< .001	881	613
Age 50–59	0.59	0.43	6.10	< .001	816	680
Age > 59	0.36	0.28	5.49	< .001	1,955	1,653
Passenger Vehicle	0.52	0.42	8.99	< .001	4,007	3,355
Pickup	0.66	0.57	3.73	< .001	944	763
Fall	0.54	0.45	5.42	<. 001	1,940	1,611
Spring	0.55	0.47	4.60	< .001	1,594	1,472
Summer	0.53	0.45	4.91	< .001	1,787	1,508
Winter	0.56	0.46	5.24	< .001	1,558	1,270

Note. The means represent the percentage of fatally injured occupants who were not wearing restraints. Independent-sample *t*-tests, weighted by fatality counts, were used for analysis. Results with $p < .05$ were considered statistically significant. Means represent the proportion of fatalities. NHTSA (2023).

Section Summary

This research indicated that *t*-tests showed that Illinois' had a significantly lower unrestrained use across most demographic, situational, and crash-related subgroups. At the same time, Ohio's weaker seat belt law is associated with higher unrestrained use among high-risk groups. However, *t*-tests confirm significant state differences. However, the *t*-tests do not account for the multiple overlapping risk variables that require further research. Utilizing logistic regression analysis will help model how demographic and situational variables jointly shape unrestrained usage.

Logistic Regression Analysis

This study used *t*-tests, which demonstrated significant state-level differences across individual subgroups; however, these tests do not account for the combined influence of multiple demographic and situational factors. To go beyond this, this section introduces multivariable logistic regression models that estimate the odds of being unrestrained. This showed Illinois relative to Ohio, while accounting for multiple predictors simultaneously. The models evaluate how each state's enforcement policies affect restraint outcomes, controlling for demographic and contextual characteristics.

Using the model allows each coefficient to show the shift in the odds of being unrestrained in Illinois relative to Ohio. A positive value indicates higher odds in Illinois, while a negative value indicates lower odds. This multivariable logistic regression analysis provides a direct way to quantify the combined effects of differences in seat belt laws and subgroup characteristics. Using a multi-variable approach helps extend this study beyond the one-variable differences previously run in this chapter.

Model fit indices, as shown in Table 5, indicate that Illinois consistently had lower probabilities of unrestrained fatalities than Ohio, even after accounting for multiple demographic and contextual factors. Improvements in the model fit indices occurred when several predictor variables were included, suggesting that risks vary most strongly along these dimensions. The most significant differences occurred among male passengers under age 20, drivers aged 20–29 in rural crashes, and older males (over 59 years old), with Ohio consistently showing unrestrained use among these groups.

Table 5

Multi-Variable Logistic Regression Analysis: Unrestrained Fatalities Across Key Subgroups

	N	*AIC*	*BIC*	Log Likelihood	Significant Predictors ($p < .05$)
State x Male/Female x Driver/Passenger	12,740	17,342.2	17,401.8	(8,663.1)	3
State x Male/Female	12,740	17,344.6	17,374.4	(8,668.3)	2
State x Male/Female x Rural/Urban	12,740	17,322.6	17,382.2	(8,653.3)	4
State x Male/Female x Driver/Passenger x Rural/Urban	12,740	17,315.0	17,434.3	(8,641.5)	5
State x Male/Female x Driver/Passenger x Day/Night	12,740	16,949.1	17,068.4	(8,458.6)	5
State x Male/Female x Day/Night	12,740	16,944.7	17,004.4	(8,464.4)	4
State x Male/Female x Age Group	12,740	16,568.1	16,747.0	(8,260.1)	7
State x Male/Female x Age Group x Driver/Passenger	12,740	16,585.2	16,942.9	(8,244.6)	9
State x Male/Female x Age Group x Day/Night	12,740	16,429.4	16,787.1	(8,166.7)	8
State x Male/Female x Age Group x Rural/Urban	12,740	16,565.6	16,923.3	(8,234.8)	7
State x Male/Female x Age Group x Rural/Urban x Day/Night	12,740	16,457.2	17,172.7	(8,132.6)	6
State x Vehicle Type	12,740	17,436.6	17,511.2	(8,708.3)	3
State x Rural/Urban	12,740	17,542.6	17,572.4	(8,767.3)	3
State x Age Group	12,740	16,750.9	16,840.3	(8,363.5)	7
State x Day/Night	12,740	17,107.4	17,137.2	(8,549.7)	2
State x Seasons (seasonal dataset)	12,740	17,570.3	17,629.9	(8,777.1)	3

Note. Models with lower *AIC* and *BIC* values fit the data better; higher log-likelihood values (closer to zero) indicate stronger explanatory power. NHTSA (2023).

When running the logistic regression analysis, it was confirmed that Illinois consistently exhibited lower odds (20–35% reduction) of unrestrained fatalities compared to Ohio across the key predictors (see Table 6; NHTSA, 2014-2023). Interaction effects suggest that unrestrained risk was highest among males, at night, in rural areas, and among younger age groups, all of which were associated with higher odds of non-seat belt use. Although interaction terms were not statistically significant, indicating that these combined effects did not meaningfully impact risk beyond the main effect.

Table 6

Logistic Regression Estimates for Interactive Variables

	B	*SE*	*OR*	95% *CI* (Lower, Upper)	*P*
State (Illinois vs Ohio)	–0.42	0.66	0.66	[0.53, 0.82]	< .001
Sex (Female vs Male)	–0.28	0.76	0.56	[0.66, 0.89]	< .001
Occupant (Passenger vs Driver)	0.35	1.42	1.42	[1.19, 1.70]	< .001
Sex × Occupant	0.26	1.30	1.30	[1.11, 1.53]	< .001

Note. The table presents the coefficients, odds ratios (Exp(B)), and *p*-values for the main predictors. Negative coefficients and Exp(B) values below 1 indicate that Illinois had lower odds of unrestrained fatalities compared to Ohio. All effects shown in this table are statistically significant ($p < 0.05$). NHTSA (2023).

Section Summary

The logistic regression showed the differences in outcomes resulting from the current enforcement policy, predicting unrestrained use across Illinois and Ohio. After controlling for demographic, situational, and contextual variables, Illinois consistently showed significantly lower odds of unrestrained fatalities, with roughly 20–35% lower unrestrained usage than Ohio across these models. The results show male occupants, younger occupants (particularly under

20), older (> 59), rural occupants, and nighttime travelers had significantly higher odds of being unrestrained. These high-risk groups had a reduced impact in Illinois, suggesting that seat belt enforcement efforts were working (see Table 6 and Figure 11).

These models highlighted individual-level and contextual risks associated with unrestrained usage, but do not consider broader structural disadvantages that affect communities. To address this, the following section incorporates the SVI to examine how county-level vulnerability interacts with the two different laws.

Social Vulnerability Index (SVI) Analysis

This statistical analysis will use the SVI to overlay unrestrained usage in fatal crashes across Ohio and Illinois from 2014 to 2022. Consistent with the methodology outlined in Chapter 3, the analyses focus on occupants and include comparisons across demographic (male and female, driver and passenger), contextual (day and night, rural and urban, and seasonal), crash-related factors (vehicle type), and socioeconomic (county-level SVI quartiles and multi-class) factors.

SVI Descriptive Comparison Analysis

To interpret the relationship among seat belt use, social vulnerability, and crash outcomes, it is necessary first to examine descriptive comparisons of fatalities in Illinois and Ohio. This section describes how unrestrained usage is distributed across SVI quartiles, while also considering key predictor variables. By establishing these descriptive baseline patterns, the analysis provides critical context for understanding whether higher social vulnerability corresponds to elevated unrestrained usage, and it will provide the foundation for the multivariate statistical models presented later in this chapter.

Overall Unrestrained Use by SVI Overlay

In Ohio, its most vulnerable counties (Q4) experienced higher unrestrained use during both time periods (2014, 2022), while its least vulnerable counties (Q1) experienced mixed results. Ohio vehicle occupants were most at risk (see Figure 12) for being in an unrestrained fatality, especially in its vulnerable counties (Q4), than in Illinois CDC/ATSDR (2014, 2022); NHTSA (2014, 2022).

Figure 12

Overall Unrestrained Usage by Social Vulnerability Quartile (SVQ): Illinois vs. Ohio (2014, 2022)

Overall — 2014

State	Q1	Q2	Q3	Q4
Illinois	0.42	0.40	0.46	0.42
Ohio	0.50	0.54	0.55	0.59

Proportion unrestrained

Proportion unrestrained
0.2
0.3
0.4
0.5
0.6
0.7
0.8

Overall SVI — 2022

State	Q1	Q2	Q3	Q4
Illinois	0.53	0.48	0.36	0.53
Ohio	0.49	0.53	0.67	0.59

Proportion unrestrained

Proportion unrestrained
0.2
0.3
0.4
0.5
6
0.7
0.8

Note. Q1 = lowest social vulnerability; Q4 = highest social vulnerability. Negative values represent reductions in non-use between 2014 and 2022. CDC/ATSDR (2014, 2022); NHTSA (2014, 2022).

Male and Female Unrestrained Use with SVI Overlay

In Ohio, its most vulnerable counties (Q4) experienced much higher unrestrained use among males and females during this time period (2014, 2022), while its least vulnerable counties (Q1) experienced higher unrestrained use among males, with mixed results among females compared to Illinois. Ohio's vehicle occupants are at higher risk (see Figure 13) for being in an unrestrained fatality within its most vulnerable counties (Q4) than in Illinois, especially for males at 0.73 proportions (see Figure 13) of unrestrained usage (CDC/ATSDR, 2014, 2022; NHTSA, 2014, 2022).

Figure 13

Male and Female Unrestrained Usage by SVQ: Illinois vs. Ohio (2014, 2022)

Male — 2014

State	Q1	Q2	Q3	Q4
Illinois	0.53	0.54	0.55	0.59
Ohio	0.62	0.60	0.59	0.63

Female — 2014

State	Q1	Q2	Q3	Q4
Illinois	0.41	0.28	0.36	0.44
Ohio	0.48	0.54	0.56	0.58

Proportion unrestrained

Proportion unrestrained
0.2
0.3
0.4
0.5
0.6
0.7
0.8

Male — 2022

State	Q1	Q2	Q3	Q4
Illinois	0.55	0.54	0.53	0.58
Ohio	0.59	0.64	0.71	0.73

Female — 2022

State	Q1	Q2	Q3	Q4
Illinois	0.49	0.32	0.27	0.41
Ohio	0.38	0.35	0.58	0.54

Proportion unrestrained

Proportion unrestrained
0.2
0.3
0.4
0.5
0.6
0.7
0.8

Note. Q1 = lowest social vulnerability; Q4 = highest social vulnerability. Negative values represent reductions in non-use between 2014 and 2022. CDC/ATSDR (2014, 2022); NHTSA (2014, 2022).

Driver and Passenger Unrestrained Use with SVI Overlay

In Ohio, its most vulnerable counties (Q4) experienced higher unrestrained use for drivers and passengers in both time periods 2014 and 2022), while its least vulnerable counties (Q1) experienced higher unrestrained use for drivers but had mixed results for its passengers compared to Illinois. Ohio’s vehicle occupants were at a higher risk (see Figure 14) of being in an unrestrained fatality than in Illinois (CDC/ATSDR, 2014, 2022; NHTSA, 2014, 2022).

Figure 14

Changes in Drivers and Passenger Unrestrained Usage by SVQ: Illinois vs. Ohio (2014, 2022)

Driver — 2014

State	Q1	Q2	Q3	Q4
Illinois	0.42	0.41	0.39	0.40
Ohio	0.49	0.56	0.53	0.60

Passenger — 2014

State	Q1	Q2	Q3	Q4
Illinois	0.40	0.36	0.64	0.47
Ohio	0.53	0.44	0.62	0.57

Proportion unrestrained
0.2
0.3
0.4
0.5
0.6
0.7
0.8

Proportion unrestrained

Driver — 2022

State	Q1	Q2	Q3	Q4
Illinois	0.53	0.51	0.46	0.55
Ohio	0.56	0.50	0.63	0.60

Passenger — 2022

State	Q1	Q2	Q3	Q4
Illinois	0.53	0.37	0.08	0.47
Ohio	0.36	0.63	0.81	0.55

Proportion unrestrained
0.2
0.3
0.4
0.5
0.6
0.7
0.8

Proportion unrestrained

Note. Q1 = lowest social vulnerability; Q4 = highest social vulnerability. Negative values represent reductions in non-use between 2014 and 2022. CDC/ATSDR (2014, 2022); NHTSA (2014, 2022).

Unrestrained Use by Age Group with SVI Overlay

In Ohio, its most vulnerable counties (Q4) had higher unrestrained use across most age groups (except those < 20) in both time periods (2014, 2022), while its least vulnerable counties (Q1) showed mixed results across age groups. For most of all age groups, Ohio's vehicle occupants are still at a higher risk (see Figure 15) for being in an unrestrained fatality than in its vulnerable counties (Q4) than Illinois, especially for its age groups of 20-49 which ranged from 0.74-0.84 proportions of unrestrained usage (see Figure 15) (CDC/ATSDR, 2014, 2022; NHTSA, 2014, 2022).

Figure 15

Changes in Age Group–Specific Unrestrained Fatalities by SVQ, Illinois vs. Ohio (2014–2022)

Proportion unrestrained

State	Q1	Q2	Q3	Q4
<20 — 2014				
Illinois	0.50	0.27	0.41	0.70
Ohio	0.64	0.70	0.46	0.79
20-29 — 2014				
Illinois	0.64	0.76	0.57	0.58
Ohio	0.72	0.61	0.61	0.61
30-39 — 2024				
Illinois	0.66	0.53	0.67	0.69
Ohio	0.67	0.77	0.74	0.73
40-49 — 2024				
Illinois	0.51	0.60	0.33	0.67
Ohio	0.69	0.67	0.73	0.60
50-59 — 2014				
Illinois	0.51	0.44	0.71	0.59
Ohio	0.60	0.48	0.61	0.55
>59 — 2014				
Illinois	0.27	0.21	0.24	0.25
Ohio	0.35	0.44	0.40	0.56

Proportion unrestrained

Proportion unrestrained
0.2
0.3
0.4
0.5
0.6
0.7
0.8

State	Q1	Q2	Q3	Q4
<20 — 2022				
Illinois	0.63	0.50	0.50	0.68
Ohio	0.33	0.53	0.71	0.48
20-29 — 2014				
Illinois	0.48	0.44	0.61	0.65
Ohio	0.68	0.51	0.58	0.76
30-39 — 2022				
Illinois	0.47	0.67	0.77	0.52
Ohio	0.59	0.62	0.88	0.84
40-49 — 2022				
Illinois	0.67	0.62	0.44	0.67
Ohio	0.59	0.73	0.78	0.74
50-59 — 2022				
Illinois	0.65	0.50	0.30	0.50
Ohio	0.59	0.70	0.67	0.68
>59 — 2022				
Illinois	0.47	0.34	0.30	0.31
Ohio	0.43	0.45	0.56	0.47

Proportion unrestrained

Proportion unrestrained
0.2
0.3
0.4
0.5
0.6
0.7
0.8

Note. Q1 = lowest social vulnerability; Q4 = highest social vulnerability. Negative values represent reductions in non-use between 2014 and 2022. CDC/ATSDR (2014, 2022); NHTSA (2014, 2022).

Day and Night Unrestrained Use with SVI Overlay

In Ohio, its most vulnerable counties (Q4) experienced much higher unrestrained usage for both day and nighttime travelers in both time periods (2014, 2022), while its least vulnerable counties (Q1) experienced much higher unrestrained usage for the daytime period, while nighttime usage did not increase as much as it did for Illinois in 2022. Nighttime travel is one of the riskier times for unrestrained usage (see Figure 16). This was especially true in Ohio's most vulnerable counties, which saw an unrestrained usage rate of 0.76. These results reinforce that Illinois' primary enforcement law reduces unrestrained use, especially in vulnerable counties, while Ohio's secondary law leaves vulnerable counties disproportionately exposed, especially at night and in higher quartiles (CDC/ATSDR, 2014, 2022; NHTSA, 2014, 2022).

Figure 16

Day and Night Unrestrained Usage by SVQ in Illinois and Ohio (2014 vs. 2022)

Proportion unrestrained

Day — 2014

State	Q1	Q2	Q3	Q4
Illinois	0.36	0.30	0.42	0.35
Ohio	0.50	0.44	0.50	0.50

Night — 2014

State	Q1	Q2	Q3	Q4
Illinois	0.49	0.55	0.50	0.46
Ohio	0.49	0.64	0.60	0.68

Proportion unrestrained: 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8

Proportion unrestrained

Day — 2022

State	Q1	Q2	Q3	Q4
Illinois	0.49	0.42	0.34	0.42
Ohio	0.49	0.49	0.56	0.62

Night — 2022

State	Q1	Q2	Q3	Q4
Illinois	0.59	0.56	0.40	0.61
Ohio	0.53	0.69	0.65	0.76

Proportion unrestrained: 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8

Proportion unrestrained

Note. Q1 = lowest social vulnerability; Q4 = highest social vulnerability. Negative values represent reductions in non-use between 2014 and 2022. CDC/ATSDR (2014, 2022) and NHTSA (2014, 2022).

Rural and Urban Unrestrained Use with SVI Overlay

In Ohio, its most vulnerable counties (Q4) experienced higher unrestrained usage, especially in rural areas, in both time periods (2014, 2022), while its least vulnerable counties (Q1) showed mixed results. Rural areas were among the riskier places for unrestrained use, especially in Ohio. Ohio's vulnerable counties experienced a 0.72 proportion (2022) of unrestrained usage (see Figure 17). Overall, widening disparities exist in Ohio, with its Q4 rural populations becoming more vulnerable, while Illinois appears to be closing the gap in its more vulnerable counties (Q4). (CDC/ATSDR, 2014, 2022; NHTSA, 2014, 2022).

Figure 17

Urban and Rural Unrestrained Usage by SVQ in Illinois and Ohio (2014 vs. 2022)

Urban — 2014

State	Q1	Q2	Q3	Q4
Illinois	0.63	0.41	0.61	0.50
Ohio	0.46	0.64	0.57	0.66

Rural — 2014

State	Q1	Q2	Q3	Q4
Illinois	0.40	0.48	0.58	0.44
Ohio	0.57	0.60	0.54	0.57

Proportion unrestrained: 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8

Proportion unrestrained

Urban — 2022

State	Q1	Q2	Q3	Q4
Illinois	0.54	0.52	0.46	0.47
Ohio	0.48	0.58	0.61	0.59

Rural — 2022

State	Q1	Q2	Q3	Q4
Illinois	0.50	0.45	0.33	0.52
Ohio	0.52	0.61	0.53	0.72

Proportion unrestrained: 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8

Proportion unrestrained

Note. Q1 = lowest social vulnerability; Q4 = highest social vulnerability. Negative values represent reductions in non-use between 2014 and 2022. CDC/ATSDR (2014, 2022); NHTSA (2014, 2022).

Unrestrained Use by Season With SVI Overlay

In Ohio, its most vulnerable counties (Q4) showed mixed results across seasons in both time periods (2014, 2022), while its least vulnerable counties (Q1) showed a similar pattern. Winter was the primary season with higher proportions of unrestrained use in both states, due to their location in the Midwest, where winter conditions are harsher, and driving is riskier, especially if you are not buckled up (see Figure 18). This illustrates that seat belt proportion in winter in Ohio (0.66) in 2022 was higher than in Illinois (CDC/ATSDR, 2014, 2022; NHTSA, 2014, 2022).

Figure 18

Unrestrained Usage by Season by SVQ in Illinois and Ohio (2014 vs. 2022)

Proportion unrestrained

Proportion unrestrained
0.2
0.3
0.4
0.5
0.6
0.7
0.8

Winter — 2014

State	Q1	Q2	Q3	Q4
Illinois	0.50	0.46	0.54	0.51
Ohio	0.60	0.59	0.49	0.80

Spring — 2014

State	Q1	Q2	Q3	Q4
Illinois	0.47	0.48	0.65	0.43
Ohio	0.51	0.48	0.60	0.62

Summer — 2014

State	Q1	Q2	Q3	Q4
Illinois	0.36	0.33	0.43	0.35
Ohio	0.38	0.51	0.57	0.52

Fall — 2022

State	Q1	Q2	Q3	Q4
Illinois	0.37	0.34	0.38	0.40
Ohio	0.52	0.57	0.55	0.48

Proportion unrestrained

Proportion unrestrained

Proportion unrestrained
0.2
0.3
0.4
0.5
0.6
0.7
0.8

Winter — 2022

State	Q1	Q2	Q3	Q4
Illinois	0.50	0.51	0.41	0.58
Ohio	0.43	0.70	0.75	0.66

Spring — 2022

State	Q1	Q2	Q3	Q4
Illinois	0.53	0.57	0.40	0.53
Ohio	0.63	0.47	0.68	0.61

Summer — 2022

State	Q1	Q2	Q3	Q4
Illinois	0.50	0.51	0.53	0.54
Ohio	0.32	0.57	0.71	0.47

Fall — 2014

State	Q1	Q2	Q3	Q4
Illinois	0.58	0.35	0.18	0.49
Ohio	0.56	0.46	0.50	0.63

Proportion unrestrained

Note. Q1 = lowest social vulnerability; Q4 = highest social vulnerability. Negative values represent reductions in non-use between 2014 and 2022. CDC/ATSDR (2014, 2022); NHTSA (2014, 2022).

Unrestrained Usage by Vehicle Type with SVI Overlay

In Ohio, its most vulnerable counties (Q4) experienced much higher unrestrained use across vehicle types during both time periods (2014, 2022), while its least vulnerable counties (Q1) showed mixed results. Pickup-truck occupants in Ohio are much more at risk than in Illinois, with a 0.79 proportion (2022) of unrestrained occupants (see Figure 19). Rural and pickup truck areas have increased over time and have a disproportionate number of unrestrained fatalities as a result (see Figures 17 and 19) (CDC/ATSDR, 2014, 2022; NHTSA, 2014, 2022).

Figure 19

Unrestrained Usage by Vehicle Type by SVQ in Illinois and Ohio (2014 vs. 2022)

Proportion unrestrained

Proportion unrestrained
0.2
0.3
0.4
0.5
0.6
0.7
0.8

Passenger Car — 2014

State	Q1	Q2	Q3	Q4
Illinois	0.32	0.33	0.37	0.40
Ohio	0.48	0.53	0.50	0.59

Pickup Truck — 2014

State	Q1	Q2	Q3	Q4
Illinois	0.52	0.63	0.50	0.57
Ohio	0.86	0.73	0.64	0.38

SUV — 2014

State	Q1	Q2	Q3	Q4
Illinois	0.74	0.52	0.63	0.41
Ohio	0.44	0.43	0.65	0.74

Van — 2014

State	Q1	Q2	Q3	Q4
Illinois	0.40	0.22	0.57	0.58
Ohio	0.29	0.44	0.58	0.71

Proportion unrestrained

Passenger Car — 2022

State	Q1	Q2	Q3	Q4
Illinois	0.55	0.52	0.38	0.55
Ohio	0.41	0.37	0.58	0.53

Pickup Truck — 2022

State	Q1	Q2	Q3	Q4
Illinois	0.90	0.42	0.47	0.50
Ohio	0.58	0.77	0.78	0.79

SUV — 2022

State	Q1	Q2	Q3	Q4
Illinois	0.23	0.46	0.37	0.50
Ohio	0.58	0.58	0.75	0.69

Van — 2022

State	Q1	Q2	Q3	Q4
Illinois	0.33	0.20	0.00	0.33
Ohio	0.71	1.00	0.67	0.60

Proportion unrestrained

Note. Q1 = lowest social vulnerability; Q4 = highest social vulnerability. Negative values represent reductions in non-use between 2014 and 2022. CDC/ATSDR (2014, 2022); NHTSA (2014, 2022).

Section Summary

Examining data and SVI from 2014 and 2022, Ohio consistently showed that a higher percentage of unrestrained fatalities occurred in most counties (Q1-Q4) than in Illinois. The data showed that males consistently had higher unrestrained use than females, especially in Ohio. The nighttime period continues to show much higher unrestrained use than the daytime period, especially in Ohio (see Figure 16). This was evident in Ohio, which had much higher unrestrained use than Illinois (see Figure 16). During the seasonal period, winter had the highest level of unrestrained use (see Figure 18), influenced by Midwestern winters. Across the various vehicle types, pickup truck occupants had the highest unrestrained rate in both states (see Figure 19), with Ohio being particularly high.

Bivariate SVI Statistical Test

To assess the significance of relationships between restraint use and key predictors, chi-square tests of independence were conducted separately for Illinois and Ohio. These analyses evaluated whether differences in restraint use are systematically associated with demographic (male and female, driver and passenger), situational (day and night, rural and urban, seasonal), and crash-related factors (vehicle type). The results provide a better understanding of which variables demonstrate meaningful associations with seat belt unrestrained usage across the two states. Additionally, this research included Cramer's *V* as a measurement. Cramer's *V* is a measure of the association between two categorical variables. This analysis showed certain factors, most notably day versus night and male versus female, that consistently emerge as significant predictors in both states, where other variables show greater variability across contexts and enforcement environments.

The χ^2 analyses identified several predictors of seat belt use that differed significantly between Illinois and Ohio. In both states, day and night, male and female, and seasons, unrestrained use was significantly associated, with effect sizes (Cramer's *V*) ranging from small to moderate. In Illinois, time of day and male and female emerged as the strongest predictors, while in Ohio, male and female and time of day were the most significant (see Table 7). Other variables showed more state-specific patterns. In Illinois, neither rural/urban nor season nor vehicle type was a significant predictor, though seasonal approached significance (see Table 7). In Ohio, however, season and vehicle type were significant in all cases, suggesting broader contextual influences on restraint use.

Table 7

χ^2 Test Results for Predictors of Seat Belt Use in Illinois and Ohio

	Illinois				Ohio			
	χ^2	*Df*	*p*	*V*	χ^2	*Df*	*p*	*V*
Male and Female	23.62	7	.001	.188	32.01	7	.001	.201
Driver and Passenger	8.41	7	.297	.112	14.05	7	.050	.133
Rural and Urban	12.25	7	.093	.148	8.51	7	.290	.114
Day and Night	45.90	7	.001	.262	43.15	7	.001	.234
Season	17.85	15	.270	.164	26.01	15	.038	.181
Vehicle Type	5.77	3	.123	.093	9.64	3	.022	.110

Note. χ^2 = chi-square statistic. *df* = degrees of freedom. *V* = Cramer's *V* effect size. *P*-values < .05 indicate statistically significant associations. CDC/ATSDR (2014, 2022); NHTSA (2014, 2022).

Section Summary

Overall, the χ^2 results demonstrated that male and female and day and night were consistent predictors of unrestrained usage across both Illinois and Ohio. At the same time, additional factors such as season and vehicle were more relevant in Ohio. These findings reinforce that Ohio's seat belt law has unrestrained usage patterns that are more vulnerable to contextual and temporal conditions, whereas Illinois' seat belt laws appear to reduce these variations.

Social Vulnerability Index (SVI) Logistic Regression Analysis

The logistic regression models presented in the previous section showed how the states' seat belt laws influence unrestrained usage across demographic and situational subgroups. However, these models do not show how seat belt use is impacted at a community level. Adding these factors to this research helps further shape restraint outcomes to understand the effect unrestrained use has on the socially vulnerable. To address this limitation, this section introduces logistic regression models that incorporate the SVI, a composite measure of county-level socioeconomic and structural disadvantage (CDC/ATSDR, 2014, 2022). By incorporating interactions between State, Year, and SVI Quartile, the models evaluate whether occupants in the most vulnerable counties (Q4) face elevated odds of being unrestrained in fatal crashes compared to those in the least vulnerable counties (Q1).

This analysis allowed for the identification of differences that emerge or increase over time, linking seat belt use to broader social causes of health. In doing so, the SVI logistic regression models extend the individual-level analysis by showing how state policy, demographic risk, and community context intersect to shape non-seat belt use.

SVI Interactive Model

The SVI Interactive Model examines how community-level vulnerability interacts with state seat belt laws across time (CDC/ATSDR, 2014, 2022; NHTSA, 2014, 2022). By incorporating an interaction between State, Year, and SVI Quartile, the model evaluates whether residents in more socially vulnerable counties (Q4) are at elevated risk of being unrestrained in fatal motor vehicle crashes. Then it compares them to the less vulnerable counties (Q1). This structure allows for the identification of disparities that emerge or widen over time, highlighting potential social vulnerable differences in traffic safety outcomes that align with broader social determinants of health (CDC/ATSDR, 2022).

In 2022, Ohio saw an increase in its odds ratio and predicted unrestrained usage in Q1, which was smaller than in Q4, and its vulnerable counties were statistically significant compared to Illinois. It should be noted that Ohio's gap between Q4 and Q1 more than tripled from 0.5 points in 2014 to 15.6 points in 2022, while Illinois' gap widened only modestly from 8.3 to 10.2 points (CDC/ATSDR, 2014, 2022; NHTSA, 2014, 2022).

Illinois has significantly lowered its odds of unrestrained usage compared to Ohio. This showed that Illinois residents buckled up. The most vulnerable counties (Q4) are characterized by at-risk populations that are more likely to take risks by not buckling up. Females were significantly less likely to be unrestrained, which validated gender differences. As seen in the earlier analysis, Ohio again shows higher disparities by SVI quartile, particularly among nighttime crashes.

Observed frequent occurrences show that unrestrained fatalities were more frequently tied to the most socially vulnerable counties (Q4) compared to the least vulnerable (Q1) in both states (see Table 8). When adjusted for demographic and situational covariates, these differences increased in Ohio but held steady in Illinois (see Table 11). Predicted probabilities indicated that unrestrained use in Ohio between the Q1-Q4 nearly doubled in high-risk areas, while in Illinois, moderate differences were observed (see Table 11). Taken together, these results suggest that social vulnerability worsens unrestrained use in both states, but the difference is more pronounced in Ohio due to its seat belt law (see Tables 9 and 10). Illinois' seat belt law appears to diminish the difference of this effect.

Table 8

SVI Interactive Analysis Findings

State	Year	*OR* (Q4 vs Q1)	95% CI	*p*-value	Q1 (%)	Q4 (%)	Gap (Q4-Q1)
Illinois	2014	1.39	[0.95, 2.04]	0.0918	45.9	54.2	8.3
Illinois	2022	1.70	[1.11, 2.59]	0.0146	48.2	58.4	10.2
Ohio	2014	1.03	[0.74, 1.43]	0.8780	58.2	58.7	0.5
Ohio	2022	1.87	[1.24, 2.81]	0.0027	52.5	68.1	15.6

Note. B = unstandardized coefficient; *OR* = odds ratio; *CI* = confidence interval (LL = lower limit, UL = upper limit). Prevalence = proportion of unrestrained fatalities. Gap = Q4 minus Q1 in percentage points. CDC/ATSDR (2014, 2022); NHTSA (2014, 2022).

Table 9

Logistic Regression Predicting Seat Belt Non-Use (Illinois and Ohio) Key Findings

Predictor	B	OR	95% CI (LL, UL)	*P*
State (Illinois)	-0.64	0.53	0.41, 0.68	< .001
Male and Female (Female)	-0.54	0.58	0.45, 0.75	< .001
Day and Night (Night)	0.95	2.58	2.03, 3.29	< .001

Note. B = unstandardized coefficient; OR = odds ratio; CI = confidence interval (LL = lower limit, UL = upper limit). Significant predictors ($p < .05$). CDC/ATSDR (2014, 2022); NHTSA (2014, 2022).

Table 10

Observed Prevalence of Seat Belt Non-Use by SVI Quartile (2014–2023)

	Q1 Prevalence	Q4 Prevalence	Rate Ratio (Q4 vs. Q1)	Gap (pp)
Ohio	0.47	0.60	1.28	13.07
Illinois	0.35	0.45	1.28	9.80

Note. Prevalence = proportion of unrestrained fatalities. Gap = Q4 minus Q1 in percentage points. CDC/ATSDR (2014, 2022); NHTSA (2014, 2022).

Observed Prevalence of Non-Seat Belt Use by SVI Quartile

Table 11

Predicted Probabilities of Seat Belt Non-Use by SVI Quartile (Adjusted Logistic Regression)

	Predicted Q1	Predicted Q4	Gap (pp)
Ohio	0.29	0.50	20.64
Illinois	0.23	0.33	10.22

Note. Predicted values adjusted for demographic and situational covariates. Gap = Q4 minus Q1. CDC/ATSDR (2014, 2022); NHTSA (2014, 2022).

Section Summary

Overall, the SVI logistic regression results reveal that community-level vulnerability intensifies the risk of unrestrained use, but the enforceability of the law profoundly influences the extent of that strengthening. In Ohio, differences between the least and most vulnerable counties widened over time, with predicted unrestrained usage differences exceeding 20 percentage points in 2022. In Illinois, by contrast, the differences remained far smaller, suggesting that primary enforcement reduces the influence of social learning and general deterrence on seat belt use, which will be further examined in Chapter 5. These findings highlight how social impacts of health intersect with state law, reinforcing that impacting non-seat belt use is rooted in the interaction between policy context and community vulnerability.

Social Vulnerability Index (SVI) Visualization Statewide Impact

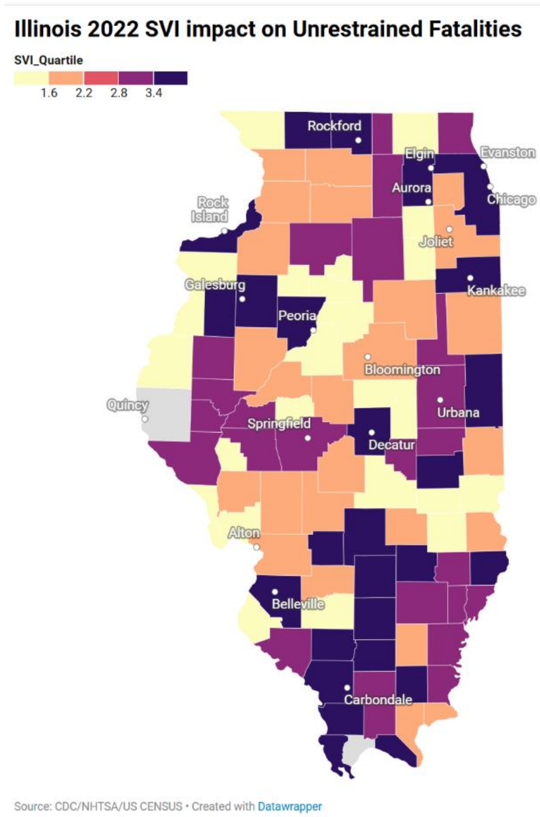
Understanding the spatial overlap between social vulnerability and unrestrained fatalities provides critical context for evaluating traffic safety policies (CDC/ATSDR, 2022; NHTSA, 2022). The CDC/ATSDR SVI provides insight about communities with higher concentrations of socioeconomic disadvantage, demographic risk factors, and infrastructure challenges (Flanagan et al., 2011), while NHTSA fatality data captures the locations of unrestrained fatalities (NHTSA, 2022). These two maps showed how social vulnerability and legal differences together affect motor vehicle fatality risk, highlighting the need to examine effective countermeasures tailored to interventions in high-SVI regions (CDC/ATSDR, 2022).

Illinois

The Illinois map (see Figure 20) shows that southern counties (near Carbondale, Belleville, and the Mississippi River corridor) are disproportionately represented in the highest SVI quartiles (CDC/ATSDR, 2022). These regions face historical socioeconomic challenges, which are also reflected in risks associated with unrestrained use (NHTSA, 2022). In all, Illinois' unrestrained use is geographically concentrated in socially vulnerable southern counties, as well as in urban hotspots that contribute to additional disparities (NHTSA, 2023; CDC/ATSDR, 2022).

Figure 20

Illinois 2022 SVI Impact on Unrestrained Fatalities



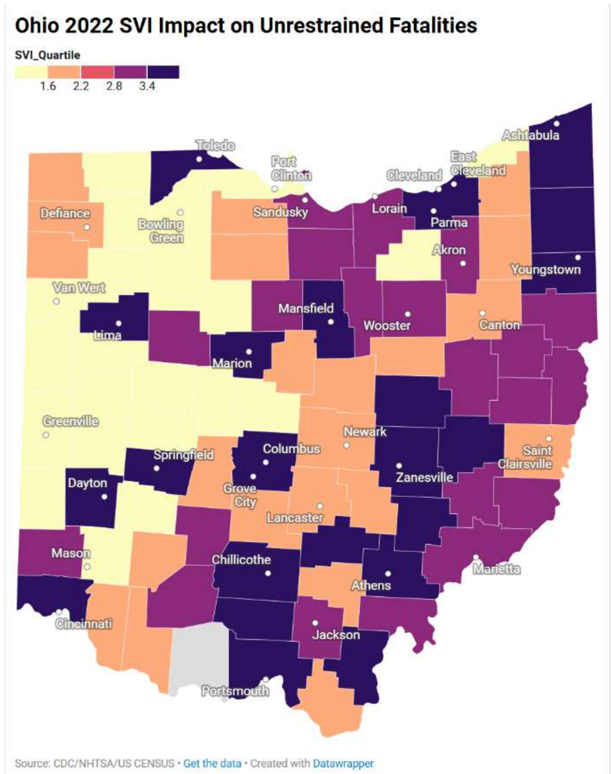
Note. CDC/ATSDR (2022); NHTSA (2022).

Ohio

The Ohio map (see Figure 21) shows a more widespread and uniform relationship between high SVI quartiles and unrestrained fatalities. The most significant effects occurred in the southeastern Appalachian region of Ohio and urban areas, where persistent poverty, rurality, and infrastructure limitations. This caused an elevated risk for unrestrained use (CDC/ATSDR, 2022).

Figure 21

Ohio SVI Impact on Unrestrained Fatalities (2022)



Note. CDC/ATSDR (2022); NHTSA (2022).

This comparison analysis visually highlighted that Illinois and Ohio have fundamental social differences, with their laws affecting unrestrained fatalities. While Illinois' seat belt law helps mitigate this risk in lower SVI regions, vulnerable counties continue to face disproportionate loss of life within the state (CDC/ATSDR, 2022; NHTSA, 2023). Ohio's seat belt law increases these vulnerabilities across both rural and urban counties. This points out that if Ohio's seat belt law is strengthened, it could improve seat belt compliance among its most vulnerable population groups (NHTSA, 2014, 2022; Shults et al., 2004).

This raised the importance of efforts to impact the socially vulnerable and focus on reducing fatalities. Implementing strategies such as targeted enforcement, education, and resource allocation is critical in providing help to reduce disparities (CDC/ATSDR, 2022). Even

Illinois, which has higher seat belt use, can improve its compliance by prioritizing interventions in its southern counties, while Ohio, on the other hand, should focus its efforts on the Appalachian region and urban centers (CDC/ATSDR, 2022; NHTSA, 2022). While using the SVI analysis underscores disparities in risk that can be used in this research, incorporating economic terms will help show the societal burden of unrestrained fatalities.

Economic Costs of Unrestrained Fatalities

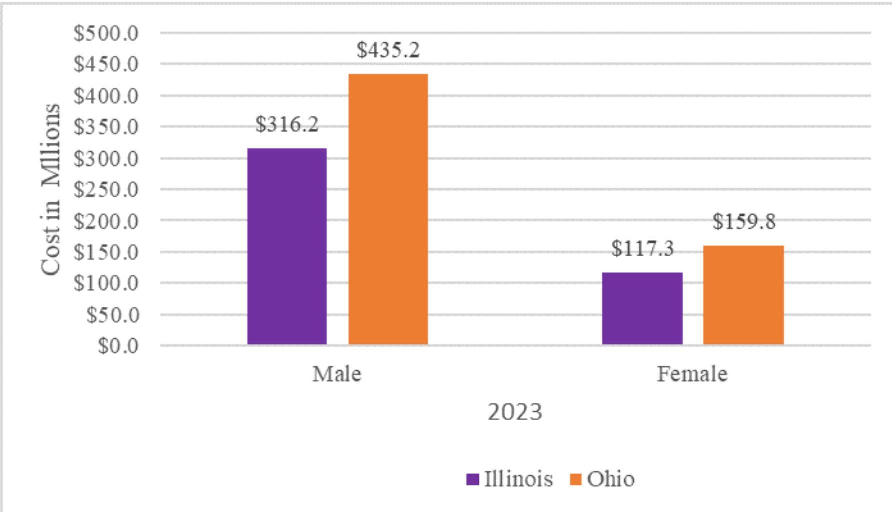
Understanding statistical analyses helps quantify the odds of unrestrained usage, and economic cost estimates illustrate the societal burden of unrestrained fatalities. This section translates fatality counts into economic losses to show the broader impact on states and communities. Further, this research provides descriptive and economic analysis of unrestrained fatalities in Illinois and Ohio in 2023. The findings are organized by gender, age group, and rural and urban areas, with estimated economic costs based on NHTSA's value of $1.7 million per fatality (inflation-adjusted from 2019).

Economic Costs of Unrestrained Fatalities by Occupants

As shown in Figure 22, males accounted for most of the economic losses. Ohio's male fatalities alone ($435M) exceed Illinois' entire statewide cost ($434M; NHTSA, 2023). As shown in Figure 24, young and middle-aged adults (20–39) contributed the highest costs, with Ohio exceeding Illinois by $180M (20–29) and $161M (30–39). Older adults had much lower costs in both states (NHTSA, 2023, economic cost estimate). Finally, as shown in Figure 23, urban costs were higher due to population size, but rural Ohio costs nearly doubled rural Illinois. This is reflected in Appalachia's elevated risk under secondary enforcement (NHTSA, 2023, economic cost estimate).

Figure 22

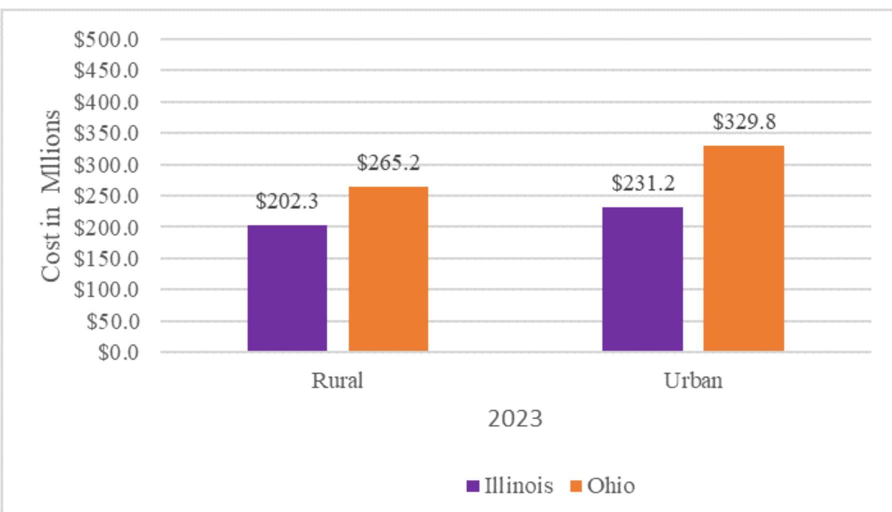
Economic Costs of Unrestrained Fatalities Male and Female 2023



Note. NHTSA (2023).

Figure 23

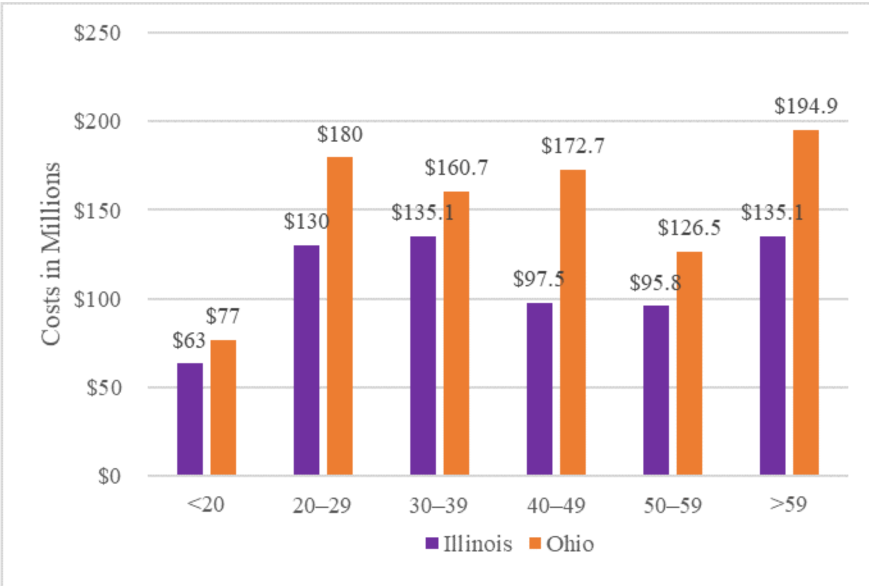
Economic Costs of Unrestrained Fatalities Rural and Urban 2023



Note. NHTSA (2023).

Figure 24

Economic Costs of Unrestrained Fatalities Age Group 2023



Note. NHTSA (2023).

Section Summary

Illinois. Consistent with prior subgroup findings, Ohio's economic costs were higher across all categories, especially among males and younger adults. Male occupants in Ohio have the most significant amount of cost associated with loss of life. This exceeds Illinois' total unrestrained economic costs. Economic costs for rural communities in Ohio, especially in Appalachia, show a disproportionately high economic cost compared to those in Illinois. This reflects the influence that secondary enforcement and geographic disparities have on unrestrained fatality costs. This research found that younger adults (ages 20–39) account for the most significant economic loss in both states. Ohio's burden of these economic costs is much higher. Collectively, these findings highlight that both demographic factors and legislative policies may be needed to curb unrestrained use through legislative change (NHTSA, 2023). Together, these findings establish a comprehensive picture of restraint non-use: who is most at risk, where disparities are most significant, and the costs to society. The chapter concludes by summarizing these results before moving to policy interpretation in Chapter 5.

Chapter Summary

When using data from 2014 to 2023, Illinois' primary enforcement laws consistently showed that, as an unrestrained occupant, your odds of being involved in a fatal crash were statistically significantly lower than in Ohio, which is affected by its secondary enforcement law. Additionally, unrestrained use is affected by high-risk groups, including males, nighttime crashes, pickups, and young (< 20) and older (> 59) occupants (see Figures 3, 7, 22; Table 4; NHTSA, 2023).

When putting together this data analysis and incorporating SVI analysis, the data points to three priorities targeting these high-risk groups (male, nighttime, pickup, young < 20 occupant, older > 59 occupant, and target high-SVI communities [southern Illinois hotspots; Appalachian and disadvantaged urban Ohio]) and match interventions to evidence-based countermeasures to impact these groups effectively. These findings set the foundation for Chapter 5, which will translate the findings here into actionable policy and effective countermeasures, SVI-guided resource allocation, messaging, and enforcement strategies targeting the subgroups identified in this chapter in most need to impact the reduction of crashes, injuries, and fatalities involving unrestrained usage over time (NHTSA, 2023).

Chapter V

Discussion and Implications

The purpose of this study is to explore differences (sociodemographic, contextual, situational) between two states with different seat belt laws (Illinois and Ohio). The previous chapter presented the study's data analysis results. This research collected crash statistics from 2014 to 2023. These results indicate the effectiveness of seat belt use and fewer fatalities. The study used disaggregated fatality data across various predictor variables. These variables consist of gender, occupant role, age groups, rural and urban areas, time of day, season, vehicle type, and county-level social vulnerability data. Social Vulnerability Index (SVI) data were from 2014 and 2022[1].

Understanding the difference between primary and secondary enforcement is important. The difference between the two is that primary seat belt laws allow law enforcement to stop and issue a seat belt citation for non-use. While a secondary law only allows law enforcement to cite if a primary infraction takes place (NCSA, 2025b). This difference has a significant impact on perceived enforcement risk and influences occupant behavior. Chapter 4 presents the results for this study, which show significant differences across enforcement types, demographic groups, and social contexts.

The following research is the most similar to this study. However, those studies' focus is more narrow in scope. The first one focused solely on how sociodemographic factors influence

[1] SVI data is only available every two years

seat belt use in primary and secondary enforcement states (Sartin et al., 2023). The second study evaluated the relative effectiveness of primary versus secondary seat belt enforcement laws by comparing their impact on seat belt use rates, crash-related injuries, and fatalities across different jurisdictions (Rivara et al., 1999). The third study has explored how socioeconomic and sociodemographic factors relate to community-level resiliency (Beck et al., 2007).

This study contributes to the field of traffic safety by building upon and expanding previous research. This study compares two neighboring states that differ in enforcement type but share similar regional, demographic, and economic characteristics. This makes Illinois and Ohio ideal for reviewing and assessing policy impact while controlling for contextual differences. One of the unique aspects of this study is that it integrates the Social Vulnerability Index (SVI) data from the CDC. The data combines SVI and county-level crash data using multiple predictor variables from traffic crashes. This study builds on previously mentioned research and fills gaps by examining sociodemographic factors alongside the effectiveness of the law type and linking SVI data.

Summary of Key Findings

While examining how states' seat belt laws affect counties with the most socially vulnerable populations, predictors were used to identify contextual examples of disproportionate risk. Overall findings show that Illinois consistently had lower unrestrained passenger vehicle occupant-related fatality rates than Ohio. Ohio's unrestrained passenger vehicle occupant-related fatality rates were consistently higher across nearly all subgroups looked at. Differences were statistically significant across multiple measures.

When factoring in SVI information, counties with higher social vulnerability (Q4) experience greater unrestrained passenger vehicle occupant risk in both states. However, differences were far more prevalent in Ohio, which tripled from 2014 to 2022. Illinois' primary law helped reduce these differences over the same period. Behavioral survey results showed that Illinois drivers reported stronger opinions about enforcement and higher seat belt use rates than Ohio drivers. The attitudinal awareness responses further indicate that stronger laws and high-visibility enforcement (HVE) significantly improve seat belt compliance. Statistical modeling showed that both demographic and situational factors influence unrestrained use. These factors included males, younger adults, nighttime travel, rural locations, and pickup truck occupants, which are most closely associated with non-seat belt use. These predictors were more present in Ohio, where weaker enforcement increased the risk, especially in highly vulnerable counties (Q4).

Economic analysis revealed that males account for nearly 75 percent of all societal costs related to unrestrained fatalities, with younger (ages 20–39) representing the most significant economic burden. In Ohio's rural areas, particularly in the Appalachian region, the cost is twice that of rural areas in Illinois. These costs are based upon the National Highway Traffic Safety Administration's (NHTSA) estimated economic value of $1.7 million per fatality in 2019 dollars (Blincoe et al., 2023).

Interpretation of Findings

The purpose of this study was to explore the impacts of a primary seat belt law state (Illinois) and a secondary seat belt law state (Ohio). The research factored in demographic subgroups, situational context, economic costs, and risky behavior traits through the integration of social vulnerability data. This allowed a better understanding of the impact of social differences on seat belt use in socially vulnerable counties. Understanding differences in law and their impact across the selected demographics of this study explained how the law affects whether someone buckles up, leading to consequences such as unrestrained fatalities and economic costs to society.

This section interprets findings through a theoretical lens, looking at the research questions and existing literature, and incorporating relevant theory to provide reasons for seat belt behavior. It integrated the previously introduced research questions with these theories and interpreted the key findings by examining the relationships among deterrence, social learning, and fatalism theories and their relevance to seat belt use.

Demographic Predictors

When comparing both states' data across various subgroups, males consistently had the highest unrestrained passenger vehicle occupant fatality rate, especially in Ohio. This high unrestrained use was prevalent among young (< 20) and older (> 59) occupants, who represent the vulnerable subgroups for all age groups. This research also found that older occupants had the lowest rate among all age groups. However, older occupants showed higher unrestrained in Ohio compared to Illinois. Logistic regression analysis confirms that young rural drivers and male passengers make up the most vulnerable subgroups (sex × occupant OR = 1.30, 95% CI [1.11, 1.53], $p < .001$).

When looking at integrated SVI overlaid data with unrestrained passenger vehicle occupant-related fatalities, it was found that in socially vulnerable counties (Q4), males and young (< 20) occupants made up the highest at-risk groups. These groups were at their highest risk at night while traveling through rural areas. Ohio had the highest risk in these vulnerable counties compared to Illinois.

Contextual Factors

Among contextual factors, traveling at night is often related to a significantly higher risk of unrestrained fatality rates. Rural areas in Ohio's socially vulnerable Appalachian region have higher unrestrained passenger vehicle occupant rates than urban areas. When factoring in social vulnerability, pickup trucks showed the highest proportions of unrestrained fatalities, particularly in Ohio's rural counties, followed by SUVs and then passenger cars. The season variable had minor variations between the data. The winter months had a slightly higher risk due to weather conditions prevalent in the Midwest, especially in Ohio. When accounting for the integrated SVI data, unrestrained fatalities occurred mainly during nighttime and in rural areas. Ohio's weak secondary law created risk by lacking certainty that seat belt enforcement would occur in these vulnerable counties.

Enforcement Type

Primary enforcement consistently reduces unrestrained use across all risk levels and nearly every situational and demographic subgroup. Illinois' primary law affects seat belt use and unrestrained fatalities through enforcement that influences its citizens to buckle up. This leads to a deterrent effect on its citizens' seat belt use. This comparison was applied across nearly all demographic and situational subgroups examined by this research. Inferential statistics were used to confirm that the variation was significant (OR = 0.66, 95% CI [0.53, 0.82], $p < .001$).

The analysis in this research revealed that Illinois had a significantly lower unrestrained passenger vehicle occupant rate across most subgroups, suggesting that law enforcement's ability to stop vehicles solely for seat belt violations is associated with lower unrestrained passenger vehicle occupant rates (NCSA, 2025b). Based on the data, there has been a reduction in unrestrained passenger vehicle occupant-related fatalities, consistent with deterrence theory. This affects seat belt use behavior; there is a certainty of sanctions when HVE is in place by the police (Nagin & Pogarsky, 2006; Wright, 2010).

Gender Differences

Having discussed the effects of primary and secondary enforcement on residents, this subsection looks at the effects of seat belt use on gender. When including gender (male vs. female) in the study, the subgroups show that males were consistently involved in higher unrestrained fatalities than females in both states. Ohio's unrestrained fatalities were higher across nearly all subgroups examined. These differences have widened in Ohio, reflecting weaker deterrence under secondary enforcement efforts there. This difference in male-female disparities across states shows that deterrence theory reduces perceived enforcement certainty by diminishing compliance among vehicle occupants (Papachristos et al., 2012). This difference is due to males typically being more risk-taking (Granié et al., 2020). This risk-taking is evident as males fail to utilize their restraint and are overrepresented in speed-related and impaired-related driving fatalities, another risk-taking behavior (Fernandes et al., 2010; NCSA, 2025b). These risk-taking attitudes among drivers contributed to their reluctance to wear a seat belt.

While conducting a controlled study on the effects of the state's seat belt law, researchers found that gender differences were statistically significant. This research had the same results. These results show a consistent difference rather than random variation. Logistic regression indicates that males have higher odds of being unrestrained passenger vehicle occupants than females (female OR = 0.76, 95% CI [0.66, 0.89], $p < .001$). Illinois' use of primary enforcement helps reduce the overall odds of being involved in an unrestrained passenger vehicle occupant fatality by about 34% compared to Ohio (Harper & Strumpf, 2017). When using both χ^2 and t

tests, results confirm that male and female were the strongest predictors (Male: $t = 8.36$, $p < .001$; Female: $t = 5.88$, $p < .001$).

Finally, when integrating SVI with gender, it was found that in socially vulnerable counties (Q4), Ohio males had the highest proportion of unrestrained passenger vehicle occupant-related rates. Females, on the other hand, were significantly less likely to be unrestrained passenger vehicle occupants in both states. Illinois' seat belt law helped reduce gender disparities even in socially vulnerable counties (Q4), whereas Ohio saw increases over time. Primary enforcement is particularly effective with risk-taking males (Harper & Strumpf, 2017). Additionally, male occupants were most at risk of injury while traveling at night in rural areas, especially when driving a pickup truck. Gender differences were more significant in Ohio due to its secondary law. This difference was most noticeable among male nighttime drivers, a subgroup that showed one of the strongest statistically significant state differences in a *t*-test analysis (rural comparison: $t = 6.92$, $p < .001$). In contrast, enforcement efforts in Illinois reduced gender-based risk across all subgroups, improving survival at night.

This higher rate of unrestrained passenger vehicle occupant-related fatalities for males in socially vulnerable counties goes hand in hand with the impact of fatalism. It is believed that those with higher levels of fatalistic beliefs perceive dangerous traffic situations as less risky and often engage in less safe behaviors, consistent with fatalism as a theory (Ngueutsa & Kouabenan, 2017). This male high-risk subgroup is also found in the Appalachian Region of Ohio, where sociocultural and socioeconomic factors influence behavior (Morgan & Calleja, 2020; Wooley & Smith, 2022). There are many negative influences on their attitudes and perceptions toward seat belt use. This culture and economy influence how rural residents express their viewpoints on enforcement. This perception is validated by the attitudinal awareness survey, which reflects their beliefs about not wearing a seat belt. The idea that, if it is going to happen, it will happen leaves this group's seat belt usage low. There is a consistent rationalization for their behavior that leaves this risk-taking group vulnerable to gender disparities, with exceptionally high unrestrained passenger vehicle occupant-related rates among males. The type of enforcement affects seat belt use, as shown by the significant differences between genders in Ohio and Illinois.

Occupant Role

The previous subsection examined gender, which helped to pinpoint risk takers (males). This subsection examines the occupant role (drivers vs. passengers), which may shape exposure and enforcement differently. When considering vehicle occupants in the analysis across subgroups, both groups show higher unrestrained passenger vehicle occupant rates in Ohio than in Illinois. Passengers were consistently unrestrained at a higher level than drivers in both states (passenger OR = 1.42, 95% CI [1.19, 1.70], $p < .001$).

These results align with social learning theory by the occupants' habits being socially reinforced. Illinois' primary law correlates with higher occupant protection use than Ohio's. According to social learning theory, individuals model observed behaviors. Modelled behavior occurs when a driver models their seat belt habits, and passengers notice these habits, which influence their seat belt behavior through modeled norms (And et al., 1983; NCSA, 2025b). In this instance, bad behavior breeds bad behavior; the modeling of the driver transfers to the passenger by not buckling up.

Rural and Urban

In rural and urban areas, drivers and passengers often have differences in seat belt use, with young male drivers having the highest unrestrained rates (see Table 12). The differences become even more evident when comparing rural and urban contexts, where enforcement and risk factors vary considerably. Ohio's unrestrained passenger vehicle occupant-related fatality rates were higher across nearly all key subgroups examined. This indicates that the secondary law would result in fewer restrained occupants than in Illinois. When looking at contextual factors, rural areas were consistently among the strongest predictors. Taking these interaction effects into account, it was found that young male drivers traveling at night in rural areas show the most significant state difference in seat belt use. These results indicate that Ohio's weaker enforcement efforts increase risk for these risk-taking subgroups (Rural comparison: $t = 4.61$, $p < .001$).

Table 12

Highest Unrestrained Use at Night by Interacted Subgroup

	Illinois	Ohio
20-39 Male Drivers-Rural-Night	*0.55*	0.85
20-39 Female Passengers-Rural-Night	*0.40*	0.70

Note. Values represent the proportion of fatally injured occupants who were unrestrained CDC/ATSDR (2014, 2022); NHTSA (2014, 2022)

Some of the difficulties that rural areas face are access to medical facilities. Medical treatment centers are often miles away from the crash location in rural areas. In addition, larger trauma centers that treat acute and complex injuries are in larger urban areas (Morgan & Calleja, 2020). Due to the vast distances between medical services traditionally located in urban areas, EMS response times are often longer in rural areas than in urban areas (Alanzy et al., 2019). This increased response time impacts the golden hour, which is a critical time period in getting crash victims the life-saving care needed to help increase the crash victim's chances for survival (Abhilash & Sivandan, 2020).

Rural areas face many challenges in conducting seat belt enforcement. These challenges are caused by limited resources for emergency services and a much smaller population base than urban communities. Rural law enforcement agencies are often understaffed, underfunded, undertrained, lacking equipment, and facing obstacles posed by rural attitudes and cultural norms (fatalism, distrust of the government, cultural resistance, etc.) that their counterparts in urban communities do not (Wooley & Smith, 2022). As a result of limited resources and a lack of traffic enforcement, deterrence is affected, and seat belt use is reduced among rural communities. Rural areas have smaller populations, large land areas, and limited law enforcement visibility, which makes traffic safety difficult (Davey & Freeman, 2011). Additionally, rural citizens engage in social norms (aversion to the government and fatalistic beliefs) that make it difficult for law enforcement to conduct seat belt enforcement. Rural citizens accept ill health with greater stoicism and often adopt a more fatalistic outlook on their daily lives, including their seat belt use. This adoption of cultural norms and the installation of fatalistic beliefs lead to aversion to government interference and authority, making the adoption of a primary seat belt a difficult task (Watson & Austin, 2021; Wooley & Smith, 2022).

Time of Day

While rural and urban areas add another layer of context to the data variances. Examining time-of-day conditions helps focus on the contrast between daytime and nighttime enforcement. This will reveal how seat belts are used in these contexts. When accounting for time of day (day versus night) as a contextual predictor, nighttime conditions corresponded to the highest rates of unrestrained passenger-occupant fatalities in both states (see Table 12). Ohio's unrestrained passenger vehicle occupant-related fatality rates were higher across nearly all key subgroups examined. Inferential statistics (χ^2 and *t* test) showed that time of day (day vs. night) is the strongest situational predictor as a control variable (Night vs. Day IL: $\chi^2 = 45.90$, $p < .001$, $V = .262$). This analysis reinforces the need for nighttime seat belt enforcement to increase seat belt use.

Driving at night is very risky. Drivers face reduced visibility, compromised night vision, fatigue, and other impairments. This makes driving on roadways at night a much more dangerous task than during the day (Wood, 2020). Additionally, occupants sometimes fail to wear their belts during the night (NCSA, 2025b). This non-use can result from taking a nap, feeling it is not as dangerous to be unbuckled because fewer people travel at night, and other reasons they engage in this risky behavior (Wood, 2020). The high risk for those traveling at night, combined with many making poor decisions not to wear their belts, results in unrestrained passenger vehicle occupant-related fatality rates being at a higher level than during the daytime. When considering that additional associate risks with nighttime driving, such as exposure to dangerous impaired drivers, are present, these impaired drivers present an increased risk of being involved in a fatal crash with other drivers on the roadway.

Another factor affecting traveling at night is seat belt enforcement conducted less frequently than during the day due to reduced call volume (Tison et al., 2010). Law enforcement consistently faces challenges when attempting to enforce seat belt enforcement at night. These challenges include officers' ability to see whether the violator is buckled up (Tison et al., 2010). This lack of vision makes it harder for the officer to detect when the belt is not being worn (Tison et al., 2010). There are fewer law enforcement officers on duty at night than during daytime operations. Due to this limited law enforcement presence at night, officers have less time to conduct seat belt enforcement (Mourtgos et al., 2024). However, in Illinois, nighttime enforcement is more likely to occur than in Ohio, which shows why Illinois' seat belt laws work even at night.

Age Group and Vehicle Type

When looking at seat belt use, this requires knowing how old the driver might be and what vehicle they might be in. When examining demographic and vehicle-related characteristics that interact with situational factors, they showed that the group had specific risk tendencies. This analysis revealed that young adults (ages 20-39) had the highest risk out of all age groups reviewed ($t = 4.19\text{-}4.28$, $p < .001$ for ages 20-39). Older adults (ages 59 and above) had the lowest unrestrained passenger vehicle occupant rate among all age groups reviewed ($t = 5.49$ for ages 59+, both $p < .001$). Inferential statistics, *t* tests, and logistic regression found that age was a significant situational predictor of being unrestrained among passenger vehicle occupants (Across all age groups, *t* values ranged from 3.77 to 6.10, all $p < .001$).

Among vehicle types, pickup truck occupants had the highest proportion of unrestrained occupants ($\chi^2 = 9.64$, $p = .022$, $V = .262$). In Ohio, pickup trucks were one of the top risk categories for unrestrained passenger vehicle occupant rates. Among the interaction effects, young male drivers traveling at night showed the most significant state differences when the interaction between the variables was accounted for. These data interaction results highlight Ohio's weaker enforcement efforts. This weaker effort included limited enforcement at night, and difficulty reaching specific populations at risk. This limited nighttime enforcement has led these subgroups to experience an increase in nighttime unrestrained fatalities.

Economic Costs Factors

This study provides context on age groups and vehicle type data results that show whether occupants buckle up. Economic cost analysis quantifies the societal burden associated with unrestrained use and the differences each law contributes. Ohio has the most significant amount of economic cost as a result of unrestrained passenger vehicle occupant-related fatalities. It was revealed that males were at the highest risk of being involved in an unrestrained fatality. In fact, Ohio males alone in 2023 had costs of $435 million, compared to Illinois' total economic costs of $434 million. Males accounted for the majority of the cost (73%). When factoring for area type, urban areas had higher overall costs, reflecting their larger populations. However, rural costs in Ohio were nearly twice those in Illinois. This aligns with the steep economic costs and losses resulting from unrestrained use in rural areas, particularly in the Appalachian region.

Males consistently experience higher involvement in unrestrained fatalities. Males tend to be risk-takers and often do not wear their seat belts as often as other age groups (Granié et al., 2020; NHTSA, 2025b). Young adults (ages 20-39) also fell into this category. They are less likely to wear their seat belts, contributing to economic losses from unrestrained fatalities. Seat belt use varies in rural and urban areas, which shows a clear difference in use, especially in Ohio. Ohio's enforcement limitations and rural culture differences associated with its secondary seat belt law add to lower seat belt use.

SVI Factors

Integrating these findings through the focus of social vulnerability underscores how community-level differences increase individual risk factors. When factoring in the Social Vulnerability Index (SVI) and examining disparities across vulnerable communities and how they interact with the focused subgroups in this research, we found that social vulnerability across the quadrilles (Q1-Q4) shows strong predicted unrestrained passenger vehicle occupant-related rates. Ohio's most socially vulnerable counties (Q4) saw the most significant increase in unrestrained rates, reaching 68.1% in 2022, while Illinois saw a moderate increase, reaching 58.4% in 2022. When SVI was factored into a logistic regression analysis, the Ohio (Q4 vs Q1) gap increased; Ohio Q4 predicted probability = 0.60 vs Q1 = 0.47; Illinois Q4 = 0.45 vs Q1 = 0.35. Ohio increased from 0.5 to 15.6 percentage points, while the Illinois gap increased from 8.3 to 10.2 percentage points. The odds of being in an unrestrained passenger vehicle occupant-related fatality increased in Ohio's high-SVI rural areas and while traveling at night.

Looking at spatial findings, Illinois' southern counties and Ohio's Appalachian region, including poor urban counties, were most affected and showed widespread disparities. Primary enforcement consistently reduces unrestrained use across all risk levels and nearly every situational and demographic subgroup. SVI data suggest that fatalistic beliefs may exacerbate unrestrained use in Ohio's most socially vulnerable counties. Those areas that were at a disadvantage could be affected by various economic or social influences, and, as a result, fatalism often shapes the beliefs, values, representations, and experiences shared by people in the same group, which, in turn, influences their bias towards non-seat belt use (Kouabenan, 1998).

Section Summary

Primary enforcement consistently reduces unrestrained use across all risk levels and nearly every situational and demographic subgroup. Statistically, *t*-tests, chi-square tests, and logistic regression confirm that significant levels across all models have affected seat belt use. These differences specifically indicate that males show significantly higher unrestrained use. These higher use rates are likely due to males' tendency to engage in riskier behavior. The difference in seat belt use across the two states indicates that Ohio has a weaker deterrent effect, as the gender gap is wider under both types of laws. In socially vulnerable, rural areas, males often have fatalistic attitudes, and disregard for traffic safety increases non-seat belt use. When factoring in SVI integration (quartile comparisons and highest-vulnerable counties, Q4), Illinois' primary law decreases gender differences, especially in socially vulnerable counties. Male passengers display the highest rates of unrestrained passenger vehicle occupant-related fatalities, suggesting they have a lower perceived risk of enforcement. Research suggests that social learning theory influences seat belt behavior through passengers observing driver behavior modeling, which in turn influences their seat belt use (Litt et al., 2014).

Rural vehicle occupants are less likely to comply with using their seat belts as a result of states like Ohio having a weaker law enforcement presence, resource constraints, and cultural fatalism. Enforcement is hampered by underfunding and the highly dispersed nature of rural policing, both of which reduce the deterrent effect. Another factor in rural areas is a delayed medical response, as EMS services have high response times, leading to fatal consequences when passenger vehicle occupants are unrestrained. Nighttime travel exhibited the highest rates of unrestrained occupants, particularly in Ohio. Nighttime enforcement is particularly challenging to conduct, especially in secondary states. As a result of the lack of nighttime enforcement in secondary states, its impact on deterrence is drastically reduced.

Young adults remain one of the highest-risk groups, who have a lower perception of enforcement efforts going on (or simply ignore it), and along with a thrill-seeking lifestyle, they have a higher exposure to being involved in a fatality (NHTSA, 2023; Topal et al., 2024). Pickup trucks are the strongest vehicle-based predictor of unrestrained rates in this study. These results are often tied to rural male drivers, who are the highest risk group when intersecting with demographic, behavioral, and situational factors. Young male pickup drivers at night are the most at risk within these subgroups when interactions among factors are considered (see Table 13).

Table 13

Summary of Significant Integrated Predictors and Direction of Effects

	Direction of Effect	*p*-value	State with Higher Risk
State (Law Type)	Illinois significantly lower	< .001	Ohio
Gender (Male vs. Female)	Males significantly higher	< .001	Both
Occupant Role (Passenger vs Driver)	Passengers significantly higher	< .001	Both
Time of Day (Day vs Night)	Night significantly higher	< .001	Both
Rural vs Urban	Rural higher (especially Ohio)	< .001	Ohio
Age Group	Ages 20–39 highest risk	< .001	Both
Vehicle Type	Pickup truck occupants highest	< .05	Both
Season	Slight winter increase, not significant	< .05	Ohio
SVI (Q4 vs Q1)	Highest risk in most vulnerable counties	0.0027–0.0146	Ohio

Note. CDC/ATSDR (2014, 2022); NHTSA (2014, 2022).

This study found that social vulnerability is a strong predictor of the unrestrained passenger vehicle occupant-related rate in Ohio's most vulnerable counties (Q4). Illinois' primary law reduces the SVI gradient, while Ohio's secondary law only increases it. The results from this research showed that unrestrained rates were highest in high-SVI vulnerable counties. These counties are poor, and the cultural attitudes of invincibility persist in both rural and urban communities.

When behavioral influences such as enforcement type, risk-taking, and fatalism interact with seat belt laws, legislation alone can be insufficient. There is a need to integrate cultural adaptation into their programs. Programs should look for ways to overcome fatalistic beliefs as they erode the perceived need for compliance and weaken the deterrent effect of enforcement. Additionally, the need to curb unrestrained use among rural male pickup drivers at night required both high-visibility enforcement (HVE) and rural-based education.

Theoretical Influence on Seat Belt Use

The following section employs several theories to motivate seat belt use behavior through multiple theoretical lenses that interact with one another. This section will look at the following theories: deterrence, social learning, and fatalism. These theories often intersect with one another to provide further explanations for why specific populations have a higher risk of death in fatal crashes. These provide a unique perspective of understanding motivation, beliefs, and social norms, which will further provide insight into seat belt use behavior. The study interprets seat belt use, along with the results from Chapter 4, and uses these theories to explain why individuals' behavior affects whether they buckle up.

Deterrence Theory

Deterrence theory finds that individuals are less likely to violate the law when they perceive that the costs of offending are influenced by the severity and swiftness of punishment. This will outweigh any potential benefits of violating the law (Nagin, 2013). The theory assumes people are rational actors who will weigh risks and rewards before engaging in criminal behavior. For traffic safety laws to deter violations, they must convey the certainty of punishment (Barnum et al., 2021).

This study indicated that nighttime travel had the highest unrestrained use in both states. Ohio's male pickup truck drivers had the strongest predictors for unrestrained passenger vehicle occupant fatality rate. As shown in Chapter 4, reduced perceived enforcement, especially in rural nighttime contexts, diminishes deterrence.

Illinois combines its seat belt law with HVE, which includes media and signage alerting the public to buckle up (NHTSA, 2025b). This strategy is often associated with general and specific deterrence, which encourages compliance of seat belt use by threatening that they will be seen and receive a ticket if they fail to buckle up. Illinois' lower restraint passenger vehicle occupant-related rate is tied to its HVE effort, which affects residents who pass through seat belt zones. Seeing those who fail to buckle up being pulled over reinforces them in modifying their behavior (Goodwin et al., 2005; Litt et al., 2014).

When fatalism influences seat belt use, it reduces the effects of perceived control on deterrence. Drivers and passengers do not believe it will happen to them and take risks, which is reinforced when they see others not buckling up (DeJoy, 1992; Wilde, 1982). As a result, deterrence will be reduced. If HVE is introduced and conducted in rural areas at night, it can minimize non-compliance and decrease fatalistic influences (Thomas et al., 2010; Tison et al., 2010).

Social Learning Theory

Social learning theory helps explain why people choose to wear or not wear seat belts through observation, modeling, and reinforcement (Akers, 1973). It was found that positive modeling, such as consistent seat belt use by family, friends, or peers, within vulnerable groups, can reduce fatalistic beliefs. This positive modeling shows them that seat belt use is both an easy and effective habit (Rimal & Real, 2003).

Social learning theory further explains how learned behavior influences traffic safety. Social learning indicates that passengers are influenced by the driver's behavior, including whether the driver uses a seat belt (Beck et al., 2019). This was confirmed in Chapter 4. Passengers use the driver's behavior as a model to reinforce norms of seat belt use or non-use. So, passengers will mirror the driver's seat belt use (passenger OR = 1.42) (Litt et al., 2014; Malekpour et al., 2021). Individuals who rationalize to not wear a seat belt due to it being a hassle, will often undervalue the long-term safety relative to short-term convenience, disregarding any benefits that seat belt use might confer (Kahneman & Tversky, 2013; Malekpour et al., 2021).

High-compliance groups that habitually buckle up due to enforcement and awareness efforts have a positive impact on seat belt use. These habits are then ingrained through social norms (And et al., 1983). In contrast, if the opposite is true, fatalistic beliefs will have a negative impact on seat belt use. When influential individuals (parents, peers, and community leaders) fail to model seat belt use correctly, they only reinforce fatalistic attitudes towards its use (Esparza-Del Villar et al., 2015). Males in Ohio's Appalachian region show the highest rates of unregulated use among rural groups.

Fatalism Theory

Fatalism directly conflicts with deterrence theory. As deterrence theory relies on perception and rationalization, fatalism relies on a person who is not easily persuaded to do anything (buckle up, obey the law, listen to safety messages, etc.). People with fatalistic beliefs believe their fate is already in the cards and that crash outcomes are inevitable. When individuals believe that crashes are due to fate, they often believe that it is useless to buckle up (Ngueutsa & Kouabenan, 2017). These fatalistic beliefs create tension between perceived control and the external enforcement, which influences an individual's decisions (Nagin & Pogarsky, 2006). As shown in Chapter 4, Rural Appalachian counties with high SVI show the highest fatality rates, aligning with the presence of fatalistic norms.

As fatalism and social learning theories intersect, they explain how each theory impacts the other through social modeling and belief transmission. As shown social learning theories show that fatalistic beliefs can be transmitted through observing behavior in group interactions, and deterrence influences environments that challenge fatalistic norms (Akers, 1990). While fatalism explains how one's beliefs are interwoven with certain environmental factors, social learning theory explains how beliefs are either adopted or influenced through group interactions (Kayani et al., 2012). If the positive behavior is consistently modeled in the community, this can eventually weaken fatalistic attitudes towards safety behavior (Kouabenan, 2007). As shown in Chapter 4, rural males at night show the highest rates of unrestrained use, most likely due to the influence of fatalistic norms. Thus, fatalism becomes self-fulfilling in high-risk communities.

Socioeconomic Factors Influencing Traffic Safety Outcomes

As previously stated, this study found that high-SVI counties with high social vulnerability had significantly higher rates of unrestrained use than counties with lower social vulnerability (Q1) (CDC/ATSDR, 2020). Rural areas (Appalachian Region) amplify the risk of unrestrained behavior due to Ohio's weaker enforcement (Beck et al., 2007). The following factors contribute to higher death rates in rural areas: higher speeds on the roadway, roadway characteristics (lack of paved shoulders), longer driving distances, lower perceived enforcement, limited access to medical care, an aging population, and along with cultural norms that affect rural cultural resistance to compliance with regulations (Fothergill & Peek, 2004).

These predictor variables contribute to reduced deterrence through limited enforcement and social norms, which can instill fatalism among economically disadvantaged individuals. The rural Appalachian regions in Ohio had nearly twice the unrestrained fatality in Q4 SVI rates. This exposure in rural areas differs from that in urban areas, in contrast, where there are shorter transport times to hospitals (access to trauma centers), urban congestion (slower speeds), higher education levels, and a greater propensity to obey regulations (Beck et al., 2007). Urban areas enhance the deterrence effect. There is a higher police presence (greater visibility and enforcement), greater media visibility, and strictly enforced laws that positively impact seat belt use, which aligns with deterrence theory.

Additionally, research found that sociodemographic factors (i.e., lower education and lower income) influenced seat belt use. These two factors were associated with lower seat belt use, and men were less likely to buckle up than their counterparts (Strine et al., 2012). As previously noted, research has shown that rural communities have fewer resources, including fewer law enforcement officers, than urban areas. These rural law enforcement officers must interact with rural citizens who have a distinct rural culture that impacts seat belt use. Research indicates that rural citizens have an aversion to government interference and authority, and that restrictive laws, such as a primary seat belt law, would be met with resistance (Watson & Austin, 2021; Wooley & Smith, 2022). These beliefs influence behavior and, when combined with poverty, can foster fatalistic beliefs. When people are poorer, they often have a bleaker view of life, leading them to take undue risks. In Ohio's high-SVI counties (Q4) saw 68.1% unrestrained rate in 2022.

Behavioral Economics

As presented earlier in this study, economic costs were lower in Illinois than in Ohio. The majority of these economic costs were from males aged 20-39, consistent with Chapter 4 findings showing them the highest unrestrained age group. These costs from this subgroup suggested that the structures of rural law enforcement agencies (understaffing, underfunding, and vast land) influenced non-seat belt use behavior (Wooley & Smith, 2022). Illinois' primary enforcement efforts appear to have improved compliance through loss aversion and the impact of penalties for not buckling up, leading to tickets that cost money and prompting individuals to comply with the law (Houston & Richardson, 2006).

The non-use of seat belts has driven the massive economic cost of life, over $1 billion across both states in 2019 dollars (NHTSA, 2023). Males were the most significant contributors to the overall amount. As Chapter 4 notes, 73% of the overall costs were borne by males. As discussed earlier, rural and urban areas showed disparities between the two states, showing higher usage in both areas in Ohio. Ohio's rural areas accounted for over 30% more costs than Illinois'. Economic cost disparities between the two states revealed that the primary state had significantly lower societal costs, mainly due to greater compliance with the seat belt law.

This section utilized behavioral economics to understand why people make the choices they do. Behavioral economics draws on various disciplines, including psychology, economics, and neuroscience. These choices help determine why people wear seat belts (Kahneman & Tversky, 2013; Thaler & Sunstein, 2009). When factoring in these choices involving traffic safety, they directly influence citizens to dismiss immediate inconveniences and discount potential penalties that are not as readily perceived as those outlined in secondary law. Illinois has the opposite effect, reflecting the certainty of enforcement. Illinois' seat belt law is primary and is certainly enforced, which aligns with the deterrence effect (Becker, 1968; Houston & Richardson, 2006).

Behavioral economics intersects with the previous theories examined. In rural Ohio, low seat belt use is due to lower enforcement presence. The high unrestrained fatalities in Ohio contribute to a greater economic cost to society than in Illinois. Looking at the impact of deterrence theory on secondary states shows that many of their citizens engage in bound rationality, weighing the costs of noncompliance against the benefits of compliance (Becker, 1968). This is a rational choice that many will struggle with, and this leads them to be overly optimistic, discount small risks, misperceive costs, or prioritize freedom and autonomy to do as they please, which results in non-compliance. Rural high-SVI populations where fatalistic norms compound these misconceptions.

Section Summary

The theories covered in this section focus on what motivates vehicle occupants' behavior when they get behind the wheel and connect it to behavioral mechanisms. These theories are then associated with Chapter 4's results and seat belt policy implications. Deterrence theory suggests that perceptions of compliance are influenced by emphasizing the effects of perceived certainty, severity, and the swiftness of punishment, which will influence behavior.

Social learning theory posits learned behavior that emphasizes the adoption of habits through observation and imitation (Akers, 1973; Bandura, 1977). This is shown when passengers tend to follow the lead of drivers and their communities, which mirrors observed behavior. As a result, when drivers demonstrate appropriate seat belt habits, passengers will mimic this seat belt use.

The perceived inevitability of harmful outcomes can lower perceived control among those with fatalistic views. They will rationalize risky behavior, thereby undermining deterrence and rational choice. However, consistent enforcement (Illinois nighttime enforcement efforts) that is viewed by others who influence them can counter fatalistic norms. Taken together, these theories help provide a multi-layered approach to address seat belt use. Incorporating HVE strategies and educational programs is required to improve seat belt use in rural areas.

Seat Belt Policy Implications

This section transitions from how theories influence findings to the implementation of evidence-based policy. These policies will help guide policymakers in improving state and local seat belt laws and programs. Data strongly indicate that rural and nighttime disparities are among the main areas where improvement can be achieved in Ohio and other secondary states. This study found that specific drivers of non-compliance include socioeconomics, cultural norms, enforcement limitations, and geographic influences (rural nighttime unrestrained disparities). All these factors should be considered when developing an effective problem identification process to begin addressing non-seat belt use. In order to get needed support from the public and political realm, policymakers must bring in multi-disciplinary collaboration efforts to be impactful and make necessary policy changes. This multi-disciplinary group should include stakeholders (public policymakers, law enforcement officials, public health professionals, EMS officials, public education system officials, community organization leaders, and business community leaders).

Socioeconomic Variables Influencing Traffic Safety Outcome

Effective reform depends on having a policy to address socioeconomic barriers that influence unrestrained driving behavior in rural Ohio. Rural areas amplify the risk of unrestrained behavior due to Ohio's weaker enforcement (Beck et al., 2007). Policymakers must find a way to influence those who buckle up, especially those in poverty, through an unconventional method of intervention (incentive-based or community-tailored). Polices addressing rural-specific issues are integral to implement. These rural-based interventions could help break down the barriers in rural cultures.

Primary vs. Secondary Enforcement

Finding out who is affected by the seat belt policy is important for moving towards consideration of the type of seat belt law needed. One of the most effective steps policymakers can take to improve seat belt use is to pass a primary law. As described earlier, primary laws are important because they permit law enforcement to pull over and cite seat belt violators solely on that offense. In contrast, secondary laws do require a primary violation first before issuing a citation (NCSA, 2025a).

Illinois, which operates under a primary law, consistently had lower unrestrained passenger vehicle occupant-related fatality rates than Ohio. This is seen across nearly all key subgroups examined; inferential tests additionally confirmed significant differences across all models (OR = .66). Data collected from primary states will help identify the impact of primary laws on seat belt use. Collecting these data is one of the first steps policymakers need to take when advocating for a change in the law.

Policymakers must gauge the public's perception of a topic, and results from attitudinal awareness surveys provide a wealth of data to consider. In addition to public support measures, results from these surveys found that Ohio residents supported having a primary law by only 50% (Seufert & Walton, 2017). Using economic and medical data will also help make the case for adopting a primary law. When policymakers use economic cost savings, they can also include the numbers for increased insurance premiums (such as vehicle insurance and healthcare). Additionally, policymakers can state that fatalities can lead to higher taxes (through increased law enforcement and EMS services) in messaging. This can be a complete way to get their citizens and politicians to change their seat belt law.

Policymakers should consider implementing HVE programs consistent with the deterrence mechanism discussed earlier. Research has indicated that HVE has the most significant impact on seat belt use (NCSA, 2025a). HVE is an important enforcement strategy that provides general deterrence, influencing a wider community by enabling them to witness, hear, and be affected (driving through seat belt zones) by it. Additional enforcement strategies could be implemented to address the unrestrained fatality disparity between Illinois and Ohio. Differences in restraint use are evident in Illinois, where a stronger deterrence effect results from the certainty and visibility of its enforcement.

Research has shown that in some states, primary seat belt enforcement has affected low-seat-belt-use groups, which include Hispanics, African Americans, impaired drivers, pickup truck occupants, younger drivers, and those on local roads (Nichols et al., 2012; Shults et al., 2004). This difference has a drastic influence on perceived enforcement, risk, and occupant behavior. Often, with the implementation of primary enforcement, there is public fear that it will be heavy-handed, intrusive, and undermine parity in targeting various communities. This is important to understand in order to develop programs that encourage these communities to buckle up and not feel closed off due to perceived indiscriminate enforcement.

Policymakers will need to examine countermeasures that can have an impact. Research has found that primarily enforcing laws with a population-based approach can effectively reduce disparities in seat belt use (Nichols & Ledingham, 2008). This method works for groups in rural areas, such as men, young adults, Blacks, and American/Indian/Alaska Natives, residents of rural areas, and people who engage in other high-risk behaviors. Policymakers must implement effective strategies to combat rural unrestrained fatalities, as rural areas have twice the death rate, and seat belt use is far lower (Beck et al., 2007). Effective reform depends on policymakers considering implementing a policy to require law enforcement, when they make seat belt stops, to focus only on that particular violation. Law enforcement should refrain from issuing unrelated tickets, such as defective equipment violations or other citations with a limited nexus to the original stop (St. Louis et al., 2011).

Targeted Interventions for Traffic Safety Programs

This section will focus on identifying specific, effective interventions to improve traffic safety programs and save lives. Target interventions will drive programming and actions to improve seat belt use. Data showed that the following control variables were significantly associated with non-seat belt use: males, younger adults (ages 20-39 years), nighttime travel, rural locations, and pickup truck occupants. The results of these control variables provide specific information that can be used to implement countermeasures to address non-seat belt use. Integrated data used found that vulnerable counties (the rural Appalachian region) were at high risk for individuals driving who could be involved in an unrestrained fatal crash.

These challenges reduce the deterrent effect by limiting the enforcement visibility and response time, which impacts seat belt use in rural areas. Another factor in rural areas is delayed medical response, as EMS has had high response times, leading to fatal consequences when passenger vehicle occupants are unrestrained. Policymakers will need to factor in both law enforcement and EMS limitations by providing support for training and resources through possible grants, helping bridge the shortcomings caused by budgetary restraints. As previously discussed, training needs to be focused on rural policing, and EMS will help address rural-specific issues.

These social norms, through fatalism and social learning, reinforce modeling when individuals witness undesired behavior, such as failing to buckle up, due to habits ingrained in this community. This aligns with the elevated unrestrained Q4 rates in Ohio. In these areas, where these subgroups originate, such as the rural Appalachian region, poverty is very high. Policymakers will need to find ways to incorporate methods that address rural social norms. They will need to adopt interventions that target the underserved communities that are overrepresented by unrestrained fatalities.

Incorporating behavioral economics (insurance incentives or community awards) into the design of effective incentives is a way to make headway amid the social norms in rural areas. This incentive-based targeted intervention positively impacts seat belt use behavior. Policymakers could explore partnering with an insurance company to offer reduced insurance premiums for continued seat belt use. Consideration will need to be factored in as feasibility concerns could arise (rural uninsured individuals). Another strategy would be to collaborate with local businesses to reward high-risk groups at checkpoints by issuing coupons for free single-item food products for properly worn seat belts. Another area for potential impact is through community organizations and employer-based groups that promote and recognize good seat belt use. Policymakers should continue to look for ways to provide positive interactions associated with seat belt use to overcome the rural social norm barrier.

To curb unrestrained use among high-risk rural groups, both HVE and education that addresses cultural norms will be required. Implementing and expanding nighttime-focused HVE in both rural and urban areas in Ohio is important. These targeted enforcement efforts impact the traditionally neglected portion of travelers who are significantly overrepresented and underrepresented in unrestrained fatalities. Policymakers could implement this strategy through enforcement interventions, establishing seat belt enforcement zones, and rural-focused awareness efforts through media, education, and behavioral nudges, as well as visible signage to alert the public that seat belt enforcement is in effect, aiming to generate a general deterrence effect.

Implementing nighttime HVE is important in rural areas. Ohio saw a 50% higher nighttime unrestrained passenger vehicle occupant-related fatality rate than in Illinois. Illinois has more success with nighttime rural restraint use due to its effective HVE policing programs. Policymakers must implement effective strategies, such as HVE, to help reduce unrestrained fatalities in states like Ohio (NCSA, 2025b). This HVE should include rural-focused awareness campaigns that focus on media, education, and behavior nudges to get citizens to buckle up. Adopting the HVE program should allow Ohio to address its weak seat belt law, offering a way to curb rising unrestrained fatalities.

Using SVI to Target At-Risk Jurisdictions

Behavioral interventions and geospatial targeting using SVI data can be used as a precision policy tool to help direct resources where they are most needed. The study found that SVI data showed that Ohio’s most socially vulnerable counties had the highest rates of unrestrained usage (Ohio Q4 rate = 68.1%). When examining the SVI data, it provided locations where socially vulnerable unrestrained seat belt users were involved in fatal car crashes. As previously mentioned in Chapter 4, using SVI data can help policymakers develop effective public health, safety, and social support interventions. This thereby reduces disparities caused by the non-use of seat belts. Policymakers should include multi-sector collaboration with health and social service agencies to support targeted interventions that cross multiple disciplines.

The use of SVI quartiles will help identify hotspots of vulnerable counties. However, SVI data is usually over two years and could provide some limitations. This hotspot data can provide valuable insights and enable effective resource allocation. Hotspot mapping is an effective tool for outlining areas impacted by unrestrained use along the lines of various control variables, such as gender or rural versus urban areas. This map (SVI overlay, crash-density hotspot map) can be used to identify clusters of problem areas, which can then be incorporated into appropriate activities to change behavior. These maps can be used by law enforcement to help direct enforcement efforts.

Effective Public Awareness Campaigns

After identifying vulnerable communities to target for interventions, it is necessary to get the message (males, young adults, rural communities, etc.) out about buckling up. This message will raise public awareness among the targeted individuals who are most likely to affect seat belt use. This requires policymakers to plan how the message will be implemented (who, what, when, how, and why). One evidence-based approach is to use well-recognized local messengers (a pastor, sheriff, superintendent, or mayor). These individuals can be very influential in delivering awareness through the vernacular of rural environments. This helps develop a sense of community, which is imperative to successfully reaching the intended audience and affecting positive change. As previously discussed in Chapter 4, rural areas with high SVI scores (Q4) may especially require culturally based messages.

When it comes to effective HVE, it is paired with communications and awareness. HVE includes strategic media placement aimed at being seen by the intended audience, such as young male adults aged 18-34 years, who are the commonly targeted age group for the annual national Click It or Ticket (CIOT) campaign. Policymakers need to develop a targeted (younger drivers, males, or rural areas) awareness campaign to support seat belt use in high-risk areas. Places such as rural areas can be challenging for messaging, and effective media communication should be used. Utilizing radio, billboards, in-person education, and other methods may break the social norms of rural living.

As discussed earlier, the attitudinal awareness survey measures individuals' perceptions of various aspects of the program. Results can range from program recognition to program support of a law, such as primary. Using this data can offer support for policy, program, and placement changes. Successful results are measured by the intended outcomes, so the message reaches the targeted audience through the awareness program. The attitudinal awareness responses further indicate that stronger laws and HVE significantly improve seat belt compliance. Strong community support, as found in these surveys, helps develop effective strategies to target the intended audience. This was evident in the responses that were given by Illinois and Ohio in their surveys. Which highlighted support for law enforcement in Illinois, and in Ohio did not support passing a primary law.

This research found that the attitudinal survey showed Illinois drivers report higher seat belt use and support for enforcement, consistent with primary laws such as those in Illinois. Behavioral survey results showed that Illinois drivers reported stronger opinions about enforcement and higher seat belt rates than Ohio drivers. Data from attitudinal awareness surveys provide policymakers with a wealth of information. Using the results of this survey often confirms how well their programs are performing. Policymakers use an attitudinal awareness survey to determine if the program implemented impacted its targeted group.

When focusing on rural areas, policymakers must factor in their unique circumstances and problems through a rural lens. Rural communities have different beliefs from those in urban environments. Rural residents sometimes have a fatalistic belief system. The citizens' belief reinforces the idea that rural groups' behavior is influenced by what they observe and believe. As stated previously, when rural citizens face poor health, they seem to adopt a fatalistic view of outcomes. This makes the adoption of primary seat belts a challenging task (Watson & Austin, 2021; Wooley & Smith, 2022). When fatalism influences seat belt use, deterrence is less effective, as perceived control is often low, which reduces deterrence. Both the driver and passenger believe that if they do not think they will be involved in a crash, then the incident will not happen to them, which leads them to take undue risks.

Policymakers should develop rural education programs that address rural issues. Adopting rural-based programs will help raise public awareness in hard-to-reach communities, consistent with findings from rural Q4 counties in Ohio. These public awareness campaigns should use a shared responsibility message on seat belt use, featuring a community leader as its voice to secure local buy-in. This example is currently in use in a program that the author interacts with, which brings in a community leader to deliver an awareness message in the community's vernacular tone. This delivery method results in a much more positive acceptance throughout this relatively small rural community where the program is currently being delivered.

Behavioral Economics

Having a deeper understanding of how to promote awareness of the program helps us explore ways to overcome stiff resistance and cultural norms (rural Appalachian region). Ohio found that the economic costs $435 million for males. The number of unrestrained fatalities was higher than in Illinois. Policymakers should use economic costs to shape public perception, particularly in rural areas, regarding seat belt use. This societal loss can catalyze policy changes.

When data shows an increase in the potential cost of medical care and insurance, as well as the loss of life, it can be compelling to provide evidence that supports change.

One of the first steps that would effect change is to switch a law from secondary to primary. Effecting this transition would require several steps. Policymakers can use this data as a way to present the costs of not buckling up (medical expenses, higher insurance premiums, and loss of life) to the public. When the public is informed about these associated economic costs, it can influence whether the law is accepted by the public (Dardis, 1983). Framing primary enforcement not as punitive but as economically prudent aligns with both behavioral and fiscal policy perspectives

Research has found that fatal crashes in rural communities occur more often as a result of limited traffic enforcement. Policymakers will need to devise strategies to persuade the rural public to adopt change through unconventional means. The community's belief system (fatalism, rural aversion to government, etc.) should be factored into any proposed intervention they may consider adopting. Policymakers should present the economic cost of potential lives lost and show how many lives could be saved if the primary seat belt law is implemented. Consumer risks can influence the degree of protection this intervention (law) has in the form of reduced taxes, insurance, and medical costs upon its implementation.

When consumers are saliently informed, for example, through a media campaign (availability heuristics) advising them to buckle up, everyone buckles up, which may influence them to change their behavior (Dardis, 1983; Elder et al., 2004). This example of behavioral nudges, which can encourage individuals to change by determining the context of their choices, rather than relying on enforcement or sanctions (Thaler & Sunstein, 2009).

This study suggests using behavioral nudges to complement primary enforcement. In addition, behavioral nudges can be used in community-based safety programs to enhance seat belt use (Elder et al., 2004). These additional programs are beneficial because governments can use behavioral nudges to improve outcomes in health, finance, and the environment without compromising individual freedom (Thaler & Sunstein, 2009). Additionally, cost-benefit analysis can influence people's positive behaviors related to traffic safety. Incentives could be an economic factor that could help some buckle up. Research has found that education, personalized tips, and planning exercises without incentives did not significantly increase buckling-up rates. Giving money directly to individuals to get them to buckle up might be cost-prohibitive. Policymakers should consider persuading insurance companies that adopt an insurance-based incentive, or reducing another type of cost, which may be persuasive and encourage restrained use (Thaler & Sunstein, 2009).

Section Summary

This research provides policymakers with ways to implement interventions, campaigns, and awareness efforts to influence the targeted groups identified in this study. Additionally, guidance on implementing these strategies is provided by various recommended interventions (nighttime rural males). The study's findings provide a clear roadmap to start this process, link it to recommended types of enforcement, acknowledge the impact of socioeconomic vulnerability, and, hopefully, lead to effective outcomes because of action.

The transition from secondary to primary enforcement states is critical for increasing seat belt use and reducing fatalities. This research shows that Illinois has lower unrestrained use and a much lower economic-loss threshold than Ohio ($435 million for male economic costs in Ohio). This data are important to policymakers, as they must demonstrate how changing this law will benefit not only public safety but also society. Policymakers could use social nudges to help steer current non-seat belt users toward becoming belt users. There is a need to make it real for society. Including SVI data will also help prioritize funding and interventions for the targeted high-risk counties.

Using a strong public awareness campaign that is influenced by rural cultural norms can help bridge gaps in aversion and resistance to the government telling them what they can and cannot do. Instead, show them how this will benefit them through savings in economic and medical costs, as well as lives saved. This message must be in the community's dialect to have any influence. Policymakers will then be able to achieve greater success when they integrate a rural community-based approach to change. Additionally, this will overcome political reluctance to implement policy changes when they receive grassroots support. It is imperative to bring a multidisciplinary approach, including stakeholders (policymakers, political supporters, law enforcement, EMS, public health, education, community, and business organizations), to help drive change through influence, political will, and community support. Multidisciplinary approaches help build community trust by fostering buy-in. Additionally, having this group will allow stakeholders a conduit to listen and voice concerns, who will be responsible for implementing these programs.

Implementing effective policies requires addressing safety in Ohio. These policies should include adopting a primary seat belt law. Enacting stronger seat belt laws will save lives. This step will not be easy; policymakers will have to be very ingenious and engage all available resources and policy strategies to convince lawmakers and citizens to support adoption.

Research Limitations

As discussed throughout this chapter, the study focused on two states as case studies to examine the impact of primary versus secondary seat belt laws. This research included data that was often two years behind. In proper problem identification, timely data is essential for developing effective programs with impactful strategies and countermeasures. In the traffic safety world, data on fatalities is limited to real-time. This will be an unforeseen issue likely to persist in future traffic safety research.

The analysis conducted in this research used vehicle miles traveled (VMT) to normalize descriptive data. VMT is a good exposure denominator; the data may not fully capture differences in occupant behavior that affect seat belt compliance across the state.

In this research, the heavy reliance on secondary data limited the use of qualitative data. This limited measurement of behavior and perception to only the annual seat belt survey and the attitudinal awareness surveys missed additional data that could have supported the research and strengthened its conclusions. As a result, attitudinal awareness surveys were used only in 2016 for this research. Unfortunately, this was the last year in which both states conducted these surveys. Recently, many states have not been conducting attitudinal awareness surveys. This is the result of these surveys being too costly, at a time when competition for funding impacts the use of traffic safety dollars.

Generalizability could allow this study to be used to address many groups. However, because of group differences, its applicability to other research may be affected. Another limitation is the use of inferential statistical models, which may not capture some effects or nonlinear patterns.

Seat belt surveys are susceptible to human error, which can affect the validity of the results. Data compiled from surveys has a human element in coding results. There is an opportunity to code seat belt use incorrectly or to count too many or too few observations, leading to misreporting. Ensuring the data has appropriate margins of error is an important requirement for collecting data to ensure it is complete and accurate. For NHTSA-approved seat belt surveys, the standard error cannot exceed 2.5 percent (Electronic Code of Federal Regulations, 2023). These factors should be included in any survey planned.

Empirical studies can entail inherent data and methodological limitations. The use of FARS/FIRST records a list of unknown data or not reported. This is the result of cases not always being reported or not being available when law enforcement completes its crash reporting. However, stability over time strongly supports the missing-at-random (MAR) assumption. This was the case for unrestrained passenger vehicle occupant-related fatalities were used in this study. As a result, these data points were excluded from the research. FARS/FIRST and SVI are the most authoritative datasets available. These limitations are due to data availability, not an analytical choice. This study tested whether the proportions of unknown restraint data were stable during the study's 2014-2023 review period. The analysis reports indicated that Illinois' proportion remained stable, with a mean of 14.5% and a standard deviation of 5.4% and Ohio's proportion remained stable, with a mean of 9.5% and a standard deviation of 1.6%. The data showed minimal year-to-year deviation. A visual trend analysis and chi-square testing ($p > .05$) showed no significant temporal or state-level differences. Interpretations may require some caution. The data results remained the same across the descriptive and inferential tests conducted. Findings from this study remained consistent across multiple years and subgroups.

SVI data is available only in 2-year increments, so this study examined (cross-sectionally) only 2 years (2014 and 2022), as crash data years do not perfectly align with SVI years. These years were selected to correlate as closely with the primary dataset examined (2014-2023). SVI uses an ecological index that cannot establish individual-level causation. Thus, SVI often correlates with unmeasured or co-occurring contextual factors, making it contextual rather than causal.

Recommendations for Future Research

This study focuses on the effects of seat belt laws on enforcement, using sociodemographic data and overlaying SVI with fatality information to determine how seat belt laws influence seat belt use in Illinois and Ohio, particularly in their vulnerable counties. Several areas could be further studied (enforcement effectiveness, rural risks, motivation, the psychology of traffic offenders) and considered in future research to strengthen the findings. Additional studies should address these missing elements and use them to strengthen policy. Additional areas that could strengthen this include the inclusion of temporal and methodological limitations, as well as the lack of a qualitative understanding of driver attitudes and fatalism in rural communities. Additionally, there is a need for expanded longitudinal and mixed-method designs that capture behavioral and enforcement effects over time.

Policymakers must know the impact of the seat belt law after its passage. One method to track this impact would be to conduct a longitudinal study. The longitudinal study would assess the long-term impacts of the seat belt law. Results could show the frequency with which enforcement is done after the law is implemented and the change in unrestrained fatalities over time. This additional information would allow us to see the change over an extended period. Additionally, observed behaviors can be examined for changes due to various interventions. For example, this should include periods when the seat belt law was in effect and prior to establishing a baseline to measure its impacts. This method would clarify gradual or delayed behavioral change resulting from the implementation or non-implementation of the law on seat belt use by vehicle occupants. This analysis could also help determine enforcement, program, and intervention levels, enabling adjustments to have a greater impact on seat belt use.

States that have utilized attitudinal awareness surveys are getting smaller. This decrease is due to rising costs of conducting attitudinal awareness surveys. The information gathered from this survey is the closest qualitative data available on citizens' perceptions. While surveys like these have some bias, they remain a valuable tool for gathering qualitative insights into the drivers and passengers' feelings and opinions on traffic safety issues. Future research could include a larger sample for an attitudinal awareness survey. The additional sample size would provide policymakers with a larger data set to consider.

Future studies should employ mixed-methods approaches better to capture perceptions of deterrence and fatalism across rural communities. The combination of the two methods provides a great breadth to the field. It captures the complexity of decision-making about seat belt use, enabling the researcher to provide more practical, context-based recommendations. Future studies should employ mixed-methods approaches to better capture perceptions of deterrence and fatalism across rural communities.

SVI data have been instrumental in establishing an ecological perspective on traffic safety. Using county-level interventions tied to SVI and its poverty indices could further focus on incorporating public health, safety, and social support interventions and programs. This SVI information will help provide a response that prioritizes interventions, programs, and tailored enforcement efforts to high-risk communities.

Future studies should fully use economic and medical data to persuade others from a fiscal and societal cost perspective. Expanding the use of a comprehensive economic analysis of seat belt use and injuries would support further research and increase the data available to inform it. This research should factor in medical costs to fully understand the broader picture of economic costs to society beyond fatalities, because crash data alone does not fully reveal the medical and financial consequences of motor vehicle crashes. Including injury data, which is astronomically more costly than fatalities due to sheer numbers, is essential.

There are several tools available to illustrate the costs of unrestrained fatalities to society. One tool that can be used is the Crash Outcomes Data Evaluation System (CODES), developed by NHTSA and used by various states to link vehicle crash outcomes with crash, vehicle, and behavior characteristics to specific medical and financial outcomes (NHTSA, 2025c). Using this information to help define the costs of lost productivity and reduced quality of life would yield a data visualization that could influence public policymakers by showing the real costs of non-seat belt use. The use of this data could serve as a compelling argument for passing primary laws and incorporating strong programs, interventions, and enforcement measures.

Evaluation is a good way to determine if a state’s policies or programs are on track and are meeting the goals and objectives established. All traffic safety policies and programs should include an evaluation component to assess whether the intended outcomes were achieved.

Conclusion

This research has taken a journey to examine the primary and secondary states of Illinois and Ohio. The comparison of these two laws regarding unrestrained use, controlling for various variables to understand the impact of wearing a belt, and additionally, factoring in SVI data to determine how vulnerability and poverty affect seat belt use. This research identifies common issues that rural areas, nighttime travel, and gender have a substantial impact on the two states. Illinois, which operates under a primary law, consistently had lower unrestrained passenger vehicle occupant-related fatality rates than Ohio.

The economic costs of loss of life are significantly different between the two states. Ohio has higher rates of loss, and gender is a key variable that plays strongly here, as males are astronomically higher than females. In fact, Ohio males have more economic costs than Illinois' total economic losses. SVI data show a substantial rural inequality of deaths, especially in socially vulnerable counties.

Previous research has found that primary states have higher seat belt use rates and lower unrestrained fatality rates. However, combining various control variables and SVI data takes this research further, showing the impact that mainly rural vulnerable counties face. These findings emphasize the fiscal and human impacts that continuing with a secondary law would lead to, including continued loss of life. One of the key recommendations from this research is for Ohio to transition to a primary state. This would help reduce economic losses.

Additionally, a short-term goal would be to expand Ohio's HVE statewide program to include both rural and urban efforts, as well as nighttime enforcement. Policymakers can use SVI mapping to help identify high-risk, vulnerable counties and provide resources to impact unrestrained fatalities. This needs to be tied into community-centered public awareness campaigns to help overcome local culture and rural fatalism that undermine seat belt use. Using behavioral economic nudges and fiscal arguments to build public and legislative support is necessary. Finally, bringing in multi-sector collaboration across public health officials, law enforcement leadership, education leadership, and local business leaders. Together, these policies will help provide a data-driven structure for parity reform. This ensures that rural and vulnerable communities receive parity under a new primary law.

This research has helped validate the difference that primary law has in seat belt use and in reducing loss. Policymakers need to be advocates for change, ensuring that grassroots efforts reach as many people as possible by using various tactics to persuade them to join the cause. Policymakers need the most up-to-date data to create visualizations that effectively highlight the problem. There is also a need to make sure that influential leaders who support this life-saving law are on board with the grassroots efforts. It is imperative to include advocacy groups and to employ research to continue providing answers that demonstrate the impact of this issue in this state and others. Turning evidence into practice by implementing seat belt use in secondary enforcement states is challenging; it requires interagency coordination and accountability. Data collection is crucial for continuing to demonstrate the impact of non-seat belt use on the community, including economic losses, and for evaluating what has worked and making adjustments to achieve broader impact.

It is essential that the public view seat belt enforcement as being for the greater good and that its use is not tied solely to that violation, but rather is not muddied with other types of enforcement, such as interdiction and violations that may excessively impact the poor. Shared responsibilities in encouraging community engagement to view seat belt use as a habit. They should want to change it away from being looked at as an infringement on their daily lives. Ohio and other secondary law states are at a crossroads. This research is clear that impactful data-driven and culturally informed police policies will save lives. Policymakers must push forward with the adoption of primary law and move past inaction that merely adds to the loss of lives, as occupants fail to apply the single most effective measure to save lives: buckling up.

This framework of deep data analysis, followed by problem identification that examines individuals such as male rural drivers traveling at night, informs the development of effective, targeted interventions that integrate rural policing with HVE and educational methods to achieve maximum impact. Together, these findings support expanding primary enforcement laws and targeted HVE in rural high-SVI areas, especially focusing on young male pickup drivers Switching to a primary law will give us the best chance of survival. Each life saved is a family member, a loved one, or a community member who will be the result of buckling up. Each of these lives saved will help validate the reform of switching laws for the sake of public safety.

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Appendix A:

Data Sources and Variables Definitions

The study used publicly available data sources and state-reported secondary data from the following agencies:

- National Highway Traffic Safety Administration (NHTSA)
- Fatality Analysis Reporting System (FARS) 2014-2023
- Fatality and Injury Reporting System Tool (FIRST)
- Centers for Disease Control and Prevention (CDC)
- CDC Social Vulnerability Index (SVI), 2014 and 2022
- Georgia Governor's Office of Highway Safety (GOHS)
- Illinois Department of Transportation (IDOT): Seat Belt Observational Surveys (2015-2024)
- Ohio Department of Public Safety (ODPS): Seat Belt Observational Surveys (2015-2024)
- IDOT: Attitudinal Awareness Survey (2016)
- ODPS: Attitudinal Awareness Survey (2016)

Independent Variables:

- Primary Seat Belt Law (Illinois) and Secondary Seat Belt Law (Ohio)

Dependent Variables:

- Unrestrained passenger vehicle occupant-related fatality
- Restrained passenger vehicle occupant-related fatality
- Fatality rate per 100 million vehicle miles traveled (MVMT)
- Observed daytime seat belt usage (%)
- Economic cost per fatality (NHTSA 2019 inflation adjustment)

Control Variables:

- Gender (male, female)
- Age group (< 20, 20-29, 30-39, 40-49 50-59, > 59)
- Occupant role (driver, passenger)
- Time of day (day, night)
- Rural vs. Urban
- Season (winter, spring, summer, fall)
- Vehicle type (passenger car, SUV, van, pickup truck)

Contextual Variable:

- CDC Social Vulnerability Index (SVI) quartiles (Q1-Q4)

Appendix B:

Analysis Tables

Table 1

Logistic Regression Predicting Unrestrained Use: State x Gender x Occupant Role

Predictor	B	SE	OR	95% CI (LL, UL)	*Z*	*P*
Intercept	0.063	0.047	1.065	0.972, 1.167	1.353	0.176
Gender (Female vs. Male)	-0.580	0.079	0.560	0.479, 0.654	-7.294	< .001
Occupant Role (Passenger vs. Driver)	-0.063	0.114	0.939	0.750, 1.174	-0.553	0.580
Time of Day (Night vs. Day)	0.664	0.069	1.943	1.699, 2.222	9.692	< .001
Gender (Female vs. Male) × Occupant Role (Passenger vs. Driver)	0.076	0.161	1.079	0.788, 1.479	0.476	0.634
Gender (Female vs. Male) × Time of Day (Night vs. Day)	0.262	0.125	1.300	1.017, 1.661	2.092	0.036
Occupant Role (Passenger vs. Driver) × Time of Day (Night vs. Day)	0.133	0.167	1.142	0.824, 1.583	0.797	0.426
Gender (Female vs. Male) × Occupant Role (Passenger vs. Driver) × Time of Day (Night vs. Day)	-0.360	0.243	0.698	0.434, 1.124	-1.480	0.139
State (Illinois vs. Ohio)	-0.416	0.070	0.659	0.575, 0.756	-5.991	< .001
State (Illinois vs. Ohio) × Gender (Female vs. Male)	0.073	0.121	1.076	0.848, 1.364	0.602	0.547
State (Illinois vs. Ohio) × Occupant Role (Passenger vs. Driver)	0.163	0.173	1.177	0.839, 1.653	0.944	0.345
State (Illinois vs. Ohio) × Time of Day	-0.020	0.100	0.980	0.805,	-0.201	0.841

Predictor	B	SE	OR	95% CI (LL, UL)	*Z*	*P*
(Night vs. Day)				1.193		
State (Illinois vs. Ohio) × Gender (Female vs. Male) × Occupant Role (Passenger vs. Driver)	-0.223	0.245	0.800	0.495, 1.294	-0.909	0.363
State (Illinois vs. Ohio) × Gender (Female vs. Male) × Time of Day (Night vs. Day)	-0.211	0.186	0.810	0.563, 1.167	-1.131	0.258
State (Illinois vs. Ohio) × Occupant Role (Passenger vs. Driver) × Time of Day (Night vs. Day)	0.034	0.241	1.035	0.645, 1.659	0.141	0.888
State (Illinois vs. Ohio) × Gender (Female vs. Male) × Occupant Role (Passenger vs. Driver) × Time of Day (Night vs. Day)	0.458	0.356	1.581	0.787, 3.176	1.286	0.198

Note. B = unstandardized coefficient; SE = standard error; OR = odds ratio; CI = confidence interval.

Table 2

Logistic Regression Predicting Unrestrained Use: State x Gender

Predictor	B	SE	OR	95% CI (LL, UL)	*z*	*P*
Intercept	0.384	0.031	1.468	1.382, 1.559	12.499	< .001
Gender (Female vs. Male)	-0.566	0.051	0.568	0.514, 0.627	-11.163	< .001
State (Illinois vs. Ohio)	-0.373	0.045	0.689	0.631, 0.752	-8.324	< .001
State (Illinois vs. Ohio) × Gender (Female vs. Male)	0.019	0.075	1.019	0.879, 1.181	0.249	0.803

Note. B = unstandardized coefficient; SE = standard error; OR = odds ratio; CI = confidence interval.

Table 3

Logistic Regression Predicting Unrestrained Use: State x Gender x Rural and Urban Area

Predictor	B	SE	OR	95% CI (LL, UL)	*z*	*P*
Intercept	0.278	0.043	1.320	1.214, 1.436	6.469	< .001
Gender (Female vs. Male)	-0.612	0.072	0.542	0.471, 0.624	-8.544	< .001
Rural and Urban Area (Rural vs. Urban)	0.215	0.062	1.240	1.099, 1.399	3.497	< .001
Gender (Female vs. Male) × Rural and Urban Area (Rural vs. Urban)	0.090	0.102	1.094	0.897, 1.336	0.887	0.375
State (Illinois vs. Ohio)	-0.223	0.065	0.800	0.705, 0.908	-3.448	< .001
State (Illinois vs. Ohio) × Gender (Female vs. Male)	-0.047	0.109	0.954	0.770, 1.182	-0.430	0.667
State (Illinois vs. Ohio) × Rural and Urban Area (Rural vs. Urban)	-0.295	0.090	0.744	0.624, 0.888	-3.288	0.001
State (Illinois vs. Ohio) × Gender (Female vs. Male) × Rural and Urban Area (Rural vs. Urban)	0.119	0.151	1.126	0.837, 1.515	0.785	0.432

Note. B = unstandardized coefficient; SE = standard error; OR = odds ratio; CI = confidence interval.

Table 4

Logistic Regression Predicting Unrestrained Use: State x Gender x Time of Day

Predictor	B	SE	OR	95% CI (LL, UL)	*Z*	*P*
Intercept	0.053	0.043	1.054	0.970, 1.146	1.235	0.217
Gender (Female vs. Male)	-0.565	0.068	0.568	0.498, 0.649	-8.313	< .001
Time of Day (Night vs. Day)	0.687	0.062	1.987	1.758, 2.246	10.996	< .001
Gender (Female vs. Male) × Time of Day (Night vs. Day)	0.157	0.105	1.170	0.952, 1.436	1.494	0.135
State (Illinois vs. Ohio)	-0.390	0.064	0.677	0.598, 0.767	-6.132	< .001
State (Illinois vs. Ohio) × Gender (Female vs. Male)	0.027	0.103	1.028	0.839, 1.259	0.263	0.792
State (Illinois vs. Ohio) × Time of Day (Night vs. Day)	-0.004	0.091	0.996	0.833, 1.191	-0.043	0.966
State (Illinois vs. Ohio) × Gender (Female vs. Male) × Time of Day (Night vs. Day)	-0.043	0.155	0.958	0.708, 1.298	-0.275	0.784

Note. B = unstandardized coefficient; SE = standard error; OR = odds ratio; CI = confidence interval.

Table 5

Logistic Regression Predicting Unrestrained Use: State x Gender x Age Group

Predictor	B	SE	OR	95% CI (LL, UL)	*Z*	*P*
Intercept	0.291	0.148	1.338	1.001, 1.787	1.967	0.049
Gender (Female vs. Male)	-0.122	0.244	0.885	0.549, 1.427	-0.501	0.616
Age Group (30–39 vs. 20–29)	0.183	0.220	1.201	0.780, 1.849	0.833	0.405
Age Group (40–49 vs. 20–29)	0.078	0.219	1.081	0.704, 1.660	0.357	0.721
Age Group (50–59 vs. 20–29)	0.013	0.223	1.013	0.654, 1.569	0.058	0.954
Age Group (< 20 vs. 20–29)	-0.478	0.226	0.620	0.398, 0.964	-2.121	0.034
Age Group (> 59 vs. 20–29)	-0.736	0.178	0.479	0.338, 0.679	-4.130	< .001
Rural and Urban Area (Rural vs. Urban)	0.433	0.230	1.542	0.983, 2.419	1.885	0.059
Time of Day (Night vs. Day)	0.573	0.200	1.773	1.198, 2.625	2.862	0.004
Gender (Female vs. Male) × Age Group (30–39 vs. 20–29)	-0.287	0.359	0.750	0.371, 1.517	-0.800	0.424
Gender (Female vs. Male) × Age Group (40–49 vs. 20–29)	-0.620	0.355	0.538	0.269, 1.078	-1.748	0.080
Gender (Female vs. Male) × Age Group (50–59 vs. 20–29)	-0.989	0.371	0.372	0.180, 0.769	-2.667	0.008
Gender (Female vs. Male) × Age Group (< 20 vs. 20–29)	-0.088	0.360	0.916	0.453, 1.854	-0.243	0.808

Gender (Female vs. Male) × Age Group (> 59 vs. 20–29)	-0.603	0.293	0.547	0.308, 0.971	-2.062	0.039
Gender (Female vs. Male) × Rural and Urban Area (Rural vs. Urban)	-0.281	0.370	0.755	0.366, 1.560	-0.759	0.448
Age Group (30–39 vs. 20–29) × Rural and Urban Area (Rural vs. Urban)	-0.364	0.341	0.695	0.356, 1.355	-1.069	0.285
Age Group (40–49 vs. 20–29) × Rural and Urban Area (Rural vs. Urban)	-0.335	0.337	0.716	0.370, 1.385	-0.994	0.320
Age Group (50–59 vs. 20–29) × Rural and Urban Area (Rural vs. Urban)	-0.102	0.340	0.903	0.464, 1.758	-0.300	0.764
Age Group (< 20 vs. 20–29) × Rural and Urban Area (Rural vs. Urban)	-0.318	0.361	0.728	0.359, 1.476	-0.881	0.378
Age Group (> 59 vs. 20–29) × Rural and Urban Area (Rural vs. Urban)	-0.492	0.271	0.611	0.359, 1.040	-1.816	0.069
Gender (Female vs. Male) × Time of Day (Night vs. Day)	-0.372	0.350	0.690	0.348, 1.368	-1.063	0.288
Age Group (30–39 vs. 20–29) × Time of Day (Night vs. Day)	-0.232	0.306	0.793	0.436, 1.443	-0.759	0.448
Age Group (40–49 vs. 20–29) × Time of Day (Night vs. Day)	-0.228	0.313	0.796	0.432, 1.470	-0.728	0.467
Age Group (50–59 vs. 20–29) × Time of Day (Night vs. Day)	0.211	0.336	1.235	0.640, 2.384	0.628	0.530
Age Group (< 20 vs. 20–29) × Time of Day (Night vs. Day)	-0.385	0.311	0.680	0.370, 1.251	-1.240	0.215
Age Group (> 59 vs. 20–29) × Time of Day (Night vs. Day)	0.049	0.278	1.051	0.609, 1.812	0.177	0.859
Rural and Urban Area (Rural vs. Urban) × Time of Day (Night vs. Day)	-0.155	0.294	0.856	0.481, 1.525	-0.528	0.598
Gender (Female vs. Male) × Age Group (30–39 vs. 20–29) × Rural and Urban Area (Rural vs. Urban)	0.666	0.554	1.947	0.657, 5.771	1.202	0.229

Gender (Female vs. Male) × Age Group (40–49 vs. 20–29) × Rural and Urban Area (Rural vs. Urban)	0.523	0.551	1.687	0.573, 4.966	0.949	0.343
Gender (Female vs. Male) × Age Group (50–59 vs. 20–29) × Rural and Urban Area (Rural vs. Urban)	0.406	0.543	1.500	0.518, 4.346	0.747	0.455
Gender (Female vs. Male) × Age Group (< 20 vs. 20–29) × Rural and Urban Area (Rural vs. Urban)	0.052	0.567	1.053	0.347, 3.202	0.092	0.927
Gender (Female vs. Male) × Age Group (> 59 vs. 20–29) × Rural and Urban Area (Rural vs. Urban)	0.564	0.436	1.758	0.748, 4.131	1.295	0.195
Gender (Female vs. Male) × Age Group (30–39 vs. 20–29) × Time of Day (Night vs. Day)	0.807	0.533	2.241	0.789, 6.366	1.515	0.130
Gender (Female vs. Male) × Age Group (40–49 vs. 20–29) × Time of Day (Night vs. Day)	0.687	0.551	1.988	0.675, 5.854	1.248	0.212
Gender (Female vs. Male) × Age Group (50–59 vs. 20–29) × Time of Day (Night vs. Day)	0.858	0.584	2.358	0.751, 7.400	1.470	0.142
Gender (Female vs. Male) × Age Group (< 20 vs. 20–29) × Time of Day (Night vs. Day)	0.492	0.528	1.635	0.580, 4.607	0.931	0.352
Gender (Female vs. Male) × Age Group (> 59 vs. 20–29) × Time of Day (Night vs. Day)	0.317	0.479	1.372	0.537, 3.507	0.662	0.508
Gender (Female vs. Male) × Rural and Urban Area (Rural vs. Urban) × Time of Day (Night vs. Day)	0.530	0.499	1.700	0.639, 4.520	1.063	0.288
Age Group (30–39 vs. 20–29) × Rural and Urban Area (Rural vs. Urban) × Time of Day (Night vs. Day)	0.452	0.446	1.571	0.655, 3.765	1.012	0.311
Age Group (40–49 vs. 20–29) × Rural and Urban Area (Rural vs. Urban) × Time of Day (Night vs. Day)	0.113	0.453	1.120	0.461, 2.721	0.250	0.803

Age Group (50–59 vs. 20–29) × Rural and Urban Area (Rural vs. Urban) × Time of Day (Night vs. Day)	-0.466	0.479	0.628	0.245, 1.605	-0.972	0.331
Age Group (< 20 vs. 20–29) × Rural and Urban Area (Rural vs. Urban) × Time of Day (Night vs. Day)	0.933	0.483	2.541	0.987, 6.543	1.933	0.053
Age Group (> 59 vs. 20–29) × Rural and Urban Area (Rural vs. Urban) × Time of Day (Night vs. Day)	0.083	0.397	1.086	0.499, 2.365	0.208	0.835
Gender (Female vs. Male) × Age Group (30–39 vs. 20–29) × Rural and Urban Area (Rural vs. Urban) × Time of Day (Night vs. Day)	-1.380	0.755	0.252	0.057, 1.105	-1.827	0.068
Gender (Female vs. Male) × Age Group (40–49 vs. 20–29) × Rural and Urban Area (Rural vs. Urban) × Time of Day (Night vs. Day)	-0.468	0.789	0.626	0.133, 2.942	-0.593	0.553
Gender (Female vs. Male) × Age Group (50–59 vs. 20–29) × Rural and Urban Area (Rural vs. Urban) × Time of Day (Night vs. Day)	-0.502	0.805	0.605	0.125, 2.934	-0.624	0.533
Gender (Female vs. Male) × Age Group (< 20 vs. 20–29) × Rural and Urban Area (Rural vs. Urban) × Time of Day (Night vs. Day)	-0.594	0.788	0.552	0.118, 2.590	-0.753	0.451
Gender (Female vs. Male) × Age Group (> 59 vs. 20–29) × Rural and Urban Area (Rural vs. Urban) × Time of Day (Night vs. Day)	-0.969	0.683	0.379	0.099, 1.448	-1.418	0.156
State (Illinois vs. Ohio)	-0.152	0.223	0.859	0.555, 1.330	-0.680	0.496
State (Illinois vs. Ohio) × Gender (Female vs. Male)	-0.034	0.350	0.966	0.487, 1.917	-0.098	0.922
State (Illinois vs. Ohio) × Age Group (30–39 vs. 20–29)	-0.356	0.331	0.701	0.366, 1.341	-1.074	0.283

State (Illinois vs. Ohio) × Age Group (40–49 vs. 20–29)	0.180	0.344	1.197	0.609, 2.351	0.522	0.602
State (Illinois vs. Ohio) × Age Group (50–59 vs. 20–29)	-0.472	0.332	0.624	0.325, 1.196	-1.421	0.155
State (Illinois vs. Ohio) × Age Group (< 20 vs. 20–29)	0.116	0.341	1.123	0.576, 2.191	0.341	0.733
State (Illinois vs. Ohio) × Age Group (> 59 vs. 20–29)	-0.044	0.269	0.957	0.564, 1.622	-0.165	0.869
State (Illinois vs. Ohio) × Rural and Urban Area (Rural vs. Urban)	-0.558	0.331	0.573	0.299, 1.096	-1.682	0.093
State (Illinois vs. Ohio) × Time of Day (Night vs. Day)	-0.124	0.294	0.883	0.497, 1.571	-0.423	0.672
State (Illinois vs. Ohio) × Gender (Female vs. Male) × Age Group (30–39 vs. 20–29)	0.507	0.534	1.660	0.583, 4.727	0.950	0.342
State (Illinois vs. Ohio) × Gender (Female vs. Male) × Age Group (40–49 vs. 20–29)	-0.437	0.554	0.646	0.218, 1.914	-0.789	0.430
State (Illinois vs. Ohio) × Gender (Female vs. Male) × Age Group (50–59 vs. 20–29)	0.815	0.544	2.258	0.777, 6.561	1.497	0.134
State (Illinois vs. Ohio) × Gender (Female vs. Male) × Age Group (< 20 vs. 20–29)	-0.165	0.524	0.848	0.304, 2.367	-0.316	0.752
State (Illinois vs. Ohio) × Gender (Female vs. Male) × Age Group (> 59 vs. 20–29)	-0.493	0.445	0.611	0.255, 1.461	-1.108	0.268
State (Illinois vs. Ohio) × Gender (Female vs. Male) × Rural and Urban Area (Rural vs. Urban)	0.264	0.541	1.302	0.451, 3.760	0.487	0.626
State (Illinois vs. Ohio) × Age Group (30–39 vs. 20–29) × Rural and Urban Area (Rural vs. Urban)	0.831	0.493	2.295	0.873, 6.038	1.684	0.092
State (Illinois vs. Ohio) × Age Group (40–49 vs. 20–29) × Rural and Urban Area (Rural vs. Urban)	-0.426	0.523	0.653	0.234, 1.819	-0.815	0.415
State (Illinois vs. Ohio) × Age Group (50–59 vs. 20–29) × Rural and Urban Area (Rural vs. Urban)	0.162	0.489	1.176	0.451, 3.069	0.331	0.741

State (Illinois vs. Ohio) × Age Group (< 20 vs. 20–29) × Rural and Urban Area (Rural vs. Urban)	0.232	0.521	1.261	0.454, 3.503	0.445	0.656
State (Illinois vs. Ohio) × Age Group (> 59 vs. 20–29) × Rural and Urban Area (Rural vs. Urban)	0.375	0.395	1.455	0.670, 3.158	0.948	0.343
State (Illinois vs. Ohio) × Gender (Female vs. Male) × Time of Day (Night vs. Day)	0.158	0.508	1.171	0.433, 3.167	0.310	0.756
State (Illinois vs. Ohio) × Age Group (30–39 vs. 20–29) × Time of Day (Night vs. Day)	0.537	0.448	1.711	0.711, 4.115	1.200	0.230
State (Illinois vs. Ohio) × Age Group (40–49 vs. 20–29) × Time of Day (Night vs. Day)	-0.306	0.479	0.736	0.288, 1.881	-0.640	0.522
State (Illinois vs. Ohio) × Age Group (50–59 vs. 20–29) × Time of Day (Night vs. Day)	0.101	0.484	1.106	0.428, 2.858	0.208	0.836
State (Illinois vs. Ohio) × Age Group (< 20 vs. 20–29) × Time of Day (Night vs. Day)	0.240	0.483	1.271	0.493, 3.278	0.496	0.620
State (Illinois vs. Ohio) × Age Group (> 59 vs. 20–29) × Time of Day (Night vs. Day)	0.027	0.418	1.028	0.453, 2.334	0.066	0.948
State (Illinois vs. Ohio) × Rural and Urban Area (Rural vs. Urban) × Time of Day (Night vs. Day)	0.349	0.417	1.417	0.625, 3.212	0.835	0.404
State (Illinois vs. Ohio) × Gender (Female vs. Male) × Age Group (30–39 vs. 20–29) × Rural and Urban Area (Rural vs. Urban)	-1.171	0.808	0.310	0.064, 1.512	-1.449	0.147
State (Illinois vs. Ohio) × Gender (Female vs. Male) × Age Group (40–49 vs. 20–29) × Rural and Urban Area (Rural vs. Urban)	0.098	0.871	1.103	0.200, 6.082	0.112	0.911
State (Illinois vs. Ohio) × Gender (Female vs. Male) × Age Group (50–59 vs. 20–29) × Rural and Urban Area (Rural vs. Urban)	-0.295	0.796	0.745	0.156, 3.544	-0.370	0.711
State (Illinois vs. Ohio) × Gender (Female vs. Male) × Age Group (< 20 vs. 20–29) × Rural and Urban Area (Rural vs. Urban)	0.307	0.829	1.360	0.268, 6.907	0.371	0.711

State (Illinois vs. Ohio) × Gender (Female vs. Male) × Age Group (> 59 vs. 20–29) × Rural and Urban Area (Rural vs. Urban)	-0.013	0.658	0.988	0.272, 3.587	-0.019	0.985
State (Illinois vs. Ohio) × Gender (Female vs. Male) × Age Group (30–39 vs. 20–29) × Time of Day (Night vs. Day)	-1.061	0.777	0.346	0.075, 1.587	-1.366	0.172
State (Illinois vs. Ohio) × Gender (Female vs. Male) × Age Group (40–49 vs. 20–29) × Time of Day (Night vs. Day)	0.429	0.834	1.535	0.299, 7.871	0.514	0.607
State (Illinois vs. Ohio) × Gender (Female vs. Male) × Age Group (50–59 vs. 20–29) × Time of Day (Night vs. Day)	-1.487	0.860	0.226	0.042, 1.219	-1.730	0.084
State (Illinois vs. Ohio) × Gender (Female vs. Male) × Age Group (< 20 vs. 20–29) × Time of Day (Night vs. Day)	-0.559	0.795	0.572	0.120, 2.716	-0.703	0.482
State (Illinois vs. Ohio) × Gender (Female vs. Male) × Age Group (> 59 vs. 20–29) × Time of Day (Night vs. Day)	0.382	0.726	1.465	0.353, 6.084	0.526	0.599
State (Illinois vs. Ohio) × Gender (Female vs. Male) × Rural and Urban Area (Rural vs. Urban) × Time of Day (Night vs. Day)	-0.308	0.719	0.735	0.180, 3.006	-0.429	0.668
State (Illinois vs. Ohio) × Age Group (30–39 vs. 20–29) × Rural and Urban Area (Rural vs. Urban) × Time of Day (Night vs. Day)	-1.241	0.633	0.289	0.084, 1.000	-1.960	0.050
State (Illinois vs. Ohio) × Age Group (40–49 vs. 20–29) × Rural and Urban Area (Rural vs. Urban) × Time of Day (Night vs. Day)	0.434	0.682	1.544	0.405, 5.879	0.636	0.525
State (Illinois vs. Ohio) × Age Group (50–59 vs. 20–29) × Rural and Urban Area (Rural vs. Urban) × Time of Day (Night vs. Day)	-0.103	0.683	0.902	0.237, 3.441	-0.151	0.880

State (Illinois vs. Ohio) × Age Group (< 20 vs. 20–29) × Rural and Urban Area (Rural vs. Urban) × Time of Day (Night vs. Day)	-0.621	0.699	0.538	0.136, 2.117	-0.888	0.375
State (Illinois vs. Ohio) × Age Group (> 59 vs. 20–29) × Rural and Urban Area (Rural vs. Urban) × Time of Day (Night vs. Day)	-0.440	0.581	0.644	0.206, 2.012	-0.757	0.449
State (Illinois vs. Ohio) × Gender (Female vs. Male) × Age Group (30–39 vs. 20–29) × Rural and Urban Area (Rural vs. Urban) × Time of Day (Night vs. Day)	1.955	1.086	7.064	0.841, 59.350	1.800	0.072
State (Illinois vs. Ohio) × Gender (Female vs. Male) × Age Group (40–49 vs. 20–29) × Rural and Urban Area (Rural vs. Urban) × Time of Day (Night vs. Day)	-0.142	1.195	0.868	0.083, 9.026	-0.118	0.906
State (Illinois vs. Ohio) × Gender (Female vs. Male) × Age Group (50–59 vs. 20–29) × Rural and Urban Area (Rural vs. Urban) × Time of Day (Night vs. Day)	0.598	1.188	1.819	0.177, 18.652	0.504	0.614
State (Illinois vs. Ohio) × Gender (Female vs. Male) × Age Group (< 20 vs. 20–29) × Rural and Urban Area (Rural vs. Urban) × Time of Day (Night vs. Day)	0.491	1.150	1.634	0.171, 15.569	0.427	0.670
State (Illinois vs. Ohio) × Gender (Female vs. Male) × Age Group (> 59 vs. 20–29) × Rural and Urban Area (Rural vs. Urban) × Time of Day (Night vs. Day)	0.466	1.012	1.594	0.219, 11.588	0.461	0.645

Note. B = unstandardized coefficient; SE = standard error; OR = odds ratio; CI = confidence interval.

Table 6

Logistic Regression Predicting Unrestrained Use: State x Vehicle Type

Predictor	B	SE	OR	95% CI (LL, UL)	*Z*	*p*
Intercept	1.792	0.764	6.000	1.343, 26.809	2.346	0.019
Vehicle Type (Pickup Truck vs. Other)	-1.152	0.767	0.316	0.070, 1.420	-1.503	0.133
Vehicle Type (SUV vs. Other)	-1.599	0.765	0.202	0.045, 0.906	-2.089	0.037
Vehicle Type (Van vs. Other)	-1.835	0.771	0.160	0.035, 0.723	-2.380	0.017
Vehicle Type (Passenger Car vs. Other)	-1.708	0.764	0.181	0.040, 0.811	-2.235	0.025
State (Illinois vs. Ohio)	-1.281	0.922	0.278	0.046, 1.692	-1.389	0.165
State (Illinois vs. Ohio) × Vehicle Type (Pickup Truck vs. Other)	0.908	0.927	2.478	0.403, 15.261	0.979	0.328
State (Illinois vs. Ohio) × Vehicle Type (SUV vs. Other)	1.088	0.925	2.969	0.485, 18.197	1.177	0.239
State (Illinois vs. Ohio) × Vehicle Type (Van vs. Other)	0.899	0.934	2.457	0.394, 15.336	0.962	0.336
State (Illinois vs. Ohio) × Vehicle Type (Passenger Car vs. Other)	0.860	0.923	2.363	0.387, 14.430	0.932	0.352

Note. B = unstandardized coefficient; SE = standard error; OR = odds ratio; CI = confidence interval.

Table 7

Logistic Regression Predicting Unrestrained Use: State x Rural and Urban Area

Predictor	B	SE	OR	95% CI (LL, UL)	*Z*	*P*
Intercept	0.057	0.034	1.058	0.990, 1.131	1.666	0.096
Rural and Urban Area (Rural vs. Urban)	0.244	0.049	1.277	1.161, 1.404	5.036	< .001
State (Illinois vs. Ohio)	-0.237	0.052	0.789	0.714, 0.873	-4.594	< .001
State (Illinois vs. Ohio) × Rural and Urban Area (Rural vs. Urban)	-0.245	0.072	0.783	0.680, 0.900	-3.425	< .001

Note. B = unstandardized coefficient; SE = standard error; OR = odds ratio; CI = confidence interval.

Table 8

Logistic Regression Predicting Unrestrained Use: State x Age Group

Predictor	B	SE	OR	95% CI (LL, UL)	Z	P
Intercept	0.703	0.057	2.020	1.805, 2.260	12.277	< .001
Age Group (30–39 vs. 20–29)	0.009	0.087	1.009	0.851, 1.196	0.099	0.921
Age Group (40–49 vs. 20–29)	-0.291	0.090	0.748	0.627, 0.891	-3.249	0.001
Age Group (50–59 vs. 20–29)	-0.361	0.091	0.697	0.583, 0.833	-3.961	< .001
Age Group (< 20 vs. 20–29)	-0.673	0.091	0.510	0.427, 0.610	-7.363	< .001

Age Group (> 59 vs. 20–29)	-1.278	0.074	0.279	0.241, 0.322	-17.233	< .001
State (Illinois vs. Ohio)	-0.336	0.080	0.715	0.610, 0.837	-4.176	< .001
State (Illinois vs. Ohio) × Age Group (30–39 vs. 20–29)	-0.051	0.123	0.950	0.747, 1.209	-0.416	0.677
State (Illinois vs. Ohio) × Age Group (40–49 vs. 20–29)	-0.125	0.133	0.882	0.680, 1.146	-0.939	0.348
State (Illinois vs. Ohio) × Age Group (50–59 vs. 20–29)	-0.296	0.132	0.744	0.574, 0.964	-2.234	0.025
State (Illinois vs. Ohio) × Age Group (< 20 vs. 20–29)	0.138	0.132	1.148	0.886, 1.487	1.043	0.297
State (Illinois vs. Ohio) × Age Group (> 59 vs. 20–29)	-0.057	0.108	0.944	0.764, 1.168	-0.528	0.597

Note. B = unstandardized coefficient; SE = standard error; OR = odds ratio; CI = confidence interval.

Table 9

Logistic Regression Predicting Unrestrained Use: State x Time of Day

Predictor	B	SE	OR	95% CI (LL, UL)	*Z*	*P*
Intercept	-0.174	0.033	0.840	0.788, 0.896	-5.300	< .001
Time of Day (Night vs. Day)	0.785	0.050	2.192	1.988, 2.416	15.781	< .001
State (Illinois vs. Ohio)	-0.371	0.050	0.690	0.626, 0.761	-7.461	< .001
State (Illinois vs. Ohio) × Time of Day (Night vs. Day)	-0.025	0.073	0.976	0.846, 1.126	-0.339	0.735

Note. B = unstandardized coefficient; SE = standard error; OR = odds ratio; CI = confidence interval.

Table 10

Logistic Regression Predicting Unrestrained Use: State x Season

Predictor	B	SE	OR	95% CI (LL, UL)	*Z*	*P*
Intercept	0.129	0.046	1.138	1.040, 1.245	2.801	0.005
Season (Summer vs. Spring]	0.074	0.068	1.076	0.942, 1.231	1.078	0.281
Season (Summer vs. Other Seasons)	0.024	0.066	1.024	0.899, 1.166	0.357	0.721
Season (Winter vs. Summer)	0.109	0.068	1.115	0.976, 1.274	1.596	0.110
State (Illinois vs. Ohio)	-0.352	0.069	0.703	0.615, 0.805	-5.122	< .001
State (Illinois vs. Ohio) × Season (Spring vs. Summer)	-0.005	0.100	0.995	0.817, 1.211	-0.052	0.959
State (Illinois vs. Ohio) × Season (Summer vs. Other Seasons)	-0.016	0.098	0.984	0.812, 1.193	-0.162	0.871
State (Illinois vs. Ohio) × Seasons (Winter vs. Summer)	-0.005	0.101	0.995	0.816, 1.213	-0.053	0.958

Note. B = unstandardized coefficient; SE = standard error; OR = odds ratio; CI = confidence interval.

Table 11

SVI Interactive Analysis (Q4 vs Q1)

Gender	Rural and Urban	Age Group	State	Year	Q1	Q4	Gap (Q4-Q1)	Occupant Role	Time of Day	Season	Vehicle Type
Male	Urban	20-29	Illinois	2014	0.62	0.62	0.00	-	-	-	-
Male	Urban	20-29	Ohio	2014	0.68	0.73	0.06	-	-	-	-
Male	Urban	20-29	Illinois	2022	0.62	0.62	0.00	-	-	-	-
Male	Urban	20-29	Ohio	2022	0.67	0.73	0.06	-	-	-	-
Female	Urban	20-29	Illinois	2014	0.50	0.48	-0.02	-	-	-	-
Female	Urban	20-29	Ohio	2014	0.56	0.60	0.05	-	-	-	-
Female	Urban	20-29	Illinois	2022	0.50	0.48	-0.02	-	-	-	-
Female	Urban	20-29	Ohio	2022	0.55	0.60	0.05	-	-	-	-
-	-	-	Illinois	2014	0.40	0.42	0.02	Driver	Day	Summer	Passenger Car
-	-	-	Ohio	2014	0.45	0.54	0.09	Driver	Day	Summer	Passenger Car
-	-	-	Illinois	2022	0.44	0.46	0.02	Driver	Day	Summer	Passenger Car
-	-	-	Ohio	2022	0.49	0.58	0.09	Driver	Day	Summer	Passenger Car
-	-	-	Illinois	2014	0.39	0.41	0.02	Driver	Night	Summer	Passenger Car
-	-	-	Ohio	2014	0.44	0.53	0.09	Driver	Night	Summer	Passenger Car
-	-	-	Illinois	2022	0.43	0.45	0.02	Driver	Night	Summer	Passenger Car

-	-	-	Ohio	2022	0.62	0.62	0.00	Driver	Night	Summer	Passenger Car
-	-	-	Illinois	2014	0.68	0.73	0.06	Passenger	Night	Summer	Passenger Car
-	-	-	Ohio	2014	0.62	0.62	0.00	Passenger	Night	Summer	Passenger Car
-	-	-	Illinois	2022	0.67	0.73	0.06	Passenger	Night	Summer	Passenger Car
-	-	-	Ohio	2022	0.50	0.48	-0.02	Passenger	Night	Summer	Passenger Car
-	-	-	Illinois	2014	0.56	0.60	0.05	Passenger	Night	Summer	Light Truck – Pickup
-	-	-	Ohio	2014	0.50	0.48	-0.02	Passenger	Night	Summer	Light Truck – Pickup
-	-	-	Illinois	2022	0.55	0.60	0.05	Passenger	Night	Summer	Light Truck – Pickup
-	-	-	Ohio	2022	0.40	0.42	0.02	Passenger	Night	Summer	Light Truck – Pickup

Note. B = unstandardized coefficient; *OR* = odds ratio; *CI* = confidence interval (LL = lower limit, UL = upper limit). Prevalence = proportion of unrestrained fatalities. Gap = Q4 minus Q1 in percentage points. CDC/ATSDR (2014, 2022); NHTSA (2014, 2022).

Table 12

Logistic Regression Predictor Table

Term	B	OR	95% CI	*P*
State (Ohio vs. Illinois)	0.45	1.57	1.37–1.79	< .001
SVI Quartile 2 (vs. Q1)	–0.06	0.94	0.78–1.13	0.510
SVI Quartile 3 (vs. Q1)	0.05	1.06	0.87–1.28	0.580
SVI Quartile 4 (vs. Q1)	0.17	1.18	0.97–1.44	0.100
Sex (Male vs. Female)	0.55	1.74	1.51–2.01	< .001
Land Use (Urban vs. Rural)	0.06	1.06	0.87–1.31	0.560
Age 30–39 (vs. 20–29)	0.30	1.35	1.07–1.69	0.010
Age 40–49	0.11	1.11	0.87–1.42	0.390
Age 50–59	–0.22	0.80	0.64–1.01	0.060
Age < 20	–0.26	0.77	0.60–0.99	0.040
Age > 59	–0.95	0.39	0.32–0.47	< .001
Year (2022 vs. 2014)	–0.03	0.97	—	1.000
State (Ohio vs. Illinois)	0.45	1.57	1.37–1.79	< .001
SVI Quartile 2 (vs. Q1)	–0.06	0.94	0.78–1.13	0.510
SVI Quartile 3 (vs. Q1)	0.05	1.06	0.87–1.28	0.580

Note. B = unstandardized coefficient; OR = odds ratio; CI = confidence interval (LL = lower limit, UL = upper limit). Significant predictors ($p < .05$). CDC/ATSDR (2014, 2022); NHTSA (2014, 2022).

Table 13

Predicted Probabilities by SVI Quartile

State	SVI Quartile	Gender	Rural and Urban	Age Group	Year	Predicted Probability
Illinois	Q1	Male	Urban	20-29	2022	0.62
Illinois	Q2	Male	Urban	20-29	2022	0.63
Illinois	Q3	Male	Urban	20-29	2022	0.52
Illinois	Q4	Male	Urban	20-29	2022	0.62
Ohio	Q1	Male	Urban	20-29	2022	0.67
Ohio	Q2	Male	Urban	20-29	2022	0.73
Ohio	Q3	Male	Urban	20-29	2022	0.67
Ohio	Q4	Male	Urban	20-29	2022	0.73

Note. Predicted probabilities were derived from the logistic regression model. SVI = Social Vulnerability Index.

Table 14

χ^2 Results Illinois

	2014			2022		
Subgroup	χ^2 (df)	*p* value	Cramer's *V*	χ^2 (df)	*p* value	Cramer's *V*
Overall	3.21(3)	0.360	0.06	2.46(3)	0.483	0.06
Male	1.44(3)	0.697	0.05	0.90(3)	0.824	0.04
Female	4.10(3)	0.250	0.12	5.39(3)	0.145	0.15
Rural	5.95(3)	0.114	0.11	3.05(3)	0.384	0.10
Urban	4.85(3)	0.183	0.11	2.99(3)	0.393	0.08
Age Group < 20	8.14(3)	0.043	0.29	2.02(3)	0.569	0.17
Age Group 20-29	4.15(3)	0.246	0.14	6.17(3)	0.104	0.19
Age Group 30-39	2.23(3)	0.526	0.13	6.28(3)	0.099	0.21

Age Group 40-49	4.54(3)	0.209	0.22	2.68(3)	0.444	0.18
Age Group 50-59	4.44(3)	0.218	0.19	4.58(3)	0.205	0.22
Age Group > 59	0.66(3)	0.882	0.05	3.70(3)	0.296	0.12
Driver	0.30(3)	0.960	0.02	4.77(4)	0.312	0.09
Passenger	9.74(4)	0.045	0.22	18.80(3)	0.001	0.31
Day	3.92(4)	0.417	0.1	6.19(4)	0.186	0.12
Night	1.42(3)	0.701	0.06	9.34(3)	0.025	0.16
Fall	1.16(4)	0.885	0.07	-	-	-
Spring	-	-	-	4.76(4)	0.313	0.16
Summer	2.16(4)	0.706	0.11	-	-	-
Winter	-	-	-	-	-	-
Pickup truck	-	-	-	-	-	-
SUV	-	-	-	-	-	-
Van	4.04(4)	0.401	0.34	-	-	-
Passenger Car	3.62(4)	0.460	0.09	9.24(4)	0.055	0.13

Note. χ^2 = chi-square statistic. *df* = degrees of freedom. *V* = Cramer's *V* effect size. *P*-values < .05 indicate statistically significant associations. CDC/ATSDR (2014, 2022); NHTSA (2014, 2022).

Table 15

χ^2 results Ohio

	2014			2022		
	χ^2 (df)	*p* value	Cramer's *V*	χ^2 (df)	*p* value	Cramer's *V*
Overall	0.95(3)	0.813	0.03	20.28(3)	0	0.14
Male	0.77(3)	0.856	0.03	10.88(3)	0.012	0.12
Female	2.25(3)	0.523	0.08	9.79(3)	0.02	0.19

Rural	0.56(3)	0.905	0.03	13.29(3)	0.004	0.17
Urban	0.33(3)	0.953	0.02	7.99(3)	0.046	0.13
Age Group < 20	6.54(3)	0.088	0.23	7.25(3)	0.064	0.28
Age Group 20-29	2.38(3)	0.497	0.09	8.05(3)	0.045	0.21
Age Group 30-39	1.41(3)	0.704	0.09	13.11(3)	0.004	0.29
Age Group 40-49	1.18(3)	0.757	0.09	2.87(3)	0.413	0.14
Age Group 50-59	2.13(3)	0.546	0.11	0.88(3)	0.829	0.08
Age Group > 59	5.60(3)	0.133	0.14	3.25(3)	0.354	0.11
Driver	16.63(4)	0.002	0.16	5.12(4)	0.276	0.13
Passenger	6.04(4)	0.196	0.16	9.03(3)	0.029	0.32
Night	7.38(3)	0.061	0.13	0.00(0)	1	-
Day	11.82(4)	0.019	0.16	0.00(0)	1	-
Fall	6.98(4)	0.137	0.16	4.24(4)	0.375	0.21
Spring	5.54(4)	0.236	0.16	-	-	-
Summer	7.82(4)	0.099	0.19	-	-	-
Winter	14.38(4)	0.006	0.27	-	-	-
Pickup truck	12.93(4)	0.012	0.38	-	-	-
SUV	12.00(4)	0.017	0.3	-	-	-
Van	4.99(4)	0.288	0.37	-	-	-
Passenger Car	12.53(4)	0.014	0.14	6.77(4)	0.149	0.18

Note. χ^2 = chi-square statistic. *df* = degrees of freedom. *V* = Cramer's *V* effect size. *P*-values < .05 indicate statistically significant associations. CDC/ATSDR (2014, 2022); NHTSA (2014, 2022).

Table 16

T tests Seat Belt Restraint Use-Ohio vs. Illinois

Category	Ohio Mean	Illinois Mean	*T*	*P*	N (OH)	N (IL)
Male	0.6	0.5	8.36	< .001	4,398	3,767
Female	0.46	0.37	5.88	< .001	2,481	2,094
Rural	0.51	0.46	4.61	< .001	3,458	2,698
Urban	0.58	0.46	9.78	< .001	3,421	3,163
Driver	0.56	0.45	9.96	< .001	5,289	4,426
Day	0.46	0.37	7.53	< .001	3,728	3,093
Night	0.65	0.55	7.44	< .001	3,151	2,768
Age 20–29	0.67	0.59	4.19	< .001	1,377	1,295
Age 30–39	0.67	0.58	4.18	< .001	1,060	939
Age 40–49	0.60	0.49	4.36	< .001	881	613
Age 50–59	0.59	0.43	6.10	< .001	816	680
Age > 59	0.36	0.28	5.49	< .001	1,955	1,653
Passenger Vehicle	0.52	0.42	8.99	< .001	4,007	3,355
Pickup	0.66	0.57	3.73	< .001	944	763
Fall	0.54	0.45	5.42	<. 001	1,940	1,611
Spring	0.55	0.47	4.60	< .001	1,594	1,472
Summer	0.53	0.45	4.91	< .001	1,787	1,508
Winter	0.56	0.46	5.24	< .001	1,558	1,270

Note. The means represent the percentage of fatally injured occupants who were not wearing restraints. Independent-sample *t* tests, weighted by fatality counts, were used for analysis. Results with $p < .05$ were considered statistically significant. NHTSA (2023).

Appendix C:

Economic Cost Calculations

1 fatality = \$1.7 million (2019 adjusted)

Unrestrained passenger vehicle occupant-related fatality (NHTSA, 2023)

Example:

Illinois Male: 186 x \$1.7 = \$316.2 million

Ohio Male: 256 x \$1.7 = \$435.2 million.

Appendix D:

Institutional Review Board (IRB) Documentation

Institutional Review Board (IRB)
For the Protection of Human Research Participants

PROTOCOL EXEMPTION REPORT

Protocol Number: 04228-2021 **Responsible Researcher(s):** T. Alex Cabral

Supervising Faculty: Dr. Lorna Alvarez-Rivera

Project Title: *The Impact of Safety Through Seat Belt Enforcement.*

INSTITUTIONAL REVIEW BOARD DETERMINATION:

This research protocol is **exempt** from Institutional Review Board (IRB) oversight under 45 CFR 46.101(b) of the federal regulations **category 4**. If the nature of the research changes such that exemption criteria no longer apply, please consult with the IRB Administrator (irb@valdosta.edu) before continuing your research study.

ADDITIONAL COMMENTS:

- *Upon completion of the research study collected data must be securely maintained (locked file cabinet, password protected computer, etc.) and accessible only by the researcher for a minimum of 3 years. At the end of the required time, collected data must be permanently destroyed.*

☒ ***If this box is checked, please submit any documents you revise to the IRB Administrator at irb@valdosta.edu to ensure an updated record of your exemption.***

Elizabeth Ann Olphie *10.07.2021*
Elizabeth Ann Olphie, IRB Administrator

Thank you for submitting an IRB application.
Please direct questions to irb@valdosta.edu or 229-253-2947.

Revised: 06.02.16