5-2019

Handgun carrying patterns and suicide risk among youth.

Teresa Jane McGeeney
University of Louisville

HANDGUN CARRYING PATTERNS AND SUICIDE RISK AMONG YOUTH

By

Teresa Jane McGeeney
B.A., University of Notre Dame, 2010
M.S., University of Louisville, 2012

A Dissertation
Submitted to the Faculty of the
School of Public Health and Information Sciences
in Partial Fulfillment of the Requirements
for the Degree of

Doctor of Philosophy
in Public Health Sciences

Department of Epidemiology and Population Health
University of Louisville
Louisville, Kentucky

May 2019

HANDGUN CARRYING PATTERNS AND SUICIDE RISK AMONG YOUTH

By

Teresa Jane McGeeney
B.A., University of Notre Dame, 2010
M.S., University of Louisville, 2012

A Dissertation Approved on

April 4, 2019

by the following Dissertation Committee:

_____
Richard Baumgartner

_____
Nicholas Peiper

_____
Kathy Baumgartner

_____
Kira Taylor

_____
Michael Anestis

_____
Robert Illback

DEDICATION

This dissertation is dedicated to the countless lives lost to suicide, to suicide attempt survivors, to those who face suicidal thoughts, to those supporting loved ones in crisis, and to those who have lost children, partners, siblings, parents, and friends to suicide.

ACKNOWLEDGMENTS

This data presented in this dissertation are from the Kentucky Incentives for Prevention (KIP) Survey. The KIP Survey is administered biennially by the Kentucky Department of Behavioral Health, Developmental and Intellectual Disabilities, using funding from the Substance Abuse and Mental Health Services Administration (SAMHSA) and using no federal Department of Education funds.

Above all, I want to thank my loving and supportive partner, Ross, who has steadily supported me on my educational journey and been by my side through all the frustrations and anxieties. Your love and support made this process easier and more enjoyable. I am so grateful for your continual encouragement for me to dream big for myself and my research. I want to thank my parents, who instilled in me the value of education and learning from the first days of my life. You inspire me to leave the world a better place than I found it. I can't imagine my life without your unending support and love. To Catherine, Trevor, Daniel, Jane, Sarah, Gary, Gloria, and Kim, I feel beyond blessed to have had you in my life to make me laugh, brainstorm with, and encourage me throughout graduate school. You lightened the load, reminded me of the importance of my work, and inspired me through the work each of you do.

Most people are not lucky enough to get along with most of their coworkers, but I am blessed to consider mine family. Every day, I count my blessings at REACH. I can't

imagine a more supportive environment or more enjoyable colleagues. Your encouragement, flexibility, and cheerleading along the way have made this possible.

Finally, to my committee members, thank you for your conscientious feedback that helped me grow and strengthen my research and for your support and encouragement. I am grateful for your support, your shared knowledge, and your commitment to my education.

ABSTRACT

HANDGUN CARRYING PATTERNS AND SUICIDE RISK AMONG YOUTH

Teresa J. McGeeney

April 4, 2019

Recent data have shown marked increases in carrying of handguns among youth. Though firearms are often discussed using a lens of prevention of violence towards others, the majority of firearm deaths are suicides. Youth suicide has also seen steady increases across the United States in the past decade, demanding urgent solutions to curb this concerning trend.

Klonsky and May's Three Step Theory (3ST) outlines three primary steps that lead to death by suicide and proposes that access to and familiarity with lethal means, such as firearms, make up a critical component of the etiology of suicide. With youth suicide and youth access to firearms both on the rise, there is a need to better understand the youth who carry guns and their risk profile for suicide.

This study used data from the statewide Kentucky Incentives for Prevention (KIP) Survey to examine characteristics, subgroups, and suicide risk among the growing group of youth who carry handguns. Data for nearly 90,000 Kentucky 10th graders were analyzed from the 2012, 2014, and 2016 KIP Survey administrations. A total of 9,268 10th graders over all three waves reported carrying handguns in the past year. Handgun

carrying increased 158% among 10th graders during the study window, with more than 12% of 10th graders carrying handguns in 2016. Handgun carrying was more common among males, certain racial/ethnic groups, students receiving free/reduced lunch, and students living in more rural communities. Handgun carrying was also associated with various suicide risk factors, and students who carried handguns were more likely than their peers to have seriously considered, planned, and attempted suicide.

Four subgroups were identified through latent class analysis, three of which had high probabilities for multiple risk factors for suicide. These three classes were found to have elevated likelihoods of suicidal thoughts and behaviors. An in-depth examination of each subgroup and their suicide risk is provided, contextualized within the 3ST.

Prevention implications are discussed: suicide prevention among handgun-carrying youth, suicide screening/prevention among youth with related risk factors, and policies that limit access to firearms all may reduce suicide risk among youth.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER I

OBJECTIVE AND AIMS

This study is a secondary data analysis of a biennial behavioral health survey of middle and high school students in Kentucky. This study investigates handgun carrying among youth and its relationship to suicide risk. Research on youth access to firearms is limited, and most research examines only household gun ownership, rather than carrying of guns by youth. The percentage of youth carrying handguns has been increasing in certain populations,[1,2] and so has the rate of youth suicide death.[3-5] The majority of youth suicide deaths in Kentucky, a state with high gun ownership, are due to a firearm.[6] This study identifies subpopulations with varying suicidal risk and capacity in the context of Klonsky and May's Three Step Theory (3ST).[7] Specifically, this study aims to a) examine characteristics of youth who carry handguns and their risk factors for suicide, b) identify subpopulations among youth who carry handguns and how these subpopulations have changed over time, and c) examine suicide risk among the identified subpopulations.

I. Objective

The objective of this study is to examine the characteristics of handgun-carrying youth, identify subpopulations among these youth and how these subpopulations have changed over time, and determine how these subpopulations can be used to understand suicide risk and capacity. Using data from a survey of middle and high school students across Kentucky, the following specific aims are addressed.

II. Specific Aims

a. *Specific Aim 1.* Describe youth who carry handguns and their risk factors for suicide within the context of the 3ST framework.

1. What is the prevalence of handgun carrying among youth, and how has it changed over time?
2. What is the distribution of the frequency of handgun carrying among youth, and how has this changed over time?
3. What demographic characteristics (gender, race/ethnicity, free/reduced lunch, rurality) are associated with handgun carrying?
4. What are the relationships between each of the following variables and handgun carrying among youth: serious psychological distress, substance use, aggression, delinquency, and victimization?
5. Is handgun carrying associated with suicide ideation, planning, and attempts?

b. *Specific Aim 2.* Identify subpopulations of handgun-carrying youth.

1. What subpopulations exist among handgun-carrying youth based on their probabilities of each of the following variables: serious psychological distress, substance use, aggression, delinquency, victimization, and frequency of handgun carrying?
2. How have these subpopulations changed between 2012 and 2016?

b. *Specific Aim 3.* Evaluate the suicide risk of youth who carry handguns.

1. Which subpopulations of handgun-carrying youth are at the highest risk of suicidal behaviors?

CHAPTER II

BACKGROUND

Research has illustrated that youth are at an increased risk for suicidal behavior, and that youth suicide is on the rise. Access to firearms as lethal means is an identified risk factor for death by suicide, and there is evidence suggesting an increasing number of youth have access to firearms. This dissertation will investigate the increase in firearm carrying among youth in Kentucky and the suicide capacity and risk of this growing subset of youth.

I. Epidemiology of youth suicide

a. Morbidity and mortality trends

The number of youth who have died by suicide has been on the rise over the past several years in the United States.[3-5] This is part of a larger trend of rising suicide rates seen in nearly every age group over the past 15 years.[3] Among youth, suicide rates had increased from the 1970s until the mid-1990s, after which there was a decline until the mid-late 2000s. In recent years, the suicide rate among youth has been on the rise.[4,5,8] Both young children (10-14 years old) and older adolescents (15-19) have seen increases in suicide rates. The number of youth aged 10-14 who died by suicide in 2014 surpassed the number who died in motor vehicle traffic accidents for the first time in history when it

reached the rate of 2.1 deaths per 100,000, which was the highest rate it had ever been.[4] It has since further increased.[9] The suicide rate for males aged 15-19 is currently lower than

its historical peak of 18.1 per 100,000 youth in the mid-1980s-1990s, but it increased 31% from 10.8 to 14.2 from 2007 to 2015.[5] In 2016, it climbed further to 14.8 deaths per 100,000.[9] The female suicide rate, which tends to be lower than males at all ages, reached an all-time high in 2015 for 15-19 year old girls at 5.1 per 100,000.[5,9]

Emergency department (ED) visits due to self-harm have also been on the rise among youth, especially among young females since 2008.[10,11] This fits with self-reported national survey data that has seen increases in suicidal ideation and attempts: the Youth Risk Behavior Surveillance System (YRBSS) notes a decline in suicide ideation and planning from 1991 to 2009, and then an increase from 2009 to 2015.[12] In 2015, 17.7% of high schoolers reported seriously considering attempting suicide in the past year, 14.6% of them made a suicide plan, 8.6% of them actually attempted suicide at least one time, and 2.8% had a suicide attempt that required medical attention.[12]

Additional data have shown that measures of depressive symptoms, psychological distress, and psychiatric illness have been on the rise among youth.[13-15] At the same time, substance use, a behavior that is correlated with mental illness and suicidal behavior, is largely on the decline among youth under 18.[16] Thus, the factors that are contributing to and associated with youth suicide in the present day may be changing. Much attention has lately focused on internet, social media, and smart phone usage as potentially problematic for the mental health of youth.[13,17] There is more research needed to

understand the etiology of present-day psychological distress, suicidal ideation and behaviors, and the general mental health of young people.

Youth in Kentucky generally fit within the trends described above. Kentucky currently ranks 20th in the nation for suicide overall,[18] and has seen increases in both overall suicide rates and suicide rates among youth.[19,20] Kentucky data on ED visits and inpatient hospitalizations among youth due to self-harm also indicate rising rates.[20] The limited data on self-reported suicidal ideation and attempts among youth have not shown increases between 2014 and 2016, but there has been an increase in youth psychological distress between 2012 and 2016.[2]

b. Demographic factors

There are a number of demographic factors associated with an increased risk for death by suicide or suicidal behavior. Females are more likely to report suicidal ideation, planning, and attempts, but males are more likely to die by suicide.[21,22] This is primarily accounted for by males' likelihood to use more lethal means, such as a firearm, compared to females, who are more likely to attempt by poisoning, though there may also be underreporting of suicidal ideation and nonfatal suicidal behavior among males due to cultural factors.[21,22]

The risk for suicidal behavior and death also varies by age. Risk for suicide death peaks in middle age for women and increases throughout the lifespan for men. However, suicide rates for both genders first start to rise notably in adolescence and young adulthood, and the rate of pre-adolescent children dying by suicide is growing quickly.[3]

Similar to many mental illnesses, the highest risk for onset of suicidal ideation, planning, and attempts is in adolescence and early adulthood.[23]

Race and ethnicity are also related to suicide. Many racial and ethnic groups in the United States have lower rates of suicide than non-Hispanic whites.[24] However, American Indians/Alaskan Natives have elevated rates of suicide, estimated at 50% higher than non-Hispanic whites.[25] African Americans and Hispanic Americans typically have lower rates of suicide than non-Hispanic whites, despite being more likely to have many risk factors for suicide.[24,26] This may be due to misclassification of suicide deaths or protective factors in these cultures.[26,27] Most racial and ethnic groups have seen increases in suicide mortality in the past several years, with the largest increases seen among white and American Indian/Alaskan Native populations.[24]

Youth and adults who identify as lesbian, gay, bisexual, transgender, queer/questioning, (LGBTQ) have been found to be at an increased risk for suicidal behaviors.[28] Sexual orientation and gender identity of suicide decedents is often difficult to obtain, limiting data on suicide mortality among sexual and gender minority populations, but in recent years there have been efforts to add data on sexual orientation and gender identity into suicide surveillance systems.[29]

Geography is another factor that is related to suicidal behavior and deaths. Within the US, people in rural areas die by suicide at a higher rate than people in urban areas, a gap that is widening in recent years.[30] This is thought to be attributable to a higher rate of gun ownership, a further distance to hospitals to treat suicide attempt injuries, and a limited availability of mental health providers.[30-32] Different parts of the country also have different rates of suicide. States in the western and northwestern part of the US have

had the highest rates of suicide for several years, with pockets of elevated rates in other parts of the country including Appalacchia.[33] Kentucky is a primarily rural state in Appalachia that has had elevated rates of suicide for several years.[6,33]

c. Other factors

Mental illness and specifically depression are among the factors most strongly associated with death by suicide.[34] However, depression and mental illness are still relatively weak predictors of suicidal behavior and death by suicide because the vast majority of people with depression and mental illness do not die by suicide.[35] In fact, in a recent analysis of the National Violent Death Reporting System (NVDRS) found that over half of suicide decedents in recent years had no known mental health condition.[18] A history of past self-harm or suicide attempts is a stronger but still weak predictor of suicidal behavior and death by suicide because again, most people who attempt suicide do not go on to attempt suicide again or die by suicide.[36]

Other life circumstances such as past trauma are also linked to increased risk of suicidal behavior. Previous research has shown that history of childhood abuse and adverse childhood experiences are associated with suicide attempt in a dose-response relationship.[37,38] Outside the home, bullying and peer victimization has been associated with suicidal behavior among youth.[39-41] Trauma experienced later in life such as domestic violence and military-related trauma are all correlated with an increased risk for suicidal behavior.[42,43]

Substance use is another risk factor for suicidal behavior and death by suicide. Youth who use substances are at an increased risk for suicidal ideation, planning, and

attempts.[44] Additionally, acute intoxication by alcohol and other substances is associated with an increased risk of suicidal behavior and death. Approximately 17% of women and 24% of men who died by suicide were intoxicated by alcohol at the time of their death.[45] In a case-crossover study of recent suicide attempters, recent drinking put individuals at 6 times the risk for a suicide attempt.[46] Level of alcohol intoxication has also been found to be associated with a higher likelihood of a suicide attempt as well as more lethal suicide attempts.[46,47]

II. The Three Step Theory

a. Overview

Though all of the aforementioned risk factors do increase one's risk of suicidal behavior and death by suicide, the vast majority of individuals with these risk factors, including a past history of suicide attempt, do not go on to make further suicide attempts, and even fewer go on to die by suicide.[36] In light of this fact, there has been a need to better understand the etiology of suicide so that it can be prevented in a more effective way.

Recent theories of suicide have been developed to better understand what causes someone to experience suicidal ideation and then progress to attempting suicide.[7,48-50] Thomas Joiner's Interpersonal Theory of Suicide (ITS) was among the first theories to take this type of approach of looking at suicide, distinguishing between suicidal ideation and suicide attempts.[48] Joiner's theory proposed that the development of suicidal ideation is caused by a combination of thwarted belongingness and perceived burdensomeness,

and that the progression to suicide attempt occurs with increased capacity to endure painful experiences.[48]

Klonsky and May's Three Step Theory (3ST) is an alternate theory of suicide that is similar in many ways to Joiner's well-researched theory. The 3ST proposes that 1) the combination of pain and hopelessness are required for suicidal ideation, 2) suicidal ideation progresses to strong ideation when connectedness is disrupted, and 3) that individuals progress to make a suicide attempt when they have the dispositional, acquired, and practical capacity to do so.[7] Dispositional capacity includes things like one's natural sensitivity to pain, which are influenced by genetics, and which would influence one's likelihood to inflict pain on themselves. Acquired capacity is borrowed from Joiner's theory, and includes an increased ability to withstand pain, injury, and self-harm due to prior exposures to painful or provocative events.[48] Practical capacity includes availability and access to lethal means, as well as knowledge of how to use these means in a suicide attempt.[7]

The present study builds off of these three proposed steps to understand subtypes of handgun-carrying youth, who, because of their access to a firearm, have at least some degree of practical capacity for a lethal suicide attempt. In this study, other risk factors for suicide are examined through the lens of the 3ST.

b. The role of means

In line with the 3ST's identification of practical capacity for suicide, research has proven the importance of means access and means safety for those at risk for suicide. Numerous studies have shown that individuals living in a house with a firearm present

are at an increased risk for death by suicide because individuals in these homes who become suicidal have access to highly lethal means.[51-55] To address practical capacity, suicide prevention practitioners implement lethal means counseling for individuals who have been identified at risk for suicidal behavior, which has been shown to reduce suicide deaths.[56,57] Lethal means counseling is an intervention that clinicians can perform with patients at risk for suicide that informs them of the risks of easily available lethal means, and steps they can take to limit the availability of these means during a crisis and increase their safety.[57]

A common misconception presented by those who do not trust the effectiveness of means safety efforts is the myth of means substitution: that individuals who are suicidal will find a way to make a fatal attempt, even if the method they had planned to use is not available. Research has revealed that means substitution is not the norm among individuals in a suicidal crisis.[58] Additionally, it has been found that most suicidal individuals are ambivalent and that suicidal crises where risk for an attempt is high are relatively brief (e.g. 10 minutes), meaning that delaying an individual from using one means may save their life.[58]

Finally, and of critical importance, means vary dramatically in their lethality. Firearms are the most lethal means to attempt suicide, with an estimated 82.5-99.5% of attempts resulting in death.[59-61] In contrast, suicide attempts by poisoning, the most frequently used method, result in death between 1 and 7% of the time.[59-61] This large variation in lethality is attributed to a number of factors including actual deadliness of the method, the ability to stop mid-attempt, and familiarity with a particular method.[62] Thus, even if suicidal individuals do substitute means during a suicide attempt, if they substitute

to a less immediately lethal means, such as overdose, this will often mean their life can be saved.

III. Firearms

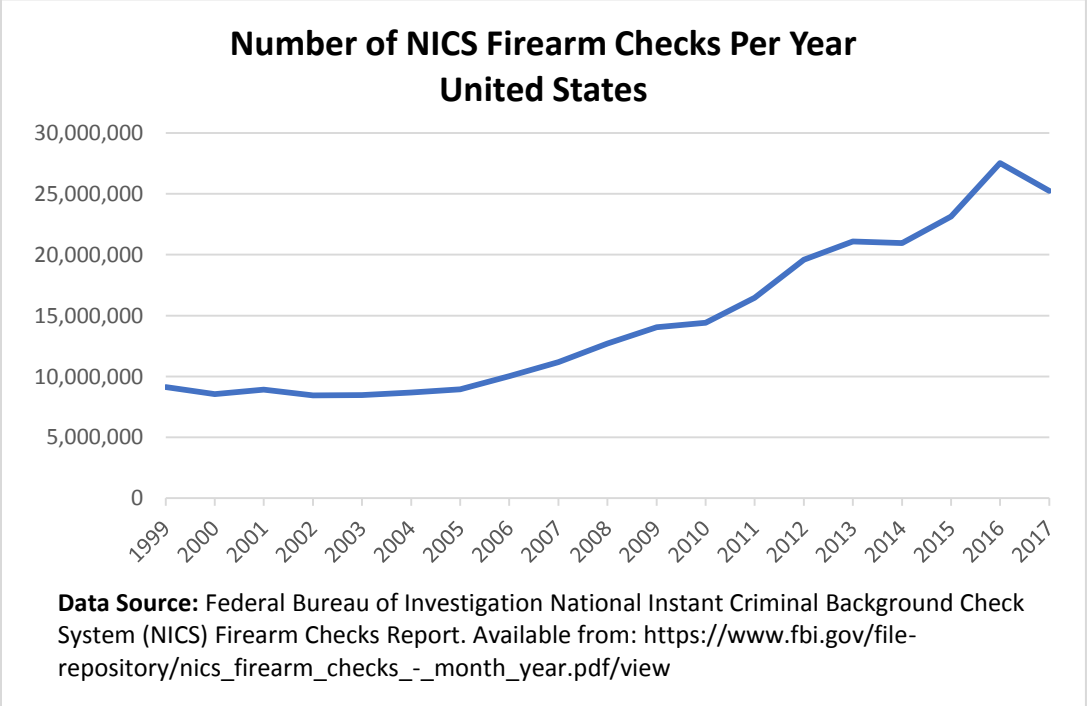
a. Firearm ownership

Data on firearm ownership are incredibly limited. There is no federal registry of firearms. Only six states and the District of Columbia require firearms to be registered in any capacity, and eight states prohibit registries of firearms.[63] There is also no federal law that requires a license or permit to own or purchase a gun, and the vast majority of states do not have any license or permit requirements to purchase or own a gun. Licensed gun dealers are required to track sales of guns in the United States,[64] but federal law has prohibited the creation of a national, centralized system of these records.[65]

The most robust data on purchases publicly available come from the FBI's National Instant Criminal Background Check System (NICS); federal law requires that all licensed firearm dealers perform a background check NICS before selling a firearm.[66] A NICS background check would fail if the person is found to have any of the identified criteria that would prohibit a firearm sale, including certain criminal convictions, protective orders filed against the individual, among others.[66] The available NICS data have shown that background checks for firearm purchases have grown steadily since 2005, and increasing nearly three-fold since 1999.[67] The NICS firearm checks for the US from 1999 to 2017 are displayed in Figure 1. Background checks underestimate actual firearm sales. Unlicensed sellers are not federally required to perform background checks. These include private sales, many purchases at gun shows, or private transfers of

guns, such as inheritance.[68,69] An estimated 22% of US gun owners reported that they obtained their most recent gun without a background check.[69] Additionally, background checks are not always performed at a one-to-one ratio of firearms sold.[67] Kentucky has the highest numbers and per-capita rates of firearm checks, but these data are skewed due to the fact that since 2006, Kentucky State Police automatically run monthly background checks on anyone with an active concealed carry license, regardless of whether or not they have purchased a new firearm.[70-72]

Figure 1. Number of firearm checks in the National Instant Criminal Background Check System (NICS) per year, 1999-2017



Data Source: Federal Bureau of Investigation National Instant Criminal Background Check System (NICS) Firearm Checks Report. Available from: https://www.fbi.gov/file-repository/nics_firearm_checks_-_month_year.pdf/view

Self-report data on gun ownership surveys are also limited. The Behavioral Risk Factor Surveillance System (BRFSS) collected data on gun ownership in 21 states from

1992 until 1998, and in all states in 2001, 2002 and 2004, but has not collected it since.[73] The General Social Survey (GSS), a now biennial survey, has included questions about gun ownership since 1973. In 2014, 32% of households surveyed reported they had a gun in the home, and 22% of adults said they personally owned a gun.[74] These rates have steadily declined 40% over the past several decades.[74] In 2015, Harvard and Northeastern researchers conducted the National Firearms Survey to examine firearm ownership and use in the United States. Using these data as a follow-up to a survey from 1994, Azrael and colleagues found a modest decline in the percentage of adults who owned a gun – from 25% in 1994 to 22% in 2015.[75]

These data taken together indicate that gun ownership is changing in a complex manner: a growing number of guns are owned by a shrinking population. This is indeed what Azrael and her colleagues found: despite a decline in the percentage of adults who owned a gun, there was an increase in the average number of guns owned per gun owner, from 4.3 to 4.8.[75] The authors also noted a change in the concentration of gun ownership: the top 20% of gun owners owned 55% of the gun stock in 1994, and now the top 20% of gun owners own 60%. Additionally, in 2015, 3% of the US population owned 50% of the gun stock.[75]

Kentucky ranks among the top 20 states for gun ownership.[76,77] Additionally, despite national declines in gun ownership, a recent poll in Kentucky has found the opposite trend in self-reported gun ownership. The Kentucky Health Issues Poll, an annual telephone survey conducted by the Foundation for a Healthy Kentucky, found that self-reported gun ownership had risen from 45% of adults in 2011 to 55% of adults in 2017.[78] In line with national trends, NICS background checks for firearm purchases have

risen in Kentucky nearly six-fold in the past 12 years, suggesting that more guns are being purchased by Kentuckians.[70] This suggests that while the rest of the country may be seeing lower rates of gun ownership, there may be pockets where gun ownership is actually increasing, such as in Kentucky.

b. Gun carrying

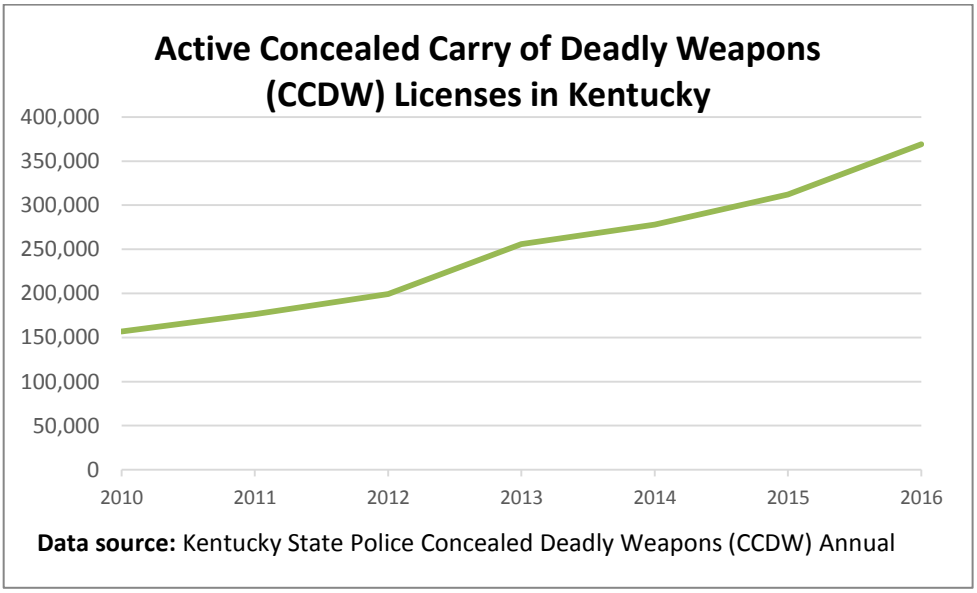
To add to the complexities of how gun ownership is changing, carrying behaviors among gun owning adults appear to be changing as well. There is no federal restriction on the carrying of firearms. The vast majority of states allow for carrying of firearms in the open ("open carry"), though 15 states require licenses to open carry. Kentucky is an open carry state that does not require any type of license for carrying firearms out in the open. Concealed carry laws are those that regulate the ability to carry a firearm hidden or concealed from plain sight. The only federal laws regulating concealed carry are two that allow for current and former law enforcement officers to carry concealed weapons.[79,80] Over the past 30 years, many more states have begun allowing concealed carrying of firearms.[81] Today, every state and the District of Columbia allow for concealed carrying of firearms at some level. Thirty-eight states require a state-issued permit to carry a concealed weapon, and twelve generally allow people to carry a concealed weapon without a permit.[81] In Kentucky, concealed carry has been permitted since 1996.[82] Between 1996 and 2019, individuals were required to obtain a concealed carry of a deadly weapon (CCDW) license in order to legally carry a firearm in a concealed manner. A background check, firearm safety training, and other certain criteria like the lack of criminal history were required in order for someone to be eligible to obtain a

CCDW license in Kentucky.[82] Additionally, though not mandated by legislation, individuals with active CCDW licenses undergo automatic monthly firearm background checks via the FBI's National Instant Background Check System.[70-72] However, in the 2019 Kentucky legislative session, Senate Bill 150 was signed into law, which eliminates the need for individuals to obtain a license to concealed carry. Now, all individuals who were previously allow to obtain a license to concealed carry can do so without undergoing training, background checks, or obtaining a license.[83]

Again, self-report data on gun carrying among the general population are limited. The 2015 National Firearm Survey found that 23.5% of gun owners carried a loaded handgun in the past 30 days, but trend data are not available for this survey.[84]

One proxy for gun carrying with trend data available are concealed carry permits. Permits are required to carry a concealed weapon (CCW) in public in 38 states, and, though these permits vary from state-to-state, the available data indicate general increasing trends in CCW permits.[85] Kentucky data from the Kentucky State Police indicate a steady increase in active Concealed Carry of a Deadly Weapon (CCDW) permits. Active permits are those that have been newly issued or renewed within the past five years. Figure 2 displays the number of active CCDW licenses in Kentucky since 2010.[86] Thus, it appears that not only does the shrinking population of gun owning adults own more guns than in the past, but they are also more likely to carry them than gun owners in the past.

Figure 2. Number of active Concealed Carry of Deadly Weapons (CCDW) licenses in Kentucky, 2010-2016



c. Youth and firearms

Before examining data on youth and firearms, it is helpful to understand the legal context. In 1994, for the first time in the United States, a minimum age of 18 was established to purchase and possess a handgun.[87] Both the suicide and unintentional gun death rates among youth dropped dramatically in years following this law.[8] Licensed firearm dealers also are prohibited from selling handguns to anyone younger than 21 and may not sell long guns, which include rifles and shotguns, to anyone younger than 18.[87] Unlicensed dealers may not sell or transfer handguns to those under 18, but there is no federal law that prohibits unlicensed sales or transfers of long guns to minors. Several states have minimum age laws with respect to purchasing or possession of handguns and long guns on top of the federal law, some of which raise the legal age of purchase or

possession to 21. Kentucky does not have any additional laws regulating minimum age of purchase or possession beyond the federal limits.

In addition to minimum age laws, several states also have child access prevention (CAP) laws. There is no federal CAP law. A total of 27 states and the District of Columbia have some type of CAP law. There is a large range in these laws, from imposing criminal liability upon adults whose firearms are negligently stored and accessible to minors to simply prohibiting parents/guardians from intentionally and directly giving their child a firearm.[88] Kentucky has a CAP law that prohibits parents, guardians, and other individuals from "intentionally, knowingly, or recklessly" providing a child under 18 with a firearm. Violation of this law is a Class D felony in Kentucky.[89]

In terms of youth access to firearms, there is a substantial amount of data available. An estimated 20-35% of households with children have guns, and an estimated 30-40% of children and adolescents live in households with guns.[90-93] However, nationally representative trend data on households with children with firearms present is unavailable. A recent poll in Kentucky found that the percentage of adults who live with a child and have a gun present in the home had risen from 44% in 2011 to 59% in 2017.[78] Thus, despite national trends of declining gun ownership, more youth in Kentucky have access to firearms in their homes.

Beyond ownership of guns among households with children, trend data on gun carrying among youth are available in two large, nationally representative surveys. The National Survey on Drug Use and Health (NSDUH) has asked adolescents aged 12-17 about whether they have carried a handgun over the past several years. Recent studies using NSDUH data have found that approximately 3% of adolescents aged 12-17

nationally report carrying a handgun in the past year.[1,94] Trend data analyzed from the NSDUH also showed that the percentage of white teenagers who carried handguns had increased in recent years, but this increase was not found among African American or Hispanic students.[1] Reasons for this increase and other characteristics of these youth remain to be explored. Another nationally representative survey of youth, the Youth Risk Behavior Surveillance System (YRBSS), found that 5.3% of high school students nationally reported carrying a gun in that past 30 days in 2015.[95] Unlike the NSDUH, the YRBSS does not specify handgun, which is notable because the possession of handguns among minors is a federal offense. This general gun-carrying measure on the YRBSS declined from 1993 to 1997, and then has not significantly changed since 1997.[95] Trend results were not presented disaggregated by race. In Kentucky, a recent survey indicated that carrying of handguns among youth in Kentucky has doubled since 2010.[2] Data were not examined disaggregated by race, but the vast majority of the sample were non-Hispanic white students. As with the NSDUH data, the characteristics of the growing group of handgun-carrying youth have not been explored in this sample. In 2016, 9.6%, 11.5%, 12.4%, and 10.6% of 6th, 8th, 10th, and 12th graders in this Kentucky sample carried a handgun in the past year, respectively.[2]

Several studies have examined characteristics of youth who carry guns. Male gender, previous incarceration, exposure to violence, having sold illegal drugs, theft, aggressive behavior, illicit drug use, and propensity for risk-taking are all associated with handgun carrying among adolescents.[94,96] More restrictive gun laws have also been associated with lower rates of gun carrying among youth.[97]

However, it is important to note that youth who carry handguns are not a homogenous group. One study identified four subtypes of youth who carry handguns: one with high risk of substance, one with elevated risk of violence, one with high risk of both substance use and violence, and a low risk group.[98] This perspective of understanding the coexistence of multiple risk factors is useful in several contexts, including suicide prevention. For example, it would be useful to examine subtypes of youth who carry handguns in order to better understand characteristics that may put them at an increased risk for suicide. Additionally, given the fact that handgun carrying among youth is on the rise, it would be valuable to understand which group(s) of handgun carrying youth is growing. Though the access to handguns alone demonstrate some degree of practical capacity for suicide among these youth, it is unknown the other risk factors for suicide that this high-risk group may have.

Though heterogeneity of handgun-carrying youth has been explored in the study mentioned above, to the author's knowledge, the temporal trends in handgun carrying among youth have not been examined through this lens, nor have other risk factors for suicide among gun-carrying youth. This is a critical gap in the knowledge of why youth are carrying handguns at higher rates in recent years and the potential risks, including suicide, associated with this behavior.

d. Firearms and suicide

Access to firearms has a very stable relationship to suicide, so much so that the percentage of suicide deaths by firearm is often used as a proxy for prevalence of firearm ownership.[73] Suicides account for approximately 60% of gun deaths nationally and

firearms have been the leading mechanism for suicide deaths for decades, accounting for roughly half of suicide deaths.[9] In Kentucky, roughly 65-70% of gun deaths are suicides, and 65-70% of suicides involve a firearm.[9] On an ecological level, it is well established that states with higher rates of gun ownership have higher rates of suicide, and that this is driven by higher rates of suicide by firearm specifically.[76,99-103] Recent studies have found that this relationship between gun ownership and state suicide rates remains present, even after controlling for other demographic and psychopathological characteristics including prevalence of suicidal ideation.[101,102] Additionally, storage practices of firearms have been found to have an effect at an ecological level as well; states with more individuals reporting loaded guns and guns unlocked and readily available had higher rates of suicide.[99]

The relationship between gun ownership and suicide rates has also been examined in settings where policies on gun ownership have changed. In other countries, suicides by firearm were significant reduced after policy changes that dramatically reduced gun ownership.[100] Similarly, state legislation, such as background checks and waiting periods, as well as permits and required registration of firearms, have been found to be associated with reduced suicide rates overall, reduced firearm suicide rates, and less severe trajectories in a period of rising suicide rates.[104-107] In terms of youth suicide, state-level minimum age laws have not been found to have a significant effect on youth suicide death rates, but on a federal level, the youth suicide rate dropped dramatically after the minimum age law was instated, suggesting that federal laws may have a stronger impact than state legislation.[8] CAP laws, which only exist on a state level and not a federal level, have been associated with reduced suicide rates among youth.[8]

On an individual level, gun ownership has been examined with respect to suicide risk in a number of studies. Numerous case-control studies have established that individuals who live in home with guns are 2-10 times more likely to die by suicide than individuals who do not own guns.[51-55] It is notable that this elevated risk applies to all family members in the home, not simply the gun owner. In one study of youth suicides, 75% of the firearms used by the decedents were owned by the parents, 7% were owned by other relatives, and 18% were owned by the decedent.[108] The storage of guns within the home is also related to risk of firearm suicide. Case-control studies have found that locked storage of guns, storage separate from ammunition, and locked ammunition were all related to reduced likelihood of death by firearm suicide, both among adults and among youth.[109,110]

All of the above data confirm that availability and ease of access of firearms increase one's practical capability of suicide. It is worth noting that, among adults, access to firearms appear to make the transition from ideation to attempt more likely, rather than being associated with increased suicidal ideation itself. For example, it has been found that adult gun owners and gun carriers are no more likely to have suicidal ideation, a suicide plan, or have attempted suicide than individuals who do not own and carry guns.[111] However, among suicidal individuals, those who owned a gun were found to be 7 times more likely to have a suicide plan than those without a gun.[112] This provides further evidence that access to guns is a facilitator of the step from ideation to attempts in the 3ST.

Findings from suicide attempt survivors who are at risk for another attempt have also provided evidence that access to guns facilitate the transition from ideation to

attempts. One recent study among suicide attempt survivors found that those who owned handguns were more likely to believe they would attempt suicide again,[113] which has been found to be a strong predictor of suicide attempts.[114,115] Another study among US military service members found that the storage of guns loaded and unsecured moderated the relationship between suicidal ideation and self-reported likelihood of a future suicide attempt.[116]

Data on adolescents and young adults who carry guns have shown that unlike adults, youth who carry firearms are more likely to report suicidal ideation and attempts.[117-119] In a study that stratified by gender, gun carrying was only associated with suicide attempts among male youth.[119] This indicates that gun carrying among youth, especially boys and young men, may operate differently compared to adults, who are not more likely to experience suicidal ideation or behaviors if they carry guns.[111] Given the fact that youth who report carrying firearms are at an elevated risk for suicidal behavior, and the fact that both handgun carrying and suicide are on the rise among youth, there is a need to elucidate groups of young people at a high risk for a lethal suicide attempt based on their practical capability for suicide by firearm and other risk factors.

IV. Summary and justification for present study

Youth suicide is on the rise, demanding a need to examine the steps that can be taken to reduce suicide risk among youth. The 3ST proposes that suicide risk is influenced by practical capability to make a fatal suicide attempt. In the case of firearms, practical capability includes availability of and access to firearms, as well as knowledge of how to use firearms. Firearms are the most lethal and the most common method for

suicide among youth in Kentucky. It is well established that firearm availability is associated with suicide rates, and there are proven interventions on national, state, community, and individual levels that can improve firearm safety and reduce suicide. In Kentucky, the number of youth who report carrying a handgun has doubled in a six-year span, with roughly one in eight 10th graders reporting carrying handguns in in the past year.[2] This indicates a growing practical capacity for suicide among those youth who may develop suicidal ideation.

The 3ST will provide information to help identify factors to be included in a model developing risk profiles. As the data set in the present study is a secondary data set, and the measures were not developed to measure the steps proposed in the 3ST, there are limitations with these proxies. However, there remains value in this data set, as it contains a large sample and a number of proxies by which the three steps will be approximated: pain/hopelessness, disrupted connectedness, and capacity.

Ultimately, there is limited knowledge about the growing number of youth with practical capacity for suicide via ready access to a handgun. Additionally, it is unknown which subgroup(s) of handgun carrying youth is growing. Examining the trends in identified subpopulations will help inform prevention efforts generally, and specifically, suicide prevention efforts. Heterogeneous subgroups of handgun carrying youth have never been examined with respect to their suicide risk, to the author's knowledge. Given that both suicide and handgun carrying among youth are on the rise, this information will give critical knowledge to suicide prevention professionals who may be able to better target their efforts, based on the identification of certain risk profiles that may put a young person at a very high risk for suicide. The present study utilizes latent class

analysis (LCA) to identify subgroups among a heterogeneous population and their respective risk profiles for suicide.[120]

The study setting is also important. Kentucky is a state with high gun ownership and limited firearm legislation, meaning that higher proportions of youth may have access to firearms. There has been an increase in the number of adults who report owning guns, as well as those who have licenses to carry them. Similarly, youth in Kentucky are also increasingly more likely to carry a gun than in the past. Kentucky also has the advantage of the availability of a very large behavioral health survey, the data source for the present study, which has been administered regularly to over 100,000 students across the state over the past 12 years.

In addition to these benefits of studying this issue in the chosen state, there is opportunity to directly apply the findings to prevention activities in Kentucky. Specifically, the Kentucky Cabinet for Health and Family Services has been awarded two grants from the Substance Abuse and Mental Health Services Administration (SAMSHA) that include a focus on suicide prevention. The Garrett Lee Smith Grant for Suicide Prevention is entirely focused on youth suicide prevention, and the Partnerships for Success 2015 Grant includes a suicide prevention priority among military and veteran families, focusing on youth. The findings from the present study that elucidate changing groups of youth at risk for suicide can then be used to identify youth at risk and intervene before a lethal attempt may be made, supported through these grants and a well-established prevention infrastructure throughout the state.

In summary, there remains a gap in the literature regarding why handgun carrying among youth is increasing and the other characteristics of this growing group of youth,

including their suicide risk. The present study explores characteristics of subpopulations of handgun-carrying youth, the change over time in these subpopulations, and their suicide risk, in order to better understand and identify youth who are at a high risk of dying by suicide by firearm.

CHAPTER III

METHODS

I. Data Source

a. Overview

The data used in the present study come from the Kentucky Incentives for Prevention (KIP) Survey, a biennial behavioral health survey conducted in even-numbered years of middle and high school students in Kentucky. The survey is supported with funds from the Substance Abuse and Mental Health Services Administration (SAMHSA) and is administered through the Substance Abuse Prevention Program in the Kentucky Cabinet for Health and Family Services.

The survey was initially part of a cross-site evaluation effort of SAMHSA Center for Substance Abuse Prevention's (CSAP) State Incentive Grant (SIG) that was awarded to Kentucky in 1999. The survey was required to have core measures from the Student Survey of Risk and Protective Factors and Prevalence of Alcohol, Tobacco, & Other Drug Use (March 24, 1998 version) prepared by M.W. Arthur, J.D. Hawkins, R.F. Catalano, and J.A. Pollard.[121] This survey was later developed into the Communities that Care Youth Survey, with the same measures and by the same researchers. Both surveys were developed to measure alcohol, tobacco, and other drug use and related risk and protective factors, and the Communities that Care Youth Survey continues today.[122]

Over the years, the KIP Survey has been updated with new measures, including new substances and new risk factors emerging in the field of behavioral health. In 2012, the K-6, a six-item measure of serious psychological distress, was added to the survey.[123,124] In 2014, a number of new items were added, including bullying and additional peer victimization measures, and measures on suicidal thoughts and behaviors. A more thorough of the specific measures to be used in this study is included below.

b. Participation

Every year the survey is administered, all school districts across the state are invited to participate. Participation at a school district level is voluntary, but highly encouraged and imposes no direct cost to the school district other than instruction time. When a school district agrees to participate, every 6^{th}, 8^{th}, 10^{th}, and 12^{th} grader in the school district is given the opportunity to take the survey. School districts have the option of administering the survey to their students on paper or online, and with every administration, the percentage of school districts participating online has grown. Additional details on administration have been described elsewhere.[124]

The survey is completely anonymous and no personally identifying data are ever collected. A passive consent model is utilized, in which parents and guardians are informed of the survey through a letter sent home from the superintendent at least 2 weeks prior to the survey administration date. Parents are given the opportunity to contact the administrators of the survey, should they wish for their child to not participate. Participation on a student level is also voluntary, and extensive efforts are made to ensure both anonymity of those who participate, and that no student feels coerced to participate.

Table 1 provides a summary of participating school districts, total sample size, response rates of students within participating districts and overall in the state, and the number of districts that have administered the survey online for the past three administrations of the survey, which comprise the study window. The response rate of students in participating school districts was calculated by dividing the total number of survey respondents within each district by the total number of students enrolled in that district. The student response rate among all students in Kentucky was calculated by dividing the total number of survey respondents by the total number of students enrolled in all public schools in Kentucky. All enrollment figures were obtained from the Kentucky Department of Education's School Report Card Historical Data Sets.

Table 1. Participation statistics for the KIP survey, 2012-2016

	2012	**2014**	**2016**
School district participation rate (%)	153/173 (88%)	159/173 (92%)	149/173 (86%)
Total sample size	122,718	124,115	111,700
Student response rate among all participating districts	85%	82%	83%
Student response rate among all Kentucky students	64%	64%	57%
School districts administering online (%)	65/153 (42%)	85/159 (53%)	92/149 (62%)

Because school district participation is voluntary, the sample is a non-probability sample. The largest limitation to the dataset is that the largest school district in the state, which is also the largest urban district, Jefferson County Public Schools, did not participate in the survey during the study years. Though this sampling design has its limitations, the vast majority of school districts in the state participate, and the KIP has been found to be highly representative of the state population as a whole, and especially the state population when Jefferson County is excluded. Table 2 shows a comparison of the KIP sample during the study period to these two Kentucky populations.

Table 2. Demographic characteristics of KIP respondents and all Kentucky students, with and without Jefferson County, 2012-2016

	2012 N (%)			2014 N (%)			2016 N (%)		
	KIP 2012 (N=122,718)	**KY Enrollment (N=193,106)**	**KY Enrollment Without Jefferson Co. (N=165,075)**	**KIP 2014 (N=124,115)**	**KY Enrollment (N=194,173)**	**KY Enrollment Without Jefferson Co. (N=166,303)**	**KIP 2016 (N=111,700)**	**KY Enrollment (N=196,094)**	**KY Enrollment Without Jefferson Co. (N=167,904)**
Grade									
6	34,262	51,363	44,521	33,533	50,280	43,109	30,186	50,246	43,064
	(27.9)	(26.6)	(27.0)	(27.0)	(25.9)	(25.9)	(27.0)	(25.6)	(25.6)
8	33,523	50,139	45,338	34,808	51,174	43,867	30,376	50,424	43,300
	(27.3)	(26.0)	(27.5)	(28.0)	(26.4)	(26.4)	(27.2)	(25.7)	(25.8)
10	29,988	48,125	39,769	30,339	49,411	42,303	28,379	51,095	43,515
	(24.4)	(24.9)	(24.1)	(24.4)	(25.4)	(25.4)	(25.4)	(26.1)	(24.4)
12	24,945	43,479	35,447	25,435	43,308	37,024	22,759	44,329	38,025
	(20.3)	(22.5)	(21.5)	(20.5)	(22.3)	(22.3)	(20.4)	(22.6)	(21.3)
Gender									
Male	59,642	99,046	84,841	61,560	99,469	85,466	55,659	100,586	86,458
	(51.8)	(51.3)	(51.4)	(49.7)	(51.2)	(51.4)	(50.4)	(51.3)	(51.5)
Female	55,408	94,060	80,234	60,914	94,704	80,837	54,728	95,508	81,446
	(48.2)	(48.7)	(48.6)	(50.3)	(48.8)	(48.6)	(49.6)	(48.7)	(48.5)
Missing	7,668	—	—	1,641	—	—	1,313	—	—
	—			—			—		

Table 2. (continued)

	2012 N (%)			2014 N (%)			2016 N (%)		
	KIP 2012 (N=122,718)	**KY Enrollment (N=193,106)**	**KY Enrollment Without Jefferson Co. (N=165,075)**	**KIP 2014 (N=124,115)**	**KY Enrollment (N=194,173)**	**KY Enrollment Without Jefferson Co. (N=166,303)**	**KIP 2016 (N=111,700)**	**KY Enrollment (N=196,094)**	**KY Enrollment Without Jefferson Co. (N=167,904)**
Race/Ethnicity									
NH White	97,713	158,308	143,590	94,621	156,684	142,786	85,349	154,830	141,542
	(84.0)	(82.0)	(87.0)	(80.8)	(80.7)	(84.9)	(80.4)	(79.0)	(84.3)
NH Black	7,609	20,946	10,760	6,119	20,787	10,577	4,889	20,989	10,595
	(6.5)	(10.8)	(6.5)	(5.2)	(10.7)	(6.4)	(4.6)	(10.7)	(6.3)
Hispanic	3,626	7,182	5,480	6,495	8,792	6,717	6,486	10,879	8,360
	(3.1)	(3.7)	(3.3)	(5.6)	(4.5)	(4.0)	(6.1)	(5.5)	(5.0)
NH AA/PI	1,291	2,805	1,857	1,245	3,135	2,105	1,038	3,544	2,405
	(1.1)	(1.5)	(1.1)	(1.1)	(1.6)	(1.3)	(1.0)	(1.8)	(1.4)
AI/AN	1,890	260	226	1,156	227	201	1,024	237	203
	(1.6)	(0.1)	(0.1)	(1.0)	(0.1)	(0.1)	(1.0)	(0.1)	(0.1)
Other/Multiracial	4,260	3,605	3,162	7,493	4,548	3,917	7,414	5,615	4,799
	(3.7)	(1.9)	(1.9)	(6.4)	(2.3)	(2.4)	(7.0)	(2.9)	(2.9)
Missing	6,329	—	—	6,986	—	—	5,500	—	—
	—			—			—		

II. Measures and justification

The measures included in the present study include demographics and a number of variables of interest. The demographics included are gender (male/female), race/ethnicity (non-Hispanic White, non-Hispanic Black, Hispanic, non-Hispanic Asian American/Pacific Islander [AA/PI], non-Hispanic Native American [NA], and Other/Multiracial), receipt of free/reduced lunch (yes/no), and rurality of county, based on the United States Office of Management and Budget's designation of rurality (metropolitan/micropolitan/non-metro). Age was not included as a demographic because analyses will be limited to one grade, thus limiting the range of ages substantially. More detail is provided below on data inclusion and exclusion criteria.

The variables of interest include a measure of serious psychological distress, measures of substance use, aggression, delinquency, peer victimization, frequency of handgun carrying in the past year, and suicidal ideation and behavior. Table 3 provides detailed information for each variable of interest, including the exact wording of the item, the source of the measure, validity/reliability studies, and the year added to the KIP Survey.

Table 3. Measures included in present study

General construct (First year with available data)	Specific measures	Response Categories	Source, Validation Studies Cited
Serious Psychological Distress (2012)	During the past 30 days, about how often did you feel nervous?	**Response options:** None of the time A little of the time Some of the time Most of the time All of the time Each question is scored 0-4, respectively. Item scores are summed, ranging from 0-26. **Dichotomized measure:** Cumulative score of ≥ 13 is classified as Serious Psychological Distress	K-6 Scale[124,125]
	During the past 30 days, about how often did you feel hopeless?		
	During the past 30 days, about how often did you feel restless or fidgety?		
	During the past 30 days, about how often did you feel so depressed that nothing could cheer you up?		
	During the past 30 days, about how often did you feel that everything was an effort?		
	During the past 30 days, about how often did you feel worthless?		
Substance Use (2004)	On how many occasions (if any) have you had alcoholic beverages (beer, wine, or hard liquor) to drink—more than a few sips in the past 30 days?	**Response options:** 0 times 1-2 times 3-5 times 6-9 times 10-19 times 20-39 times 40+ times **Dichotomized measure:** 0 times, 1 or more times (NOTE: Other illicit substances will be dichotomized into a single measure – 0 times if no occasions have been reported for any substance, and 1 or more times if any substance was used at least once.)	Communities that Care Youth Survey (CTCYS)[121,122,126]
	On how many occasions (if any) have you smoked cigarettes in the past 30 days?		
	On how many occasions (if any) have you used marijuana in the past 30 days?		
	Other illicit substances: On how many occasions (if any) have you used _____ in the past 30 days? • Cocaine or crack • Narcotics or drugs that require a doctor's prescription without a doctor telling you to take them • Methamphetamines • Heroin • Ecstasy		
	How many times (if any) in the past year (12 months) have you been drunk or high at school?		

Table 3. (continued)

General construct (First year with available data)	Specific measures	Response Categories	Source, Validation Studies Cited
Delinquency (2004)	How many times (if any) in the past year (12 months) have you been suspended from school?	**Response options:** 0 times 1-2 times 3-5 times 6-9 times 10-19 times 20-39 times 40+ times **Dichotomized measure:** 0 times, 1 or more times	CTCYS[121,122,126]
	How many times (if any) in the past year (12 months) have you been arrested?		
	How many times (if any) in the past year (12 months) have you sold illegal drugs?		
Aggression (2004)	How many times (if any) in the past year (12 months) have you attacked someone with the idea of seriously hurting them?		
Peer victimization (2004)	During the last school year, did someone take money or things directly from you by using force, weapons, or threats at school?	**Response options:** Yes No	Items were initially added to the survey with guidance from the National School Safety Center, resembling questions on one of their assessments.[120] The measures were evaluated for validity in an initial pilot study of the survey.[127,128]
	During the last school year, did someone verbally threaten you at school?		
	During the last school year, did someone physically threaten, attack, or hurt you at school?		
	During the last school year, did someone make unwanted sexual advances or attempt to sexually assault you at school?		
Handgun carrying (2004)	How many times (if any) in the past year (12 months) have you carried a handgun?	**Response options:** 0 times 1-2 times 3-5 times 6-9 times 10-19 times 20-39 times 40+ times **Dichotomized measure:** 0 times, 1 or more times	CTCYS[121,122,126]

Table 3. (continued)

General construct (First year with available data)	Specific measures	Response Categories	Source, Validation Studies Cited
Suicidal ideation and behavior (2014)	During the past 12 months, did you ever seriously consider attempting suicide?	**Response options:** Yes No	Youth Risk Behavior Surveillance System (YRBS)[129,130]
	During the past 12 months, did you make a plan about how you would attempt suicide?		
	During the past 12 months, how many times did you actually attempt suicide?	**Response options:** None 1 time 2-3 times 4-5 times 6+ times **Dichotomized measure:** 0 times, 1 or more times	

Though the variables of interest were not developed in order to measure the 3ST, they each fit within the framework. Serious psychological distress, measured by the K-6 scale, includes pain and hopelessness on its scale, which is the first step in the 3ST that is proposed to contribute to suicidal ideation. In the second step of the 3ST, strong ideation develops when connectedness is disrupted. Among the measures available on the KIP, the peer victimization questions will be used as proxies of disrupted connectedness. The third step of the 3ST is about dispositional, acquired, and practical capacity to attempt suicide. The KIP Survey does not include any direct or proxy measures relating to dispositional capacity for suicide. Acquired capacity typically includes things such as pain tolerance, which is also not collected on the KIP. However, "painful and provocative events," which can include violence, aggression, and substance abuse, and sensation seeking have also been shown to contribute to one's acquired capacity for suicide.[48,131-133] Thus, the measures of substance use, aggression, and delinquency will be used as proxy measures

for acquired capacity. Finally, practical capacity relates to one's ability to access and use lethal means by which to attempt suicide. Frequency of handgun carrying was used as a proxy for practical capacity for suicide by firearm.

To measure suicide risk as a distal outcome in aim 3, a variable was constructed to assess this risk. Table 4 shows the values of the constructed variable assessing suicide risk using the suicide measures.

Table 4. Constructed suicide risk variable values

Risk category	Coded value	Definition
Suicide attempter	3	Any student who reported a suicide attempt, with or without a plan or ideation
Suicide planner	2	Any student who reported a suicide plan, with or without ideation, but no attempt
Suicide ideator	1	Any student who reported suicide ideation, but no plan or attempt
Low Risk	0	Any student who did not report suicide ideation, planning or attempt

III. Data Inclusion Criteria

This study focuses on 10th grade students only. Outcomes such as gun carrying, substance use, aggression, delinquency, and suicidality have all been found to vary substantially by age.[23,134-136] Thus, it would be reasonable to assume that subgroups of handgun-carrying students would statistically vary between ages or grades. To focus this study on the change in the types of subgroups of handgun-carrying over time among high

risk youth, analyses were limited to the 10th graders. Many behavioral health outcomes peak in 10th grade, lending more statistical power for complex analyses to this subset of students. Additionally, onset of many behavioral health issues including substance use, serious emotional disturbance, and suicidal ideation have begun by mid-adolescence.[23,134] Finally, students who drop out prior to their completion of 12th grade has been found to artificially depress estimates of behavioral health outcomes in school-based surveys.[137]

Analyses for the first aim of the study were limited to students who participated in the KIP Survey in 2012, 2014, or 2016. The measure for serious psychological distress, one of the variables of interest to be included in the latent class analysis (LCA) in the first aim, was not added to the survey until 2012, so responses prior to that year would not include data for this important variable. The third aim of the study evaluates the suicide risk for the subgroups of students that emerge from the LCA. Because the suicidality questions were not added to the survey until 2014, these analyses will be limited to students who participated in 2014 and 2016. Additionally, the analyses for the second and third aims were limited to students who reported carrying a handgun at least once in the past year to focus on this population and how it has changed over time.

In addition to the above inclusion/exclusion criteria, sensitivity analyses were used to determine whether students answering inconsistently (e.g. reporting using a substance more times in the past 30 days than they did in the past 12 months) and reporting using of a fictional substance named Zycopan impacted the parameter estimates in the models. Models were run excluding students with any inconsistent answers and all students who reported any use of Zycopan to see whether parameter estimates were changed. The models remained unchanged (See Figures 11 and 12 in the Appendix.)

Additionally, sensitivity analyses were conducted to determine whether students who answered the survey online had significantly different results from those who answered on paper by running these two groups of students in separate analyses. The model again remained unchanged (See Figures 13 and 14 in the Appendix).

IV. Data Analysis

a. Specific Aim 1

Specific Aim 1 focuses on the group of students who carry handguns as a whole and how they compare to students who do not carry handguns. Analyses for this aim utilized the entire set of 10^{th} grade students, other than those that have been excluded for reasons listed above.

i. Research Question 1

To calculate the prevalence of dichotomized handgun carrying among youth, cross tabulations were calculated for each year. To determine whether this prevalence has statistically changed over time, a chi-square difference test was performed. Because the prevalence over time appeared to be a part of a trend, the trend was tested using the Cochran-Armitage test for trend.

ii. Research Question 2

The distribution of handgun carrying frequency among youth was examined with contingency tables for each year. These relationship between frequency of handgun carrying and year were tested using a Spearman rank test.

iii. Research Question 3

To examine the demographic characteristics associated with handgun carrying, gender, race/ethnicity, receipt of free/reduced lunch, and rurality of county were all cross-tabulated with dichotomized handgun carrying and tested with chi-square difference tests, examining for significant associations and effect sizes of associations using Cramer's V. Effect sizes were noted as large if V is equal to 0.5 or greater, medium if V if V is equal to 0.3-0.5 and small if V is less than 0.3.

iv. Research Question 4

This research question seeks to assess the relationships between handgun carrying and each of the following sets of variables: serious psychological distress, substance use, aggression, delinquency, and peer victimization. For each of these variables, chi-square tests were calculated to determine whether a significant relationship exists between handgun carrying and the variable of interest.

v. Research Question 5

This research question seeks to determine whether an association is present between handgun carrying and suicide ideation, planning, and attempts. For each of these variables, chi-square tests were used to test for an association with handgun carrying.

b. Specific Aim 2

Specific Aim 2 seeks to better understand the handgun-carrying population specifically, so all of the analyses only included students who report having carried a handgun at least once in the past year.

i. Research Question 1

To investigate the subpopulations that exist among handgun-carrying youth, a latent class analysis (LCA) was conducted. First, a latent class measurement model using all of the variables of interest was chosen by running latent class models iteratively, beginning with two classes, and increasing the number of classes by one with every subsequent model. Fit statistics, including the Akaike information criterion (AIC), sample-size adjusted Bayesian information criterion (saBIC), and model entropy were used to determine goodness of fit for each model. Additionally, the Lo-Mendell-Rubin likelihood ratio test (LMR-LRT) and the bootstrapped likelihood ratio test (BLRT) was used to determine whether the fit of the model was improved compared to the previous model with one fewer class. Given the large sample size of this study, the BLRT is especially helpful in determining improvement of model fit is less prone to Type I error than other information criteria.[138] Finally, ease of interpretation and parsimony was considered when determining the number of classes to include in the final model.

Once the measurement model was chosen, the demographic covariates and the year were added into the model, and the iterative model building process was repeated to ensure the ideal number of classes has not changed.

ii. Research Question 2

To explore the relationship between year and the subpopulations (latent classes) identified in the previous research question, the coefficient of the year variable was examined for significant associations with each latent class.

c. Specific Aim 3

Specific Aim 3 continues to explore the handgun-carrying population specifically, so analyses were limited to students who have reported carrying a handgun at least once in the past year. Additionally, to explore the relationship between the identified latent classes and suicide risk, analyses were limited to students from the 2014 and 2016 samples, as data on the suicide measures is not available prior to 2014.

i. Research Question 1

To assess the suicide risk for subpopulations of handgun-carrying youth, another LCA was performed. The first step of the LCA was to identify the measurement model using only the variables of interest, confirming that the model has not substantially changed from the prior measurement model. Then, demographic covariates were added in to the model. Finally, the suicide risk variable was added as a distal categorical outcome to the latent class model using the method described by Lanza, Tan, and Bray using the auxiliary command in Mplus as described by Asparouhov and Muthén.[139,140] The coefficients produced for the suicide risk variable were used to calculate odds ratios for each level of suicide risk for each latent class identified.

CHAPTER IV

RESULTS

I. Specific Aim 1

a. Research Question 1: What is the prevalence of handgun carrying among youth, and how has it changed over time?

In 2016, 12.4% (n=3,511) of 10th graders carried a handgun at least once in the past year, compared to 11.5% (n=3,464) in 2014, and 7.8% (n=2,293) in 2012. The change between 2012 and 2016 was statistically significantly ($\chi^2 = 331.48$, $p<0.001$, Cramer's V = 0.076). Furthermore, there is a statistical trend of increasing handgun carrying among 10th graders between 2012 and 2016 (p-trend<0.001).

b. Research Question 2: What is the distribution of the frequency of handgun carrying among youth, and how has this changed over time?

Table 5 summarizes the distribution of the frequency of handgun carrying among all 10th graders for each year, and Figure 3 displays the percent of all 10th graders who carried handguns in each frequency category for each year. The proportion of 10th graders who carried handguns in each frequency category has increased since 2012. When tested with a Spearman rank test, this association was found to be significant (p<0.0001).

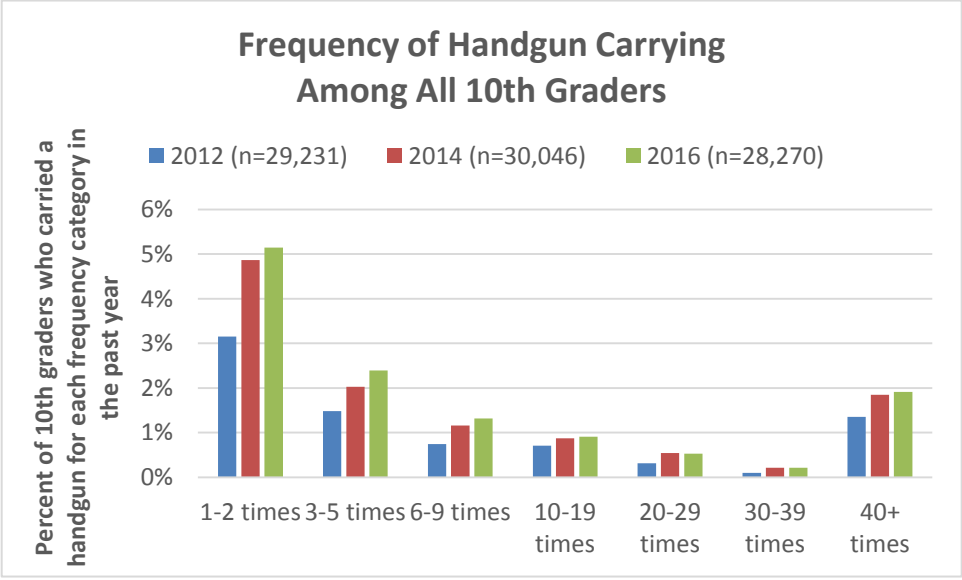
Across all years, the most common frequency among those who carried a handgun was 1-2 times, followed by 3-5 times, and then followed by 40 or more times.

This suggests that the most common pattern of carrying a handgun is just a few times, but there is a substantial portion of handgun-carrying youth who carry handguns regularly.

Table 5. Frequency of handgun carrying in past year among all 10th graders, 2012-2016

Frequency of handgun carrying in past year	2012 (n=29,231)	2014 (n=30,046)	2016 (n=28,270)
Never	92.16%	88.47%	87.58%
1-2 times	3.15%	4.87%	5.15%
3-5 times	1.48%	2.03%	2.39%
6-9 times	0.74%	1.16%	1.32%
10-19 times	0.71%	0.87%	0.91%
20-29 times	0.31%	0.54%	0.53%
30-39 times	0.10%	0.21%	0.21%
40+ times	1.35%	1.85%	1.91%

Figure 3. Frequency of handgun carrying in past year among all 10th graders, 2012-2016



c. Research Question 3: What demographic characteristics (gender, race/ethnicity, free/reduced lunch, rurality) are associated with handgun carrying?

Each of the individual-level demographic characteristics tested (gender, race/ethnicity, and receipt of free/reduced lunch) were significantly associated with handgun carrying at the $p<0.001$ level. The demographic characteristics had varying effect sizes, measured with Cramer's V. Males were more likely to carry handguns than females, and gender had the largest effect size of all the demographic covariates tested, though the effect size was still modest ($V=0.20$). Additionally, non-Hispanic American Indian/Alaska Native (NH AI/AN), non-Hispanic students of other races and more than one race, Hispanic, and non-Hispanic White youth were all more likely to carry handguns than other racial groups, with NH AI/AN youth with the highest likelihood. Finally, students who received free/reduced lunch were more likely than those who did not to carry a handgun. The effect sizes for race/ethnicity and free/reduced lunch were both small, though statistically significant. County-level rurality was also significantly associated with handgun carrying at the $p<0.001$ level. Students living in more rural areas were more likely to carry handguns than students in more urban areas, though the effect size was small.

Table 6. Handgun carrying among 10th graders by demographic characteristics, 2012-2016

	Handgun Carrying in Past Year		
	Never	**1+ times**	**Cramer's V**
Individual-level factors			
Gender*			
Male (n=42,875)	83.2%	16.8%	0.2012
Female (n=42,246)	95.6%	4.4%	
Race*			
NH White (n=69,953)	89.7%	10.3%	0.0475
NH Black (n=4,476)	90.9%	9.1%	
Hispanic (n=3,909)	87.9%	12.1%	
NH AA/PI (n=876)	92.2%	7.8%	
NH AI/AN (n=718)	78.8%	21.2%	
NH Other/Multiracial (n=4,521)	85.6%	14.4%	
Free/reduced lunch*			
No (n=40,877)	90.5%	9.6%	0.0284
Yes (n=41,501)	88.7%	11.3%	
County-level factors			
Rurality*			
Metropolitan (n=36,705)	90.2%	9.9%	0.0211
Micropolitan (n=23,815)	89.1%	10.9%	
Non-metro/rural (n=27,027)	88.7%	11.3%	

*Significantly associated with handgun carrying at the $p<0.001$ level, chi square tests

d. Research Question 4: What are the relationships between each of the following variables and handgun carrying among youth: serious psychological distress, substance use, aggression, delinquency, and victimization?

Students who were seriously psychologically distressed in the past 30 days were found to be significantly more likely to carry a handgun in the past year ($p<.001$). Table 7 summarizes handgun carrying among those psychologically distressed and those who were not.

Table 7. Handgun carrying among 10th graders by serious psychological distress, 2012-2016

	Handgun Carrying in Past Year		
	Never	**1+ times**	**Cramer's V**
Serious psychological distress in past 30 days*			
No (n=66,949)	90.1%	9.9%	0.0362
Yes (n=15,335)	87.3%	12.7%	

*Significantly associated with handgun carrying at the $p<0.001$ level, chi square test

Additionally, handgun carrying was examined among those who used alcohol, cigarettes, marijuana, and other illicit drugs in the past 30 days, and those who had been drunk or high at school within the past year. All of these students were significantly more likely to have carried a handgun in the past year ($p<.001$ for all chi-square tests). Results are summarized in Table 8.

Table 8. Handgun carrying among 10th graders by substance use, 2012-2016

	Handgun Carrying in Past Year		
	Never	**1+ times**	**Cramer's V**
Past 30-day alcohol use*			
No (n=65,071)	92.3%	7.7%	0.1695
Yes (n=18,144)	79.8%	20.2%	
Past 30-day cigarette use*			
No (n=71,347)	91.5%	8.5%	0.1458
Yes (n=13,392)	79.4%	20.7%	
Past 30-day marijuana use*			
No (n=73,515)	91.1%	8.9%	0.1289
Yes (n=10,611)	79.3%	20.7%	
Past 30-day other illicit drug use*			
No (n=74,562)	90.8%	9.2%	0.1464
Yes (n=5,143)	72.6%	27.4%	
Drunk/high at school in past year*			
Never (n=77,473)	91.6%	8.4%	0.1933
Yes (n=9,752)	72.7%	27.3%	

*Significantly associated with handgun carrying at the p<0.001 level, chi square tests

Students who reported delinquent and aggressive behaviors in the past year, including being suspended, arrested, selling drugs, and physically attacking someone with the intention of seriously hurting them, were found to be significantly more likely than their peers to carry a handgun (p<.001 for all chi-square tests). Table 9 summarizes the patterns of handgun carrying among students who reported these behaviors.

Table 9. Handgun carrying among 10th graders by delinquent and aggressive behaviors, 2012-2016

	Handgun Carrying in Past Year		
	Never	**1+ times**	**Cramer's V**
Delinquency			
Suspended in past year*			
No (n=76,244)	91.4%	8.6%	0.1672
Yes (n=11,051)	75.9%	24.1%	
Arrested in past year*			
No (n=83,065)	90.9%	9.1%	0.2074
Yes (n=4,169)	61.0%	39.0%	
Sold drugs in the past year*			
No (n=81,641)	91.4%	8.6%	0.2432
Yes (n=5,451)	60.6%	39.4%	
Aggression			
Physically attacked someone in the past year*			
No (n=77,528)	92.3%	7.8%	0.2597
Yes (n=9,629)	66.8%	33.2%	

*Significantly associated with handgun carrying at the p<0.001 level, chi square tests

Finally, students who said they had been victimized by peers at school in the past year were also significantly more likely to carry a handgun in the past year (p<.001 for all chi-square tests). Table 10 summaries these results.

Table 10. Handgun carrying among 10th graders by peer victimization, 2012-2016

	Handgun Carrying in Past Year		
	Never	**1+ times**	**Cramer's V**
Forcibly stolen from in the past year*			
No (n=83,159)	90.0%	10.0%	0.0867
Yes (n=2,828)	75.1%	24.9%	
Verbally threatened in the past year*			
No (n=65,193)	91.6%	8.4%	0.1225
Yes (n=20,819)	82.8%	17.2%	
Physically threatened in the past year*			
No (n=77,952)	90.5%	9.5%	0.1047
Yes (n=7,980)	79.5%	20.6%	
Received unwanted sexual advances in the past year*			
No (n=78,102)	89.9%	10.1%	0.0444
Yes (n=7,630)	85.1%	14.9%	

*Significantly associated with handgun carrying at the p<0.001 level, chi square tests

e. Research Question 5: Is handgun carrying associated with suicide ideation, planning, and attempts?

Next, suicidality was examined by handgun carrying. Students who carried handguns in the past year were found to be significantly more likely to report suicide ideation, planning, and attempts in the past year compared to their peers who did not carry handguns. Table 11 summarizes these results.

Table 11. Prevalence of suicidality among 10th graders by handgun carrying, 2014-2016

	Percentage who seriously considered suicide in past year*	**Percentage who made a suicide plan in past year***	**Percentage who attempted suicide in past year***
Handgun carrying in past year			
Never	14.8%	11.7%	7.5%
1+ times	20.0%	18.2%	12.6%

*Significantly associated with handgun carrying at the p<0.001 level, chi square tests

II. Specific Aim 2

a. *Research Question 1: What subpopulations exist among handgun-carrying youth based on their probabilities of each of the following variables: serious psychological distress, substance use, aggression, delinquency, victimization, and frequency of handgun carrying?*

Four primary subpopulations were identified using latent class analysis. The number of classes was determined based on a number of fit criteria, ease of interpretation, and class separation. The best fitting model was determined to be the four-class model. Both the Lo-Mendell-Rubin likelihood ratio test (LMR-LRT) and the bootstrapped likelihood ratio test (BLRT) had p-values of <0.0001 for the four-class model, indicating an improved fit from the model with three classes. Though the LMR-LRT and BLRT continued to have highly significant values for the five- and six-class models, the model entropy dropped to below 0.8 after the four-class model (Figure 4). Entropy values approaching 1 indicate clear class separation, and values below 0.8 are generally considered reflective of poorer class separation.[141] The Akaike information criterion (AIC), Bayesian information criterion (BIC), and sample-size adjusted Bayesian information criterion (saBIC) only moderately improved in the five- and six-class models (Figure 5). However, ultimately the four-class model was chosen because the classes appeared most distinct in the four-class model than either the five- or six-class model, and the interpretability of these classes was also clearest with the four-class model.

Figure 4. Entropy for latent class measurement models with 2-6 classes

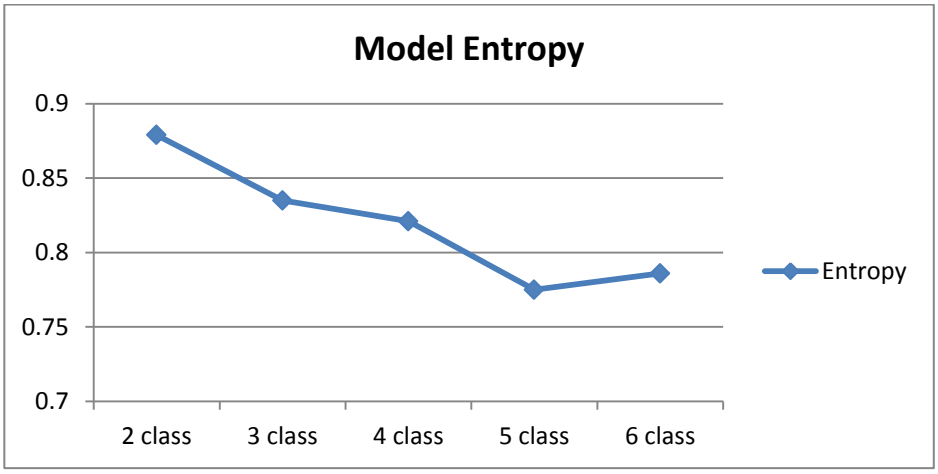
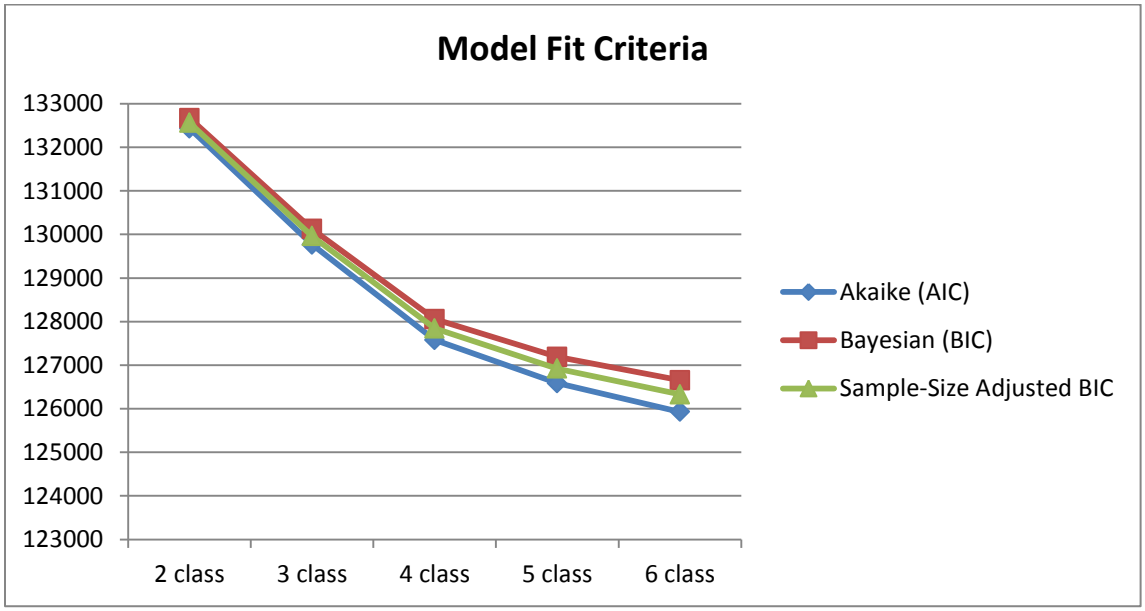


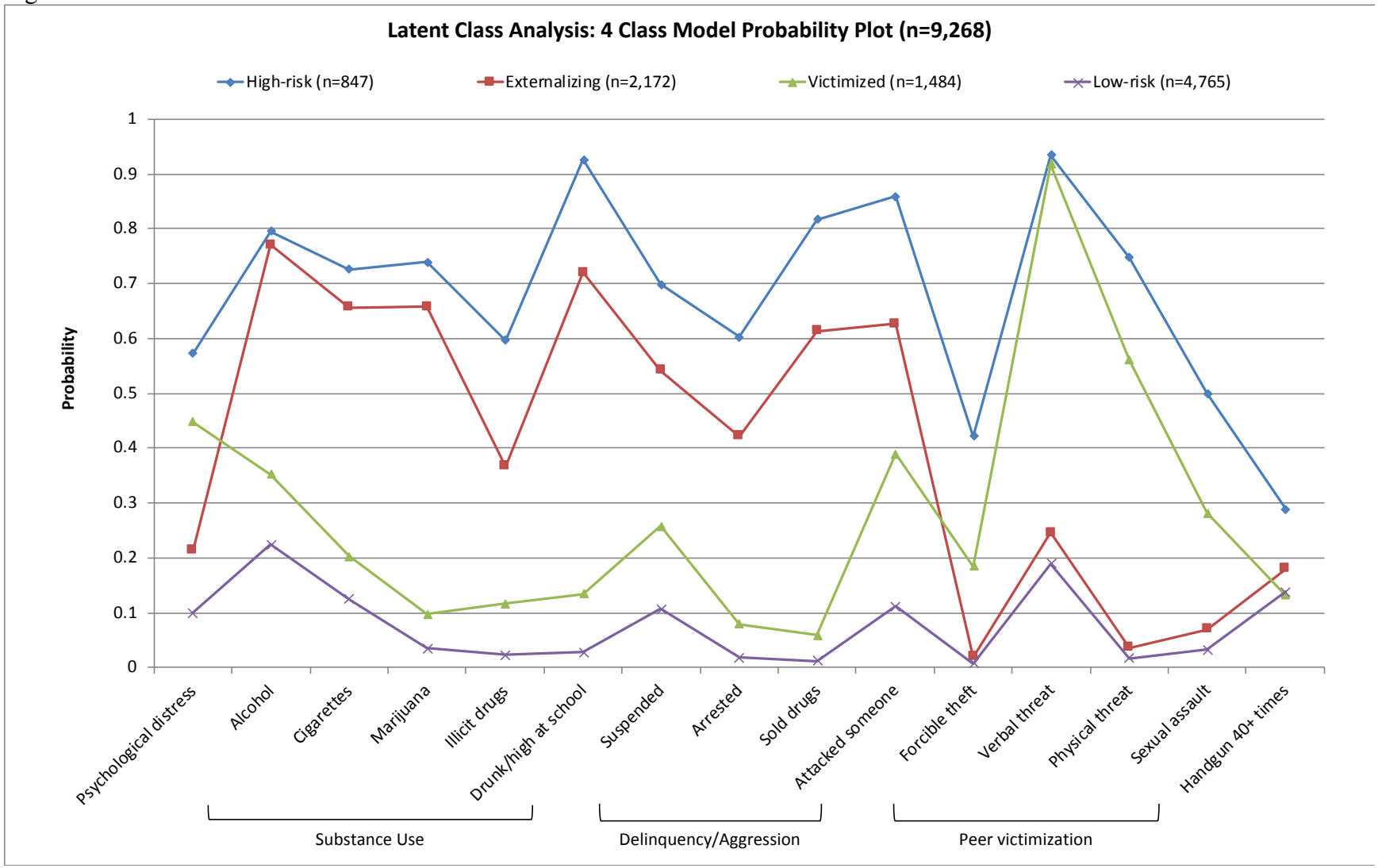
Figure 5. Information criteria for latent class measurement models with 2-6 classes



The four classes in the final model can be classified as follows: a high-risk class; a class characterized by substance use and externalizing behaviors such as delinquency and aggression; a class victimized by peers; and a low-risk class. Class probabilities of each variable are shown in Figure 6. The low-risk class was by far the largest, with just over half of the sample (51.4%, n= 4,765). The next largest class was the substance use

and externalizing class (23.4%, n=2,172), followed by the peer victimization class (16.0%, n=1,484). The smallest class was the high-risk class, comprising 9.1% of the sample (n=847).

Figure 6. Probabilities of observed variables in each latent class of 4-class measurement model



b. Research Question 2: How have these subpopulations changed between 2012 and 2016?

When year was added as a covariate in the model, the model remained nearly identical to the measurement model described above. Additional individual-level demographic covariates of interest, including gender, race/ethnicity, free/reduced lunch, and county-level rurality were then added to the model. The model again remained very similar to the measurement model above. The final model with year and covariates is shown in Figure 7. The demographic characteristics of each class are shown in Table 12, and the model parameter estimates are shown in Table 13.

As seen in Tables 12 and 13, males were more likely to be in every class than females, particularly in the low-risk class and the externalizing class. Interestingly, the high-risk class had the largest proportion of females of all of the classes. In all classes, non-Hispanic white students were the most likely to carry handguns. This disparity was the most prominent in the low risk class, of which 88% were white. The high-risk class had the lowest percentage of white students and higher percentages of students of other races and ethnicities. Finally, the proportion of students receiving free or reduced lunch was highest among the externalizing class, followed by the high-risk class, and then the peer victimization class. Only the low-risk class had a majority of students not receiving free or reduced lunch.

Figure 8 shows the prevalence of each class over time among handgun-carrying students. Between 2012 and 2016, the proportion of gun-carrying students that were in the externalizing class decreased (34.8% in 2012 vs. 17.5% in 2016), and the proportion

of gun-carrying students in the low-risk class and the victimization class increased (43.7% in 2012 vs. 52.1% in 2016 and 12.3% in 2012 vs. 21.3% in 2016, respectively). The proportion of gun-carrying students in the high-risk class remained stable (9.3% in 2012 vs. 9.2% in 2016). Figure 9 shows the prevalence of each of these four classes among all 10th graders, to portray the growth and change over time compared to the entire student body. This figure shows the substantial growth of the low-risk and peer-victimization classes, the slower growth of the high-risk class, and the slight decline of the externalizing class.

Figure 7. Probabilities of observed variables in each latent class of 4-class model with year and demographic covariates

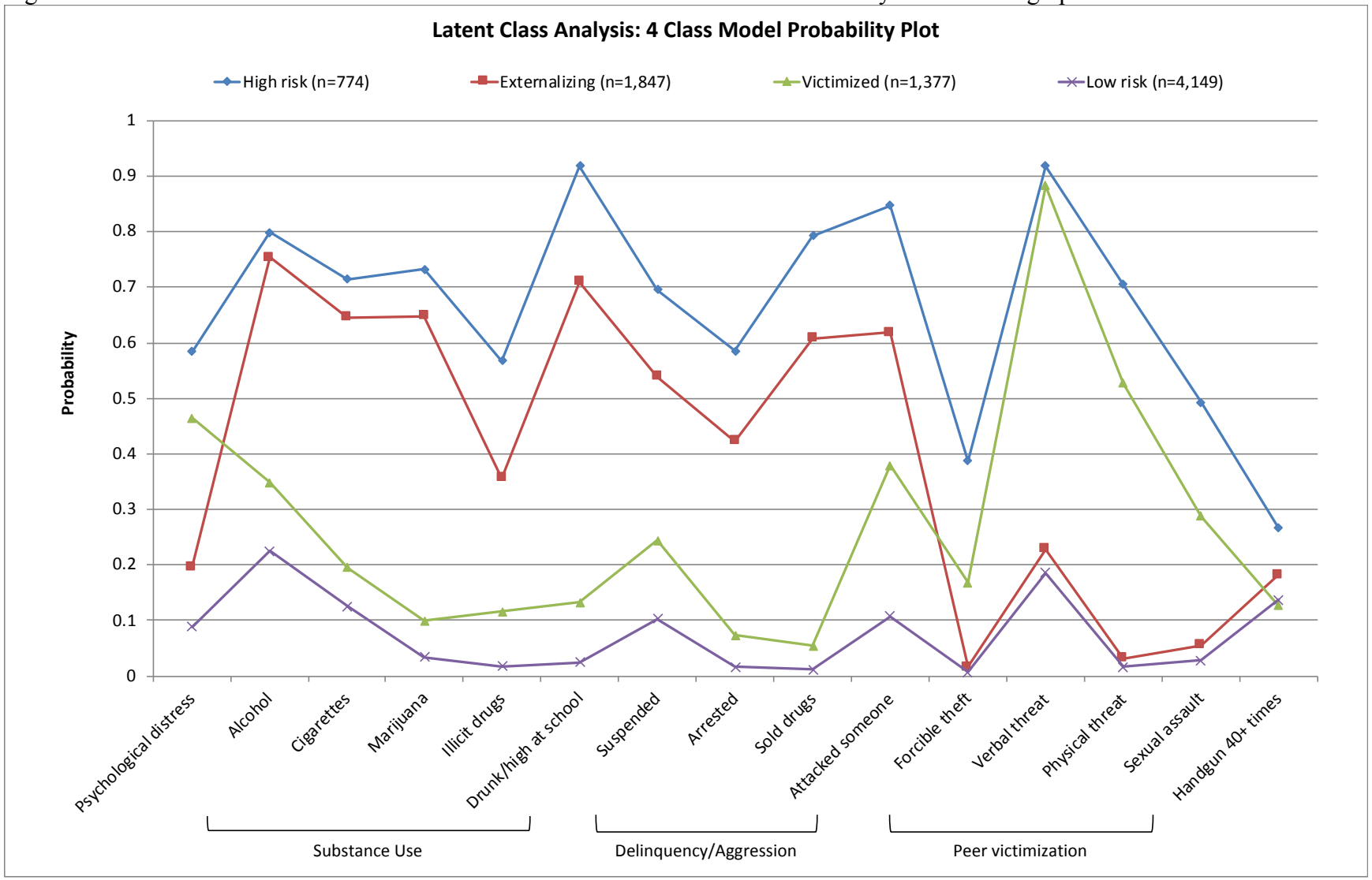


Table 12. Demographic characteristics of each latent class in adjusted 4-class model with covariates and year

	High-risk class (N, %)		Externalizing class (N, %)		Victimized class (N, %)		Low-risk class (N, %)	
Gender								
Female	266	(34.4%)	294	(16.0%)	475	(33.5%)	670	(16.3%)
Male	508	(65.6%)	1,543	(84.0%)	943	(66.5%)	3,448	(83.7%)
Race/ethnicity								
NH White	493	(63.7%)	1,298	(70.7%)	1,149	(81.0%)	3,628	(88.1%)
NH Black	46	(5.9%)	191	(10.4%)	45	(3.2%)	88	(2.1%)
Hispanic	90	(11.6%)	139	(7.6%)	71	(5.0%)	120	(2.9%)
NH AA/PI	35	(4.5%)	11	(0.6%)	1	(0.1%)	14	(0.3%)
NH AI/AN	32	(4.1%)	35	(1.9%)	27	(1.9%)	43	(1.0%)
NH Other/Multiracial	78	(10.1%)	163	(8.9%)	125	(8.8%)	225	(5.5%)
Free/reduced lunch								
No	290	(37.5%)	618	(33.6%)	591	(41.7%)	2,205	(53.6%)
Yes	484	(62.5%)	1,219	(66.4%)	827	(58.3%)	1,913	(46.5%)
Rurality								
Metropolitan	350	(45.2%)	774	(42.1%)	552	(38.9%)	1,509	(36.6%)
Micropolitan	232	(30.0%)	481	(26.2%)	423	(29.8%)	1,109	(26.9%)
Non-metro (rural)	192	(24.8%)	582	(31.7%)	443	(31.2%)	1,500	(36.4%)

Table 13. Adjusted odds ratios for year and demographic characteristics associated with each latent class in 4-class model

	High-risk class		Externalizing class		Victimized class		Low-risk class	
	AOR	**95% CI**	**AOR**	**95% CI**	**AOR**	**95% CI**	**AOR**	**95% CI**
Year								
2012	1.00	Ref.	1.00	Ref.	1.00	Ref.	Ref.	Ref.
2014	0.78	(0.62,0.98)	0.45	(0.38,0.53)	0.96	(0.78,1.19)		
2016	0.70	(0.55,0.89)	0.38	(0.32,0.45)	1.17	(0.95,1.44)		
Gender								
Female	1.00	Ref.	1.00	Ref.	1.00	Ref.	Ref.	Ref.
Male	0.38	(0.31,0.47)	0.97	(0.79,1.20)	0.40	(0.33,0.49)		
Race/ethnicity								
NH White	1.00	Ref.	1.00	Ref.	1.00	Ref.	Ref.	Ref.
NH Black	3.19	(2.02,5.02)	4.52	(3.31,6.17)	1.42	(0.85,2.37)		
Hispanic	4.44	(3.16,6.24)	3.22	(2.39,4.34)	1.54	(1.05,2.25)		
NH AA/PI	15.08	(7.45,30.55)	1.94	(0.74,5.11)	0.30	(0.02,4.36)		
NH AI/AN	6.10	(3.60,10.35)	2.09	(1.18,3.69)	2.30	(1.22,4.33)		
NH Other/ Multiracial	2.40	(1.75,3.30)	2.12	(1.65,2.73)	1.69	(1.27,2.26)		
Free/reduced lunch								
No	1.00	Ref.	1.00	Ref.	1.00	Ref.	Ref.	Ref.
Yes	2.06	(1.70,2.50)	2.35	(2.04,2.71)	1.60	(1.36,1.87)		
Rurality								
Metropolitan	1.00	Ref.	1.00	Ref.	1.00	Ref.	Ref.	Ref.
Micropolitan	0.84	(0.67,1.05)	0.76	(0.64,0.91)	0.97	(0.79,1.18)		
Non-metro (rural)	0.53	(0.41,0.67)	0.67	(0.56,0.80)	0.73	(0.59,0.90)		

Figure 8. Proportion of each latent class among handgun-carrying 10th graders in 4-class model by year, 2012-2016

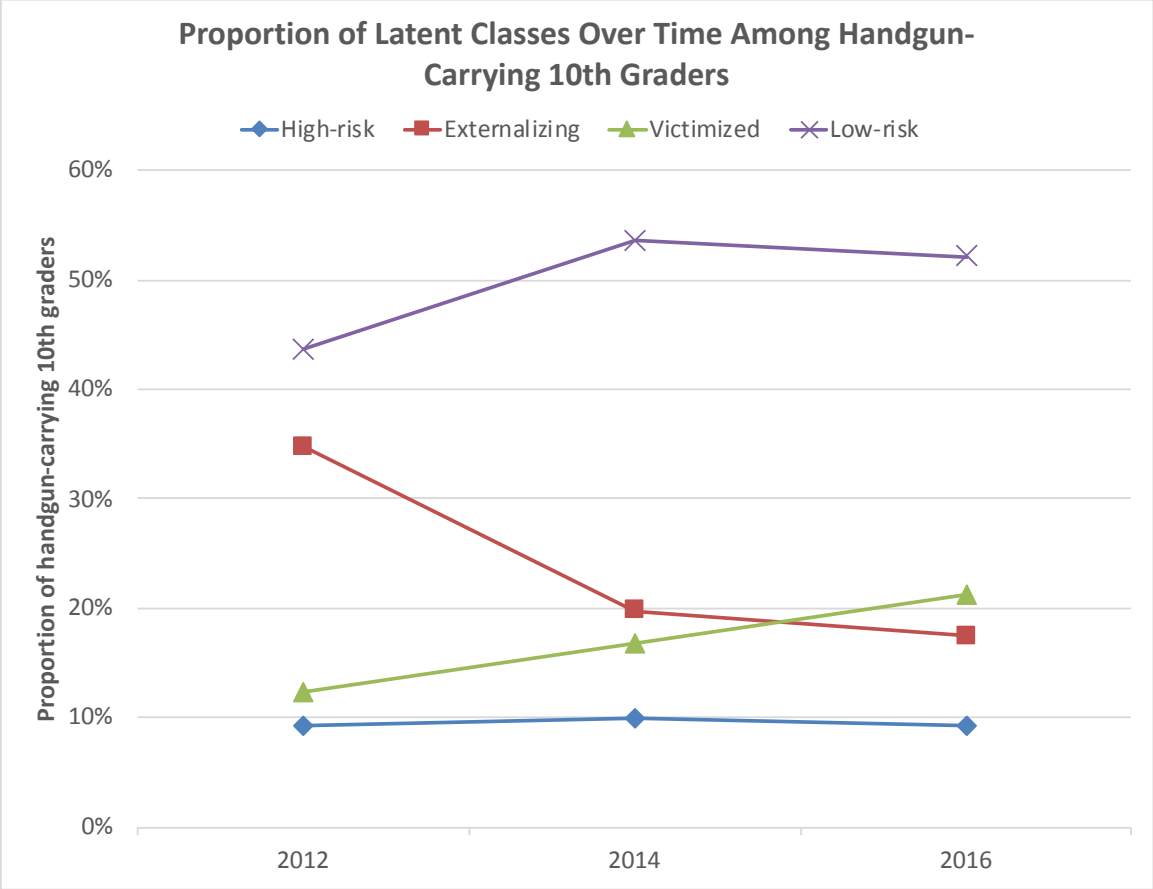
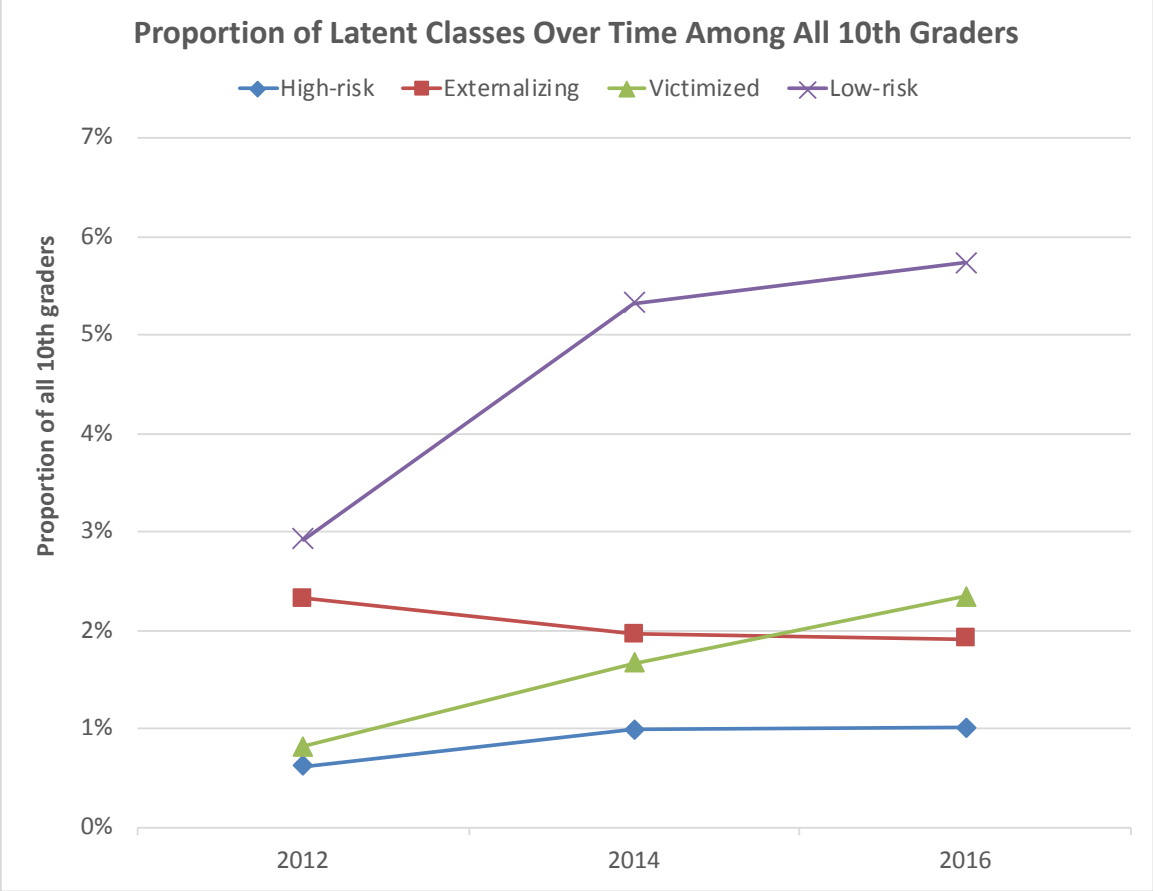


Figure 9. Proportion of each latent class among all 10th graders in 4-class model by year, 2012-2016



III. Specific Aim 3

a. Research Question 1: Which subpopulations of handgun-carrying youth are at the highest risk of suicidal behaviors?

Because this model only used 2014 and 2016 data, a measurement model was first run to assure that no substantial changes were observed from the prior model using three years of data. Then, a model with the demographic covariates and year was run. No substantial changes were observed during either of these steps. Finally, a latent class model was run with the calculated suicide risk variable as a distal outcome. Because the

demographic covariates and year were not found to affect the class structure in the previous analyses, they were not adjusted for in this model. In this analysis, the class variable was found to be significantly associated with the suicide risk variable. Table 14 shows the prevalence of suicidal ideation, planning, and attempts for each class, and Figure 10 shows the proportions of the calculated suicide risk levels for each class (attempters, planners, ideators, low risk). Table 15 shows the odds ratios of the calculated suicide risk levels for each latent class.

These results indicate that the high-risk class is the most likely to have attempted suicide, and these students' calculated suicide risk levels skew higher than all of the other groups, with more than half of the students reporting suicidal ideation, planning, or attempt within the past year. Students in the high-risk group are 91 times as likely as students in the low-risk group to be suicide attempters as opposed to ideators, planners, or no reported suicidality. The class with the next highest suicidality risk is the victimized group, which had 39% of its members reporting suicidal ideation, planning, or attempt within the past year. Students in this group were 33 times as likely as those in the low-risk group to be suicide attempters, as opposed to ideators, planners, or no reported suicidality. The externalizing group of students had the next highest risk for suicidality, with 31% of students reporting suicidal ideation, planning, or attempts in the past year. These externalizing students were 10 times as likely as the low-risk group to be suicide attempters.

Table 14. Prevalence of suicidal thoughts and behaviors among each latent class

	Suicide Ideation (N, %)		Suicide Plan (N, %)		Suicide Attempt (N, %)	
Class						
High-Risk	282	(50.1%)	271	(48.3%)	219	(38.8%)
Externalizing	344	(25.1%)	322	(23.5%)	255	(18.6%)
Victimized	374	(33.2%)	351	(31.3%)	228	(20.3%)
Low-Risk	324	(9.1%)	255	(7.2%)	130	(3.7%)

Figure 10. Proportions of calculated suicide risk levels among each latent class

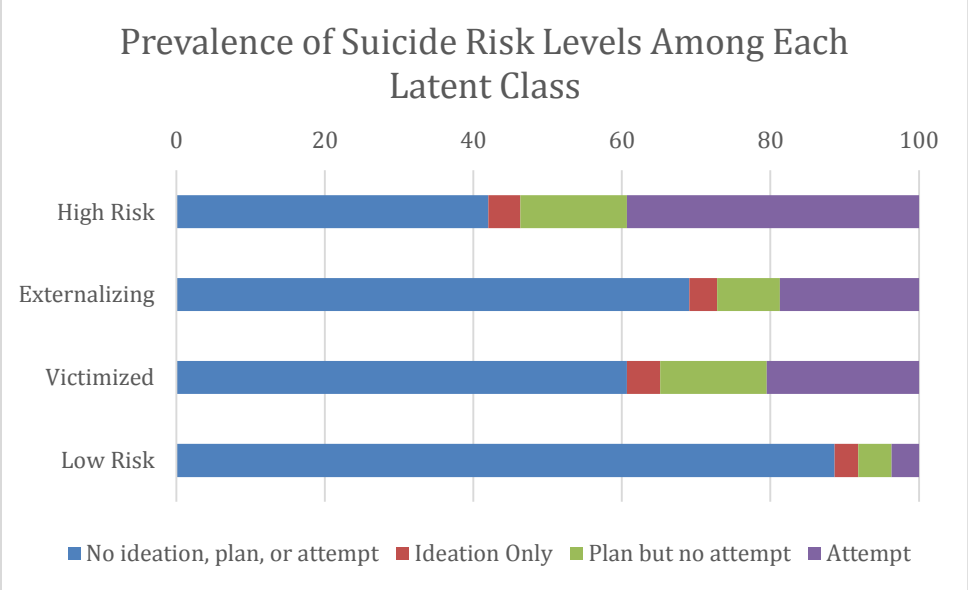


Table 15. Odds ratios for calculated suicide risk levels for each latent class

	Suicide Risk Level							
	Attempters		**Planners (No attempt)**		**Ideators (No planning or attempt)**		**No suicide ideation, plan, or attempt**	
	OR	**95% CI**	**OR**	**95% CI**	**OR**	**95% CI**	**OR**	**95% CI**
Class								
High-Risk	91.3	(49.5, 168.5)	13.9	(8.5, 22.5)	5.4	(3.3, 8.7)	Ref.	-
Externalizing	10.2	(4.6, 22.9)	3.2	(2.0, 5.1)	1.1	(0.5, 2.4)	Ref.	-
Victimized	33.1	(18.3, 60.2)	12.5	(8.2, 19.1)	4.0	(2.6, 6.4)	Ref.	-
Low-Risk	1.0	Ref.	1.0	Ref.	1.0	Ref.	Ref.	-

CHAPTER V

DISCUSSION

I. Characteristics of handgun-carrying youth

a. Prevalence and frequency of handgun carrying among youth

In 2016, roughly one in eight 10th grade respondents to in the present study had carried a handgun at least once in the past year. This is notably higher than national estimates of similarly aged youth. Respondents to the 2016 National Survey on Drug Use and Health (NSDUH) who were aged 14-15 and 16-17 had much lower rates of handgun carrying in the past year: 4.5% and 5.2%, respectively.[142] Similar to national findings, the prevalence of handgun carrying among youth was found to be increasing in recent years, particularly among white youth, who comprise the vast majority of the present study sample.[1]

The frequency of handgun carrying has also shifted with youth carrying handguns more frequently in 2016 than in 2012. Overall, most youth who carry handguns only carry them a small number of times in a year. However, there remains a notable and growing group of youth who have carried handguns 40 or more times in the past year.

b. Characteristics associated with handgun carrying

Males in this study were more likely to carry handguns than females, which is consistent with previous literature.[94,96] Of all racial/ethnic groups, non-Hispanic American Indian/Alaska Native students had the highest likelihood of carrying handguns, followed by students of other races and multiple races. Hispanic students had the next highest rate of handgun carrying and then non-Hispanic white students. Non-Hispanic black students and non-Hispanic Asian American/Pacific Islander students had lower likelihoods of carrying handguns. These patterns are generally similar to those found in other studies – non-Hispanic black and Asian American students tend to have lower rates of carrying handguns, and multiracial, American Indian/Alaska Native, white, and Hispanic students have been found to have higher rates of handgun carrying.[142] Students who received free and reduced lunch were also more likely to carry handguns than their peers. There is limited research on the relationship between handgun carrying and measures of poverty among youth. One study found an association between parental/household income and handgun carrying among youth, though this relationship varied by race.[1] Students in rural areas were also more likely to report carrying handguns, which mirrors national findings.[142] This is likely reflective of higher gun ownership and carrying and cultural connection to firearms in rural areas among adults.[143,144]

Beyond demographic characteristics, a number of psychological and behavioral characteristics were found to be associated with handgun carrying. Students who reported serious psychological distress, substance use, delinquent and aggressive behaviors, and those who were victimized by peers were all more likely to carry a handgun than their peers. This is in line with the previous literature that has found that youth who report

trauma, substance use, delinquency, aggression, and peer victimization are all more likely to carry a handgun.[39,94,96] These associations varied in their strength, with the delinquent and aggressive behaviors having the strongest associations with handgun carrying, followed by substance use, followed by certain types of peer victimization, and then serious psychological distress.

Additionally, these characteristics are all characteristics that the Three Step Theory (3ST) suggests would increase one's suicide risk. Serious psychological distress is a composite measure designed to measure psychological pain and distress and was measured in this study with six individual items, including one that ask directly about hopelessness. This measure can thus be considered in the 3ST as a proxy measure of pain and hopelessness, which is the first step in the 3ST, and which is theorized to be required for the onset of suicidal ideation.

The next step in the 3ST is disrupted connectedness. The peer victimization questions indicate that connectedness with peers has been disrupted, and these questions can be interpreted as a proxy measure for this step in the 3ST. Therefore, it is expected that youth who report both psychological distress and peer victimization would have a higher likelihood of suicidal ideation than those who report only one of these risk factors.

The final step in the 3ST when severe suicidal ideation progresses to a suicide attempt is when someone has the dispositional, acquired, and practical capacity for a suicide attempt. Dispositional capacity, such as one's sensitivity to pain, was not measured in this study. One example of practical capacity would be access and familiarity with firearms, making the frequency of handgun carrying a proxy measure for practical capacity. Finally, acquired capacity includes an increase over time in one's

ability to withstand pain and injury based on previous painful and provocative events.[48] Such events might include substance use, which can be self-injurious; delinquent behaviors, which often involve sensation-seeking; and aggressive behaviors, which expose someone to violence (even if the individual is the perpetrator of the violence).[48,131-133] Thus, in this study, proxies were available for acquired and practical capacity for suicide. The existing research supporting the 3ST and other similar theories supports the link between each of these proxy measures and the elevated suicide risk that was found.[48,131-133]

Similar to previous findings that youth who carry guns are more likely to think about and attempt suicide, carrying handguns among Kentucky youth in this study was also associated with suicidal ideation, planning, and attempts in the past year.[117-119] This finding underscores the importance of suicide prevention efforts among youth who have access to firearms, especially in a state with a higher rate of gun carrying among youth.

II. Subpopulations of handgun-carrying youth and suicide risk

There were four primary subgroups identified among youth who carry firearms – a high-risk group, a group characterized by substance use and externalizing behaviors, a group characterized by psychological distress and peer victimization, and a low-risk group. To the author's knowledge, a similar analysis has not been conducted with the same breadth of variables. One study similar in terms of the analytic methods used found four subgroups: a high-risk group, a group characterized by alcohol and marijuana use, a group characterized by aggressive behaviors, and a low-risk group.[98] However, the

previous study did not examine psychological distress or peer victimization, which are both highly relevant when considering suicide as a potential outcome of handgun access.

In the present study, the four subgroups found can be understood in the context of the 3ST. The high-risk group specifically had high probabilities of serious psychological distress (pain and hopelessness); peer victimization (disrupted connectedness); and substance use, aggression, and delinquency (acquired capacity). Additionally, all of these students had carried handguns in the past year, which indicates practical capacity for suicide. This high-risk group has evidence for all three steps of the 3ST, making them a very high-risk group for suicide attempt. When the suicide risk was further evaluated based on their self-reported suicidal ideation, planning, and attempts, this group faced staggering odds of suicidality. The majority (58%) of students in this high-risk group reported some level of suicidality in the past year, and nearly 40% of these students had actually attempted suicide within the past year.

The group with the next highest risk of suicidal behavior was the group characterized by peer victimization. This group had moderate probabilities of serious psychological distress (pain and hopelessness) and moderate to high probabilities of peer victimization (disrupted connectedness). Students in this group did not have high probabilities of substance use, delinquency, and aggression (contributing to acquired capacity) but may have had other painful and provocative events in their life that were not captured. They also all had access to a firearm (practical capacity). With a moderate to high probability of the first two steps of the 3ST being present among students in this group, but with lower probabilities and fewer of the risk factors/steps than the high-risk group, it would be expected that this group would have the next highest risk for suicide

attempt. Specifically, many students in this group would likely be in the second step of the 3ST, which is severe suicidal ideation, but a suicide attempt at this point would be less likely. In the suicidality analyses, that is exactly what was found. The proportion of students who had attempted suicide in the past year in this group was half the proportion of those in the high-risk group (20.5% vs. 39.3%). Additionally, the odds of being a suicide ideator or suicide planner were similar among the high-risk and victimized groups, but the odds of being an attempter among the high-risk group was nearly triple that of the victimized group. This lends support to the hypothesis that acquired capacity via painful and provocative events is one of the distinguishing factors between those who think about suicide and those who attempt.

The group with the next highest risk for suicidal behavior was the externalizing group. This is the group that had low probability of serious psychological distress, high probabilities of substance use, aggressive, and delinquent behaviors, and low probabilities of peer victimization. In the 3ST, their characteristics align most with acquired capacity for suicide. Additionally, because they have access to firearms, this contributes to their practical capacity for suicide. However, without the existing pain and hopelessness or disrupted connectedness, these youth are less likely to die by suicide with their current risk profile. Should these young people face adversity and endure pain, hopelessness, and disrupted connectedness, they would likely suddenly find themselves in the high-risk group of students and their risk for suicide would escalate very quickly. The suicidality analyses found these youth at a lower risk of being suicide ideators, planners, or attempters compared to the two previously discussed groups. Compared to the low-risk group, the externalizing students were no more likely to be in the suicide

ideator group. However, they were significantly more likely to either have made a suicide plan without an attempt and to have attempted suicide.

The last group found among handgun-carrying students was a low-risk group. This group was characterized by low probability of all of the indicator variables included in the model, meaning they did not have any of the 3ST steps among those measured in this study. As would be expected, this group had the lowest likelihood of suicidality among all of the groups and was used as the referent group for the multivariate suicidality analysis. Despite their apparent low risk, it is important to remember that access to a firearm alone is a risk factor for suicide.[51-55,109,110] Similar to the externalizing group, if students in this group faced some of the risk factors the other groups faced, they could quickly transition to a significantly higher risk profile simply because they have access to a firearm and thus have higher practical capacity for suicide than their peers without access to a firearm.

With respect to risk of death by firearm suicide, the risk for these groups may differ from their risk for suicidal behavior. Prior research has shown that suicide decedents who die by firearm are less likely than other suicide decedents to have a history of prior suicide attempts.[145] This is likely because those who attempt suicide by firearm are more likely to die in their first attempt,[59-61] and prior research has shown that most suicide decedents die by the same method by which they first attempted suicide.[146] Additionally, it is uncommon for individuals intent on attempting suicide to switch methods if their planned method is somehow thwarted or interrupted.[58,147] This lack of prior suicide attempts among firearm suicide decedents, the tendency to maintain one's planned method of attempting suicide, and the higher likelihood of males dying by

firearm suicide shift the picture of suicide risk among the subgroups. Specifically, the externalizing group of handgun-carrying students may be at the highest risk for future death by firearm suicide. Because of their existing acquired and practical capacity for suicide and their lack of prior suicide attempts, their predominately male gender, these individuals would be at a very high risk for suicide if they should experience pain and hopelessness and disrupted connectedness. The individuals in the high-risk group who have not already attempted suicide may also be at very high risk for suicide by firearm.

In terms of the distribution of these groups, the largest group was the low-risk group. This group is growing, and though they are lower risk than the other groups, they remain at risk for suicide simply because of their access to firearms. This large and growing low-risk group may indicate that handgun-carrying behaviors are becoming increasingly normalized among youth. Roughly half of students who carried a handgun at least once in the past year were in the low-risk group in 2016. This inversely means that roughly half of students who carried a handgun at least once in the past year were in one of the higher risk classes, with evidence of at least one of the three steps in the 3ST. This underscores the critical importance of suicide prevention among all youth with access to handguns, and especially among those who have other risk factors.

The highest risk group, with evidence of all three steps within the 3ST being present, made up roughly 9% of the subsample. This means that 1 in 11 10^{th} graders who carried a handgun exhibited numerous risk factors for suicide and all of the steps of the 3ST. It is imperative for these high-risk youth that intervention and prevention efforts targeting any related risk factors (e.g. substance use, delinquency, aggression, or peer victimization) also include suicide prevention and means safety. Discussions with parents

about firearms in the home among this population of youth are highly encouraged, as limiting access to firearms has been shown in prior research to reduce suicide deaths.[51-55,109,110] Over the past several years, this high-risk group has remained stable in the proportion of handgun-carrying students that it comprises, but it has grown in its proportion to the entire student body, signaling a growing importance of suicide prevention to this very high-risk group.

The peer victimization group made up 21.3% of handgun carrying students in 2016, which is more than 1 in 5 students. Additionally, this subgroup has grown 73% since 2012 in its proportion among handgun-carrying students, and its proportion has almost tripled among the entire student population, making it the fastest growing of all the subgroups identified. Considering the suicide risk of this group, this growth is especially concerning.

The externalizing group made up 17.5% of the subsample in 2016, which is roughly 1 in 6 students. The proportion of students in this group has declined from 2012 to 2016, both among handgun-carrying students and the entire student population. This may reflect a general decline in substance use and externalizing behaviors among all youth that has been seen in recent years.[2,148] Despite the decline, this group still makes up a substantial portion of handgun-carrying students – more than 1 in 6 handgun-carrying students are in this externalizing group.

Demographics were found to vary significantly between these groups. The low-risk group was overwhelmingly male and white, and close to evenly split in terms of receipt of free/reduced lunch. The distribution of students in this group living in metropolitan, micropolitan, and non-metro or rural areas was the most evenly split of all

groups. This group had the highest proportion of students living in rural areas of any of the groups.

The other three groups varied in their demographics. Though these demographic characteristics were all significantly related to class membership, they did not impact the structure of the classes. Adding year into the model also did not impact the class structure. This speaks to the robustness and strength of the model and the stability of the classes over time.

All groups were mostly male, though the victimized group and the high-risk group had the lowest proportion of males of the four, with about two-thirds of the students in each group male. Males are more likely to carry firearms in general, so the males in the low-risk and the externalizing groups may reflect that. [94,96] Firearms are more associated with males culturally, and it may be that males are more likely to carry them due to cultural reasons, especially in rural areas,[149] which may account for their large makeup of the low-risk class. Males are also more likely than females to exhibit externalizing behaviors,[150] so that may explain the larger proportion of males in that class. Females are more likely to report certain types of peer victimization,[151] so that may contribute to why they make up a larger portion of that class. This distribution of gender among victimized students may also be driving the larger proportion of females in the high-risk class as well.

There were interesting race/ethnicity effects found among the four classes as well. The low-risk class had the most non-Hispanic white students of any class and had a slightly larger proportion of white students than the entire sample of all 10th grade students. This larger proportion of white students was likely due to the higher proportion

of rural students. The most similar class in terms of race/ethnicity to the low-risk class was victimized class, which had slightly more students of color in almost every racial/ethnic group. Then, the externalizing group, which was still predominately white, saw further increases among students of color, particularly among black students. Finally, the high-risk class had the fewest white students, though it was still the largest racial/ethnic group by far. The next largest proportion of students in this group were Hispanic, then students of other races and multiracial students. Across all groups, students who were Asian-American/Pacific Islander and those who were American Indian/Alaskan Native made up the smallest proportion of students.

For all groups except the low-risk group, students who received free/reduced lunch were more prevalent than those who did not. Free/reduced lunch is a proxy measure for poverty, and poverty has been shown to be associated with psychological distress, externalizing behaviors, and peer victimization.[152,153] Therefore, these findings are in line with previous research.

Finally, as mentioned previously, the low-risk class was the most rural of any class, followed by the peer victimization class and the externalizing class. The high-risk class was the least rural class. These results may indicate that handgun carrying among youth has become especially normalized in rural communities, with lower-risk youth carrying most frequently in these communities. Firearm ownership has been found to be different among adults in rural areas than among adults in urban areas – gun owners in rural areas are more likely than those in urban areas to own guns for sport and are more likely to associate the right to own guns with a sense of personal freedom.[143,154] Cultural differences in attitudes and uses of firearms in rural and urban may help to explain the

differences in proportion of rurality in each class, but further research is needed to clarify these relationships.

III. Prevention Implications

Taken together, these results may indicate that handgun-carrying is becoming increasingly normalized among youth today, particularly in rural communities. Though these youth have fewer risk factors than the youth in the other groups, they remain at an elevated risk for suicide simply because they have access to a firearm, and 11% of these low-risk youth still experienced suicidal thoughts or behaviors without exhibiting the other risk factors examined in this study. This highlights that these low-risk youth remain at risk for suicide, perhaps without many warning signs, and universal prevention efforts would be required to reach these youth. This is in line with recent data from the CDC, which showed that half of those who died by suicide in recent years did not have a prior known mental health condition.[18] Universal suicide prevention in schools and communities, especially among gun-owning and rural communities, would likely be very beneficial to reduce the risk of suicide of youth living in these communities. Additional prevention measures like limiting youth access to firearms in homes, particularly if they begin to exhibit any warning signs of psychological distress, would be of utmost importance.

The above results also clearly indicate that students with other risk factors, including the three steps described in the 3ST – pain and hopelessness, disrupted connectedness, and capacity for suicide – are at a much higher risk for suicidal behavior, and therefore for death by suicide. For these youth, selective and indicated prevention

practices are recommended. Parents, school personnel, and others who work with youth should watch for psychologically distressed youth who may face victimization at school and in the home and screen for suicidality, gun ownership, and gun access among youth and parents. If a distressed youth does have access to firearms, particularly if they express suicidal intentions, measures should be made to ideally remove the firearms from homes, add locks, and store ammunition separate from the firearm for maximized safety for the youth at risk.

On an environmental level, policies and laws have often had the broadest impact on public health problems. As a relevant example, one of the most dramatic declines in youth suicide in US history coincided with the passage of the federal minimum age law, which made it illegal for youth under 18 to own and possess handguns.[8] Other policies that have been proven to be associated with reduced suicide risk on a state level include universal background checks on all firearm purchases, mandatory waiting periods, and permits and required registration of firearms.[104-107] Extreme Risk Protective Orders (ERPOs) or "red flag laws", which allow for a judge to temporarily remove firearms from the possession of someone who may be at risk of hurting themselves or others, have also been associated with reduced suicide rates.[155,156] These laws have also been used to remove firearms from the home of individuals with children who are believed at risk for harming themselves or others, indicating they could be useful in preventing youth suicide. Additionally, Child Access Protection laws have been shown to reduce youth suicide on a state level.[8] All of these policies would likely have equal if not greater impact at a federal level.

Though all the above policies would likely lower suicide rates and merit advocacy efforts, the gun-control political debate tends to be highly polarized. However, some of these promising policies are strongly supported among gun-owners and non-gun-owners alike. A nationally representative poll of Americans found that 77% of gun owners and 87% of non-owners supported background checks for private sales and at gun shows.[143] Additionally, 89% of both groups supported limiting access to firearms among the mentally ill.[143] This may translate into support for ERPOs. Though support is lower among gun-owners, the majority of both gun-owners and non-owners support creating a federal database to track gun sales (54% and 80%, respectively). Thus, in a politically divided era, universal background checks, ERPOs, and databases to register gun sales may be the most feasible policies to pursue first that would likely reduce suicide rates.

Another potential suicide prevention opportunity may be as a part of required firearm safety training. For example, in certain states, individuals are required to go through firearm safety training before they can purchase a gun or before they can obtain a concealed carry license. Adding suicide prevention into these trainings could be another opportunity to make gun owners aware of the risk of suicide that not only they face, but also their family members. However, in Kentucky, there is no required training prior to purchasing a gun, and the required safety training for obtaining a concealed carry license was just removed in the 2019 state legislative session.[83] This eliminates another opportunity to educate gun owners on firearm safety with respect to suicide risk.

Finally, efforts have been made around the country to engage the gun-owning community in proactive ways to reduce suicide risk. Of particular note, The Gun Shop Project is a collaborative effort between gun shops across the country and suicide

prevention agencies to educate gun shop employees about potential signs of suicide among shoppers and to disseminate suicide prevention resources to post and share in the shop.[157,158] The Gun Shop Project has had great receptivity among gun shop owners and is currently in 21 states, including Kentucky. Despite the fact that youth under 18 cannot purchase firearms, educating their parents or the owners of the guns when they purchase about the risk of suicide may help to reduce the problem of youth suicide.

IV. Limitations

There are a number of limitations with this study. First, the data are self-reported and data accuracy depends on the survey respondents being truthful in their answers. Though the prevalence of reported behaviors may be underrepresented or overrepresented than students' actual behaviors, determining the actual prevalence of these behaviors is cost-prohibitive and impractical for most studies. Prevalence estimates of behaviors are similar to those gathered via national surveys, which supports the likelihood that these data are of acceptable quality. Additionally, less than one percent of all 10th graders included in the study reported use of a fictional substance. As a more conservative check for untrue responses, students with any inconsistencies on the survey were excluded (e.g. reported more times using alcohol in the past 30 days than in the past 12 months). When both of these groups of students were excluded in sensitivity analyses, the results of the models remained unchanged.

Second, the data in this study are cross-sectional. Though associations and relationships have been found, the data are insufficient to prove causality or temporality between these variables due to the cross-sectional nature of the data.

Third, the large sample size in this study may contribute to type I error, giving statistically significant findings for relationships or differences that are so small that they are not practically meaningful. Because of this possibility, effect sizes were estimated in the bivariate analyses and a broad array of criteria were used in the LCAs to determine the ideal models.

Fourth, the measures in this study were not developed with the purpose of testing or measuring the 3ST. Thus, these are proxy measures and may not represent the steps in the 3ST fully or as accurately as other measures. Additionally, there were missing confounders, especially with respect to variables relating to the 3ST, such as family connectedness or pain tolerance, that were unmeasured in this study. These confounders may impact the relationships found if they were to be included in the study. However, the fact that the present study findings aligned well with previous research on the 3ST supports the use of these proxy measures of the 3ST.

Finally, the study findings are specific to Kentucky 10th grade students and may not be generalizable to other populations. Of particular note, the county that is home to Louisville, the largest city in Kentucky, Jefferson County, did not participate in the survey in the three years included in the study. Though there were smaller metropolitan areas included in the study, the lack of a large urban area emphasizes the fact that the study findings may not apply to such populations.

V. Further research

Beyond the implications mentioned above, this study has many implications for future research. Because the size of the classes identified in the LCA changed over time,

further exploration into the stability of the classes over time may be warranted. Continued exploration of these classes in future years would also be valuable to observe whether these classes continue to remain stable and observe changes in the size of these classes.

Additionally, there were many interesting relationships between the latent classes and gender and race/ethnicity. Studies examining measurement invariance in latent classes among handgun-carrying students by gender and race/ethnicity could further elaborate on differences between these groups. Qualitative data to add a narrative dimension to the relationships between gender and race/ethnicity and handgun carrying among youth would also add significant depth and meaning to the findings. Additionally, examining these findings by age and grade would be highly useful to explore how these latent classes change over a young person's development.

There were notable differences in rural and urban youth in their handgun-carrying behaviors. There is limited academic research on the nature of gun culture in rural versus urban areas. Qualitative and quantitative research exploring differences in gun ownership, carrying behaviors, and attitudes among residents, and especially youth, would be very useful to better understand the relationships observed in the present study.

For the first time in the KIP survey's history, Jefferson County, the county of Louisville, the largest city in Kentucky, participated in the survey in 2018. A replication of the present study with Jefferson County data included would provide further insight into the effects of rurality on the findings and give more generalizable results.

Finally, access to handguns not only carries risk for harm to oneself, but also risk for harm to others. Re-examining the study data through a theoretical framework of violence prevention and correlating prevalence of latent classes of students with

ecological measures of violence may be useful to better understand the impact of handgun carrying behavior on violence among youth.

VI. Summary

This study indicates a rise in handgun-carrying among youth, and an associated increase in suicide risk. This rise is alarming both among the low-risk youth and especially among the growing groups of youth with other significant risk factors for suicidal behavior. Particularly for these high-risk youth, handgun carrying may be a sign that a youth is at risk of harming themselves or others, and these issues should be dealt with care, sensitivity, and expediency via appropriate screening and prevention practices. Additionally, policies that may reduce suicide among youth should be advocated for on a community, state, and federal level.

REFERENCES

1. Vaughn MG, Nelson EJ, Salas-Wright CP, DeLisi M, Qian Z. Handgun carrying among White youth increasing in the United States: New evidence from the National Survey on Drug Use and Health 2002–2013. *Preventive Medicine.* 2016;88:127-133.

2. Sanders DH, Illback RJ, Crabtree L, Sanders D, McGeeney TJ, Luther EG. *KIP 2016: Statewide Trends Related to Substance Abuse, School Safety, and Gambling, 2004-2016.* Louisville, KY: Kentucky Cabinet for Health and Family Services, Department for Behavioral Health, Developmental and Intellectual Disabilities;2017.

3. Curtin SC, Warner M, Hedegaard H. Increase in Suicide in the United States, 1999-2014. *NCHS data brief.* 2016(241):1-8.

4. QuickStats: Death Rates for Motor Vehicle Traffic Injury, Suicide, and Homicide Among Children and Adolescents aged 10–14 Years — United States, 1999–2014. *MMWR Morb Mortal Wkly Rep 2016.* 2016;65:1203.

5. *QuickStats: Suicide Rates for Teens Aged 15–19 Years, by Sex — United States, 1975–2015.* Atlanta, Georgia: Centers for Disease Control and Prevention; November 4, 2016 2017.

6. Brown S, Seals J, McCarthy M, Bush H. *Violent Deaths in Kentucky 2005-2014: A Statewide Statistical Summary of Homicides, Suicides and Unintentional Firearm Fatalities.* Lexington, KY: College of Public Health, Kentucky Injury Prevention and Research Center, University of Kentucky;2017.

7. Klonsky ED, May AM. The Three-Step Theory (3ST): A New Theory of Suicide Rooted in the "Ideation-to-Action" Framework. *International Journal of Cognitive Therapy.* 2015;8(2):114-129.

8. Gius M. The impact of minimum age and child access prevention laws on firearm-related youth suicides and unintentional deaths. *Soc Sci J.* 2015;52(2):168-175.

9. Web-based Injury Statistics Query and Reporting System (WISQARS) [online]. Centers for Disease Control and Prevention, National Center for Injury Prevention and Control; 2005. www.cdc.gov/injury/wisqars. Accessed May 27, 2018.

10. Mercado MC, Holland K, Leemis RW, Stone DM, Wang J. Trends in emergency department visits for nonfatal self-inflicted injuries among youth aged 10 to 24 years in the united states, 2001-2015. *JAMA.* 2017;318(19):1931-1933.

11. Bell TM, Qiao N, Jenkins PC, Siedlecki CB, Fecher AM. Trends in Emergency Department Visits for Nonfatal Violence-Related Injuries Among Adolescents in the United States, 2009–2013. *Journal of Adolescent Health.* 2016;58(5):573-575.

12. Centers for Disease C, Prevention. *Youth Risk Behavior Survey (YRBS). Trends in the prevalence of suicide-related behaviors: national YRBS: 1991–2015.* 2017 2017.

13. Twenge JM, Joiner TE, Rogers ML, Martin GN. Increases in Depressive Symptoms, Suicide-Related Outcomes, and Suicide Rates Among U.S. Adolescents After 2010 and Links to Increased New Media Screen Time. *Clinical Psychological Science.* 2017;6(1):3-17.

14. Mojtabai R, Olfson M, Han B. National Trends in the Prevalence and Treatment of Depression in Adolescents and Young Adults. *Pediatrics.* 2016;138(6).

15. Safer DJ, Rajakannan T, Burcu M, Zito JM. Trends in subthreshold psychiatric diagnoses for youth in community treatment. *JAMA Psychiatry.* 2015;72(1):75-83.

16. Han B, Compton WM, Blanco C, DuPont RL. National Trends in Substance Use and Use Disorders Among Youth. *Journal of the American Academy of Child & Adolescent Psychiatry.* 2017;56(9):747-754.e743.

17. Anderson EL, Steen E, Stavropoulos V. Internet use and Problematic Internet Use: a systematic review of longitudinal research trends in adolescence and emergent adulthood. *International Journal of Adolescence and Youth.* 2017;22(4):430-454.

18. Stone DM, Simon TR, Fowler KA, et al. Vital Signs: Trends in State Suicide Rates — United States, 1999–2016 and Circumstances Contributing to Suicide — 27 States, 2015. *Morbidity and Mortality Weekly Report.* 2018;67(22):617-624.

19. Brown T. *Confirmatory factor analysis for applied research.* 2nd ed. New York: Guilford Press; 2015.

20. McGeeney TJ, Clark P, Webb A, Singleton M, Robeson S. Kentucky's Suicide Data and Surveillance Committee: An interdisciplinary effort to respond to rising youth suicide rates. American Public Health Association 2017 Annual Meeting; 2017; Atlanta, Georgia.

21. Canetto SS, Sakinofsky I. The Gender Paradox in Suicide. *Suicide and Life-Threatening Behavior.* 1998;28(1):1-23.

22. Schrijvers DL, Bollen J, Sabbe BGC. The gender paradox in suicidal behavior and its impact on the suicidal process. *Journal of Affective Disorders.* 2012;138(1):19-26.

23. Kessler RC, Borges G, Walters EE. Prevalence of and risk factors for lifetime suicide attempts in the national comorbidity survey. *Archives of General Psychiatry.* 1999;56(7):617-626.

24. Curtin SC, Warner M, Hedegaard H. Suicide rates for females and males by race and ethnicity: United States, 1999 and 2014. *NCHS Health E-Stat.* 2016.

25. Herne MA, Bartholomew ML, Weahkee RL. Suicide Mortality Among American Indians and Alaska Natives, 1999–2009. *American Journal of Public Health.* 2014;104(S3):S336-S342.

26. Rockett IR, Wang S, Stack S, et al. Race/ethnicity and potential suicide misclassification: window on a minority suicide paradox? *BMC Psychiatry.* 2010;10(1):35.

27. Davidson CL, Wingate LR. Racial Disparities in Risk and Protective Factors for Suicide. *J Black Psychol.* 2011;37(4):499-516.

28. Haas AP, Eliason M, Mays VM, et al. Suicide and Suicide Risk in Lesbian, Gay, Bisexual, and Transgender Populations: Review and Recommendations. *Journal of Homosexuality.* 2010;58(1):10-51.

29. Haas AP, Lane A. Collecting Sexual Orientation and Gender Identity Data in Suicide and Other Violent Deaths: A Step Towards Identifying and Addressing LGBT Mortality Disparities. *LGBT Health.* 2015;2(1):84-87.

30. Kegler SR, Stone DM, Holland KM. Trends in Suicide by Level of Urbanization — United States, 1999–2015. *MMWR Morbidity and Mortality Weekly Report.* 2017;66(10):270-273.

31. Searles VB, Valley MA, Hedegaard H, Betz ME. Suicides in Urban and Rural Counties in the United States, 2006–2008. *Crisis.* 2014;35(1):18-26.

32. Nestadt PS, Triplett P, Fowler DR, Mojtabai R. Urban–Rural Differences in Suicide in the State of Maryland: The Role of Firearms. *American Journal of Public Health.* 2017;107(10):1548-1553.

33. Rossen LM, Hedegaard H, Khan D, Warner M. County-Level Trends in Suicide Rates in the U.S., 2005–2015. *American Journal of Preventive Medicine.*

34. Hawton K, Casañas i Comabella C, Haw C, Saunders K. Risk factors for suicide in individuals with depression: A systematic review. *Journal of Affective Disorders.* 2013;147(1):17-28.

35. Blair-West GW, Cantor CH, Mellsop GW, Eyeson-Annan ML. Lifetime suicide risk in major depression: sex and age determinants. *Journal of Affective Disorders.* 1999;55(2):171-178.

36. Owens D, Horrocks J, House A. Fatal and non-fatal repetition of self-harm. Systematic review. *Br J Psychiatry.* 2002;181:193-199.

37. Dube SR, Anda RF, Felitti VJ, Chapman DP, Williamson DF, Giles WH. Childhood abuse, household dysfunction, and the risk of attempted suicide throughout the life span: findings from the Adverse Childhood Experiences Study. *JAMA.* 2001;286(24):3089-3096.

38. Afifi TO, Enns MW, Cox BJ, Asmundson GJG, Stein MB, Sareen J. Population Attributable Fractions of Psychiatric Disorders and Suicide Ideation and Attempts Associated With Adverse Childhood Experiences. *American Journal of Public Health.* 2008;98(5):946-952.

39. van Geel M, Vedder P, Tanilon J. Relationship between peer victimization, cyberbullying, and suicide in children and adolescents: A meta-analysis. *JAMA Pediatrics.* 2014;168(5):435-442.

40. Klomek AB, Sourander A, Gould M. The Association of Suicide and Bullying in Childhood to Young Adulthood: A Review of Cross-Sectional and Longitudinal Research Findings. *The Canadian Journal of Psychiatry.* 2010;55(5):282-288.

41. Klomek AB, Sourander A, Niemelä S, et al. Childhood bullying behaviors as a risk for suicide attempts and completed suicides: a population-based birth cohort study. *J Am Acad Child Adolesc Psychiatry.* 2009;48(3):254-261.

42. Devries K, Watts C, Yoshihama M, et al. Violence against women is strongly associated with suicide attempts: Evidence from the WHO multi-country study on women's health and domestic violence against women. *Social Science & Medicine.* 2011;73(1):79-86.

43. Ramsawh HJ, Fullerton CS, Mash HBH, et al. Risk for suicidal behaviors associated with PTSD, depression, and their comorbidity in the U.S. Army. *Journal of Affective Disorders.* 2014;161:116-122.

44. Nock MK, Green J, Hwang I, et al. Prevalence, correlates, and treatment of lifetime suicidal behavior among adolescents: Results from the national comorbidity survey replication adolescent supplement. *JAMA Psychiatry.* 2013;70(3):300-310.

45. Kaplan MS, McFarland BH, Huguet N, et al. Acute alcohol intoxication and suicide: a gender-stratified analysis of the National Violent Death Reporting System. *Injury Prevention.* 2012.

46. Bagge CL, Lee H-J, Schumacher JA, Gratz KL, Krull JL, Holloman G. Alcohol as an Acute Risk Factor for Recent Suicide Attempts: A Case-Crossover Analysis. *Journal of Studies on Alcohol and Drugs.* 2013;74(4):552-558.

47. Sher L, Oquendo MA, Richardson-Vejlgaard R, et al. Effect of acute alcohol use on the lethality of suicide attempts in patients with mood disorders. *Journal of psychiatric research.* 2009;43(10):901-905.

48. Joiner T. *Why People Die by Suicide.* Harvard University Press; 2005.

49. O'Connor RC. Towards an integrated motivational-volitional model of suicidal behaviour. *International handbook of suicide prevention: Research, policy and practice.* 2011;1:181-198.

50. Klonsky ED, May Alexis M. Differentiating Suicide Attempters from Suicide Ideators: A Critical Frontier for Suicidology Research. *Suicide and Life-Threatening Behavior.* 2013;44(1):1-5.

51. Wiebe DJ. Homicide and suicide risks associated with firearms in the home: A national case-control study. *Annals of Emergency Medicine.* 2003;41(6):771-782.

52. Anglemyer A, Horvath T, Rutherford G. The accessibility of firearms and risk for suicide and homicide victimization among household members: A systematic review and meta-analysis. *Annals of Internal Medicine.* 2014;160(2):101-110.

53. Miller M, Hemenway D. The relationship between firearms and suicide: A review of the literature. *Aggression and Violent Behavior.* 1999;4(1):59-75.

54. Brent DA, Perper JA, Allman CJ, Moritz GM, Wartella ME, Zelenak JP. The presence and accessibility of firearms in the homes of adolescent suicides: A case-control study. *JAMA.* 1991;266(21):2989-2995.

55. Henrich CC, Brookmeyer KA, Shrier LA, Shahar G. Supportive relationships and sexual risk behavior in adolescence: an ecological-transactional approach. *J Pediatr Psychol.* 2006;31.

56. Mann JJ, Apter A, Bertolote J, Beatrais A, Currier D, Haas A. Suicide prevention strategies: a systematic review. *JAMA.* 2005;294.

57. Bryan CJ, Stone SL, Rudd MD. A practical, evidence-based approach for means-restriction counseling with suicidal patients. *Professional Psychology: Research and Practice.* 2011;42(5):339-346.

58. Daigle MS. Suicide prevention through means restriction: Assessing the risk of substitution: A critical review and synthesis. *Accident Analysis & Prevention.* 2005;37(4):625-632.

59. Elnour AA, Harrison J. Lethality of suicide methods. *Injury Prevention.* 2008;14(1):39.

60. Spicer RS, Miller TR. Suicide acts in 8 states: incidence and case fatality rates by demographics and method. *American Journal of Public Health.* 2000;90(12):1885-1891.

61. Shenassa ED, Catlin SN, Buka SL. Lethality of firearms relative to other suicide methods: a population based study. *Journal of Epidemiology and Community Health.* 2003;57(2):120-124.

62. Barber CW, Miller MJ. Reducing a Suicidal Person's Access to Lethal Means of Suicide: A Research Agenda. *American Journal of Preventive Medicine.* 2014;47(3, Supplement 2):S264-S272.

63. Gun Laws: Registration. Giffords Law Center to Prevent Gun Violence. http://lawcenter.giffords.org/gun-laws/policy-areas/gun-owner-responsibilities/registration/. Accessed May 27, 2018.

64. Record of receipt and disposition. *27 CFR § 478.125*.

65. Firearm Owners Protection Act. *18 USC § 923.*1986.

66. Brady Handgun Violence Prevention Act. *18 USC § 921.*1993.

67. *NICS Firearm Checks: Month/Year.* FBI;2018.

68. Wintemute GJ. Inside gun shows: what goes on when everybody thinks nobody's watching. *Sacramento, CA: Violence Prevention Research Program, University of California Davis School of Medicine Retrieved May.* 2009;20.

69. Miller M, Hepburn L, Azrael D. Firearm acquisition without background checks: Results of a national survey. *Annals of Internal Medicine.* 2017;166(4):233-239.

70. *NICS Firearm Checks: Month/Year by State.* FBI;2018.

71. Ryan J. Kentucky's Background Checks for Gun Owners Stand Out. *89.3 WFPL*. Dec 7, 2015, 2015.

72. *Kentucky State Police 2006 Annual Report.* Kentucky State Police; 2006.

73. Azrael D, Cook PJ, Miller M. State and Local Prevalence of Firearms Ownership Measurement, Structure, and Trends. *Journal of Quantitative Criminology.* 2004;20(1):43-62.

74. *A Shrinking Minority: The Continuing Decline of Gun Ownership in America.* Violence Policy Center; 2015/5 2015.

75. Azrael D, Hepburn L, Hemenway D, Miller M. The Stock and Flow of U.S. Firearms: Results from the 2015 National Firearms Survey. *RSF*. 2017;3(5):38-57.

76. Siegel M, Rothman EF. Firearm Ownership and Suicide Rates Among US Men and Women, 1981-2013. *Am J Public Health.* 2016;106(7):1316-1322.

77. Siegel M, Ross CS, King C, 3rd. A new proxy measure for state-level gun ownership in studies of firearm injury prevention. *Inj Prev.* 2014;20(3):204-207.

78. *Ownership and storage of firearms among adults in Kentucky.* Foundation for a Healthy Kentucky;2017.

79. Carrying of concealed firearms by qualified law enforcement officers. *18 USC § 926B.*

80. Carrying of concealed firearms by qualified retired law enforcement officers. *18 USC § 926C*.

81. Gun Laws: Concealed Carry. Giffords Law Center to Prevent Gun Violence. https://lawcenter.giffords.org/gun-laws/policy-areas/guns-in-public/concealed-carry. Accessed May 27, 2018.

82. License to carry concealed deadly weapon -- Criteria -- Training -- Paper or electronic application -- Issuance and denial of licenses -- Automated listing of license holders -- Suspension or revocation -- Renewal -- Prohibitions -- Reciprocity -- Reports -- Requirements for training classes. *KRS 237.110.*1996.

83. AN ACT relating to carrying concealed weapons. In: Kentucky GAotCo, ed. *Senate Bill 150*. Frankfort, KY2019.

84. Rowhani-Rahbar A, Azrael D, Lyons VH, Simonetti JA, Miller M. Loaded Handgun Carrying Among US Adults, 2015. *American Journal of Public Health.* 2017;107(12):1930-1936.

85. Lott JR. *Concealed Carry Permit Holders Across the United States: 2017*. 2017/7/18 2017.

86. *Concealed Deadly Weapons (CCDW) Annual Statistical Reports: 2010-2016.* Kentucky State Police.

87. Unlawful Acts. *18 USC § 922*.

88. Gun Laws: Child Access Prevention. Giffords Law Center to Prevent Gun Violence. http://lawcenter.giffords.org/gun-laws/policy-areas/child-consumer-safety/child-access-prevention/. Accessed May 27, 2018.

89. Unlawfully providing handgun to juvenile or permitting juvenile to possess handgun. *KRS 527.110.*1994.

90. Johnson RM, Coyne-Beasley T, Runyan CW. Firearm ownership and storage practices, U.S. households, 1992–2002: A systematic review. *American Journal of Preventive Medicine.* 2004;27(2):173-182.

91. Connor SM. The Association Between Presence of Children in the Home and Firearm-Ownership and -Storage Practices. *Pediatrics.* 2005;115(1):e38-e43.

92. Schuster MA, Franke TM, Bastian AM, Sor S, Halfon N. Firearm storage patterns in US homes with children. *American Journal of Public Health.* 2000;90(4):588-594.

93. Simonetti JA, Mackelprang JL, Rowhani-Rahbar A, Zatzick D, Rivara FP. Psychiatric comorbidity, suicidality, and in-home firearm access among a nationally representative sample of adolescents. *JAMA Psychiatry.* 2015;72(2):152-159.

94. Vaughn MG, Perron BE, Abdon A, Olate R, Groom R, Wu L-T. Correlates of Handgun Carrying Among Adolescents in the United States. *Journal of Interpersonal Violence.* 2012;27(10):2003-2021.

95. Kann L, McManus T, Harris WA, et al. Youth Risk Behavior Surveillance - United States, 2015. *MMWR Surveill Summ.* 2016;65(6):1-174.

96. Kemal S, Sheehan K, Feinglass J. Gun carrying among freshmen and sophomores in Chicago, New York City and Los Angeles public schools: the Youth Risk Behavior Survey, 2007-2013. *Injury Epidemiology.* 2018;5(1):12.

97. Xuan Z, Hemenway D. State gun law environment and youth gun carrying in the united states. *JAMA Pediatrics.* 2015;169(11):1024-1031.

98. Vaughn MG, Salas-Wright CP, Boutwell BB, DeLisi M, Curtis MP. Handgun Carrying Among Youth in the United States:An Analysis of Subtypes. *Youth Violence and Juvenile Justice.* 2017;15(1):21-37.

99. Kposowa A, Hamilton D, Wang K. Impact of Firearm Availability and Gun Regulation on State Suicide Rates. *Suicide and Life-Threatening Behavior.* 2016;46(6):678-696.

100. Mann JJ, Michel CA. Prevention of Firearm Suicide in the United States: What Works and What Is Possible. *American Journal of Psychiatry.* 2016;173(10):969-979.

101. Anestis MD, Houtsma C. The Association Between Gun Ownership and Statewide Overall Suicide Rates. *Suicide and Life-Threatening Behavior.* 2018;48(2):204-217.

102. Miller M, Barber C, White RA, Azrael D. Firearms and Suicide in the United States: Is Risk Independent of Underlying Suicidal Behavior? *American Journal of Epidemiology.* 2013;178(6):946-955.

103. Miller M, Warren M, Hemenway D, Azrael D. Firearms and suicide in US cities. *Injury Prevention.* 2015;21(e1):e116-e119.

104. Anestis MD, Anestis JC. Suicide Rates and State Laws Regulating Access and Exposure to Handguns. *Am J Public Health.* 2015;105(10):2049-2058.

105. Anestis MD, Khazem LR, Law KC, et al. The Association Between State Laws Regulating Handgun Ownership and Statewide Suicide Rates. *Am J Public Health.* 2015;105(10):2059-2067.

106. Anestis MD, Selby EA, Butterworth SE. Rising longitudinal trajectories in suicide rates: The role of firearm suicide rates and firearm legislation. *Preventive Medicine.* 2017;100:159-166.

107. Anestis MD, Anestis JC, Butterworth SE. Handgun Legislation and Changes in Statewide Overall Suicide Rates. *American Journal of Public Health.* 2017;107(4):579-581.

108. Johnson RM, Barber C, Azrael D, Clark DE, Hemenway D. Who are the owners of firearms used in adolescent suicides? *Suicide & life-threatening behavior.* 2010;40(6):609-611.

109. Grossman DC, Mueller BA, Riedy C, et al. Gun storage practices and risk of youth suicide and unintentional firearm injuries. *JAMA.* 2005;293(6):707-714.

110. Shenassa ED, Rogers ML, Spalding KL, Roberts MB. Safer storage of firearms at home and risk of suicide: a study of protective factors in a nationally representative sample. *Journal of Epidemiology and Community Health.* 2004;58(10):841-848.

111. Ilgen MA, Zivin K, McCammon RJ, Valenstein M. Mental Illness, Previous Suicidality, and Access to Guns in the United States. *Psychiatric Services.* 2008;59(2):198-200.

112. Betz ME, Barber C, Miller M. Suicidal Behavior and Firearm Access: Results from the Second Injury Control and Risk Survey. *Suicide and Life-Threatening Behavior.* 2011;41(4):384-391.

113. Houtsma C, Anestis MD. Practical capability: The impact of handgun ownership among suicide attempt survivors. *Psychiatry Research.* 2017;258:88-92.

114. Nock MK, Park JM, Finn CT, Deliberto TL, Dour HJ, Banaji MR. Measuring the Suicidal Mind: Implicit Cognition Predicts Suicidal Behavior. *Psychological Science.* 2010;21(4):511-517.

115. Czyz EK, Horwitz AG, King CA. Self-Rated Expectations of Suicidal Behavior Predict Future Suicide Attempts Among Adolescent and Young Adult Psychiatric Emergency Patients. *Depression and Anxiety.* 2016;33(6):512-519.

116. Khazem LR, Houtsma C, Gratz KL, Tull MT, Green BA, Anestis MD. Firearms Matter: The Moderating Role of Firearm Storage in the Association Between Current Suicidal Ideation and Likelihood of Future Suicide Attempts Among United States Military Personnel. *Military Psychology.* 2015;28(1):25-33.

117. Barrios LC, Everett SA, Simon TR, Brener ND. Suicide Ideation Among US College Students Associations With Other Injury Risk Behaviors. *Journal of American College Health.* 2000;48(5):229-233.

118. Woods ER, Lin YG, Middleman A, Beckford P, Chase L, DuRant RH. The Associations of Suicide Attempts in Adolescents. *Pediatrics.* 1997;99(6):791-796.

119. Olshen E, McVeigh KH, Wunsch-Hitzig RA, Rickert VI. Dating violence, sexual assault, and suicide attempts among urban teenagers. *Archives of Pediatrics & Adolescent Medicine.* 2007;161(6):539-545.

120. Lanza ST, Rhoades BL. Latent Class Analysis: An Alternative Perspective on Subgroup Analysis in Prevention and Treatment. *Prevention Science.* 2013;14(2):157-168.

121. Arthur M, Hawkins J, Richard F, Catalano, A Pollard J. *Student Survey of Risk and Protective Factors and Prevalence of Alcohol, Tobacco, and Other Drug Use.* 1998.

122. Arthur MW, Briney JS, Hawkins JD, Abbott RD, Brooke-Weiss BL, Catalano RF. Measuring risk and protection in communities using the Communities That Care Youth Survey. *Evaluation and Program Planning.* 2007;30(2):197-211.

123. Kessler RC, Andrews G, Colpe LJ, et al. Short screening scales to monitor population prevalences and trends in non-specific psychological distress. *Psychological Medicine.* 2002;32(6):959-976.

124. Peiper N, Clayton R, Wilson R, Illback R. The performance of the K6 Scale in a large school sample. *Psychological Assessment.* 2015;27(1):228-238.

125. Peiper N, Lee A, Lindsay S, Drashner N, Wing J. The performance of the K6 scale in a large school sample: A follow-up study evaluating measurement invariance on the Idaho Youth Prevention Survey. *Psychological assessment.* 2016;28(6):775.

126. Briney JS, Brown EC, Hawkins JD, Arthur MW. Predictive Validity of Established Cut Points for Risk and Protective Factor Scales from the Communities That Care Youth Survey. *The Journal of Primary Prevention.* 2012;33(5):249-258.

127. Talking to Kids About School Safety. In: Center NSS, ed: VisdomK12; 2016.

128. Collins D, Johnson K, Neace W. *Kentucky Incentives for Prevention (KIP) Project: Year One Results of the Student Survey.* Pacific Institute for Research and Evaluation;2000.

129. Brener ND, Kann L, Shanklin S, et al. Methodology of the youth risk behavior surveillance system—2013. *Morbidity and Mortality Weekly Report: Recommendations and Reports.* 2013;62(1):1-20.

130. Brener ND, Kann L, McManus T, Kinchen SA, Sundberg EC, Ross JG. Reliability of the 1999 youth risk behavior survey questionnaire. *Journal of adolescent health.* 2002;31(4):336-342.

131. Van Orden KA, Witte TK, Cukrowicz KC, Braithwaite S, Selby EA, Joiner TE. The Interpersonal Theory of Suicide. *Psychological review.* 2010;117(2):575-600.

132. Bender TW, Anestis MD, Anestis JC, Gordon KH, Joiner TE. Affective and Behavioral Paths Toward the Acquired Capacity for Suicide. *Journal of Social and Clinical Psychology.* 2012;31(1):81-100.

133. Litwiller BJ, Brausch AM. Cyber Bullying and Physical Bullying in Adolescent Suicide: The Role of Violent Behavior and Substance Use. *Journal of Youth and Adolescence.* 2013;42(5):675-684.

134. Kessler RC, Amminger GP, Aguilar‐Gaxiola S, Alonso J, Lee S, Ustun TB. Age of onset of mental disorders: A review of recent literature. *Current opinion in psychiatry.* 2007;20(4):359-364.

135. Wallace LN. Armed Kids, Armed Adults? Weapon Carrying From Adolescence to Adulthood. *Youth Violence and Juvenile Justice.* 2015;15(1):84-98.

136. Patterson GR, DeBaryshe BD, Ramsey E. A developmental perspective on antisocial behavior. *Developmental and Life-course Criminological Theories*: Routledge; 2017:29-35.

137. Comparing and evaluating youth substance use estimates from the National Survey on Drug Use and Health and other surveys. Substance Abuse and Mental Health Services Administration; 2012.

138. Asparouhov T, Muthén BO. Deciding on the Number of Classes in Latent Class Analysis and Growth Mixture Modeling: A Monte Carlo Simulation Study AU - Nylund, Karen L. *Structural Equation Modeling: A Multidisciplinary Journal.* 2007;14(4):535-569.

139. Lanza ST, Tan X, Bray BC. Latent Class Analysis With Distal Outcomes: A Flexible Model-Based Approach AU. *Structural Equation Modeling: A Multidisciplinary Journal.* 2013;20(1):1-26.

140. Asparouhov T, Muthén BO. Auxiliary Variables in Mixture Modeling: 3-Step Approaches Using Mplus. 2014. https://www.statmodel.com/examples/webnotes/webnote15.pdf.

141. Celeux G, Soromenho G. An entropy criterion for assessing the number of clusters in a mixture model. *Journal of Classification.* 1996;13(2):195-212.

142. *Results from the 2017 National Survey on Drug Use and Health: Detailed Tables.* Rockville, MD: Center for Behavioral Health Statistics and Quality; 2018.

143. *America's Complex Relationship With Guns.* Pew Research Center; June 2017.

144. Felson RB, Pare P-P. Gun Cultures or Honor Cultures? Explaining Regional and Race Differences in Weapon Carrying. *Social Forces.* 2010;88(3):1357-1378.

145. Anestis MD. Prior suicide attempts are less common in suicide decedents who died by firearms relative to those who died by other means. *Journal of Affective Disorders.* 2016;189:106-109.

146. Runeson B, Tidemalm D, Dahlin M, Lichtenstein P, Långström N. Method of attempted suicide as predictor of subsequent successful suicide: national long term cohort study. *BMJ.* 2010;341:c3222.

147. Law C-k, Sveticic J, De Leo D. Restricting access to a suicide hotspot does not shift the problem to another location. An experiment of two river bridges in Brisbane, Australia. *Australian and New Zealand Journal of Public Health.* 2014;38(2):134-138.

148. Johnston L, Miech R, PM OM, JG B, Schulenberg J, Patrick M. *Monitoring the Future national survey results on drug use 1975-2018: Overview, key findings on adolescent drug use.* Ann Arbor: Institute for Social Research, University of Michigan;2019.

149. Froese P, Mencken FC. Gun Culture in Action. *Social Problems.* 2017;66(1):3-27.

150. Thompson R, Tabone JK, Litrownik AJ, et al. Early adolescent risk behavior outcomes of childhood externalizing behavioral trajectories. *The Journal of Early Adolescence.* 2011;31(2):234-257.

151. Veenstra R, Lindenberg S, Oldehinkel AJ, De Winter AF, Verhulst FC, Ormel J. Bullying and Victimization in Elementary Schools: A Comparison of Bullies, Victims, Bully/Victims, and Uninvolved Preadolescents. *Developmental Psychology.* 2005;41(4):672-682.

152. Yoshikawa H, Aber JL, Beardslee WR. The effects of poverty on the mental, emotional, and behavioral health of children and youth: implications for prevention. *American Psychologist.* 2012;67(4):272.

153. Brooks-Gunn J, Duncan GJ. The effects of poverty on children. *The future of children.* 1997:55-71.

154. Igielnik R. *Rural and urban gun owners have different experiences, views on gun policy.* Pew Research Center; July 10, 2017 2017.

155. Swanson JW, Norko MA, Lin H-J, et al. Implementation and effectiveness of connecticut's risk-based gun removal law: Does it prevent suicides. *Law & Contemp Probs.* 2017;80:179.

156. Kivisto AJ, Phalen PL. Effects of Risk-Based Firearm Seizure Laws in Connecticut and Indiana on Suicide Rates, 1981–2015. *Psychiatric Services.* 2018;69(8):855-862.

157. Gun Shop Project. *Means Matter* https://www.hsph.harvard.edu/means-matter/gun-shop-project/. Accessed March 23, 2019.

158. Barber C, Frank E, Demicco R. Reducing Suicides Through Partnerships Between Health Professionals and Gun Owner Groups—Beyond Docs vs GlocksReducing Suicides Through PartnershipsReducing Suicides Through Partnerships. *JAMA Internal Medicine.* 2017;177(1):5-6.

APPENDIX

Figure 11. Probabilities of observed variables in each latent class of 4-class model with students with inconsistent responses excluded

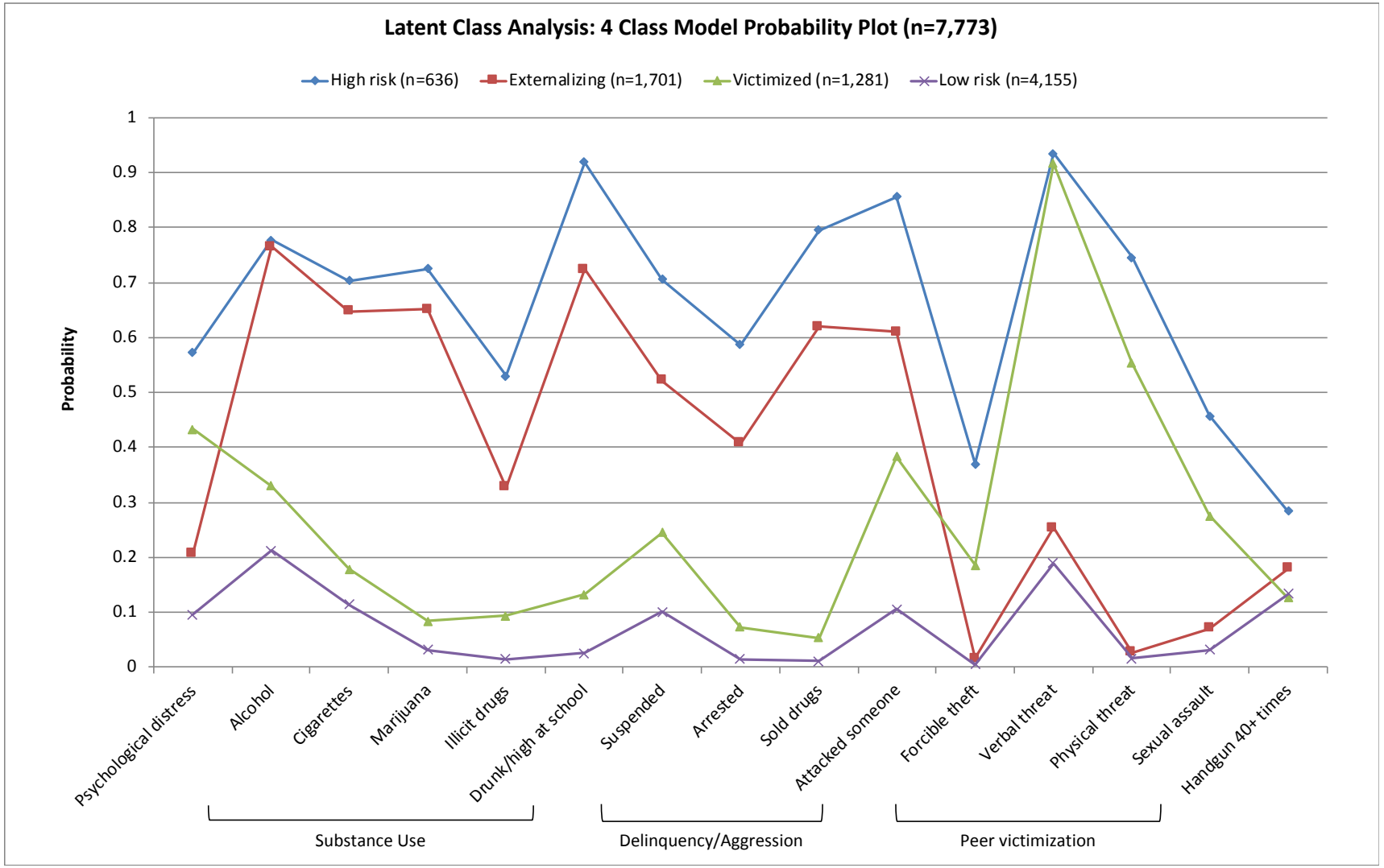


Figure 12. Probabilities of observed variables in each latent class of 4-class model with students reporting fiction substance excluded

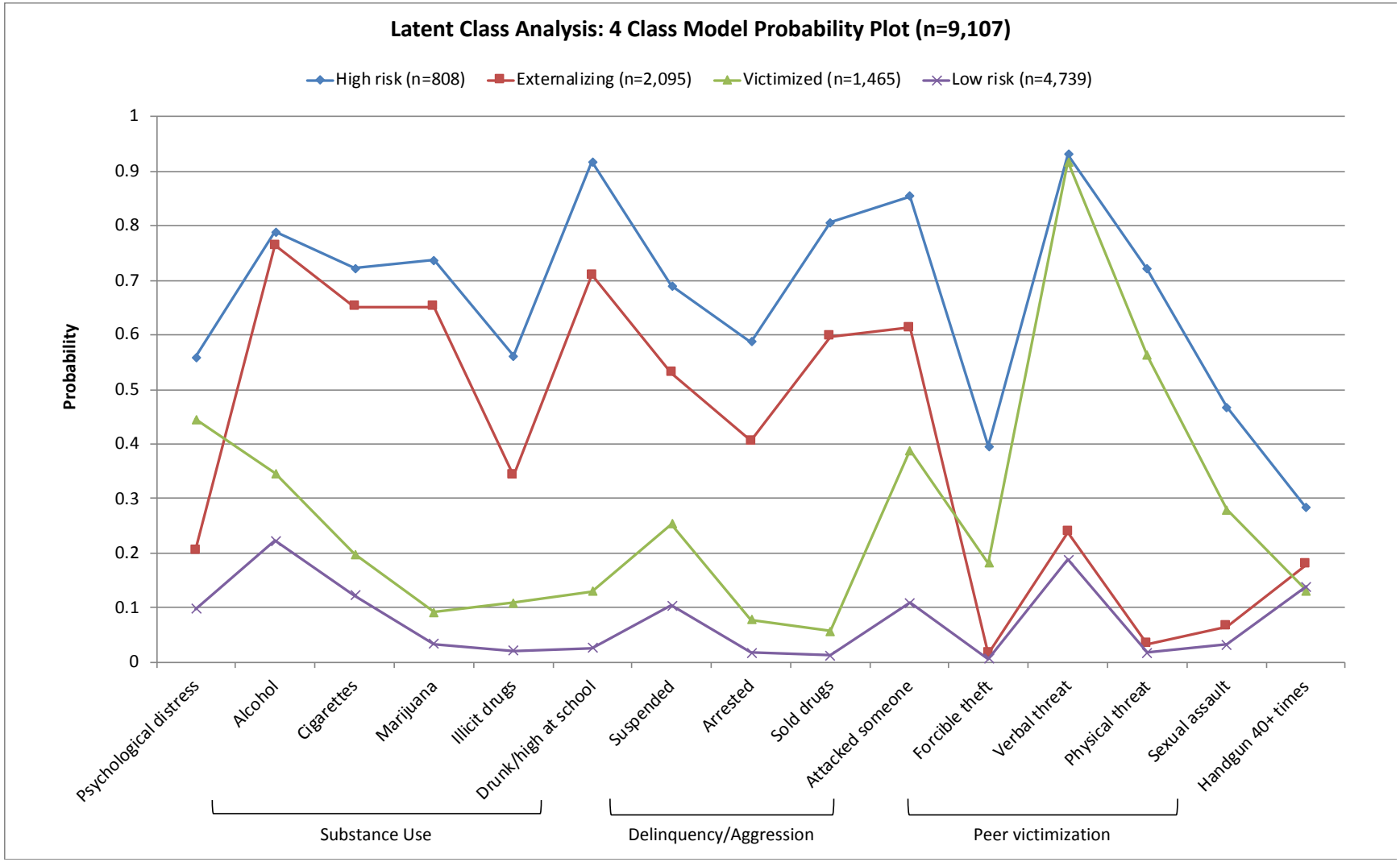


Figure 13. Probabilities of observed variables in each latent class of 4-class model among online survey respondents only

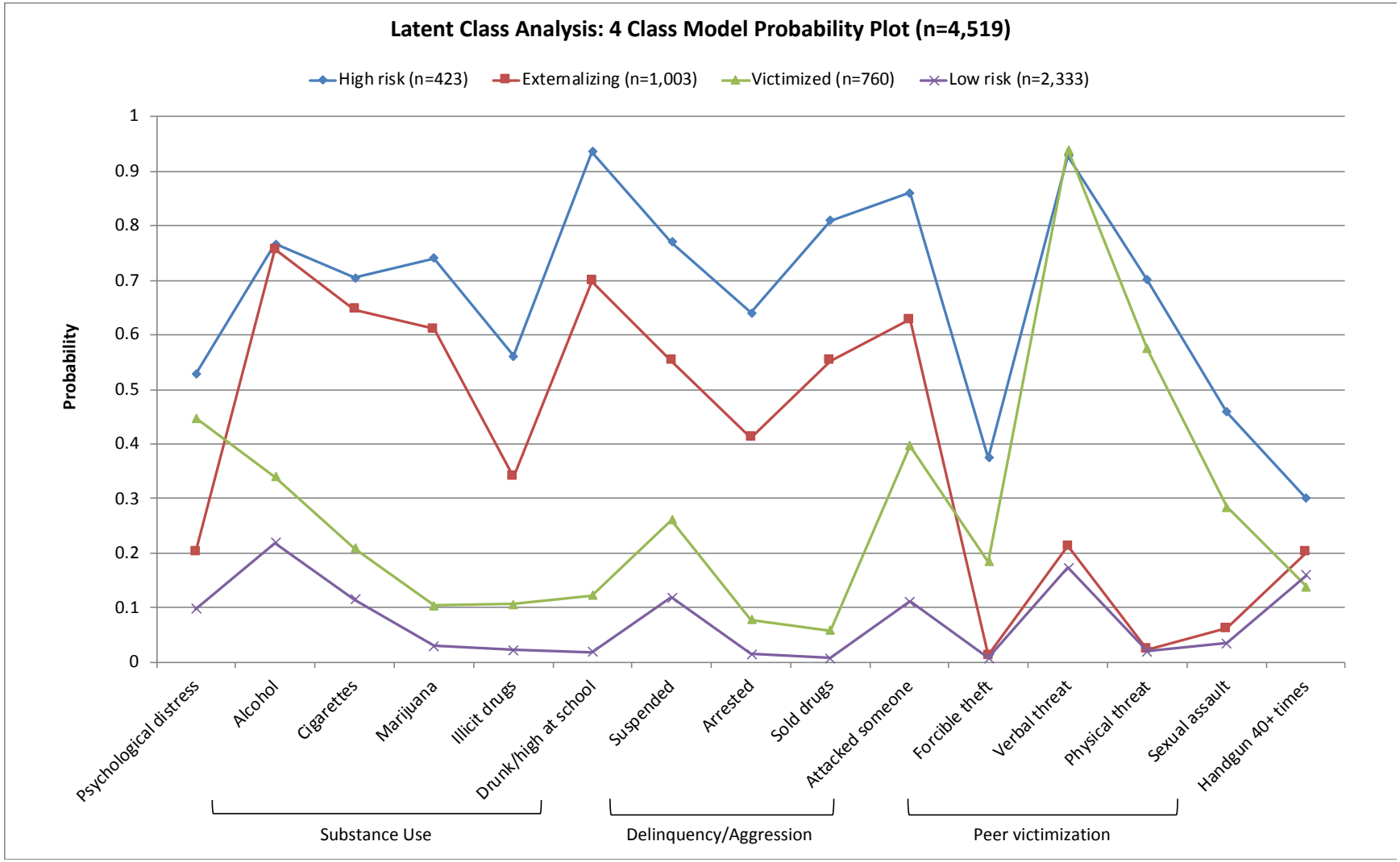
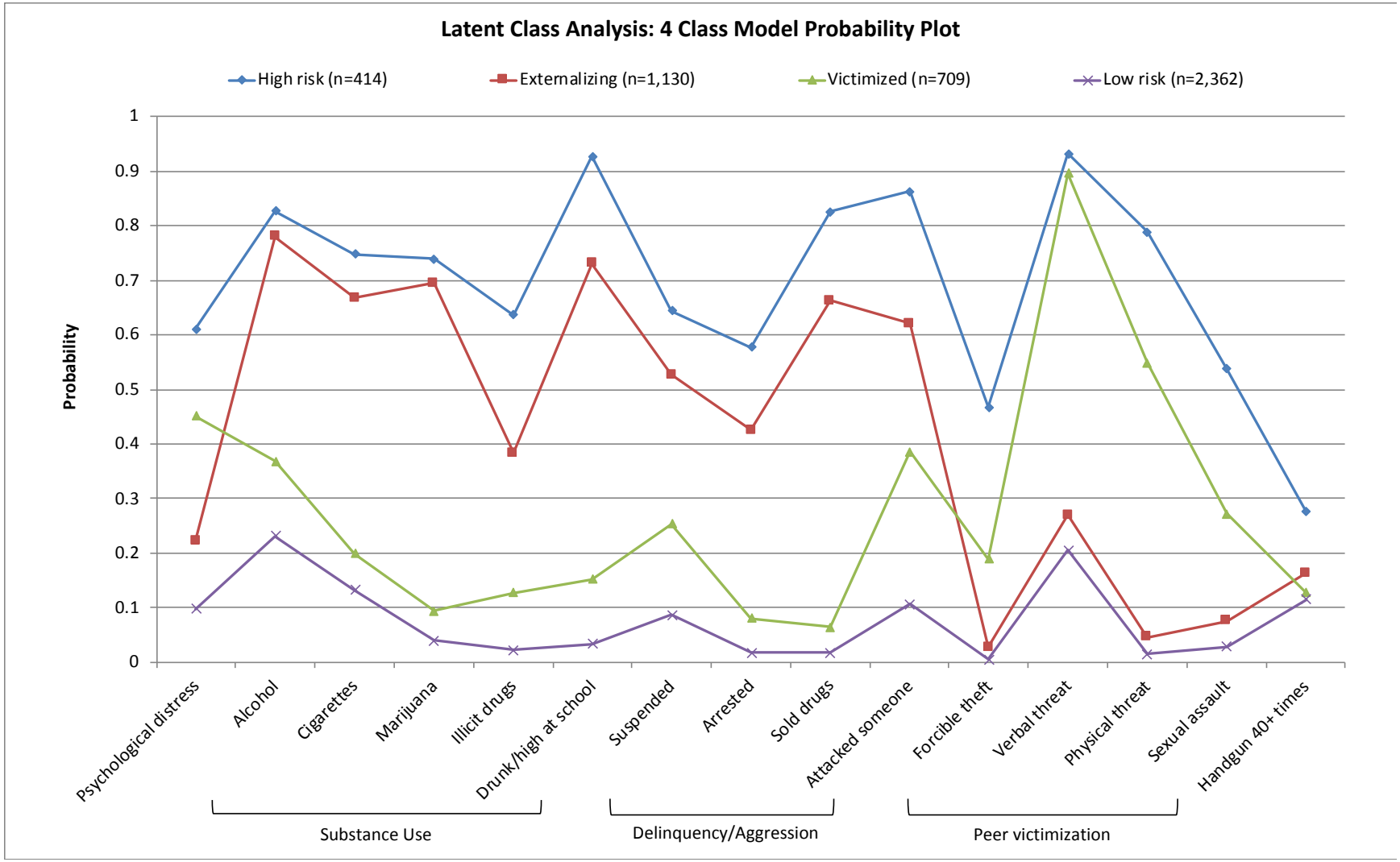


Figure 14. Probabilities of observed variables in each latent class of 4-class model among paper survey respondents only



CURRICULUM VITAE

Teresa J. McGeeney

CONTACT INFORMATION

REACH Evaluation
501 Park Avenue
Louisville, KY 40208
502.585.1911 x 2631
teresa@reacheval.com

EDUCATION

PhD	Epidemiology	University of Louisville, Louisville, KY (2019)
MS	Epidemiology	University of Louisville, Louisville, KY (2012)
BA	Pre-Medical Studies Arabic	University of Notre Dame, Notre Dame, IN (2009)

PROFESSIONAL EXPERIENCE

Epidemiologist, REACH Evaluation, Louisville, Kentucky, May 2015 – Present

Project Director, Kentucky State Epidemiological Outcomes Workgroup, Department for Behavioral Health, Developmental and Intellectual Disabilities, Kentucky Cabinet for Health and Family Services, May 2015 – present.

Project Manager, KIPDA Rural Diabetes Coalition, Division of Social Services, Kentuckiana Regional Planning and Development Agency, Louisville, Kentucky, December 2011 – May 2015

Co-Chair, Advocacy and Outreach Committee, Kentucky Diabetes Network, Frankfort, Kentucky, September 2013 – May 2015

Graduate Research Assistant, Department of Epidemiology, School of Public Health and Information Sciences, University of Louisville, Louisville, Kentucky, June 2010 – December 2011

FUNDED RESEARCH AND IMPLEMENTATION PROJECTS

"Strategic Prevention Framework Partnership for Success 2015." Grant SP020780-01, Center for Substance Abuse Prevention, Substance Abuse and Mental Health Services Administration, $3,675,090, September 2015-September 2020.

"Strategic Prevention Framework Partnership for Success II." Grant SP019436-01, Center for Substance Abuse Prevention, Substance Abuse and Mental Health Services Administration, $2,674,187, September 2012-October 2015.

"Strategic Prevention Framework Partnership for Success II SEOW Supplement." Grant SP019436-01-2, Center for Substance Abuse Prevention, Substance Abuse and Mental Health Services Administration, $198,000, September 2013-October 2015.

"Kentucky Initiative for Zero Suicides." Cooperative Agreements for State-Sponsored Youth Suicide Prevention and Early Detection, Grant SM061777, Center for Mental Health Services, Substance Abuse and Mental Health Services Administration, $3,680,000 September 2014-October 2019.

"National Program to Eliminate Diabetes-Related Disparities Among Vulnerable Populations." Cooperative Agreement 1U58DP002815, National Center for Chronic Disease Prevention and Health Promotion, Division of Diabetes Translation, Centers for Disease Control and Prevention, $2,500,000 September 2010-August 2015

"Evaluation of Safety Training, Supervision, and Injury Among Working Teenagers." Grant R21 OH0089340-02, Centers for Disease Control and Prevention/National Institute for Occupational Safety and Health, K. M. Zierold, Principal Investigator.

HONORS AND AWARDS

2019 Graduate Dean's Citation, School of Public Health and Information Sciences, University of Louisville, Louisville, KY, May 2019

2018 Student Poster of Distinction Award, American Academy of Health Behavior, Portland, OR, March 2018

2017 Outstanding Student Research Award, American Public Health Association School Health Education and Services Section, Atlanta, GA, November 2017

2014 Translational Health Disparities Scholar, National Institute on Minority Health and Health Disparities, National Institutes of Health, Bethesda, MD, August 2014

Dean's List, University of Notre Dame, 2006, 2008

PROFESSIONAL AFFILIATIONS

2018	American Evaluation Association
2017	Kentucky Suicide Data and Surveillance Committee
2017	American Public Health Association
2015	Kentucky State Epidemiolocial Outcomes Workgroup
2015	Building Epidemiological Capacity in Kentucky
2015	Kentucky Safety and Prevention Alignment Network

RESEARCH AND SCHOLARLY PRODUCTIVITY

McGeeney TJ. Handgun Carrying Patterns and Suicide Risk among Youth, University of Louisville Doctoral Dissertation, May 2019.

McGeeney TJ. Teenagers' Safety at Work: Dangerous Tasks and Safety Training, University of Louisville Master's Thesis, August 2012.

Peer-Reviewed Publications

Yankeelov PA, Faul AC, D'Ambrosio JG, Gordon BA, **McGeeney TJ**. World Cafés create healthier communities for rural, older adults living with diabetes. *Health Promotion Practice* 2019; 20(2):223-230.

Zierold KM, **McGeeney TJ**. Communication breakdown: How working teen's perceptions of their supervisors impact safety and injury. *Work* 2016; 54(1):3-9.

Zierold KM, Welsh EC, **McGeeney TJ**. Attitudes of teenagers towards workplace safety training. *Journal of Community Health* 2012; 37(6):1289-95.

Posters and Presentations

McGeeney TJ, Cambron S, Millspaugh P, Clark P, Birkby B. *Exploring military youth's increased risk for suicide attempts.* Poster presentation, American Academy of Health Behavior Annual Meeting, Portland, OR, March 2018.

McGeeney TJ, Cambron S, Millspaugh P, Clark P, Birkby B. *Military youth and prescription opioid abuse risk factors.* Poster presentation, American Academy of Health Behavior Annual Meeting, Portland, OR, March 2018.

McGeeney TJ, Clark P, Birkby B. *School anti-bullying policies and suicide risk among bullied students.* Oral presentation, Atlanta, GA, November 2017.

McGeeney TJ, Clark P, Birkby B. *Victimization and suicide risk among adolescents.* Poster presentation, Atlanta, GA, November 2017.

McGeeney TJ, Clark P, Birkby B. *Kentucky's Suicide Data and Surveillance Committee: An interdisciplinary effort to respond to rising youth suicide rates.* Poster presentation, Atlanta, GA, November 2017.

McGeeney TJ, Clark P, Birkby B. *Psychological distress and suicidal thoughts and behaviors among students with military connections.* Poster presentation, Atlanta, GA, November 2017.

McGeeney TJ, Welsh EC, Zierold KM. *Injury severity among working teenagers as related to safety training.* Poster presentation, American Public Health Association 139th Annual Meeting and Exposition, Washington, D.C., October/November 2011.

McGeeney TJ, Welsh EC, Zierold KM. *Quality of supervision and injury among teenagers in the workplace.* Poster presentation, American Public Health Association 139th Annual Meeting and Exposition, Washington, D.C., October/November 2011.

McGeeney TJ, Welsh EC, Zierold KM. *Gender disparities in risk-taking tendencies and workplace injury among teenagers.* First national conference on Eliminating Health and Safety Disparities at Work, Chicago, IL, September 2011.

McGeeney TJ, Zierold KM. *Supervision in the workplace: Shaping teenagers' perception of safety and reporting of injury.* Poster presentation, Research!Louisville, Louisville, KY, October 2010.

Collaborative Posters and Presentations

D'Ambrosio JG, Faul AC, Gordon B, **McGeeney TJ**. *Food Deserts and Healthy Living for Older Adults with Diabetes.* Oral presentation, American Society on Aging 2014 Aging in America Conference, San Diego, CA, March 2014.

Gordon B, **McGeeney TJ**. *Serving Up Strategies: Utilizing World Café Methodology for Strategic Planning.* Oral presentation, Southeastern Association of Area Agencies on Aging, Orange Beach, AL, September 2013.

Faul AC, Yankeelov PA, D'Ambrosio JG, Gordon B, **McGeeney TJ**. *Food Deserts and Healthy Living for Older Adults with Diabetes: Understanding Rural Context.* Poster presentation, 2013 Summer Series on Aging, Lexington, KY, June 2013.

Welsh EC, **McGeeney TJ**, Zierold KM. *Healthy communication between parents and working teens and its influence on work-related injury.* Oral presentation, American Public Health Association 139th Annual Meeting and Exposition, Washington, D.C., October/November 2011.

Welsh EC, **McGeeney TJ**, Zierold KM. *Use of dangerous equipment in the workplace and safety training: Effects on work-related injury in teenagers*. Poster presentation, American Public Health Association 139th Annual Meeting and Exposition, Washington, D.C., October/November 2011.

Welsh EC, **McGeeney TJ**, Zierold KM. *Knowledge of US child labor laws and influence on work-related injury among working teenagers.* Poster presentation, American Public Health Association 139th Annual Meeting and Exposition, Washington, D.C., October/November 2011.

Welsh EC, **McGeeney TJ**, Zierold KM. *Evaluation of safety training for teenagers in regards to dangerous situation response for injury prevention*. Poster presentation, American Public Health Association 139th Annual Meeting and Exposition, Washington, D.C., October/November 2011.

Welsh EC, **McGeeney TJ**, Zierold KM. *Racial Differences in Supervision Among Teens at Work.* . First national conference on Eliminating Health and Safety Disparities at Work, Chicago, IL, September 2011.

Zierold KM, **McGeeney TJ**. *The role of safety training in preventing workplace injuries in teenagers.* Poster presentation, 11th Annual American Academy of Health Behavior Meeting, Hilton Head Island, SC, March 2011.