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The relationships between state-level economic policies, child maltreatment, and suicidal behavior and mortality.

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THE RELATIONSHIPS BETWEEN STATE-LEVEL ECONOMIC POLICIES, CHILD MALTREATMENT, AND SUICIDAL BEHAVIOR AND MORTALITY

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DEDICATION

This dissertation is dedicated to all the moms that are struggling, but nonetheless working toward fulfilling their wildest dreams.

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ABSTRACT

THE RELATIONSHIPS BETWEEN STATE-LEVEL ECONOMIC POLICIES, CHILD MALTREATMENT, AND SUICIDAL BEHAVIOR AND MORTALITY

Yana B Feygin

July 7, 2023

Suicide has proven to be difficult to predict and prevent at the individual level,[1–3] so much so that a recent analysis of individual risk assessments found a maximal positive predictive value of 5.5% for suicide death,[2] and suicide continues to be a leading cause of death among adolescents age 10-19 years.[4] By targeting modifiable risk factors at the population level, policy has the potential to extend our reach to people and subgroups that are missed by individual level interventions.

This ecological study of adolescent suicide rates, state policies, and child maltreatment in US states from 2005-2019 and Kentucky counties from 2010-2019, combines secondary data from multiple databases to implement a mediation analysis and investigate whether the incidence rate of child maltreatment is a mediator between state policies promoting socioeconomic stability and rates of suicidal behavior among youth.

No evidence of mediation is found in this analysis to support our primary hypothesis that child maltreatment rates acted as a mediator between state policy and suicidal mortality rates at the national level, nor is there evidence of mediation when investigating access to these programs at the county-level in Kentucky. At the national

level, a generous state minimum wage and an increase in TANF access are associated with decreases in adolescent suicide mortality rates. However, despite previous work implicating child maltreatment as a significant risk factor for suicide mortality, the rate of child maltreatment is not significantly associated with the adolescent suicide rate. The results of this study also indicate a significant role for a refundable state EITC in the decrease of the child maltreatment rate.

Shifting the focus to a population level decrease in suicidal behavior and mortality among children and adolescents in addition to effective individual level supports may be a positive strategy toward overall population health. State governments aiming to decrease expenditures by reducing economic benefits and weakening policies that support socioeconomic stability in the population may be failing to take advantage of the upstream prevention benefits for many well-established public health risks of economic insecurity.

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INTRODUCTION

Background

Although suicide prevention has been the target of many national and local public health campaigns and research endeavors, child and adolescent suicidal behavior has been increasing steadily in the US.[5] Suicide has proven to be difficult to predict and prevent at the individual level,[1–3] so much so that a recent analysis of individual risk assessments found a maximal positive predictive value of 5.5% for suicide death,[2] and suicide continues to be a leading cause of death among adolescents age 10-19 years.[4] In 2019, 2,744 adolescents died by suicide in the US, increasing from 1,925 a decade before. Similarly, ideation and planning among high-school students have increased over the last decade.[5] It is plausible that by decreasing the prevalence of risk factors associated with suicidal behavior, the overall suicide rate can be reduced at the population level. Suicidal behavior has been linked to both population and individual level factors, including cultural attitudes, media coverage of suicide, economic factors, societal homogeneity and cohesion, hereditary factors, socioeconomic characteristics, and psychiatric illnesses.[1,6,7] Additionally, exposure to child maltreatment is a well-documented risk factor among individuals that attempt and die by suicide.[7–10]

In December 2021, the U.S. Surgeon General issued an advisory on youth mental health,[11] underscoring the importance of policy recommendations that include strengthening economic stability among families to improve outcomes for children and adolescents at risk. Macro-level protective factors such as state policies that promote socioeconomic security, such as the Earned Income Tax Credit (EITC), Supplemental Nutrition Assistance Program (SNAP), and minimum wage, are thought to influence both suicide rates and child maltreatment. For example, in a 2018 manuscript focusing on comprehensive prevention of suicide published in the American Journal of Preventive Medicine, Ports et al[12] note the importance of focusing on adverse childhood experiences as a "viable suicide prevention target." In its technical package that aimed at preventing suicide, the Centers for Disease Control and Prevention (CDC) recommend policies that promote economic stability to decrease the likelihood of suicidal behavior.[13] By targeting modifiable risk factors at the population level, policy has the potential to extend our reach to people and subgroups that are missed by individual level interventions. While current research has established links between child maltreatment and suicidal behaviors,[8–10] economic factors and child maltreatment,[14–19] and economic factors and suicide rates,[20–22] the relationship among these factors has not been established. In this study, we aim to establish the state incidence rate of child maltreatment as a potential mediator between state policies promoting the economic wellbeing of families and rates of suicidal behavior among youth. This study aims to contribute evidence that the rate of child maltreatment is an important mediator on the path between state-level policy and the rate of suicidal behavior and mortality.

Objective and Specific Aims

The long-term goal is to reduce suicide rates among adolescents in the US through the promotion of macro-level governmental policy changes that can decrease the prevalence of risk factors for suicidal behavior. The objective of this study is to identify the association, if present, and explore the efficacy of state legislation as a form of primordial disease prevention for suicidal behavior among adolescents. We aim to extend the results of individual-level analyses in previous studies to the population level, investigating the association between state-level adolescent suicide rates and state-level policies promoting economic stability, focusing on quantifying the direct effect of state policies on suicide rates and the indirect effect through a decrease in state level child maltreatment rates. Additionally, using Kentucky data, we will explore county-level characteristics that may modify these complex relationships in the context of suicidal behaviors that resulted in hospital visits. Our central hypothesis is that state-level policies that promote economic stability reduce the state-level adolescent suicide and attempt rates by acting to reduce state-level child maltreatment rates. This is based on previous literature, showing poverty as a significant risk factor for both child maltreatment and suicidal behavior, and child maltreatment as a major risk factor for suicidal behavior among adolescents. Our rationale for the proposed research is that establishing the link and mechanism by which state policy impacts adolescent suicide rates will increase public support for strengthening and expanding economic policies that promote financial stability in families. The specific aims include:

Specific Aim 1: To describe the association between state policies promoting economic stability, child maltreatment rates, and adolescent suicide rates over time.

Hypothesis 1: Higher generosity of state policies promoting economic stability is associated with lower rates of child maltreatment and adolescent suicide over time.

Specific Aim 2: To describe the longitudinal association between state-level child maltreatment rates and adolescent suicide rates over time.

Hypothesis 2: Lower state-level child maltreatment rates are associated with lower adolescent suicide rates over time.

Specific Aim 3: To assess the portion of the total effect of state policies on suicide rates that is due to child maltreatment rates over time.

Hypothesis 3: There is a significant indirect effect of state policies on adolescent suicide rates through child maltreatment rates over time.

Specific Aim 4: Explore county-level characteristics as effect modifiers of the longitudinal relationships between state policies, county-level adolescent suicide attempt rates and county-level child maltreatment rates in the context of suicidal attempts that resulted in emergency visits in KY.

Hypothesis 4: County-level characteristics are significant effect modifiers of the longitudinal relationships between state policies, adolescent suicide attempt rates and child maltreatment rates in the context of suicidal attempts that resulted in emergency visits in KY.

According to the technical package from the CDC[23], it may be possible to prevent some cases of child maltreatment through state policies that promote household financial stability,[23] and thereby preventing some cases of adolescent suicide. This study aims to

contribute evidence that the child maltreatment rate is an important mediator on the path between state-level policy and the rate suicidal behavior, and quantify the effect, if present. Focusing on population level primordial prevention through state policy is an important strategy for preventing many negative health outcomes, including suicide behavior and death among adolescents.

Significance and Existing Studies

Study Rationale and Objective

Studies have consistently found links between suicide rates and state or county level poverty, health care access, and socioeconomic status, and similarly, many studies have identified an association between child maltreatment, such as sexual, emotional, and physical abuse and neglect and suicidal behaviors.[10]

State-level economic policies have been reported to have an association with lower rates of child maltreatment rates,[14,24–27] likely due to a reduction in chronic stress among caregivers. Studies have found an association between child maltreatment and socioeconomic status,[19] minimum wage laws,[25] family leave,[28] and Medicaid expansion.[29] In a study by Kovski et al.,[14] using National Child Abuse and Neglect Data System (NCANDS) data, a 10-percentage point increase in the generosity of EITC benefits was associated with 241 fewer reports of neglect per 100,000 children, along with a decrease in physical and emotional abuse, although not statistically significant. In December 2021, the U.S. Surgeon General issued an advisory on youth mental health,[11] underscoring the importance of policy recommendations that include strengthening both families and economic stability to improve outcomes for children and adolescents at risk.

However, no studies have investigated what portion of the total effect of state policies that aim to improve household financial stability on suicidal behavior and suicide mortality rates is due to a decrease in child maltreatment rates. The present work endeavors to address this gap by extending the results of previous studies to test whether the presence and generosity of state policies that improve economic stability is associated with a reduction in adolescent suicide rates due, at least in part, to a reduction in child maltreatment rates, by quantifying the proportion of the total effect mediated through child maltreatment by using a mediation analysis.

LITERATURE REVIEW

Epidemiology of Suicide Among Children and Adolescents

Suicide has been the second or third leading cause of death among adolescents age 10-19 years since 1999 in the U.S.[30] The crude suicide rate among 10-19 year old adolescents has been increasing since 2007, a year that presents the lowest rate of suicide in this population (3.9 per 100,000 children) after decreasing in the previous decade.[4] According to data from the Youth Risk Behavior Surveillance System (YRBSS), a biannual nationwide survey of high school students conducted by the Centers for Disease Control and Prevention (CDC), ideation and planning among high-school students have also been increasing over the last decade.[5] Among high school students in 2019, 18.4% considered attempting suicide, 15.9% made a plan, 8.1% made an attempt, and 3% reported an attempt serious enough to require medical treatment in the past year[31] (Figure 1). Among middle school students in 2019, 22.4% considered attempting suicide, 13.6% made a plan, and 8.8% made an attempt[31] (Figure 1). Forty-four children and adolescents under 20 years of age died by suicide in Kentucky in 2021 and 12 of them were less than 16 years old. In 2019, the year before the COVID-19 pandemic, this number had decreased to 39 from the previous year's 48 deaths. Eight percent of adolescents in Kentucky reported attempting suicide in 2019, and 3% made an attempt serious enough to require medical attention.[5] Ideation, planning, and attempt among high-school students have been relatively stable over the last decade (Figure 2). The rate of suicide among

Kentucky children and adolescents aged 10-19 years in 2019 was 6.8 per 100,000.[4] The percent of adolescents that reported a serious attempt is higher in KY than in the US overall – in 2019, 3% of Kentucky adolescents and 2.5% of US adolescents reported an attempt serious enough to require medical attention.

Suicidal behavior has been associated with both population and individual level risk factors, including cultural attitudes, media coverage of suicide, economic factors, societal homogeneity and cohesion, hereditary factors, socioeconomic characteristics, and psychiatric illnesses.[1,6–8,32,33] Exposure to violence, such as child maltreatment has been found to be an important risk factor among individuals with suicidal ideation and those that attempt and die by suicide.[1,6–8,34,35] Exposure to child maltreatment has been a well-documented risk factor among individuals with suicidal ideation and those that attempt and die by suicide through multiple cross-sectional and longitudinal analyses at the individual level.[7–10,36] In its technical package aimed at preventing suicide, the CDC recommends both a decrease in child maltreatment and an increase in policies that promote economic stability to decrease the likelihood of suicidal behavior.[13] In December 2021, the U.S. Surgeon General issued an advisory on youth mental health,[11] underscoring the importance of policy recommendations that include strengthening economic stability among families to improve outcomes for children and adolescents at risk.

Epidemiology of Child Maltreatment

The Child Abuse Prevention and Treatment Act (CAPTA) law defines child abuse and neglect as "any recent act or failure to act on the part of a parent or caregiver that results in death, serious physical or emotional harm, sexual abuse, or exploitation, or an

act or failure to act that presents an imminent risk of serious harm."[37] Although the federal definition of child abuse and neglect is defined at the federal level under CAPTA and applies to each state, it is up to individual states to outline the specific behaviors that fall under the federal definition. There are generally two standards for defining child abuse and neglect, including (1) the Harm Standard – which requires demonstrable harm to the child, and (2) the Endangerment Standard – which only requires endangerment of the child.[19] Nonetheless, most states define: physical abuse as including non-accidental physical injury, along with threatening or risking harm to the child; neglect as failure to provide necessities to the extent that a threat of harm occurs; and, sexual abuse as inclusive of sexual exploitation,[37] in line with the Endangerment Standard definition of abuse. Emotional abuse is commonly defined as emotional maltreatment that results in "substantial change in behavior, emotional response, or cognition,"[37] more in line with the Harm Standard definition.

Similarly, there are differences in how reports are screened, investigated, and substantiated across states, along with requirements for mandatory reporting. When a report of suspected child abuse is "substantiated," this means that the level of evidence necessary by state law is met to determine that a child was maltreated, while "indicated" means the level of evidence is not met, but there is sufficient reason to suspect the child was maltreated.[38]

According to the most recent report on child maltreatment, approximately 656,000 individual children in the US were documented victims of child maltreatment in 2019, or 8.9 victims per 1,000 children in the population.[39] The same report found that girls have a slightly higher rate of abuse than boys. Among children that were victims of

maltreatment, 75% were neglected, while nearly 18% suffered physical abuse, and 9% suffered sexual abuse. Most children had only one type of abuse, while approximately 16% of victims had suffered two or more types of maltreatment. It is important to note, however, that many cases of abuse are never reported and the rates based on child welfare organizations are under-estimated. Some studies that used self-report measures of child maltreatment found a higher prevalence of child maltreatment. For example, Finkelhor et al.[40] reports that in a sample of children surveyed in 2013-14, 15.2% of children responded that they had been victims of any maltreatment in the past year, while 24.9% reported lifetime maltreatment. The same study reported 5% reporting physical abuse, 9.3% reporting emotional abuse, 0.1% reporting sexual abuse, and 5.1% reporting neglect in the past year.

The most common types of child maltreatment vary widely by state. In 2019, substantiated cases of maltreatment for reasons of neglect ranged from 2.9% in Vermont to 97.6% of maltreatment in Montana. Physical abuse ranged from 2% in Wyoming to 80% of victims in West Virginia. Emotional abuse ranged from nearly zero victims in Arizona to 63% of victims in West Virginia, while sexual abuse ranged from 2.5% of victims in Montana to 44% of victims in Pennsylvania. In Kentucky, the rate of any maltreatment is 20.1 per 1,000 children, of which 95.5% suffer from neglect, 6.7% physical abuse and 3.9% sexual abuse.[39] Kentucky has had the highest rate of child maltreatment in the United States between 2017 and 2019.[41]

State Policy Variation

Policies that promote household financial stability have varied over time and by state. These include programs like the Supplemental Nutrition Assistance Program

(SNAP), the state and federal Earned Income Tax Credit (EITC), and Temporary Assistance for Needy Families (TANF). Another tool used to combat poverty has been the state and federal minimum wage. While generally, SNAP has become more accessible to households in all states over time, TANF has often been revised to create stricter guidelines. In SNAP, a fair amount of state-to-state variation has existed over time in terms of eligibility criteria, transaction costs, stigma, and outreach to families. Similarly, only 59% of states currently allow for an additional state-level earned income tax credit.

Between 2005 and 2019, variation in the generosity of state economic policies is present across states (Figures 3-6). In 2004, the year prior to our first measured suicide mortality year in 2005, aside from the District of Columbia, only eleven states had a refundable state earned income tax credit and ten had a state minimum wage higher than the federal level. The number of states with a refundable state earned income tax credit nearly doubled in 2018 (n=20) and the number of states with a higher state minimum wage than the federal minimum increased to half of all US states (n=25). Similarly, the SNAP Program Access Index score improved during the study period (2005-2019). A mixed effects linear regression analysis of the SNAP Program Access Index data obtained from the US Department of Agriculture,[42] pointed to an average increase of 1.5% points per year over the study period (β=1.5, SE=0.09, $p<0.001$), decreasing from 71.9% use among people in poverty in 2005, to 52.2% in 2006, and climbing back to 71.7% in 2019. However, a similar analysis of the TANF-Poverty Ratio, obtained from the University of Kentucky Poverty Research Center,[43] shows an overall decrease from a

high of 35.3% access among those in poverty in 2005, to 23.4% access in 2019 (β=-0.72, SE=0.07, p<0.001).

In Kentucky between 2010 and 2019, variation in the accessibility of the Supplemental Nutrition Assistance Program (SNAP) and the Kentucky Transitional Assistance Program (KTAP) is present between counties and over time, with a general decrease in accessibility over the study period of 2004-2018 (Figure 7 and Figure 8). SNAP access significantly declined in Kentucky between 2004-2018 (β=-3.64, SE=0.15, p<0.001). At the beginning of the study period, in 2010, a mean of 128 children were receiving SNAP benefits for every 100 children in poverty; in 2018, that number decreased to a mean of 105 children for every 100 in poverty. Thirteen counties had fewer than 100 children receiving SNAP benefits for every 100 children in poverty, on average, with a minimum as low as 63 in Crittenden County, KY (2014). The highest ratio was 196 to 100 in Carroll County, KY (2011). Similarly, access to KTAP benefits among children decreased among counties in KY (β=-0.369, SE=0.03, p<0.001). In 2010, 14.9 children received KTAP benefits for every 100 children in poverty. Access decreased to only 12.2 children receiving KTAP benefits for every 100 children in poverty in 2018 (Figure 7 and Figure 8).

Relationship between socioeconomic instability and suicidal behavior

Suicidal behavior has been associated with both population and individual level factors, including cultural attitudes, media coverage of suicide, economic factors, societal homogeneity and cohesion, hereditary factors, socioeconomic characteristics, and psychiatric illnesses.[1,6–8,32,33] In its technical package aimed at preventing suicide,[13] the

CDC recommends policies that promote economic stability to decrease the likelihood of suicidal behavior.

Significant associations have been found between socioeconomic instability and both adult and pediatric suicide rates in cross-sectional individual and ecological level analyses.[20–22,44–47] Using an ecological study design, Steelesmith et al.[20] additionally note that while higher economic deprivation was associated with higher rates of suicide, this effect was modified by rurality, with a larger effect in rural areas. McIntyre et al.[44] reported a significant relationship between childhood hunger and suicidal ideation in adolescence and early adulthood based on individual, cross-sectional data from the Canadian National Longitudinal Survey of Children and Youth between 1994 and 2009. Similar ecological studies of pediatric suicides[21] also found that counties with higher economic deprivation were associated with higher rates of suicide among children. Both studies noted that gun ownership was additionally a strong predictor, measured as gun stores and firearm suicides, respectively. The state-level gun ownership rate was also found to be a significant predictor of suicide rates in another ecological study by Dev et al.,[22] primarily focusing on social capital, and also finding county-level income and education as significant predictors. Firearms in the home predict suicide among youth[48], and were the method used in 42% of suicides between 2005-2019 among children and adolescents 10-19 years old.[30]

Similarly, multiple individual-level and ecological studies have found that generosity of state policies that address socioeconomic instability among families is negatively associated with suicidal behavior and suicide mortality.[45–47,49] However, in

studying the impact of socioeconomic instability and policies that address it, child maltreatment rates were not included in the analyses.

Relationship between child maltreatment and suicidal behavior

Child maltreatment has been described as a transdiagnostic factor that changes the way a child prioritizes and identifies threats, becomes emotionally reactive, and experiences accelerated biological aging;[50] recent studies[51,52] have found that posttraumatic stress disorder (PTSD), impulsivity and other psychiatric symptoms acted as mediators in this relationship. Turecki and Brent[7] similarly explain that child maltreatment may increase hyperactivity of the hypothalamic-pituitary-adrenal (HPA) axis, which is associated with increased DNA methylation and induce epigenetic changes. Martin et al.[53] found that a majority (80.1%) of adults that reported a suicide attempt in a nationally representative Canadian Community Health Survey – Mental Health, had a previous history of child abuse. In another study of children between 5 and 11 years old that died by suicide, 20.0% were cases that involved reports child maltreatment.[54] In a nationally representative survey in the United States, a history of emotional neglect (25.7%), physical neglect (21.2%), emotional abuse (49.9%), sexual abuse (44.3%), and physical abuse (35.0%) was indicated among adults that attempted suicide.[55]

Multiple longitudinal and cross-sectional studies[8,9,33,34,36,53,56–58] at the individual level have reported significant and positive associations between child maltreatment and suicidal behavior among both adult and child and adolescent participants. Definitions and associations varied in the type of maltreatment, including neglect, and physical, emotional and sexual abuse, and whether the outcome was suicide attempt or ideation.

For example, using the 1958 British Birth Cohort, Stansfeld et al.[56] found that physical and sexual abuse reported at the age of 45 was associated with significantly higher odds of lifetime suicide ideation [Odds Ratio: 3.07 (95% Confidence Intervals: 2.07-4.56) and Odds Ratio: 3.55 (95% Confidence Intervals: 1.95-6.46) respectively], a population based study in Canada[53] and researchers using data from the Adverse Childhood Experiences Study[8] found similar effects for suicide attempt. Compared to adults without a history of abuse, a higher lifetime prevalence of suicide attempt was found among adults with a history of emotional abuse (14.3% vs 2.5%), physical abuse (7.8% vs 2.2%), and sexual abuse (9.1% vs 2.4%).[8] Previously, a longitudinal cohort study, following children (mean age=5 years) for 17 years into adulthood, also found a higher prevalence of suicide attempt among adolescents (10% vs 3%) and young adults (11% vs 2%) who were neglected or abused compared to those without a history of maltreatment.[57]

Age at first attempt was found to be significantly younger among a nationally representative sample of adults in the US that experienced childhood maltreatment compared to those that didn't.[55] Experiencing child maltreatment was also associated with increased risk for suicide ideation and attempt among children and adolescents that experienced childhood maltreatment, as well. Duprey et al.[9] found child maltreatment to be positively associated with suicide ideation among 175 adolescent girls with depression, while another study reported this association among eight year old children participating in the Longitudinal Studies of Child Abuse and Neglect (LONGSCAN).[36] Two longitudinal cohort studies, one of nearly 6 thousand low-income children in St. Louis, Missouri and another including children in New Jersey and Colorado, suicidal behavior increased with maltreatment.[59,60] In a recent systematic review and meta-

analysis based on 79 studies and included 337,185 children, Angelakis et al.[10] found that child maltreatment was strongly associated with suicide attempt with odds ratios ranging from 1.79 to 3.41 and suicide plans (Odds Ratios: 2.5-4.0). Similar findings were reported by Liu et al. and Serafini et al.[58,61] in earlier systematic reviews and meta-analysis.

Relationship between socioeconomic instability and child maltreatment

Several studies have found a strong association between economic hardship and child maltreatment at the individual level.[15,62–66] The Fourth National Incidence Study of Child Abuse and Neglect (NIS-4), found that children living in households with low socioeconomic status, defined by household income, participation in a poverty program, parental education have an increased risk of maltreatment ranging from 3 to 7 times the rate of other children.[19]

Similarly, studies have aimed to understand the impact of state and federal programs that aim to ameliorate poverty among families and found mixed results with most impact in cases of child neglect and weaker associations with physical abuse.[14,67] However, several studies successfully identified associations between economic policies and rates of child maltreatment by using area-level panel data, Difference-In-Difference (DID) methods, and models controlling for state and time effects.[14,16,18,24,25,28,29,68]

Most studies focused on TANF recipients, including some longitudinal individual level studies in Illinois[64,66,69] and ecological studies.[17,24,70,71] Other studies looked at the impact of other policies, such as SNAP benefits,[17,26] EITC,[14,67] Medicaid expansion,[29] state minimum wage,[25] foreclosure[63] and paid family leave.[28] Kovski[14] found

significantly fewer reports of neglect among children 0-5 and 6-17, and non-statistically significant, but possible association between the EITC and lower physical and emotional abuse. Other studies have focused on unemployment rates, finding a significant association between increasing unemployment rates and increase in child neglect cases.[16,18] Lindo et al.[18] found differential effects of unemployment on child maltreatment outcomes for men and women, with an increase in male unemployment increasing child maltreatment. Similarly, Paxson and Waldfogel[27] reported that substantiated cases of maltreatment increased as the proportion of children with working single, but not two-parent household, mothers increased. Additionally, using National Child Abuse and Neglect Data System (NCANDS) data between 2012 and 2015 (4 years), Smith et al.[72] showed an interaction between rurality and race, where the majority black rural areas had the lowest mean child maltreatment reporting and the highest mean rate of child poverty. Rural counties that were majority white and Latinx had significantly higher reported rates of child maltreatment, adding a layer of complication to how child maltreatment can be impacted by economic conditions. An earlier study by Morris et al.[17] also found that substantiated child abuse and neglect rates were negatively associated with percentages of Black youth in counties in Tennessee.

Conceptual model and potential mechanism

The Socio-Ecological perspective was used to understand the potential mechanisms by which child maltreatment rates may act as a mediator in the relationship between state policies promoting economic stability and suicide behavior and mortality rates within a state. This model informs public health policy research and directly informs the analytic approach of the study (Figure 9).

There is evidence that a high rate of socioeconomic instability in the community is associated with a high rate of child maltreatment. Similarly, communities with high rates of poverty tend to have increased rates of suicide mortality and behavior. Individual level data point to child maltreatment as a major risk factor for suicidal behavior, along with socioeconomic instability. Geoffrey Rose[73] proposed that small reductions in risk across an entire population may prevent more deaths, than large reductions in risk, but across a smaller, high-risk subgroup of the population. This study posits that a reduction in community-level adolescent suicide mortality and behavior rates can be attained by increasing the availability of financial support for households and thereby reducing the prevalence of a major risk factor, child maltreatment.

Study Design Summary

This ecological study of adolescent suicide rates, state policies, and child maltreatment in US states from 2005-2019 and Kentucky counties from 2010-2019, combines publicly available secondary data from multiple databases with restricted de-identified data on child maltreatment from the National Data Archive on Child Abuse and Neglect (NDACAN) to implement a mediation analysis that incorporates the effect of time. Additionally, this association will be assessed for county-level rates of suicide attempt requiring medical attention and access to socioeconomic support benefits from 2010-2019 in Kentucky, a state with the highest rate of child maltreatment in the country between 2017 and 2019. In the examination of these relationships in Kentucky, county-level socioeconomic characteristics will be included as covariates. A full summary of included data and sources is presented in Supplemental Table 1.

THE ASSOCIATION BETWEEN STATE POLICIES PROMOTING ECONOMIC STABILITY, CHILD MALTREATMENT RATES, AND ADOLESCENT SUICIDE MORTALITY RATES OVER TIME

Introduction

Suicide is difficult to predict or prevent at the individual level,[1–3] and continues to be a leading cause of death among adolescents.[4] Suicidal behavior has been increasing steadily in the US[5], continuing through the COVID-19 pandemic.[74] In 2019, adolescents between 10-19 years died by suicide at a rate of 6.6 per 100,000 in the population.[4] Results from the 2019 Youth Risk Behavior Survey, a biannual nationwide survey of high school students conducted by the Centers for Disease Control and Prevention (CDC), indicate that 8.9% of high school students in the US attempted suicide and 2.5% made an attempt that required medical treatment.[75] Adolescent suicide has become a public health emergency, complicated further by the COVID-19 pandemic.[74] In December 2021, the U.S. Surgeon General issued an advisory on youth mental health,[11] underscoring the importance of policy to improve outcomes for children and adolescents at risk.

Exposure to child maltreatment is a well-documented risk factor among individuals that attempt and die by suicide.[7–10] Recently, a large meta-analysis reported significantly higher odds of suicidal attempt among adolescents exposed to each type of abuse. The impact ranged from nearly twice the odds among those exposed to physical neglect to

more than 3 times the odds among those with a history of sexual abuse compared to those without history of abuse.[10] Similarly, previous research has reported poverty, food insecurity, and other risk factors associated with economic instability to be associated with increases in suicidal behavior and mortality,[20–22,44,76] though fewer studies focus on children and adolescents.[21,44,76]

Much of youth suicide prevention has focused on individual level interventions; however, individual level risk assessments that inform much of resource allocation for interventions at the individual level struggle with low clinical accuracy. A recent analysis of individual risk assessments found a maximal positive predictive value of 5.5% for suicide death,[2] However, it may be that reducing the incidence rate of child maltreatment at the population level, a significant risk factor for suicide behavior and death, can work to lower the overall population rate of adolescent suicide.[12,77] Policies that promote economic stability among families have the potential to impact both child maltreatment and suicidal mortality at the population level, acting as a primordial prevention strategy, reaching subpopulations that may be missed by individual level interventions.[13,23]

Policies included in this study – refundable Earned Income Tax Credit (EITC), the accessibility of Supplemental Nutrition Assistance Program (SNAP) and Temporary Assistance to Needy Families (TANF), and a generous minimum wage, have been shown to reduce both child maltreatment rates[14,16,24–27,71] and suicide rates,[45–47,49,78,79] and vary significantly by state and over time. For example, recent work by Austin et al. found that broad based categorical eligibility for SNAP benefits was associated with a significant decrease in Child Protective Services (CPS)-investigated child maltreatment reports.[26] Generous earned income tax credit policies have been associated with lower rates of

suicide attempts.[46] The majority of studies assessing the relationship between economic policy and suicide mortality focus on adult populations,[45–47] despite evidence for family economic instability associated with poor mental health among children and adolescents.[76,80]

While current research has established links between child maltreatment and suicidal behaviors,[9,10] economic factors and child maltreatment,[14–19] and economic factors and suicide rates,[20–22,44] the complex interplay between economic factors and child maltreatment and its impact on suicide mortality needs further investigation at the population level. The present work endeavors to address this gap by extending the results of previous studies to test whether the presence and generosity of state policies that improve economic stability is associated with a reduction in adolescent suicide rates due, at least in part, to a reduction in child maltreatment rates, by quantifying the proportion of the total effect mediated through child maltreatment by using a mediation analysis.

Methods

The sample for this study included all US states between 2005 and 2019 where annual data for our primary outcome (adolescent suicide mortality rates), exposure (state policy data in the year prior to suicide mortality) and mediator (child maltreatment rate in the year prior to suicide mortality) were available for adolescents aged 10-19 years. In observations where suicide data were suppressed, a value of zero was assigned for suicide mortality and addressed by using two-stage models in our statistical analysis. The suicide rate was suppressed in Rhode Island and District of Columbia for all years. For some

states, suicide rates were suppressed for some years for: Delaware (n=12), Vermont (n=14), Wyoming (n=10), New Hampshire (n=9), Hawaii (n=7), Maine (n=5), W Virginia (n=2), Nebraska (n=2), Alaska (n=1), and Montana (n=1). Child maltreatment rates were not available for some states in several years, including Maryland (n=1), Michigan (n=1), Oregon (n=7). In North Dakota (n=7) five years were missing reported child maltreatment rates and two years where suicide rates were suppressed. Observations where child maltreatment rates were not available were excluded from the analysis for a total sample of state year observations of N=740 (Figure 10).

Adolescent Suicide Rates

Our primary outcome, adolescent suicide rates were defined as a crude rate of suicide among adolescents aged 10 to 19 years old in each state from 2005-2019, based on ICD codes (ICD 10: X60-X84) and were recorded as a rate per 100,000 adolescents. Crude adolescent suicide rates were drawn from the CDC Wide-ranging Online Data for Epidemiologic Research (WONDER)[4] database for each state per year of observation, with the denominator based on census and intercensal estimates. Data included all cases recorded by the physician as intentional self-harm as the underlying cause of death, and data at the state-level were suppressed when fewer than 10 suicide deaths occurred. Suppressed observations were assigned a zero value for suicide mortality and addressed by using two-stage models in our statistical analysis.

Child Maltreatment Rates

Reported child maltreatment in the year before suicide mortality was operationalized as the natural log of the child maltreatment rate. Child maltreatment

reports were obtained from the National Child Abuse and Neglect Data System (NCANDS)[38] for all cases of neglect, physical, emotional, and sexual abuse among adolescents 10 to 19 years old in each state for 2005-2019. In NCANDS, a single report may include more than one child and more than one type of abuse, and similarly a child may be included in multiple reports over time. Each unique child identifier remains consistent throughout reports and years. Similarly, a unique report identifier remains consistent over time as the disposition of the report may be updated. For this study, an incident of child maltreatment was defined as a unique report-child pair, excluding duplicate reports from the same day and same child. Unique incidents of child maltreatment were included as the numerator, with the denominator for the rate based on the census and intercensal estimates of adolescents 10 to 19 years old, matching the denominators used for adolescent suicide rates.

State Policy Data

State policies in the year prior to suicide mortality for this analysis included the accessibility of SNAP benefits, a refundable state EITC, the accessibility of TANF, and the generosity of state minimum wage as individual measures. A one-year lag was chosen for both policy and child maltreatment to preserve the temporal association between the exposures and outcome, while ensuring that the exposure remains proximate. The accessibility of SNAP benefits was operationalized using the SNAP Program Access Index (PAI),[42] created by the United States Department of Agriculture (USDA) to assess how well SNAP benefits are administered in each state. The PAI is calculated as a ratio of SNAP recipients to total population at 125% poverty level, with higher scores indicating better access to SNAP benefits.

A generous minimum wage was operationalized as a dichotomous indicator for whether the state minimum wage was higher than the federally mandated minimum wage in the same year for each state. This data was obtained from the National Welfare Data available at The Center for Poverty Research at University of Kentucky,[43] along with a dichotomous variable for the presence of a refundable state EITC. The National Welfare Data were also used to obtain information on the accessibility of TANF benefits, operationalized as a modified TANF-to-Poverty Ratio (TPR), a ratio of state TANF cases to the total number of families with children in poverty, with higher ratio values indicating increased access to support (sourced from The Annie E. Casey Foundation's KIDS COUNT data center[81]). The TANF-to-Poverty Ratio and SNAP Program Access Index were both multiplied by 100 and grand-mean centered to reflect changes away from the national means over time.

Additional Covariates

Guided by the socio-ecological perspective to understand the potential mechanisms by which child maltreatment rates may act as a mediator in the relationship between state policies promoting socioeconomic stability and suicide mortality rates, we additionally tested whether relevant community level risk factors from previous literature impacted the complex relationships between state policies at the macro level, child maltreatment rates, and adolescent suicide rates. For suicide mortality, these included covariates from the same year such as household gun ownership proportion, estimated by RAND in previous work compiling data from surveys, firearm injuries, and multiple other sources described in Schell et al.,[82] and access to mental healthcare. Access to mental healthcare was operationalized as the number of mental health professionals per

1,000 people in poverty drawn from the Occupational Employment and Wage Statistics database from the United States Bureau of Labor Statistics.[83] We also considered the previous year poverty levels sourced from The National Welfare Data.[43] The poverty level was also included as a risk factor for child maltreatment, along with the state-level unemployment proportion obtained from the National Welfare Data,[43] as well as the proportion of adults with at least a bachelor's degree based on data from the US Census Bureau Current Population Survey. All continuous covariates were grand-mean centered to reflect changes away from the national means over time.

Statistical Analysis

The impact of each policy on the adolescent suicide rate was tested along with the child maltreatment rate using a 2-stage hurdle model[84] to analyze both the probability of having fewer than 10 suicides per year (the threshold at which suicide data was suppressed) with a logistic regression in the first stage (n of observations with <10 suicides per year = 96; n of observations with 10 or more suicides per year = 644), and the increase in suicide counts, conditioned on the suicide data being available (when at least 10 suicides occurred per year) using a Negative Binomial regression with a log link in the second stage. The poverty rate, household firearm ownership, and availability of mental healthcare were included as covariates for the exposure-outcome model. Rate ratios from the conditional model are reported, along with 95% confidence intervals. State and year were included as clustering effects in each model. A 2-sided p-value of < 0.05 was considered statistically significant.

In order to assess the relationship between state policy and child maltreatment rates, linear mixed effects models[85] were used to examine the natural log of the child

maltreatment rate. The parameterization of child maltreatment as the natural log of the rate required the interpretation of the exponentiated beta estimates as percentage changes in the child maltreatment rate associated with each policy and the adjustment variables - unemployment rate, education level, and poverty level.

Finally, to test for direct and indirect effects, the *mediation* package[86] was used to assess the average mediated, direct, and total effects using quasi-Bayesian confidence intervals, along with the proportion mediated effect. The mediation model was estimated for each policy in three steps, slightly modifying the regression models examining the exposure-outcome and exposure-mediator to accommodate the *mediation* package requirements. First, using a linear mixed effects regression model, the impact of policy on the child maltreatment rate was assessed, controlling for state as random effect as previously defined, however the year was included as a fixed effect due to a limit of one random effect that could be calculated in the mediation package. Next, instead of a negative binomial regression, a Poisson regression, conditioned on the occurrence of at least 10 suicide deaths per year, was used to assess the impact of the child maltreatment rate and the policies on suicide counts. Because a negative binomial model could not be calculated in the *mediation* package, an observation identifier was created and included as a random effect to adjust for over-dispersion in the data while state and year were included as fixed effects.[87]

A post-hoc analysis investigated whether an interaction between each policy and the child maltreatment rate was present to examine whether the impact of child maltreatment on adolescent suicide mortality rates was modified by policy modification. All analyses were performed using R[88] statistical software.

Results

Overall, the adolescent suicide rate across states over time in our sample (N=740) has increased from a mean rate of 5.72 per 100,000 adolescents in 2005 to 9.25 per 100,000 adolescents in 2019 (β=0.27, SE=0.016, $p<0.001$) across the study period. Similarly, reported child maltreatment also climbed from 29.5 incidents per 1,000 adolescents aged 10-19 years in 2005, to 40.6 incidents per 1,000 in 2019, increasing by approximately 2% each year (β=0.02, SE=0.002, $p<0.001$). The suicide and child maltreatment rates over the study period for each state are presented in Figure 11.

Variation in the generosity of state economic policies is present across states over the study period (Figure 3). In 2004, the year prior to our first measured suicide mortality year in 2005, aside from the District of Columbia, only eleven states had a refundable state earned income tax credit and ten had a state minimum wage higher than the federal level. The number of states with a refundable state earned income tax credit nearly doubled in 2018 (n=20) and the number of states with a higher state minimum wage than the federal minimum increased to half of all US states (n=25). Similarly, the SNAP Program Access Index score improved at an average of 1.5% points per year over the study period (β=1.5, SE=0.09, $p<0.001$), decreasing from 71.9% use among people in poverty in 2005, to 52.2% in 2006, and climbing back to 71.7% in 2019, indicating access to SNAP benefits among a higher proportion of people in poverty. However, the TANF-Poverty Ratio has been decreasing from a high of 35.3% access among those in poverty in 2005, to 23.4% access in 2019 (β=-0.72, SE=0.07, $p<0.001$), indicating fewer families in poverty are receiving assistance.

State policies, characteristics, and child maltreatment associations with the adolescent suicide rate

Though not statistically significantly associated with an increased rate of suicide mortality when more than 10 suicides occurred per year, higher child maltreatment rates were independently associated with lower odds of having fewer than 10 suicides per year, adjusted for each of the policies and the poverty rate, household firearm rate, and access to mental healthcare. A 10% increase in the child maltreatment rate was independently associated with 25% lower odds (adjusted OR=0.75, 95% CI=0.60, 0.93) of having fewer than 10 suicides per year when all four policies were included, and the model was adjusted for poverty, mental healthcare access, and gun ownership.

Results from the negative binomial models examining the rate of adolescent suicide deaths where at least ten deaths occurred are presented in Table 1. A state minimum wage that exceeded the federal minimum wage was associated with a statistically significant decrease in adolescent suicide deaths (IRR=0.936, 95%CI= 0.895, 0.979), which remained consistent in the final model adjusting for poverty, household firearm rate, and access to mental healthcare (adjusted IRR=0.946, 95%CI= 0.903, 0.990). A slight decrease in adolescent suicide mortality was also present with each single unit increase (an additional household for every 100 households with children in poverty) in the TANF-Poverty ratio (adjusted IRR=0.998, 95%CI=0.996, 0.999). In the final adjusted models, single unit increases in the TANF-Poverty ratio (adjusted IRR=0.999, 95% CI=0.997, 1.001) and SNAP Program Access Index (adjusted IRR=1.001, 95% CI=0.999, 1.003) were not significantly associated with a decrease in adolescent suicide deaths. A non-significant protective effect of the presence of a refundable state EITC on adolescent suicide deaths was noted as well, compared to

observations where a refundable state EITC was absent (adjusted IRR=0.963, 95% CI=0.910, 1.018).

An increase in the percent of adults living in a household with a firearm significantly increased the rate of suicide among adolescents (adjusted IRR=1.009, 95%CI= 1.003, 1.015). The poverty rate, however, was associated with a decrease in suicide mortality (adjusted IRR=0.989, 95%CI=0.979, 1.000).

State policies and characteristics associated with the child maltreatment rate

Factors associated with the natural log of the child maltreatment rate are presented in Table 2. In unadjusted analyses, the presence of a refundable state earned income tax credit (EITC) policy was associated with a decrease in the natural log of the child maltreatment rate (β=-0.092, SE=0.03, p=0.004), such that the presence of a refundable state EITC is associated with an 8.79% decrease in the child maltreatment rate. This effect was slightly attenuated to a 7.82% decrease when all four policies were included in the model (adjusted β=-0.081, SE=0.03, p=0.012); however, it rebounded to an 8.84% decrease in child maltreatment rates when the unemployment, poverty rate, and educational level were added into the final model (adjusted β=-0.093, SE=0.03, p=0.004). An increase in the SNAP Program Access Index (PAI) was also significantly associated with a decrease in the child maltreatment rate, such that a standard deviation (SD=16.4) increase in PAI would be associated with a 3.24% decrease in the child maltreatment rate in the crude model (β=-0.002, SE=0.001, p=0.019), attenuating to a 2.27% decrease in the fully adjusted model that included all four policies, the unemployment rate, poverty rate, and educational attainment (adjusted β=-0.001, SE=0.001, p=0.109).

The presence of a higher minimum wage was not associated with a significant decrease in the natural log of the child maltreatment rate (-2.73% decrease in the child maltreatment rate; adjusted β=-0.028, SE=0.02, p=0.228). Similarly, an increase in the TANF-Poverty Ratio was not significantly associated with a decrease in the child maltreatment rate (adjusted β=-0.001, SE=0.001, p=0.223), such that a standard deviation increase (18.4) was associated with a 1.88% decrease in the child maltreatment rate. An increase in the state unemployment rate was significantly associated with a decrease in the child maltreatment rate, with a single percentage point increase above the mean unemployment rate decreasing the child maltreatment rate by 2.81% (adjusted β=-0.029, SE=0.01, p=0.001).

Causal Mediation Analysis

No mediation by child maltreatment rates was found in this study, with the proportion of the total effect of policy on suicide mortality rates mediated through the child maltreatment rate ranging from 0.26% to 1.87% (Table 3).

Effect Modification by State policies, in the association between child maltreatment and the adolescent suicide rate

As a post-hoc analysis we examined whether instead of mediation, state policies may behave as effect modifiers in the relationship between child maltreatment and adolescent suicide mortality. The results are presented in Table 4. We found a significant interaction effect between the presence of a refundable state earned income tax credit and the child maltreatment rate (adjusted IRR=0.887, 95% CI=0.791, 0.994), implying that the effect of child maltreatment on suicide mortality is attenuated by 11% when a refundable state earned income tax credit policy is present. In the absence of a

refundable state earned income tax credit or a generous minimum wage, and at the mean levels of SNAP and TANF access, the child maltreatment rate was positively, though not significantly, associated with adolescent suicide mortality. As such a 10% increase in child maltreatment rates may be associated with a 10.6% increase in adolescent suicide mortality (adjusted IRR=1.058, 95%CI=0.965, 1.161). No evidence of effect modification (moderation) was found for the remaining policies.

Discussion

A generous state minimum wage and an increase in TANF uptake were associated with decreases in adolescent suicide mortality rates. However, despite previous work implicating child maltreatment as a significant risk factor for suicide mortality, the rate of child maltreatment was not significantly associated with the adolescent suicide rate in the present analysis, among states where at least ten deaths occurred. As such, no evidence of mediation was found in this analysis to support our primary hypothesis that child maltreatment rates acted as a mediator between state policy and suicidal mortality rates. Many previous studies where child maltreatment has been found to be a significant risk factor for suicidal behavior were at the individual level[9,36,60] and among adult respondents,[8,10,33,53] - the relationship may not extend as well to the population level. Another explanation for the incongruence may be that a one-year lag is not sufficient to measure the impact of child maltreatment or policy on adolescent suicide mortality. Studies that focus on suicide attempts among adults with a history of maltreatment as children, include a longer length of time between exposure and outcome. Similarly, Dev et al.[22] reported a significant impact of poverty, unemployment, and educational attainment in 1990 on suicide mortality in the years between 2010-2017, and noted that

the effects of county-level social capital weakened as the exposure became more recent, though child maltreatment was not included as a variable in the analysis. Consistent with previous literature, household gun ownership was positively associated with adolescent suicide mortality rates. Firearms in the home predict suicide among youth,[48] and were the method used in 42% of suicides between 2005-2019 among children and adolescents 10-19 years old.[30]

The results of this study also indicate a significant role for a refundable state Earned Income Tax Credit in the decrease of the child maltreatment rate, consistent with findings from Kovski et al.[14] and Berger et al.[67] A higher SNAP Program Access Index score was also associated with a decrease in the child maltreatment rate, similar to the impact reported by Austin et al.,[26] though not statistically significant in our final adjusted models. The current study found that in the final adjusted model, an increase in the unemployment rate was associated with a decrease in child maltreatment, such that an increase of 1% point in the unemployment rate was associated with a 2.81% decrease in the child maltreatment rate. Studies investigating the impact of the unemployment rate on child maltreatment have reported mixed results.[16,18,89] Recent work, investigating child maltreatment rates through the COVID-19 pandemic, found overall decreases in child maltreatment reporting,[41,90–92] with some researchers positing that an increase of parental presence at home provided protection for children.[93] Future work aimed at disentangling the negative impact of job loss from a potentially positive impact of parental presence in the home is necessary. Similarly, while no mediation effects were found, a significant moderation effect of a refundable state EITC was noted in the association between child

maltreatment and suicide mortality in the post-hoc analysis and merits further investigation.

This study has many strengths, and the mixed study design allows for estimates of within group changes over time and between group variation. The national study across states over 15 years, captures macro-level socioeconomic exposures and assesses their impact on maltreatment and suicide mortality among adolescents, difficult to assess in individual level studies. The ecological design of this study permits the exploration of several policy impacts on population level effects, focusing on smaller changes in population rates that may have large public health impact, in line with the National Institute of Mental Health's (NIMH) strategic plan.[94]

This study has several important limitations stemming from the rarity of adolescent suicide – the number of suicides was suppressed among states in years that have fewer than ten adolescent suicide deaths and incident rate ratios could not be calculated for those observations. Consequently, gender and race could not be included in the study because stratifying the counts by demographic characteristics would decrease the available data. The difficulty to stratify the results by race or gender is a potential source of residual confounding, as disparities by both characteristics have been documented in both suicide[74] and child maltreatment reporting,[95] and may be differentially impacted by rurality and poverty related risk factors, and by extension policies that target these risk factors.[22,72,74] Similarly, social media use has been increasing over the study period and may have both positive and negative impacts on youth mental health and suicidality.[96–98]

Another set of limitations includes the reliance on reported rates of child maltreatment, which tend to underestimate its prevalence, while overestimating the proportion maltreatment rates among lower SES and urban communities where child welfare system involvement is increased.[62] Many incidents of child maltreatment occur in financially stable environments and go unreported due to a lower frequency of contact with mandatory reporters.[62] Varying definitions of child maltreatment and mandatory reporting laws between states, and disparate resources allocated to Child Protective Services (CPS) for investigations also present a challenge for reporting as an accurate measure. NCANDS makes efforts to increase the reliability of reported child maltreatment by providing a coding scheme to state reporting agencies, attempting to standardize the maltreatment categories. Finally, the study design is ecological with a relatively short lag between the exposures and outcome, and relationships are meant to be interpreted at the state-level - no inference can be made at the individual child level. The ecological design facilitates the study of both child maltreatment and suicide mortality among adolescents, which are difficult to assess at the individual level. However, this study cannot examine the exacerbating or protective factors that impact whether children and adolescents that experience child maltreatment exhibit suicidal behaviors or die by suicide, and such an analysis would require prospective, individual level information. Similarly, a history of maltreatment is not present in all, or even most, children that die by suicide[54,55] and understanding the many underlying experiences that are present in suicidal behavior and mortality is crucial to prevention. The population level approach in this analysis instead focuses on shifting the overall incidence rate of adolescent suicide mortality by targeting the prevalence of modifiable risk factors. Considering the

challenges with individual level interventions, and low yield of risk assessments for clinical use,[2] strengthening policies that support economic stability may be an important tool in reaching subpopulations that are otherwise overlooked.

The data for this analysis ends in 2019, prior to school closures associated with the COVID-19 pandemic beginning in March 2020. The associated school closures had mixed effects on suicide,[74] with younger children experiencing a significant increase and adolescents 13-17 years old remaining stable. Similarly, increases differed by race, with Black youth experiencing an increase and White youth suicide remaining stable.[74] Medical injuries due to child maltreatment also declined,[91–93] along with reporting,[41,90] though possibly due to a decrease of interaction between abuse victims and mandatory reporters.[99] It is unknown if the relationships between policy, suicide and child maltreatment rates found in this analysis will be present in the period during or post pandemic. However, there is good reason to believe this is the case. For example, in a survey of youth between Jan 2021 and June 2021, both physical and emotional abuse were still significantly associated with increased suicidal behavior, along with parental job loss.[76,100]

Suicide is currently the second leading cause of death among adolescents and impacts the health of families and communities. Strengthening policies that promote financial stability in families, such as a refundable EITC, has the potential to prevent some cases of child maltreatment and adolescent suicide, reducing the overall rate of each. Focusing on population level primordial prevention through state policy may be an important strategy for preventing many negative health outcomes, including child

maltreatment and suicide mortality among adolescents, where relatively small decreases in an incidence rate may result in a substantial impact when applied across populations.

TRANSITION CHAPTER

In the preceding manuscript, the first, second, and third aim were explored, attempting to investigate and describe the complex relationships between state policies and whether they can be leveraged to decrease state child maltreatment rates and suicidal mortality rates. A major limitation in this work is lack of complete suicide mortality data, with several states being excluded from the calculation of incident rate ratios, and missing child maltreatment report data, reducing the overall sample of states available over time. As a post hoc exploratory objective, some state characteristics were explored as both confounding and moderating variables to further understand these complex relationships.

We found that mediation was not supported by our results. The rate of child maltreatment was not significantly associated with the adolescent suicide rate in the prior chapter; however, a generous state minimum wage and an increase in TANF uptake were associated with decreases in adolescent suicide mortality rates. There are important differences among individuals at risk for suicide mortality and suicidal behavior, most pronounced between gender, and the impacts of policy and child maltreatment may also vary.

Having explored suicide mortality at the national level in the previous chapter, the following manuscript will investigate the fourth aim of the study, focusing on suicidal behavior differences by county within a single state. Kentucky has the highest rate of

child maltreatment in the U.S. and suicide is the second leading cause of death among youth below 20 years of age. Kentucky has never had a refundable state EITC, nor has the minimum wage ever been higher than what was federally mandated. Kentucky has many rural areas and a vulnerable population with decreased access to mental health services. The primary focus here is to investigate whether county-level access to KTAP and SNAP benefits among the impoverished population can predict child maltreatment rates, suicidal behavior rates, and whether child maltreatment serves as the mediator. The county characteristics will serve as the context under which the impact of access to state-level supports on child maltreatment, and thereby suicidal behavior, strengthens or weakens.

KENTUCKY POLICIES PROMOTING ECONOMIC STABILITY, CHILD MALTREATMENT RATES, AND SUICIDAL BEHAVIOR RATES

Introduction

Forty-four children and adolescents under 20 years of age died by suicide in Kentucky in 2021 and 12 of them were less than 16 years old. In 2019, the year before the COVID-19 pandemic, this number had decreased to 39 from the previous year's 48 deaths. Eight percent of adolescents in Kentucky reported attempting suicide in 2019, and 3% made an attempt serious enough to require medical attention[5]. Though child and adolescent suicide is relatively rare, it is a leading cause of death among children[30] and its impact echoes through families and communities so much so, that in December, 2021 the U.S. Surgeon General issued an advisory on youth mental health to improve outcomes for children and adolescents at risk.[11]

Suicide is difficult to predict or prevent at the individual level[2,5], and many initiatives that target individuals are limited in their ability to make population-level impact. Because of these challenges, policy level interventions may be advantageous because they can be leveraged to decrease the prevalence of modifiable risk factors and better impact child and adolescent suicidal behavior rates. Exposure to child maltreatment is a well-documented risk factor among individuals that exhibit suicidal behavior,[7–10] as is financial instability.[44] Multiple studies have found that poverty is associated with higher rates of child maltreatment and the presence of policies that promote economic stability in families have been associated with lower rates of child maltreatment

[14,16,24–27,71] and lower rates of suicidal behavior among adolescents and adults.[20–22,45–47,49] By strengthening policies that promote economic stability, it may be possible to decrease the prevalence of child maltreatment and thereby decrease the rate of suicidal behavior among children.

In Kentucky, the rate of child maltreatment is 20.1 per 1,000 children.[39] Kentucky has had the highest rate of child maltreatment in the United States since 2017.[39] Kentucky is also a relatively poor state, with the population suffering from many coexistent risk factors for both suicide and child maltreatment, including poor access to mental health services. Nearly all counties in Kentucky are designated Health Professional Shortage Areas (HPSA) for mental health care. However, no existing studies have examined the complex relationship between policy, child maltreatment and child and adolescent suicidal behavior rates at the population level, and there is no existing work on child or adolescent suicide focusing on Kentucky, despite the state experiencing the highest rate of child maltreatment in the US.

This study aims to address this gap within Kentucky by focusing on the accessibility of Kentucky's primary forms of non-medical support for families in poverty - Supplemental Nutrition Assistance Program (SNAP) and Kentucky Transitional Assistance Program (KTAP) and quantifying the direct and indirect effects of these policies, through a decrease in child maltreatment prevalence, on suicidal behavior rates. The Supplemental Nutrition Assistance Program (SNAP) provides nutritional support for eligible families that experience food insecurity. The Kentucky Transitional Assistance Program (KTAP), also called Temporary Assistance for Needy Families (TANF), provides short-term, direct cash assistance to families in poverty, providing much needed

relief to families when barriers to access are overcome. Several studies have linked poverty, along with TANF and SNAP benefits to decreases in child maltreatment and suicidal behavior.[21,24,26,44,101,102] We aim to test the hypothesis that increased access to SNAP and KTAP will decrease the prevalence of child maltreatment and thereby decrease suicidal behavior among children and adolescents. We additionally examine the way in which county characteristics, such as urbanicity, educational attainment, mental healthcare access, and poverty are associated with the complex relationships between policy, child maltreatment, and suicidal behavior rates. This study presents a novel approach to investigating these complex relationships through formal mediation analysis.

Methods

The sample for this study included all Kentucky counties (N=120) between 2010 and 2019 where annual data for our primary outcome (child and adolescent suicidal behavior rates), exposure (prior year policy information), and mediator (child maltreatment prevalence rates in the prior year) were available. The child maltreatment rate was missing or suppressed across 5 observations between 2010 and 2018. Suicidal behavior rates that were suppressed when fewer than five incidents were reported (N=408) were assigned a zero value and addressed by using two-stage models in our statistical analysis. The final analytic sample consisted of 1,067 county-year observations for suicidal behavior reported between 2011 and 2019, and child maltreatment reported prevalence and policy in each year prior, between 2010 and 2018 (Figure 12).

Suicidal Behavior Rates

Suicidal behavior rates were obtained using ICD codes for suicide ideation, suicide attempt and initial encounters for intentional self-harm (Supplemental Table 2)

from all inpatient, emergency department, and other outpatient records found in the Health Facility and Services Data (HFSD) from the Kentucky Cabinet for Health and Family Services, including mortality cases. Children under 20 years old and living in KY between 2011-2019 were included in the analysis. Suicidal behavior rates were calculated using county-year observations from HFSD and denominators based on census and intercensal estimates for the same age group taken from CDC WONDER. Observations were suppressed when fewer than 5 cases of suicidal behavior were reported, as required in the HFSD data use agreement.

Child Maltreatment Rates

Reported child maltreatment was operationalized as the natural log of the child maltreatment prevalence in the year prior to the suicidal behavior. The number of individual children involved in child maltreatment reports for neglect, physical abuse or sexual abuse throughout each year were sourced from The Annie E. Casey Foundation's KIDS COUNT data center[81] for each county between 2010 and 2018 with the denominator based on the same census and intercensal estimates used for our primary outcome of suicidal behavior rates. This data is provided through Kentucky Youth Advocates and sourced from the Kentucky Cabinet for Health and Family Services, Department for Community Based Services. Data is suppressed when fewer than 6 children are reported throughout the year.

State Policy Data

State policies for this analysis included the accessibility of SNAP and KTAP benefits in the year prior to the suicidal behavior outcome, using uptake as a proxy

measure. A one-year lag was chosen for both policy and child maltreatment to preserve the temporal association between the exposures and outcome, while ensuring that the exposure remains proximate. Policy accessibility was calculated as ratios of children receiving benefits, obtained from The Annie E. Casey Foundation's KIDS COUNT data center[81] to the total number of children in poverty, obtained from annual County Health Rankings[103] reports, with higher ratios indicating better access to economic support. Accessibility ratios were each multiplied by 100 and for the regression analysis, grand mean centered to reflect changes away from the Kentucky mean over time.

Additional Covariates

We additionally tested whether relevant covariates from previous literature impacted the complex relationships between economic policies, child maltreatment prevalence and suicidal behavior rates. Guided by the socio-ecological model, county-level risk factors for suicide attempt and behavior included county-level access to mental healthcare in the previous year, operationalized as the number of mental health professionals per 100,000 in the population, previous year poverty levels, and percent rurality, all sourced from the annual County Health Rankings[103] reports. The poverty level and percent rurality were also included as potential effect modifiers for the impact of each policy on child maltreatment, along with the county-level percent of 3 and 4-year-old children enrolled in public preschool, obtained from The Annie E. Casey Foundation's KIDS COUNT data center,[81] and the mean proportion of adults with at least a bachelor's degree, obtained from the Economic Research Service at the US Department of Agriculture,[104] and the county-level unemployment percent, sourced from the US Bureau of Labor Statistics. Missing values for preschool enrollment (N=284), rurality

(N=120) and mental healthcare access (N=290) were imputed using the linear weighted moving average for each county, using the imputeTS[105] package. All continuous covariates were grand mean centered to reflect changes away from the county mean over time.

Statistical Analysis

The impact of access of each policy and the prevalence of child maltreatment in the prior year on child suicidal behavior was tested using a 2-stage hurdle model[84] to analyze both the probability of having fewer than 5 incidents per year (the threshold at which suicidal behavior data was suppressed) with a logistic regression in the first stage, and the increase in suicidal behavior counts, conditioned on data being available (when at least 5 incidents occurred per year) using a Negative Binomial regression with a log link in the second stage. The poverty rate, percent rurality, and availability of mental healthcare were included as covariates for the exposure-outcome model. Additionally, a potential interaction between each policy and the child maltreatment prevalence was included to examine whether access to KTAP and SNAP modified the association between child maltreatment and suicidal behavior rates. Incident rate ratios (IRR) were reported, along with 95% confidence intervals (CI). County and year were included as clustering effects in each model. A 2-sided p-value of < 0.05 was considered statistically significant.

To assess the relationship between uptake of each policy and child maltreatment prevalence, linear mixed effects models[85] were used to examine the natural log of the child maltreatment rate. The parameterization of child maltreatment as the natural log of the rate required the interpretation of the exponentiated beta estimates as percentage

changes in the child maltreatment prevalence associated with uptake of each policy adjusted for the county-level unemployment rate, preschool access, percent rurality, and poverty level. A stepwise regression approach was used to fit a parsimonious model and investigate the potential interaction effects between county characteristics and benefit access, on child maltreatment prevalence rates.

Finally, the *mediation* package[86] was used to assess the average mediated, direct, and total effects using quasi-Bayesian confidence intervals, along with the proportion mediated effect for each policy in three steps. First, using a linear mixed effects regression model, the impact of policy on the child maltreatment prevalence was assessed, controlling for county as random effect and year as fixed effect. Next, a Poisson regression, conditioned on the occurrence of at least 5 suicidal behavior incidents per year, was used to assess the impact of the child maltreatment prevalence rates and access to KTAP and SNAP benefits on suicidal behavior rates. An observation identifier was created and included as a random effect to adjust for over dispersion in the data while county and year were included as fixed effects.[87] All analyses were performed using R[88] statistical software.

Results

Overall, the mean rate of suicidal behavior claims among children and adolescents in Kentucky grew from 5.17 to 17.3 children per 1,000 in the population over the study period between 2011 and 2019 (β=1.61, SE=0.05, $p<0.001$) (Figure 13). The number of children with a reported incident of child maltreatment increased as well between 2010 and 2018 (β=3.16, SE=4.14, $p<0.001$), with the mean proportion of children increasing from 184 per 1,000 to 402 per 1,000 children among Kentucky counties (Figure 14).

Variation in the accessibility of SNAP and KTAP is present between counties and over time, with a general decrease in accessibility between 2010 and 2018 (Figure 7 and Figure 8). SNAP access significantly declined in Kentucky over the study period (β=-3.64, SE=0.15, $p<0.001$) (Figure 8). In 2010, a mean of 128 children were receiving SNAP benefits for every 100 children in poverty; in 2018, that number decreased to a mean of 105 children for every 100 in poverty. Thirteen counties had fewer than 100 children receiving SNAP benefits for every 100 children in poverty, on average, with a minimum as low as 63 in Crittenden County, KY (2014). The highest ratio was 196 to 100 in Carroll County, KY (2011). Similarly, access to KTAP benefits among children decreased among counties in KY (β=-0.369, SE=0.03, $p<0.001$). In 2010, 14.9 children received KTAP benefits for every 100 children in poverty. Access decreased to only 12.2 children receiving KTAP benefits for every 100 children in poverty in 2018 (Figure 7).

Access to benefits, socioeconomic characteristics, and child maltreatment associations with the suicidal behavior rate

Increases in child maltreatment prevalence, KTAP, or SNAP access, were not associated with suicidal behavior among children and adolescents across Kentucky counties, and no significant interaction between access to economic support and child maltreatment was present. A higher percent of county rurality was associated with slightly lower rates of suicidal behavior among children (IRR=0.998, 95%CI=0.995, 1.000) (Table 5).

Access to benefits and socioeconomic characteristics associated with the child maltreatment rate

Factors associated with the natural log of the child maltreatment prevalence are presented in Table 6. Neither an increase in KTAP access (β=0.008, 95%CI=-0.003, 0.019), nor an increase in SNAP access (β=0.000, 95%CI=-0.002, 0.003) were associated with decreases in child maltreatment prevalence in Kentucky counties in bivariate and fully adjusted models. However, a higher percent of 3- and 4-year-olds in public preschools within the county (β=0.009, 95%CI=0.002, 0.016) and a higher county poverty rate (β=0.010, 95%CI=0.000, 0.020) were both associated with increases in reported child maltreatment prevalence in the crude models. When adjusting for KTAP and SNAP access and each of the covariates (the unemployment rate, educational attainment, poverty rate, and childcare accessibility, and percent rurality), at mean levels of covariates, the poverty rate was associated with a 2.6% increase (β=0.025, 95%CI=0.011, 0.039) and educational attainment was associated with a 2.4% increase (β=0.024, 95%CI=0.002, 0.045) in child maltreatment prevalence for each percentage point increase in the respective covariates. Significant statistical interaction effects were found between KTAP access and each of the county characteristics, such that higher access to KTAP attenuated the positive association between child maltreatment and percent rurality, educational attainment and childcare access, and the negative association between child maltreatment prevalence and the unemployment rate (Table 6).

Mediation Analysis

No mediation effects by child maltreatment prevalence were found in this study, with the proportion of the total effect of KTAP and SNAP access on suicidal behavior rates mediated through the child maltreatment rate of 0.13% for SNAP accessibility and 0.36% for KTAP accessibility (Table 7).

Discussion

Contrary to our hypothesis, neither KTAP nor SNAP access decreased suicidal behavior or child maltreatment in our analysis. Similarly, there was no evidence that a higher prevalence of child maltreatment was associated with an increase in suicidal behavior in the pediatric population. Consequently, a mediational relationship was not found between either KTAP or SNAP, child maltreatment prevalence, and child and adolescent suicidal behavior rates. Significant interaction effects were noted between KTAP access and each of the county characteristics measured, likely indicating an attenuation of socioeconomic effects on child maltreatment as KTAP access increases.

The significant interaction between KTAP access and the unemployment rate, percent rurality, childcare access, and educational attainment may indicate that higher access to KTAP benefits attenuated the positive association between child maltreatment and percent rurality, educational attainment and childcare access, and the negative association between child maltreatment prevalence and the unemployment rate. This may point to differential effects of KTAP access on subpopulations, such as those in rural settings, demonstrating the potential strength of policy to reach those overlooked by individual level interventions. Studies investigating the impact of the unemployment rate on child maltreatment have reported mixed results in separating the negative impact of job loss from a potentially positive impact of increased parental presence at home.[16,18,89] Though few inferences can be made from this analysis, this may be an interesting area of focus for future work outside of Kentucky and would benefit from additional suicide behavior data being made available for more states, similar to that provided in Kentucky by the Kentucky Cabinet for Health and Family Services.

The primary findings presented here seem to contradict previous work. For example, child maltreatment has been documented as a significant risk factor for suicidal behavior and mortality. A potential reason for this incongruence between the current study and previous work may be that the majority of studies reporting this association were at the individual level,[10] and this association does not extend to the county population level. Another explanation may be that this analysis was not limited to adolescence, the period where suicidal behavior becomes more common, due to a lack of age stratified county-level child maltreatment data, and especially important because child maltreatment is more common among younger children. The incongruence between the current study and previous work surrounding the impact of economic policy on child maltreatment and suicidal behavior may have a few explanations. This may be due to the way KTAP and SNAP were operationalized as ratios of the number of cases to the population in poverty, instead of targeting whether a specific implementation mechanism such as broad based eligibility[26] or a state earned income tax credit[14,45,46] was present. It may also be the case that accessibility did not sufficiently vary within a single state, or that either the time period, or one-year lag between the policy measure and suicidal behavior was not long enough. For example, another study using county-level analysis of suicide mortality found significant impact of socioeconomic variables across the United States, using a time period of twenty years between exposure and suicide mortality measures.[22] The association was strongest with a twenty year lag, and weakened as the time period decreased.

Significant limitations also include the lack of county-level firearm ownership data. The availability of firearms is a significant risk factor in suicidal mortality.[48] Due to

limited data availability, neither race nor gender could be included in the analysis. Significant differences have been documented in child maltreatment reporting by race and gender, along with suicidal behavior.[74] Further, suicidal behavior and child maltreatment may be differentially impacted by poverty related risk factors and by extension policies that target these risk factors.[74] The data for this analysis ends in 2019, prior to school closures associated with the COVID-19 pandemic beginning in March 2020. The associated school closures had mixed effects on both the suicide[74,106] and child maltreatment rates,[91,93] along with altering the characteristics associated with suicidal behavior. The ecological design facilitates the study of both child maltreatment and suicide mortality among adolescents, which are difficult to assess at the individual level, though consequently, inference can only be made at the population level. Understanding the factors that impact whether children and adolescents that experience child maltreatment exhibit suicidal behaviors would require prospective, individual level information, not currently available. Importantly, not all children that die by suicide experience child maltreatment,[54,55] nor do all children that experience child maltreatment exhibit suicidal behaviors. Considering the challenges with individual level interventions, and low yield of risk assessments for clinical use,[2] Strengthening policies that support economic stability may be an important tool in reaching subpopulations that are otherwise overlooked, and understanding the impact of a population level intervention may benefit from a population level approach to analysis.

The current work presents a novel approach to investigating how state policies may impact the state's suicidal behavior rates among children by decreasing the rate of child maltreatment through formal mediation analysis. Future work may benefit from

improved reporting of county-level child maltreatment and suicidal behavior with a focus on the differential impact of policy by race, gender, and additional socioeconomic characteristics.

Suicide is currently the second leading cause of death among adolescents in Kentucky and continues to impact the health of families and communities. In Kentucky, the rate of child maltreatment is 20.1 per 1,000 children - the highest rate of child maltreatment in the United States between 2017 and 2019.[39] Though neither SNAP or KTAP access were significant predictors of child maltreatment or suicidal behavior rates, previous work suggests that strengthening policies that promote financial stability in families, such as SNAP and KTAP can lead to a reduction in both rates. Future research may focus on specific aspects of state policy that may differentially impact health outcomes. Focusing on population level primordial prevention through state policy may be an important strategy for preventing many negative health outcomes where relatively small decreases have the potential to make a large impact when applied across a population.

DISCUSSION

Summary

The objective of this study was to establish the link and explore the potential efficacy of state legislation that addresses socioeconomic instability among families as a form of primordial disease prevention for suicidal behavior and mortality among children and adolescents. We aimed to extend the results of individual level analyses in previous studies to the population level and investigate the association between state and county-level adolescent suicide attempt and mortality rates and state-level policies promoting economic stability, focusing on quantifying the direct effect of economic support and the indirect effect through a decrease in child maltreatment rates. Additionally, using Kentucky data, we explored county and state-level characteristics that may interact with these complex relationships in the context of suicidal attempts that resulted in emergency visits. Our central hypothesis was that state-level policies that promote economic stability among families, reduce the level adolescent suicide and attempt rates by acting to reduce state-level child maltreatment rates.

No evidence of mediation was found in this analysis to support our primary hypothesis that child maltreatment rates acted as a mediator between state policy and suicidal mortality rates at the national level, nor was there evidence of mediation when investigating access to these programs at the county-level in Kentucky. At the national

level, a generous state minimum wage and an increase in TANF access were associated with decreases in adolescent suicide mortality rates. However, despite previous work implicating child maltreatment as a significant risk factor for suicide mortality, the rate of child maltreatment was not significantly associated with the adolescent suicide rate. Many previous studies where child maltreatment has been found to be a significant risk factor for suicidal behavior were at the individual level[9,36,60] and among adult respondents,[8,10,33,53] - the relationship may not extend as well to the population level or to suicide mortality. Consistent with previous literature, household gun ownership was positively associated with adolescent suicide mortality rates. Firearms in the home predict suicide among youth,[48] and were the method used in 42% of suicides between 2005-2019 among children and adolescents 10-19 years old.[30]

The results of this study also indicate a significant role for a refundable state EITC in the decrease of the child maltreatment rate, consistent with findings from Kovski et al.[14] and Berger et al.[67] A higher SNAP Program Access Index score was also associated with a decrease in the child maltreatment rate, similar to the impact reported by Austin et al.,[26] though not statistically significant in our final adjusted model. This study found that an increase in the unemployment rate was associated with a decrease in child maltreatment, such that an increase of 1% point in the unemployment rate was associated with a 2.81% decrease in the child maltreatment rate.

Although strengthening policies that promote financial stability in families, such as SNAP and KTAP, have been previously reported to reduce child maltreatment and suicidal behavior, neither KTAP or SNAP access decreased suicidal behavior or child maltreatment in this analysis. Consequently, our primary hypothesis that a mediational

relationship is present between policy supporting family financial stability, child maltreatment prevalence, and child and adolescent suicidal behavior rates was not supported by the results of the current study. Significant interaction effects were noted between KTAP access and each of the county characteristics measured, likely indicating a potential attenuation of the impact of socioeconomic factors on child maltreatment when KTAP access is increased from the mean level. Similarly, in this analysis, there was no evidence that the prevalence of child maltreatment was associated with an increase in suicidal behavior in the pediatric population.

Specific Aim 1: To describe the association between state policies promoting economic stability, child maltreatment rates, and adolescent suicide rates over time.

Hypothesis 1: Higher generosity of state policies promoting economic stability is associated with lower rates of child maltreatment, and adolescent suicide over time.

The results of our study partially support our hypothesis from the first aim of the study that higher generosity of state policies promoting economic stability is associated with lower rates of child maltreatment and adolescent suicide rates over the study period. The presence of a generous state minimum wage, defined as higher than the federal minimum wage, was associated with lower suicide mortality rates. A refundable state earned income tax credit significantly lowered rates of child maltreatment. Similarly, the presence of a refundable state earned income tax credit significantly attenuated the impact of child maltreatment on suicidal mortality rates.

Specific Aim 2: To describe the longitudinal association between state-level child maltreatment rates and adolescent suicide rates over time.

Hypothesis 2: Lower state-level child maltreatment rates are associated with lower adolescent suicide rates over time.

There was only partial evidence to support the hypothesis from the second aim of the study that lower state-level child maltreatment rates are associated with lower state-level adolescent suicide rates over time. Higher child maltreatment rates were associated with lower probability of fewer than ten suicide deaths occurring. However, once that threshold had been reached, the association between child maltreatment rates and incidence of suicide mortality was non-significant.

Specific Aim 3: To assess the portion of the total effect of state policies on suicide rates that is due to child maltreatment rates over time.

Hypothesis 3: There is a significant indirect effect of state policies on adolescent suicide rates through child maltreatment rates over time.

The results of this study do not support the hypothesis from the third aim that there is a significant indirect effect of state policies on adolescent suicide rates through child maltreatment rates over time. No mediation by child maltreatment rates was found in this study, with the proportion of the total effect of policy on suicide mortality rates mediated through the child maltreatment rate ranging from 0.26% to 1.87%.

Specific Aim 4: Explore county-level characteristics as effect modifiers of the longitudinal relationships between state policies, county-level adolescent suicide attempt rates and county-level child maltreatment rates in the context of suicidal attempts that resulted in emergency visits in KY.

Hypothesis 4: County-level characteristics are significant effect modifiers of the longitudinal relationships between state policies, adolescent suicide attempt rates and child maltreatment rates in the context of suicidal attempts that resulted in emergency visits in KY.

The results of this study did not support the hypothesis from the fourth aim that significant associations exist in the longitudinal relationships between state policies, suicide attempt rates among children and child maltreatment rates. Additionally, no statistical interactions were present in models examining suicide attempt rates among children. Significant statistical interaction effects were only found between KTAP access and each of the county characteristics, such that higher access to KTAP, attenuated the positive association between child maltreatment and percent rurality, educational attainment and childcare access, and the negative association between child maltreatment prevalence and the unemployment rate.

Broader conclusions

This work presents, to the author's knowledge, a first attempt at investigating the mechanism by which state policies that address socioeconomic instability among families may work to decrease the rates of suicidal behavior and mortality, and test whether child maltreatment rates may be the mediating factor.

Strengths & Limitations

This study has many strengths, and the mixed study design allows for estimates of within group changes over time and between group variation. The national study across states over 15 years, captures macro-level socioeconomic exposures and assesses their

impact on maltreatment and suicide mortality among adolescents, difficult to assess in individual level studies. Similarly, focusing on aggregated data across Kentucky counties provides valuable insight into the complex relationships between policy, and child and adolescent suicidal behavior and maltreatment prevalence. The ecological design of these studies permits the exploration of several policy impacts on population level effects, focusing on smaller changes in population rates that may have large public health impact, in line with the National Institute of Mental Health's (NIMH) strategic plan.[94]

The ecological design of this study also has some limitations and while relationships can be ascertained at the state and county-level, no inference can be made at the individual child level. This study cannot ascertain whether a child living in a state that has increased level of economic support is more or less likely to experience child maltreatment or die by suicide. Similarly, this study cannot examine the exacerbating or protective factors that impact whether children and adolescents that experience child maltreatment exhibit suicidal behaviors or die by suicide, and such an analysis would require prospective, individual level protected health information. Similarly, a history of maltreatment is not present in all, or even most, children that die by suicide[54,55] and understanding the many underlying experiences that are present in suicidal behavior and mortality is important for individual level interventions and risk assessments. The clinical yield from currently available risk assessments meant to inform individual level interventions is very low, so much so that a recent analysis of individual risk assessments found a maximal positive predictive value of 5.5% for suicide death alone, and a maximal positive predictive value of 27.5% for self-harm alone.[2] Focusing on policy extends the

our reach to people and subgroups that are overlooked by individual level interventions and risk assessments.

This study also has several important limitations stemming from the rarity of adolescent suicide - states and counties that have too few adolescent suicides were excluded from the analysis when the value was suppressed by the CDC. Consequently, gender and race could not be included in the study because stratifying the counts by demographic characteristics would decrease the available data. The difficulty to stratify the results by race is a potential source of residual confounding, as disparities by both gender and race have been documented in both suicidal behavior and mortality[74] and child maltreatment reporting.[72,95] Further, suicidal behavior and child maltreatment may be differentially impacted by rurality and poverty related risk factors, and by extension policies that target these risk factors.[72,74] Relying on reports of child maltreatment is a significant limitation as it is higher in urban areas and communities with lower socioeconomic characteristics where child welfare system involvement is increased.[62,72] Coulton et al. disentangles child maltreatment behaviors, caused by environmental stressors and social support characteristics from self-selection into neighborhoods, and from child maltreatment reporting, which depends on definitions, recognition, and reporting processes, documenting that when studies focus on parental self-report measures of child maltreatment, the link with poverty becomes weaker.[62] Many incidents of child maltreatment occur in financially stable environments and go unreported due to a lower frequency of contact with authorities and other mandatory reporters.[62] The reliance on reported rates of child maltreatment also tends to underestimate its overall prevalence, along with inconsistency due to varying definitions of child maltreatment and mandatory

reporting laws between states, and resources allocated to Child Protective Services (CPS) for investigations. Consequently, NCANDS makes efforts to increase the reliability of reported child maltreatment by providing a coding scheme to state reporting agencies, attempting to standardize the maltreatment categories.

The data for this analysis ends in 2019, prior to school closures associated with the COVID-19 pandemic beginning in March 2020. The associated school closures had mixed effects on suicide,[74] with younger children experiencing a significant increase and adolescents 13-17 remaining stable. Similarly, increases differed by race, with Black youth experiencing an increase and White youth suicide remaining stable.[74] Medical injuries due to child maltreatment also declined,[91–93] along with reporting,[41,90] though possibly due to a decrease of interaction between abuse victims and mandatory reporters.[99] It is unknown if the relationships between policy, suicide and child maltreatment rates found in this analysis will be present in the period during or post pandemic. However, there is good reason to believe this is the case. For example, in a survey of youth between Jan 2021 and June 2021, both physical and emotional abuse were still significantly associated with increased suicidal behavior, along with parental job loss.[76,100]

Significant limitations also include the lack of county-level firearm ownership data. The availability of firearms is a significant risk factor in suicidal mortality.[48,54] However, the current work presents a novel approach to investigating how state policies may impact the state's suicidal behavior and mortality rates among children by decreasing the rate of child maltreatment through formal mediation analysis. Future work

may benefit from improved reporting of county-level child maltreatment and suicidal behavior with a focus on the differential impact of policy by race and gender.

Recommendations for further studies

This work has several implications for future studies. Firstly, there are significant differences in suicidal behavior and suicide mortality by gender, but further, there are significant differences in trends by age and race.[74] These should all be carefully investigated when studying these outcomes and the risk factors for suicidal behavior, such as suicidal ideation, should be disentangled from those of suicidal attempt, or suicide mortality. The current work presents an initial attempt at leveraging mediation analysis in understanding the complex relationship between family economic well-being, child maltreatment, and suicidal behavior and mortality. Though few inferences about mediational effects of child maltreatment rates can be made from this analysis, this may be an interesting area of focus for future county-level analysis outside of Kentucky and would benefit from additional suicide behavior data being made available for more states, similar to that provided in Kentucky by the Kentucky Cabinet for Health and Family Services. However, a longitudinal study at the individual level may provide stronger evidence for or against mediation, and a better understanding of the proposed relationship within individuals and subgroups. Obtaining the data is a major challenge to this work, as mandatory reporting laws disqualify many questions in reference to child maltreatment, and suicide mortality is not often preceded with a survey nor are family demographics and circumstances made publicly available, leaving a very limited sample for studying these effects. In order to understand the relationship between socioeconomic policy and its impact on history of child maltreatment, and later suicide mortality, future work may

utilize restricted mortality data linked to survey data where a history of child maltreatment was disclosed, such as the Behavioral Risk Factor Surveillance System (BRFSS). Similarly, restricted data can be used to link the National Violent Death Reporting System (NVDRS) to state maltreatment reporting data to examine the history among children and adolescents that have died by suicide. Understanding the complex relationships between socioeconomic instability, child maltreatment, and suicidal behavior and mortality relies on improving reporting and data systems, though the enforcement of privacy is a primary concern.

Public health significance and policy implications

While limited in its ability to disentangle the complex risk factors and associations surrounding socioeconomic instability and child maltreatment that are involved in suicide behavior and mortality outcomes among children and adolescents, this study posits that a macro level intervention, may have a larger public health impact than individually targeted interventions. A well-established link between socioeconomic insecurity and negative health outcomes has been documented across time and populations, and ultimately relieving socioeconomic instability across the whole population may increase the overall quality of life across multiple domains. Adults that grew up in socioeconomically unstable environments are more likely to themselves have experienced more adverse childhood events (ACEs).[107] These adverse experiences have been linked to many negative health outcomes,[8,33,108,109] including substance abuse, criminality, poorer physical and mental health, and poverty, which are in turn risk factors associated with maltreatment of children.[110,111]

Much of youth suicide prevention has focused on individual level interventions however, individual level risk assessments that inform much of resource allocation for interventions at the individual level struggle with low clinical accuracy.[2] Targeting an improvement in outcomes like suicidal behavior and child maltreatment may consist of caregiver support, such as accessible high-quality childcare, and generous unemployment benefits to ameliorate the stress of job loss. Similarly, public health campaigns may increase awareness of suicide mortality and decrease stigma surrounding mental healthcare.

However, strengthening policies that promote economic stability among families has the potential to impact both child maltreatment and suicidal mortality at the population level, acting as a primordial prevention strategy, reaching subpopulations that may be overlooked by costly individual level interventions.[13,23] For example, a higher federal minimum wage, and a federal eligibility standard could be enacted for TANF and SNAP, so that access to benefits and higher wages are more equitable across states. State governments can work to remove or weaken barriers to accessing assistance such as job search requirements, time limits, sanctions, asset tests, and can increase income thresholds so that more families can benefit from support. This study found wide variations across states for TANF-Poverty ratio, the SNAP Program Access Index, a generous minimum wage, and whether a refundable state Earned Income Tax Credit was present. State governments aiming to decrease expenditures by reducing economic benefits and weakening policies that support socioeconomic stability in the population may be failing to take advantage of the upstream prevention benefits for many well-established public health risks, in turn requiring increased spending on costly, and

sometimes less effective, interventions targeted at individual outcomes that are in part downstream effects of economic insecurity. It may be that shifting the focus to a population level decrease in suicidal behavior and mortality among children and adolescents, in addition to effective individual level supports may be a positive strategy toward overall population health.

TABLES

Table 1. Increase in adolescent suicide rate by policy and child maltreatment among states with at least ten suicide deaths per year

	IRR (95%CI)*	**IRR (95%CI)****	**IRR (95%CI)*****
Total Observations	N=740	N=740	N=714
Log Child Maltreatment Rate	1.037 (0.962, 1.117)	1.012 (0.938, 1.092)	1.012 (0.938, 1.092)
Refundable State EITC	0.950 (0.899, 1.003)	0.966 (0.914, 1.022)	0.963 (0.910, 1.018)
SNAP Program Access Index	1.000 (0.998, 1.002)	1.000 (0.998, 1.002)	1.001 (0.999, 1.003)
TANF-Poverty Ratio	**0.998 (0.996, 1.000)**	0.998 (0.996, 1.000)	0.999 (0.997, 1.001)
State Min Wage > Federal Min Wage	**0.936 (0.895, 0.979)**	**0.937 (0.896, 0.981)**	**0.946 (0.903, 0.990)**
Poverty Rate			0.989 (0.979, 1.000)
Mental Health Providers per 1,000			0.950 (0.894, 1.009)
Household Firearm Rate			1.009 (1.003, 1.015)

*Estimates from bivariate (crude) models, separately assessing child maltreatment and each policy adjusted for state and year random effects (n=740); ** Including all four state policies, and adjusting for state and year random effects (n=740); *** Including all four state policies, and adjusting for poverty rate, household firearm rate, mental healthcare access and, state and year random effects (n=714); Bold values indicate statistically significant estimates at $p<0.05$

Table 2. Policies and state characteristics associated with the natural log of child maltreatment rate

	β Est. (95%CI)*	**β Est. (95%CI)****	**β Est. (95%CI)*****
Total Observations	N=740	N=740	N=725
TANF-Poverty Ratio	-0.001 (-0.002, 0.001)	-0.001 (-0.002, 0.001)	-0.001 (-0.003, 0.001)
State Min Wage > Federal Min Wage	-0.031 (-0.076, 0.014)	-0.028 (-0.073, 0.017)	-0.028 (-0.073, 0.017)
Refundable State EITC	**-0.092 (-0.155, -0.029)**	**-0.081 (-0.145, -0.018)**	**-0.093 (-0.156, -0.029)**
SNAP Program Access Index	**-0.002 (-0.004, 0.000)**	**-0.002 (-0.004, 0.000)**	-0.001 (-0.003, 0.000)
Unemployment Rate	--	--	**-0.029 (-0.045, -0.012)**
Adults with Bachelor's Degree	--	--	0.005 (-0.010, 0.019)
Poverty Rate	--	--	0.004 (-0.007, 0.014)

*Estimates from bivariate (crude) models, separately assessing each policy adjusted for state and year random effects (n=740); **Including all four state policies, and adjusting for state and year random effects (n=740); ***Including all four state policies, and adjusting for poverty rate, unemployment rate, educational attainment and state and year random effects (n=725); Bold values indicate statistically significant estimates at $p<0.05$

Table 3. Proportion of policy impact mediated by child maltreatment rates when at least ten deaths occurred in a year

	Refundable State EITC	**TANF-Poverty Ratio**	**SNAP Program Access Index**	**State Min. Wage > Federal Min. Wage**
Total Observtions (N)	644	644	644	644
Total Effect	-1.82E-06	-1.08E-07	-1.61E-08	**-4.92E-06**
Direct Effect	-1.77E-06	-1.07E-07	-1.37E-08	**-4.89E-06**
Indirect Effect	-5.28E-08	-1.08E-09	-2.44E-09	-3.17E-08
Proportion Mediated	0.0147	0.0026	0.0187	0.0043

Bold values indicate statistically significant estimates at $p<0.05$

Table 4. Effect modification of the association between child maltreatment rates and suicide mortality by policy

	Incidence Rate Ratio (95%CI)	**p-value**
Total Observations	N=714	
Main effect of Log Child Maltreatment Rate	1.058 (0.965, 1.161)	0.227
Main effect of Refundable State EITC	**0.638 (0.429, 0.947)**	**0.026**
Interaction of Log Child Maltreatment Rate and Refundable State EITC	**0.887 (0.791, 0.994)**	**0.040**
Main effect of SNAP Program Access Index	1.001 (0.996, 1.014)	0.293
Interaction of Log Child Maltreatment Rate and SNAP Program Access Index	1.001 (0.999, 1.003)	0.44
Main effect of TANF-Poverty Ratio	0.991 (0.981, 1.002)	0.125
Interaction of Log Child Maltreatment Rate and TANF-Poverty Ratio	0.998 (0.995, 1.001)	0.194
Main effect of State Min Wage > Federal Min Wage	0.791 (0.623, 1.005)	0.055
Interaction of Log Child Maltreatment Rate and State Min Wage > Federal Min Wage	0.951 (0.890, 1.017)	0.139
Mental Health Providers per 1,000	0.951 (0.895, 1.010)	0.101
Household Firearm Rate	**1.010 (1.003, 1.015)**	**0.002**
Poverty Rate	**0.989 (0.979, 1.000)**	**0.042**

Including all four state policies and interaction with child maltreatment, and adjusting for poverty rate, household firearm rate, mental healthcare access and state and year random effects (n=714); Bold values indicate statistically significant estimates at $p<0.05$

Table 5. Child maltreatment, access to benefits and socioeconomic characteristics associated with the prevalence of adolescent suicidal behavior rates

	IRR (95%CI)*	**IRR (95%CI)****	**IRR (95%CI)*****
Total Observations	N=1067	N=1067	N=1067
Main effect of Log of Child Maltreatment Prevalence	1.016 (0.961, 1.074)	1.015 (0.960, 1.074)	1.026 (0.966, 1.090)
Main effect of KTAP Access	1.000 (0.992, 1.007)	1.000 (0.991, 1.008)	1.007 (0.986, 1.028)
Interaction of KTAP access and Log of Child Maltreatment Prevalence			1.004 (0.993, 1.015)
Main effect of SNAP Access	1.000 (0.998, 1.002)	1.000 (0.998, 1.002)	1.000 (0.995, 1.005)
Interaction of SNAP access and Log of Child Maltreatment Prevalence			1.000 (0.998, 1.002)
Main effect of Mental Healthcare Access	1.001 (0.999, 1.002)	1.000 (0.998, 1.002)	1.000 (0.998, 1.002)
Main effect of Poverty Rate	0.997 (0.992, 1.002)	0.999 (0.993, 1.006)	0.999 (0.992, 1.006)
Main effect of Percent Rurality	**0.998 (0.996, 1.000)**	**0.998 (0.995, 1.000)**	**0.998 (0.995, 1.000)**

*Estimates from bivariate (crude) models, separately assessing child maltreatment prevalence, access to economic support and socioeconomic characteristic adjusted for county and year random effects (n=1067); **Including child maltreatment prevalence, access to economic support and socioeconomic characteristic adjusted for county and year random effects (n=1067); *** Including child maltreatment prevalence, access to economic support and socioeconomic characteristic and interaction between KTAP access and socioeconomic characteristics and, county and year random effects (n=1067); Bold values indicate statistically significant estimates at $p<0.05$

Table 6. Access to benefits and socioeconomic characteristics associated with the natural log of child maltreatment prevalence

	β Est. (95%CI)*	**β Est. (95%CI)****	**β Est. (95%CI)*****
Total Observations	N=1075	N=967	N=967
Main effect of SNAP Access	0.000 (-0.002, 0.003)	0.001 (-0.002, 0.005)	0.003 (-0.001, 0.007)
Main effect of KTAP Access	0.008 (-0.003, 0.019)	0.010 (-0.004, 0.024)	0.002 (-0.014, 0.017)
Main effect of Unemployment Rate	0.017 (-0.01, 0.044)	0.008 (-0.023, 0.039)	-0.012 (-0.043, 0.019)
Interaction of KTAP access and the Unemployment Rate			**0.005 (0.002, 0.007)**
Main effect of Educational Attainment	0.010 (-0.005, 0.024)	**0.025 (0.004, 0.047)**	**0.024 (0.002, 0.045)**
Interaction of KTAP access and Educational Attainment			**-0.004 (-0.006, -0.001)**
Main effect of Poverty Rate	**0.010 (0.000, 0.020)**	**0.018 (0.004, 0.032)**	**0.025 (0.011, 0.039)**
Interaction of KTAP access and the Poverty Rate			**0.001 (0.000, 0.002)**
Main effect of Childcare Access	**0.009 (0.002, 0.016)**	**0.008 (0.001, 0.015)**	0.006 (-0.001, 0.013)
Interaction of KTAP Access and Childcare Access			-0.001 (-0.002, 0.000)
Main effect of Percent Rurality	0.001 (-0.003, 0.005)	0.002 (-0.004, 0.008)	0.001 (-0.005, 0.008)
Interaction of KTAP access and Percent Rurality			**-0.001 (-0.002, -0.001)**

*Estimates from bivariate (crude) models, separately assessing access to economic support and socioeconomic characteristic adjusted for county and year random effects (n=1075); **Including all access to economic support and socioeconomic characteristics adjusted for county and year random effects (n=967); *** Including all access to economic support and socioeconomic characteristics with interaction between KTAP access and socioeconomic characteristics and, county and year random effects (n=967); Bold values indicate statistically significant estimates at $p<0.05$

Table 7. Proportion of benefit access impact on suicidal behavior mediated by child maltreatment rates

	SNAP Access	KTAP Access
Total Observations (N)	971	971
Total Effect	-1.55E-06	2.28E-06
Direct Effect	-1.72E-06	4.34E-06
Indirect Effect	1.73E-07	-2.06E-06
Proportion Mediated	0.00131	0.0036

Supplemental Table 1. Summary of data sources and years of availability

Data Source	Description	Years Available
NCANDS	Child level maltreatment reports	1999-2020
HFSD	KY inpatient and emergency department discharge records - aggregated	2000-2020
CDC WONDER	Suicide rates by county, state, and year	1999-2020
The Center for Poverty Research at UK	National Welfare Data by state and year, including Unemployment, SNAP, Food Insecurity, EITC, TANF, Poverty, Minimum Wage	1980-2020
USDA	SNAP policy index based on eligibility, stigma, outreach, and transaction costs	1996-2014
The Annie E. Casey Foundation's KIDS COUNT data center	County and state level economic and sociodemographic characteristics, child maltreatment prevalence	2010-2019
RAND Corporation	State-Level Estimates of Household Firearm Ownership	1980-2016
US Census	State and county level percent of children in households below poverty level, and educational attainment at household level	2000, 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019
US Bureau of Labor Statistics	Occupational Employment and Wage Statistics database – mental health professionals	1997-2020
National Institute for Early Education Research (NIEER)	State and year level percent of population enrolled in state-funded preschools, taken from the State of Preschool Yearbook	2001-2020

Supplemental Table 2. Summary of ICD-10-CM and External Cause Codes defining records with suicidal behavior

ICD-10-CM Code	***ICD-10-CM Code Definition***
R45851	Suicidal ideations
T1491	Suicide attempt
T1491XA	Suicide attempt, initial encounter
T360X2A	Poisoning by penicillins, intentional self-harm, initial encounter
T361X2A	Poisoning by cephalosporins and other beta-lactam antibiotics, intentional self-harm, initial encounter
T362X2A	Poisoning by chloramphenicol group, intentional self-harm, initial encounter
T363X2A	Poisoning by macrolides, intentional self-harm, initial encounter
T364X2A	Poisoning by tetracyclines, intentional self-harm, initial encounter
T365X2A	Poisoning by aminoglycosides, intentional self-harm, initial encounter
T366X2A	Poisoning by rifampicins, intentional self-harm, initial encounter
T367X2A	Poisoning by antifungal antibiotics, systemically used, intentional self-harm, initial encounter
T368X2A	Poisoning by other systemic antibiotics, intentional self-harm, initial encounter
T3692XA	Poisoning by unspecified systemic antibiotic, intentional self-harm, initial encounter
T370X2A	Poisoning by sulfonamides, intentional self-harm, initial encounter
T371X2A	Poisoning by antimycobacterial drugs, intentional self-harm, initial encounter
T372X2A	Poisoning by antimalarials and drugs acting on other blood protozoa, intentional self-harm, initial encounter
T373X2A	Poisoning by other antiprotozoal drugs, intentional self-harm, initial encounter
T374X2A	Poisoning by anthelminthics, intentional self-harm, initial encounter
T375X2A	Poisoning by antiviral drugs, intentional self-harm, initial encounter
T378X2A	Poisoning by other specified systemic anti-infectives and antiparasitics, intentional self-harm, initial encounter
T3792XA	Poisoning by unspecified systemic anti-infective and antiparasitics, intentional self-harm, initial encounter
T380X2A	Poisoning by glucocorticoids and synthetic analogues, intentional self-harm, initial encounter
T381X2A	Poisoning by thyroid hormones and substitutes, intentional self-harm, initial encounter
T382X2A	Poisoning by antithyroid drugs, intentional self-harm, initial encounter
T383X2A	Poisoning by insulin and oral hypoglycemic [antidiabetic] drugs, intentional self-harm, initial encounter
T384X2A	Poisoning by oral contraceptives, intentional self-harm, initial encounter
T385X2A	Poisoning by other estrogens and progestogens, intentional self-harm, initial encounter

T386X2A	Poisoning by antigonadotrophins, antiestrogens, antiandrogens, not elsewhere classified, intentional self-harm, initial encounter
T387X2A	Poisoning by androgens and anabolic congeners, intentional self-harm, initial encounter
T38802A	Poisoning by unspecified hormones and synthetic substitutes, intentional self-harm, initial encounter
T38812A	Poisoning by anterior pituitary [adenohypophyseal] hormones, intentional self-harm, initial encounter
T38892A	Poisoning by other hormones and synthetic substitutes, intentional self-harm, initial encounter
T38902A	Poisoning by unspecified hormone antagonists, intentional self-harm, initial encounter
T38992A	Poisoning by other hormone antagonists, intentional self-harm, initial encounter
T39012A	Poisoning by aspirin, intentional self-harm, initial encounter
T39092A	Poisoning by salicylates, intentional self-harm, initial encounter
T391X2A	Poisoning by 4-Aminophenol derivatives, intentional self-harm, initial encounter
T392X2A	Poisoning by pyrazolone derivatives, intentional self-harm, initial encounter
T39312A	Poisoning by propionic acid derivatives, intentional self-harm, initial encounter
T39392A	Poisoning by other nonsteroidal anti-inflammatory drugs [NSAID], intentional self-harm, initial encounter
T394X2A	Poisoning by antirheumatics, not elsewhere classified, intentional self-harm, initial encounter
T398X2A	Poisoning by other nonopioid analgesics and antipyretics, not elsewhere classified, intentional self-harm, initial encounter
T3992XA	Poisoning by unspecified nonopioid analgesic, antipyretic and antirheumatic, intentional self-harm, initial encounter
T400X2A	Poisoning by opium, intentional self-harm, initial encounter
T401X2A	Poisoning by heroin, intentional self-harm, initial encounter
T402X2A	Poisoning by other opioids, intentional self-harm, initial encounter
T403X2A	Poisoning by methadone, intentional self-harm, initial encounter
T404X2A	Poisoning by other synthetic narcotics, intentional self-harm, initial encounter
T405X2A	Poisoning by cocaine, intentional self-harm, initial encounter
T40602A	Poisoning by unspecified narcotics, intentional self-harm, initial encounter
T40692A	Poisoning by other narcotics, intentional self-harm, initial encounter
T407X2A	Poisoning by cannabis (derivatives), intentional self-harm, initial encounter
T408X2A	Poisoning by lysergide [LSD], intentional self-harm, initial encounter
T40902A	Poisoning by unspecified psychodysleptics [hallucinogens], intentional self-harm, initial encounter
T40992A	Poisoning by other psychodysleptics [hallucinogens], intentional self-harm, initial encounter
T410X2A	Poisoning by inhaled anesthetics, intentional self-harm, initial encounter

T411X2A	Poisoning by intravenous anesthetics, intentional self-harm, initial encounter
T41202A	Poisoning by unspecified general anesthetics, intentional self-harm, initial encounter
T41292A	Poisoning by other general anesthetics, intentional self-harm, initial encounter
T413X2A	Poisoning by local anesthetics, intentional self-harm, initial encounter
T4142XA	Poisoning by unspecified anesthetic, intentional self-harm, initial encounter
T415X2A	Poisoning by therapeutic gases, intentional self-harm, initial encounter
T420X2A	Poisoning by hydantoin derivatives, intentional self-harm, initial encounter
T421X2A	Poisoning by iminostilbenes, intentional self-harm, initial encounter
T422X2A	Poisoning by succinimides and oxazolidinediones, intentional self-harm, initial encounter
T423X2A	Poisoning by barbiturates, intentional self-harm, initial encounter
T424X2A	Poisoning by benzodiazepines, intentional self-harm, initial encounter
T425X2A	Poisoning by mixed antiepileptics, intentional self-harm, initial encounter
T426X2A	Poisoning by other antiepileptic and sedative-hypnotic drugs, intentional self-harm, initial encounter
T4272XA	Poisoning by unspecified antiepileptic and sedative-hypnotic drugs, intentional self-harm, initial encounter
T428X2A	Poisoning by antiparkinsonism drugs and other central muscle-tone depressants, intentional self-harm, initial encounter
T43012A	Poisoning by tricyclic antidepressants, intentional self-harm, initial encounter
T43022A	Poisoning by tetracyclic antidepressants, intentional self-harm, initial encounter
T431X2A	Poisoning by monoamine-oxidase-inhibitor antidepressants, intentional self-harm, initial encounter
T43202A	Poisoning by unspecified antidepressants, intentional self-harm, initial encounter
T43212A	Poisoning by selective serotonin and norepinephrine reuptake inhibitors, intentional self-harm, initial encounter
T43222A	Poisoning by selective serotonin reuptake inhibitors, intentional self-harm, initial encounter
T43292A	Poisoning by other antidepressants, intentional self-harm, initial encounter
T433X2A	Poisoning by phenothiazine antipsychotics and neuroleptics, intentional self-harm, initial encounter
T434X2A	Poisoning by butyrophenone and thiothixene neuroleptics, intentional self-harm, initial encounter
T43502A	Poisoning by unspecified antipsychotics and neuroleptics, intentional self-harm, initial encounter
T43592A	Poisoning by other antipsychotics and neuroleptics, intentional self-harm, initial encounter
T43602A	Poisoning by unspecified psychostimulants, intentional self-harm, initial encounter
T43612A	Poisoning by caffeine, intentional self-harm, initial encounter

T43622A	Poisoning by amphetamines, intentional self-harm, initial encounter
T43632A	Poisoning by methylphenidate, intentional self-harm, initial encounter
T43692A	Poisoning by other psychostimulants, intentional self-harm, initial encounter
T438X2A	Poisoning by other psychotropic drugs, intentional self-harm, initial encounter
T4392XA	Poisoning by unspecified psychotropic drug, intentional self-harm, initial encounter
T440X2A	Poisoning by anticholinesterase agents, intentional self-harm, initial encounter
T441X2A	Poisoning by other parasympathomimetics [cholinergics], intentional self-harm, initial encounter
T442X2A	Poisoning by ganglionic blocking drugs, intentional self-harm, initial encounter
T443X2A	Poisoning by other parasympatholytics [anticholinergics and antimuscarinics] and spasmolytics, intentional self-harm, initial encounter
T444X2A	Poisoning by predominantly alpha-adrenoreceptor agonists, intentional self-harm, initial encounter
T445X2A	Poisoning by predominantly beta-adrenoreceptor agonists, intentional self-harm, initial encounter
T446X2A	Poisoning by alpha-adrenoreceptor antagonists, intentional self-harm, initial encounter
T447X2A	Poisoning by beta-adrenoreceptor antagonists, intentional self-harm, initial encounter
T448X2A	Poisoning by centrally-acting and adrenergic-neuron-blocking agents, intentional self-harm, initial encounter
T44902A	Poisoning by unspecified drugs primarily affecting the autonomic nervous system, intentional self-harm, initial encounter
T44992A	Poisoning by other drug primarily affecting the autonomic nervous system, intentional self-harm, initial encounter
T450X2A	Poisoning by antiallergic and antiemetic drugs, intentional self-harm, initial encounter
T451X2A	Poisoning by antineoplastic and immunosuppressive drugs, intentional self-harm, initial encounter
T452X2A	Poisoning by vitamins, intentional self-harm, initial encounter
T453X2A	Poisoning by enzymes, intentional self-harm, initial encounter
T454X2A	Poisoning by iron and its compounds, intentional self-harm, initial encounter
T45512A	Poisoning by anticoagulants, intentional self-harm, initial encounter
T45522A	Poisoning by antithrombotic drugs, intentional self-harm, initial encounter
T45602A	Poisoning by unspecified fibrinolysis-affecting drugs, intentional self-harm, initial encounter
T45612A	Poisoning by thrombolytic drug, intentional self-harm, initial encounter
T45622A	Poisoning by hemostatic drug, intentional self-harm, initial encounter
T45692A	Poisoning by other fibrinolysis-affecting drugs, intentional self-harm, initial encounter

T457X2A	Poisoning by anticoagulant antagonists, vitamin K and other coagulants, intentional self-harm, initial encounter
T458X2A	Poisoning by other primarily systemic and hematological agents, intentional self-harm, initial encounter
T4592XA	Poisoning by unspecified primarily systemic and hematological agent, intentional self-harm, initial encounter
T460X2A	Poisoning by cardiac-stimulant glycosides and drugs of similar action, intentional self-harm, initial encounter
T461X2A	Poisoning by calcium-channel blockers, intentional self-harm, initial encounter
T462X2A	Poisoning by other antidysrhythmic drugs, intentional self-harm, initial encounter
T463X2A	Poisoning by coronary vasodilators, intentional self-harm, initial encounter
T464X2A	Poisoning by angiotensin-converting-enzyme inhibitors, intentional self-harm, initial encounter
T465X2A	Poisoning by other antihypertensive drugs, intentional self-harm, initial encounter
T466X2A	Poisoning by antihyperlipidemic and antiarteriosclerotic drugs, intentional self-harm, initial encounter
T467X2A	Poisoning by peripheral vasodilators, intentional self-harm, initial encounter
T468X2A	Poisoning by antivaricose drugs, including sclerosing agents, intentional self-harm, initial encounter
T46902A	Poisoning by unspecified agents primarily affecting the cardiovascular system, intentional self-harm, initial encounter
T46992A	Poisoning by other agents primarily affecting the cardiovascular system, intentional self-harm, initial encounter
T470X2A	Poisoning by histamine H2-receptor blockers, intentional self-harm, initial encounter
T471X2A	Poisoning by other antacids and anti-gastric-secretion drugs, intentional self-harm, initial encounter
T472X2A	Poisoning by stimulant laxatives, intentional self-harm, initial encounter
T473X2A	Poisoning by saline and osmotic laxatives, intentional self-harm, initial encounter
T474X2A	Poisoning by other laxatives, intentional self-harm, initial encounter
T475X2A	Poisoning by digestants, intentional self-harm, initial encounter
T476X2A	Poisoning by antidiarrheal drugs, intentional self-harm, initial encounter
T477X2A	Poisoning by emetics, intentional self-harm, initial encounter
T478X2A	Poisoning by other agents primarily affecting gastrointestinal system, intentional self-harm, initial encounter
T4792XA	Poisoning by unspecified agents primarily affecting the gastrointestinal system, intentional self-harm, initial encounter
T480X2A	Poisoning by oxytocic drugs, intentional self-harm, initial encounter
T481X2A	Poisoning by skeletal muscle relaxants [neuromuscular blocking agents], intentional self-harm, initial encounter
T48202A	Poisoning by unspecified drugs acting on muscles, intentional self-harm, initial encounter
T48292A	Poisoning by other drugs acting on muscles, intentional self-harm, initial encounter

T483X2A	Poisoning by antitussives, intentional self-harm, initial encounter
T484X2A	Poisoning by expectorants, intentional self-harm, initial encounter
T485X2A	Poisoning by other anti-common-cold drugs, intentional self-harm, initial encounter
T486X2A	Poisoning by antiasthmatics, intentional self-harm, initial encounter
T48902A	Poisoning by unspecified agents primarily acting on the respiratory system, intentional self-harm, initial encounter
T48992A	Poisoning by other agents primarily acting on the respiratory system, intentional self-harm, initial encounter
T490X2A	Poisoning by local antifungal, anti-infective and anti-inflammatory drugs, intentional self-harm, initial encounter
T491X2A	Poisoning by antipruritics, intentional self-harm, initial encounter
T492X2A	Poisoning by local astringents and local detergents, intentional self-harm, initial encounter
T493X2A	Poisoning by emollients, demulcents and protectants, intentional self-harm, initial encounter
T494X2A	Poisoning by keratolytics, keratoplastics, and other hair treatment drugs and preparations, intentional self-harm, initial encounter
T495X2A	Poisoning by ophthalmological drugs and preparations, intentional self-harm, initial encounter
T496X2A	Poisoning by otorhinolaryngological drugs and preparations, intentional self-harm, initial encounter
T497X2A	Poisoning by dental drugs, topically applied, intentional self-harm, initial encounter
T498X2A	Poisoning by other topical agents, intentional self-harm, initial encounter
T4992XA	Poisoning by unspecified topical agent, intentional self-harm, initial encounter
T500X2A	Poisoning by mineralocorticoids and their antagonists, intentional self-harm, initial encounter
T501X2A	Poisoning by loop [high-ceiling] diuretics, intentional self-harm, initial encounter
T502X2A	Poisoning by carbonic-anhydrase inhibitors, benzothiadiazides and other diuretics, intentional self-harm, initial encounter
T503X2A	Poisoning by electrolytic, caloric and water-balance agents, intentional self-harm, initial encounter
T504X2A	Poisoning by drugs affecting uric acid metabolism, intentional self-harm, initial encounter
T505X2A	Poisoning by appetite depressants, intentional self-harm, initial encounter
T506X2A	Poisoning by antidotes and chelating agents, intentional self-harm, initial encounter
T507X2A	Poisoning by analeptics and opioid receptor antagonists, intentional self-harm, initial encounter
T508X2A	Poisoning by diagnostic agents, intentional self-harm, initial encounter
T50902A	Poisoning by unspecified drugs, medicaments and biological substances, intentional self-harm, initial encounter
T50992A	Poisoning by other drugs, medicaments and biological substances, intentional self-harm, initial encounter
T50A12A	Poisoning by pertussis vaccine, including combinations with a pertussis component, intentional self-harm, initial encounter

T50A22A	Poisoning by mixed bacterial vaccines without a pertussis component, intentional self-harm, initial encounter
T50A92A	Poisoning by other bacterial vaccines, intentional self-harm, initial encounter
T50B12A	Poisoning by smallpox vaccines, intentional self-harm, initial encounter
T50B92A	Poisoning by other viral vaccines, intentional self-harm, initial encounter
T50Z12A	Poisoning by immunoglobulin, intentional self-harm, initial encounter
T50Z92A	Poisoning by other vaccines and biological substances, intentional self-harm, initial encounter
T510X2A	Toxic effect of ethanol, intentional self-harm, initial encounter
T511X2A	Toxic effect of methanol, intentional self-harm, initial encounter
T512X2A	Toxic effect of 2-Propanol, intentional self-harm, initial encounter
T513X2A	Toxic effect of fusel oil, intentional self-harm, initial encounter
T518X2A	Toxic effect of other alcohols, intentional self-harm, initial encounter
T5192XA	Toxic effect of unspecified alcohol, intentional self-harm, initial encounter
T520X2A	Toxic effect of petroleum products, intentional self-harm, initial encounter
T521X2A	Toxic effect of benzene, intentional self-harm, initial encounter
T522X2A	Toxic effect of homologues of benzene, intentional self-harm, initial encounter
T523X2A	Toxic effect of glycols, intentional self-harm, initial encounter
T524X2A	Toxic effect of ketones, intentional self-harm, initial encounter
T528X2A	Toxic effect of other organic solvents, intentional self-harm, initial encounter
T5292XA	Toxic effect of unspecified organic solvent, intentional self-harm, initial encounter
T530X2A	Toxic effect of carbon tetrachloride, intentional self-harm, initial encounter
T531X2A	Toxic effect of chloroform, intentional self-harm, initial encounter
T532X2A	Toxic effect of trichloroethylene, intentional self-harm, initial encounter
T533X2A	Toxic effect of tetrachloroethylene, intentional self-harm, initial encounter
T534X2A	Toxic effect of dichloromethane, intentional self-harm, initial encounter
T535X2A	Toxic effect of chlorofluorocarbons, intentional self-harm, initial encounter
T536X2A	Toxic effect of other halogen derivatives of aliphatic hydrocarbons, intentional self-harm, initial encounter
T537X2A	Toxic effect of other halogen derivatives of aromatic hydrocarbons, intentional self-harm, initial encounter
T5392XA	Toxic effect of unspecified halogen derivatives of aliphatic and aromatic hydrocarbons, intentional self-harm, initial encounter
T540X2A	Toxic effect of phenol and phenol homologues, intentional self-harm, initial encounter

T541X2A	Toxic effect of other corrosive organic compounds, intentional self-harm, initial encounter
T542X2A	Toxic effect of corrosive acids and acid-like substances, intentional self-harm, initial encounter
T543X2A	Toxic effect of corrosive alkalis and alkali-like substances, intentional self-harm, initial encounter
T5492XA	Toxic effect of unspecified corrosive substance, intentional self-harm, initial encounter
T550X2A	Toxic effect of soaps, intentional self-harm, initial encounter
T551X2A	Toxic effect of detergents, intentional self-harm, initial encounter
T560X2A	Toxic effect of lead and its compounds, intentional self-harm, initial encounter
T561X2A	Toxic effect of mercury and its compounds, intentional self-harm, initial encounter
T562X2A	Toxic effect of chromium and its compounds, intentional self-harm, initial encounter
T563X2A	Toxic effect of cadmium and its compounds, intentional self-harm, initial encounter
T564X2A	Toxic effect of copper and its compounds, intentional self-harm, initial encounter
T565X2A	Toxic effect of zinc and its compounds, intentional self-harm, initial encounter
T566X2A	Toxic effect of tin and its compounds, intentional self-harm, initial encounter
T567X2A	Toxic effect of beryllium and its compounds, intentional self-harm, initial encounter
T56812A	Toxic effect of thallium, intentional self-harm, initial encounter
T56892A	Toxic effect of other metals, intentional self-harm, initial encounter
T5692XA	Toxic effect of unspecified metal, intentional self-harm, initial encounter
T570X2A	Toxic effect of arsenic and its compounds, intentional self-harm, initial encounter
T571X2A	Toxic effect of phosphorus and its compounds, intentional self-harm, initial encounter
T572X2A	Toxic effect of manganese and its compounds, intentional self-harm, initial encounter
T573X2A	Toxic effect of hydrogen cyanide, intentional self-harm, initial encounter
T578X2A	Toxic effect of other specified inorganic substances, intentional self-harm, initial encounter
T5792XA	Toxic effect of unspecified inorganic substance, intentional self-harm, initial encounter
T5802XA	Toxic effect of carbon monoxide from motor vehicle exhaust, intentional self-harm, initial encounter
T5812XA	Toxic effect of carbon monoxide from utility gas, intentional self-harm, initial encounter
T582X2A	Toxic effect of carbon monoxide from incomplete combustion of other domestic fuels, intentional self-harm, initial encounter
T588X2A	Toxic effect of carbon monoxide from other source, intentional self-harm, initial encounter
T5892XA	Toxic effect of carbon monoxide from unspecified source, intentional self-harm, initial encounter

T590X2A	Toxic effect of nitrogen oxides, intentional self-harm, initial encounter
T591X2A	Toxic effect of sulfur dioxide, intentional self-harm, initial encounter
T592X2A	Toxic effect of formaldehyde, intentional self-harm, initial encounter
T593X2A	Toxic effect of lacrimogenic gas, intentional self-harm, initial encounter
T594X2A	Toxic effect of chlorine gas, intentional self-harm, initial encounter
T595X2A	Toxic effect of fluorine gas and hydrogen fluoride, intentional self-harm, initial encounter
T596X2A	Toxic effect of hydrogen sulfide, intentional self-harm, initial encounter
T597X2A	Toxic effect of carbon dioxide, intentional self-harm, initial encounter
T59812A	Toxic effect of smoke, intentional self-harm, initial encounter
T59892A	Toxic effect of other specified gases, fumes and vapors, intentional self-harm, initial encounter
T5992XA	Toxic effect of unspecified gases, fumes and vapors, intentional self-harm, initial encounter
T600X2A	Toxic effect of organophosphate and carbamate insecticides, intentional self-harm, initial encounter
T601X2A	Toxic effect of halogenated insecticides, intentional self-harm, initial encounter
T602X2A	Toxic effect of other insecticides, intentional self-harm, initial encounter
T603X2A	Toxic effect of herbicides and fungicides, intentional self-harm, initial encounter
T604X2A	Toxic effect of rodenticides, intentional self-harm, initial encounter
T608X2A	Toxic effect of other pesticides, intentional self-harm, initial encounter
T6092XA	Toxic effect of unspecified pesticide, intentional self-harm, initial encounter
T6102XA	Ciguatera fish poisoning, intentional self-harm, initial encounter
T6112XA	Scombroid fish poisoning, intentional self-harm, initial encounter
T61772A	Other fish poisoning, intentional self-harm, initial encounter
T61782A	Other shellfish poisoning, intentional self-harm, initial encounter
T618X2A	Toxic effect of other seafood, intentional self-harm, initial encounter
T6192XA	Toxic effect of unspecified seafood, intentional self-harm, initial encounter
T620X2A	Toxic effect of ingested mushrooms, intentional self-harm, initial encounter
T621X2A	Toxic effect of ingested berries, intentional self-harm, initial encounter
T622X2A	Toxic effect of other ingested (parts of) plant(s), intentional self-harm, initial encounter
T628X2A	Toxic effect of other specified noxious substances eaten as food, intentional self-harm, initial encounter
T6292XA	Toxic effect of unspecified noxious substance eaten as food, intentional self-harm, initial encounter

T63002A	Toxic effect of unspecified snake venom, intentional self-harm, initial encounter
T63012A	Toxic effect of rattlesnake venom, intentional self-harm, initial encounter
T63022A	Toxic effect of coral snake venom, intentional self-harm, initial encounter
T63032A	Toxic effect of taipan venom, intentional self-harm, initial encounter
T63042A	Toxic effect of cobra venom, intentional self-harm, initial encounter
T63062A	Toxic effect of venom of other North and South American snake, intentional self-harm, initial encounter
T63072A	Toxic effect of venom of other Australian snake, intentional self-harm, initial encounter
T63082A	Toxic effect of venom of other African and Asian snake, intentional self-harm, initial encounter
T63092A	Toxic effect of venom of other snake, intentional self-harm, initial encounter
T63112A	Toxic effect of venom of gila monster, intentional self-harm, initial encounter
T63122A	Toxic effect of venom of other venomous lizard, intentional self-harm, initial encounter
T63192A	Toxic effect of venom of other reptiles, intentional self-harm, initial encounter
T632X2A	Toxic effect of venom of scorpion, intentional self-harm, initial encounter
T63302A	Toxic effect of unspecified spider venom, intentional self-harm, initial encounter
T63312A	Toxic effect of venom of black widow spider, intentional self-harm, initial encounter
T63322A	Toxic effect of venom of tarantula, intentional self-harm, initial encounter
T63332A	Toxic effect of venom of brown recluse spider, intentional self-harm, initial encounter
T63392A	Toxic effect of venom of other spider, intentional self-harm, initial encounter
T63412A	Toxic effect of venom of centipedes and venomous millipedes, intentional self-harm, initial encounter
T63422A	Toxic effect of venom of ants, intentional self-harm, initial encounter
T63432A	Toxic effect of venom of caterpillars, intentional self-harm, initial encounter
T63442A	Toxic effect of venom of bees, intentional self-harm, initial encounter
T63452A	Toxic effect of venom of hornets, intentional self-harm, initial encounter
T63462A	Toxic effect of venom of wasps, intentional self-harm, initial encounter
T63482A	Toxic effect of venom of other arthropod, intentional self-harm, initial encounter
T63512A	Toxic effect of contact with stingray, intentional self-harm, initial encounter
T63592A	Toxic effect of contact with other venomous fish, intentional self-harm, initial encounter

T63612A	Toxic effect of contact with Portugese Man-o-war, intentional self-harm, initial encounter
T63622A	Toxic effect of contact with other jellyfish, intentional self-harm, initial encounter
T63632A	Toxic effect of contact with sea anemone, intentional self-harm, initial encounter
T63692A	Toxic effect of contact with other venomous marine animals, intentional self-harm, initial encounter
T63712A	Toxic effect of contact with venomous marine plant, intentional self-harm, initial encounter
T63792A	Toxic effect of contact with other venomous plant, intentional self-harm, initial encounter
T63812A	Toxic effect of contact with venomous frog, intentional self-harm, initial encounter
T63822A	Toxic effect of contact with venomous toad, intentional self-harm, initial encounter
T63832A	Toxic effect of contact with other venomous amphibian, intentional self-harm, initial encounter
T63892A	Toxic effect of contact with other venomous animals, intentional self-harm, initial encounter
T6392XA	Toxic effect of contact with unspecified venomous animal, intentional self-harm, initial encounter
T6402XA	Toxic effect of aflatoxin, intentional self-harm, initial encounter
T6482XA	Toxic effect of other mycotoxin food contaminants, intentional self-harm, initial encounter
T650X2A	Toxic effect of cyanides, intentional self-harm, initial encounter
T651X2A	Toxic effect of strychnine and its salts, intentional self-harm, initial encounter
T65212A	Toxic effect of chewing tobacco, intentional self-harm, initial encounter
T65222A	Toxic effect of tobacco cigarettes, intentional self-harm, initial encounter
T65292A	Toxic effect of other tobacco and nicotine, intentional self-harm, initial encounter
T653X2A	Toxic effect of nitroderivatives and aminoderivatives of benzene and its homologues, intentional self-harm, initial encounter
T654X2A	Toxic effect of carbon disulfide, intentional self-harm, initial encounter
T655X2A	Toxic effect of nitroglycerin and other nitric acids and esters, intentional self-harm, initial encounter
T656X2A	Toxic effect of paints and dyes, not elsewhere classified, intentional self-harm, initial encounter
T65812A	Toxic effect of latex, intentional self-harm, initial encounter
T65822A	Toxic effect of harmful algae and algae toxins, intentional self-harm, initial encounter
T65832A	Toxic effect of fiberglass, intentional self-harm, initial encounter
T65892A	Toxic effect of other specified substances, intentional self-harm, initial encounter
T6592XA	Toxic effect of unspecified substance, intentional self-harm, initial encounter
T71112A	Asphyxiation due to smothering under pillow, intentional self-harm, initial encounter

T71122A	Asphyxiation due to plastic bag, intentional self-harm, initial encounter
T71132A	Asphyxiation due to being trapped in bed linens, intentional self-harm, initial encounter
T71152A	Asphyxiation due to smothering in furniture, intentional self-harm, initial encounter
T71162A	Asphyxiation due to hanging, intentional self-harm, initial encounter
T71192A	Asphyxiation due to mechanical threat to breathing due to other causes, intentional self-harm, initial encounter
T71222A	Asphyxiation due to being trapped in a car trunk, intentional self-harm, initial encounter
T71232A	Asphyxiation due to being trapped in a (discarded) refrigerator, intentional self-harm, initial encounter
X710XXA	Intentional self-harm by drowning and submersion while in bathtub, initial encounter
X711XXA	Intentional self-harm by drowning and submersion while in swimming pool, initial encounter
X712XXA	Intentional self-harm by drowning and submersion after jump into swimming pool, initial encounter
X713XXA	Intentional self-harm by drowning and submersion in natural water, initial encounter
X718XXA	Other intentional self-harm by drowning and submersion, initial encounter
X719XXA	Intentional self-harm by drowning and submersion, unspecified, initial encounter
X72XXXA	Intentional self-harm by handgun discharge, initial encounter
X730XXA	Intentional self-harm by shotgun discharge, initial encounter
X731XXA	Intentional self-harm by hunting rifle discharge, initial encounter
X732XXA	Intentional self-harm by machine gun discharge, initial encounter
X738XXA	Intentional self-harm by other larger firearm discharge, initial encounter
X739XXA	Intentional self-harm by unspecified larger firearm discharge, initial encounter
X7401XA	Intentional self-harm by airgun, initial encounter
X7402XA	Intentional self-harm by paintball gun, initial encounter
X7409XA	Intentional self-harm by other gas, air or spring-operated gun, initial encounter
X748XXA	Intentional self-harm by other firearm discharge, initial encounter
X749XXA	Intentional self-harm by unspecified firearm discharge, initial encounter
X75XXXA	Intentional self-harm by explosive material, initial encounter
X76XXXA	Intentional self-harm by smoke, fire and flames, initial encounter
X770XXA	Intentional self-harm by steam or hot vapors, initial encounter
X771XXA	Intentional self-harm by hot tap water, initial encounter
X772XXA	Intentional self-harm by other hot fluids, initial encounter
X773XXA	Intentional self-harm by hot household appliances, initial encounter
X778XXA	Intentional self-harm by other hot objects, initial encounter
X779XXA	Intentional self-harm by unspecified hot objects, initial encounter

X780XXA	Intentional self-harm by sharp glass, initial encounter
X781XXA	Intentional self-harm by knife, initial encounter
X782XXA	Intentional self-harm by sword or dagger, initial encounter
X788XXA	Intentional self-harm by other sharp object, initial encounter
X789XXA	Intentional self-harm by unspecified sharp object, initial encounter
X79XXXA	Intentional self-harm by blunt object, initial encounter
X80XXXA	Intentional self-harm by jumping from a high place, initial encounter
X810XXA	Intentional self-harm by jumping or lying in front of motor vehicle, initial encounter
X811XXA	Intentional self-harm by jumping or lying in front of (subway) train, initial encounter
X818XXA	Intentional self-harm by jumping or lying in front of other moving object, initial encounter
X820XXA	Intentional collision of motor vehicle with other motor vehicle, initial encounter
X821XXA	Intentional collision of motor vehicle with train, initial encounter
X822XXA	Intentional collision of motor vehicle with tree, initial encounter
X828XXA	Other intentional self-harm by crashing of motor vehicle, initial encounter
X830XXA	Intentional self-harm by crashing of aircraft, initial encounter
X831XXA	Intentional self-harm by electrocution, initial encounter
X832XXA	Intentional self-harm by exposure to extremes of cold, initial encounter
X838XXA	Intentional self-harm by other specified means, initial encounter

Supplemental Table 3. Policies and state characteristics associated with the natural log of the child maltreatment rate for substantiated or indicated reports

	β Est. (95%CI)*	**β Est. (95%CI)****	**β Est. (95%CI)*****
TANF-Poverty Ratio	0.001 (-0.001, 0.003)	0.001 (-0.001, 0.003)	0.001 (-0.002, 0.003)
State Min Wage > Federal Min Wage	0.018 (-0.042, 0.077)	0.018 (-0.041, 0.078)	0.017 (-0.042, 0.075)
EITC Main Effect	-0.05 (-0.132, 0.033)	-0.05 (-0.134, 0.034)	-0.043 (-0.126, 0.039)
SNAP Program Access Index	**-0.003 (-0.005, -0.001)**	**-0.003 (-0.005, -0.001)**	-0.002 (-0.004, 0.000)
Unemployment Rate	--	--	-0.009 (-0.027, 0.010)
Adults with Bachelor's Degree	--	--	**-0.021 (-0.038, -0.005)**
Poverty Rate	--	--	-0.005 (-0.019, 0.009)

*Estimates from bivariate (crude) models, separately assessing each policy adjusted for state and year random effects (n=740); **Including all four state policies and, state and year random effects (n=740); *** Including all four state policies, poverty rate, unemployment rate, educational attainment and, state and year random effects (n=725); Bold values indicate statistically significant estimates at $p<0.05$

Supplemental Table 4. Increase in adolescent suicide rate by policy and child maltreatment for substantiated or indicated reports among states with at least ten suicide deaths per year

	IRR (95%CI)*	**IRR (95%CI)****	**IRR (95%CI)*****
Log of Child Maltreatment Rate	0.968 (0.918, 1.02)	0.972 (0.923, 1.02)	0.995 (0.933, 1.06)
TANF-Poverty Ratio	0.998 (0.996, 1.001)	0.999 (0.997, 1.001)	1 (0.987, 1.010)
State Min Wage > Federal Min Wage	**0.938 (0.896, 0.981)**	**0.946 (0.904, 0.991)**	0.826 (0.602, 1.130)
EITC Main Effect	0.966 (0.913, 1.020)	0.962 (0.91, 1.02)	0.827 (0.486, 1.410)
SNAP Program Access Index	1 (0.998, 1.001)	1 (0.999, 1.001)	1.01 (0.994, 1.020)
Poverty Rate		0.989 (0.979, 1.001)	**0.989 (0.979, 0.999)**
Mental Health Providers per 1,000		0.95 (0.895, 1.01)	0.946 (0.891, 1.010)
Household Firearm Rate		1.01 (1, 1.01)	**1.01 (1, 1.010)**
Interaction of Log Child Maltreatment Rate and Refundable State EITC			0.972 (0.88, 1.07)
Interaction of Log Child Maltreatment Rate and SNAP Program Access Index			1.000 (0.999, 1.000)
Interaction of Log Child Maltreatment Rate and TANF-Poverty Ratio			1.000 (0.998, 1.000)
Interaction of Log Child Maltreatment Rate and State Min Wage > Federal Min Wage			0.975 (0.92, 1.03)

*Estimates from bivariate (crude) models, separately assessing child maltreatment and each policy adjusted for state and year random effects (n=740); **Including all four state policies and, state and year random effects (n=740); ***Including all four state policies, poverty rate, household firearm rate, mental healthcare access and, state and year random effects (n=714); Bold values indicate statistically significant estimates at $p<0.05$

FIGURES

Figure 1. Rates of suicide mortality based on CDC WONDER data and percent of high-school students with suicidal thoughts and attempts based on the CDC Youth Risk Behavior Surveillance System, Nationwide 1999-2019

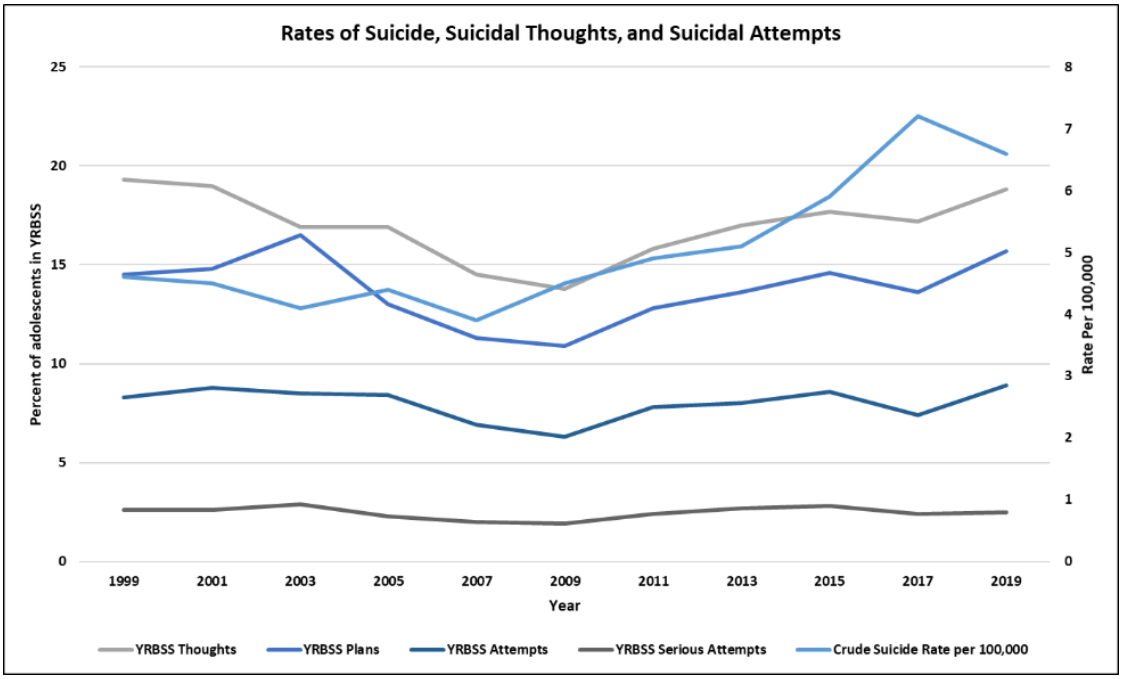


Figure 2. Rates of suicide mortality based on CDC WONDER data and percent of high-school students with suicidal thoughts and attempts based on the CDC Youth Risk Behavior Surveillance System, Kentucky 1999-2019

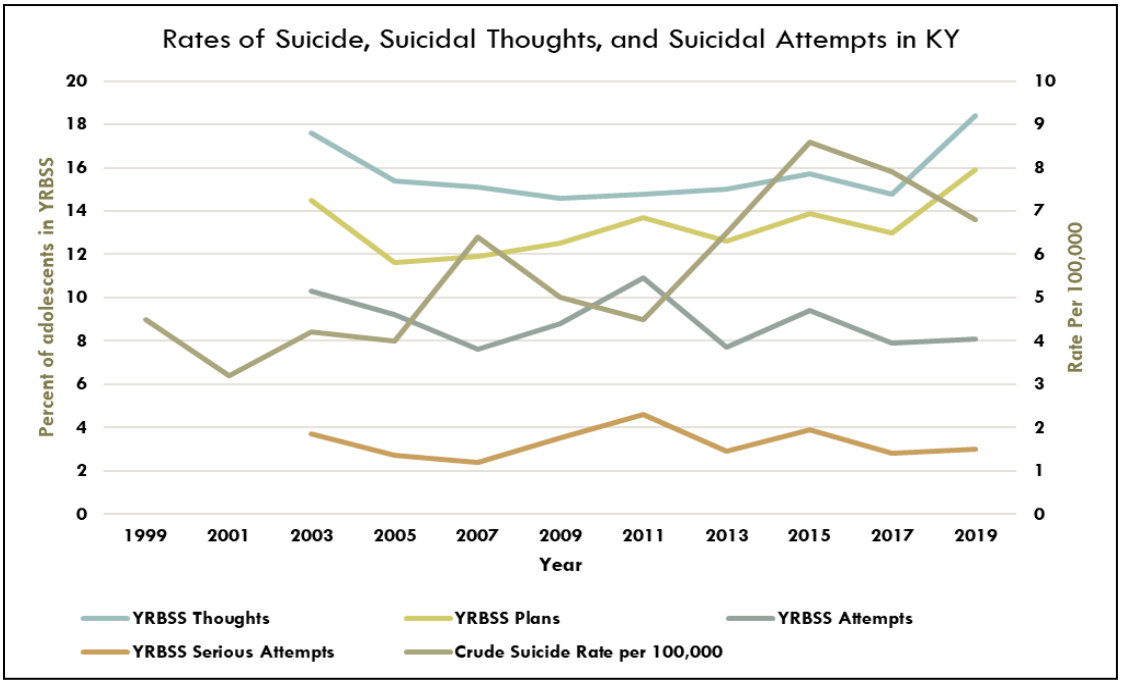


Figure 3. Author's analysis of refundable state Earned Income Tax Credit presence (in red) by state for 2004, 2009, 2014, and 2018

Figure 4. Author's analysis of minimum wage generosity presence (in red) by state for 2004, 2009, 2014, and 2018

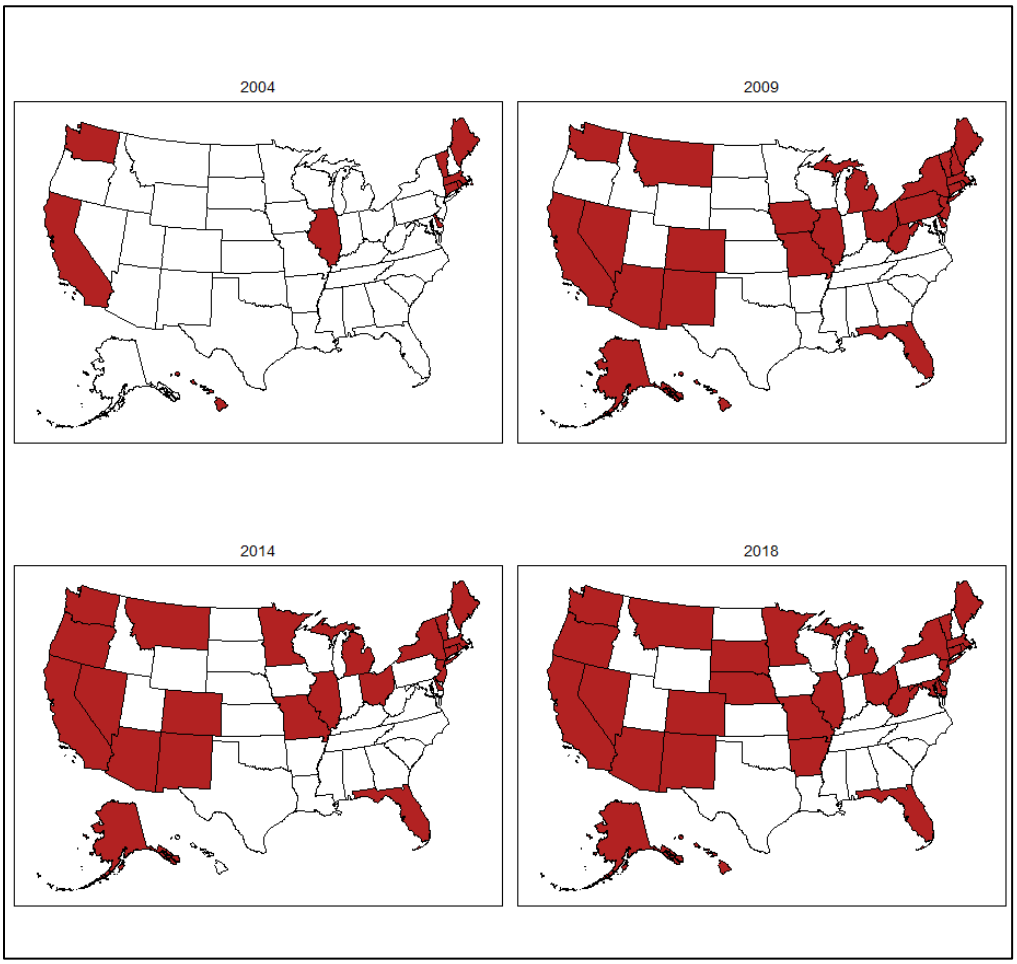
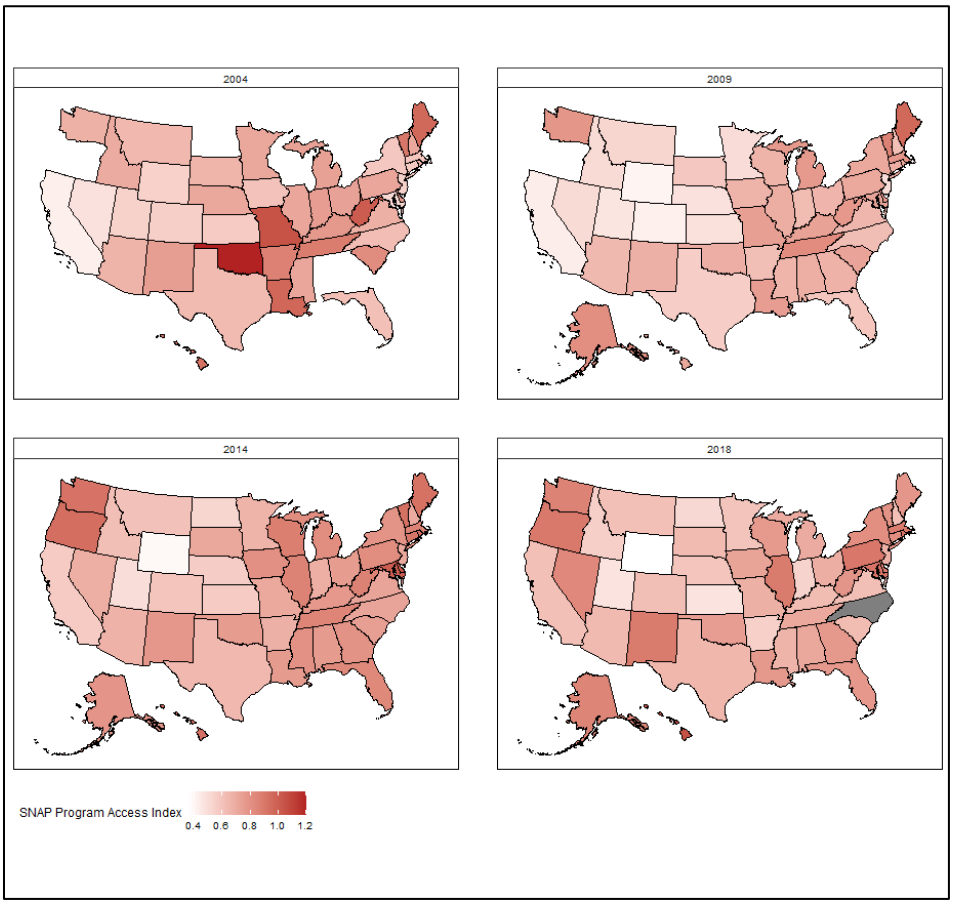
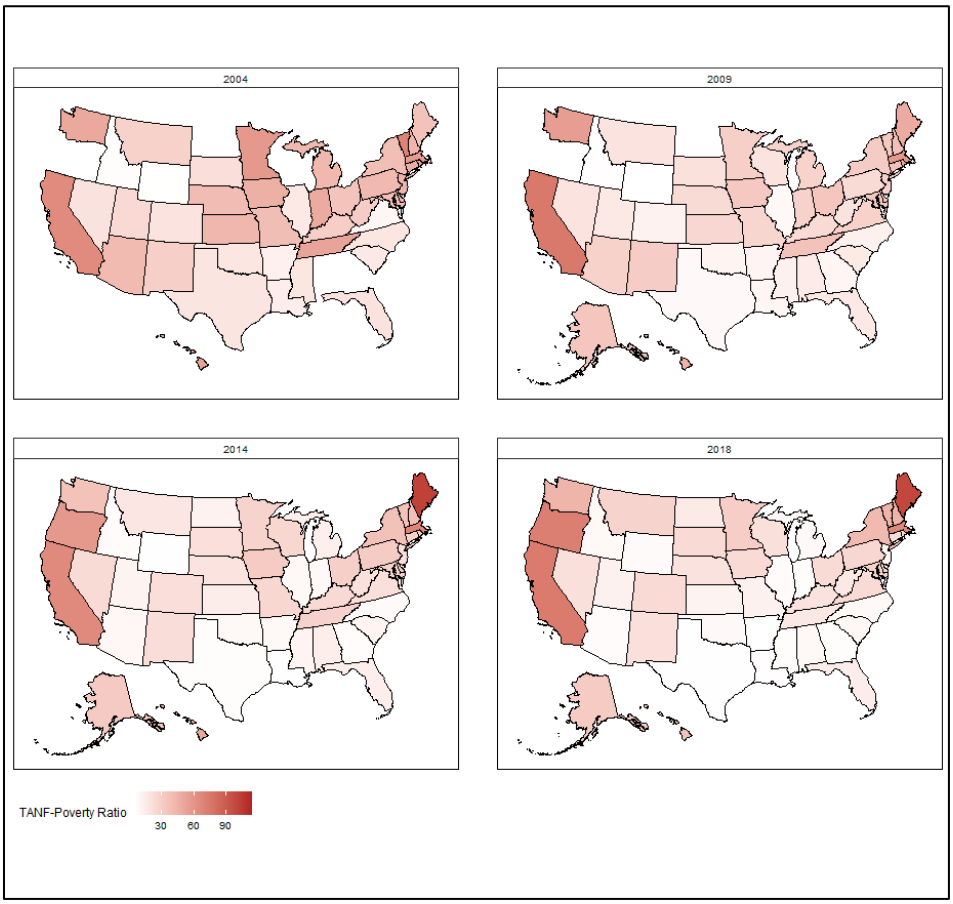


Figure 5. Author's analysis of SNAP Program Access Index scores (darker red indicating higher access among families in poverty) by state for 2004, 2009, 2014, and 2018



A higher SNAP Program Access Index score (a ratio of the number of people receiving SNAP benefits and the number of people at the 125% poverty level) is indicated by darker red shading in 2004, 2009, 2014, 2018, and indicating access to SNAP benefits among a higher proportion of people in poverty

Figure 6. Author's analysis of TANF-Poverty ratios (darker red indicating higher access to TANF among families in poverty) by state for 2004, 2009, 2014, and 2018



A higher TANF-Poverty ratio (a ratio of the number of TANF cases to the number of families with children in poverty, indicating access to TANF benefits) is indicated by darker red shading in 2004, 2009, 2014, 2018

Figure 7. Author's analysis of distribution of KTAP Access (darker red indicating higher access to KTAP among families in poverty) across Kentucky counties for 2010, 2013, 2016, and 2018

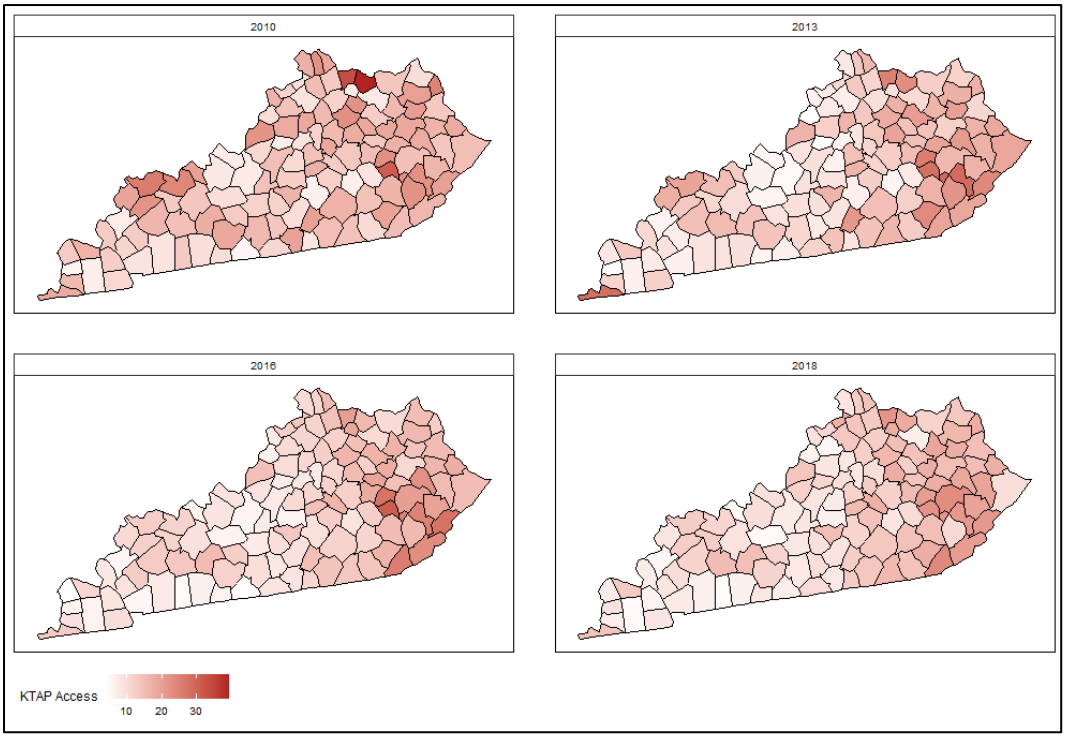


Figure 8. Author's analysis of distribution of SNAP Access (darker red indicating higher access to SNAP among families in poverty) across Kentucky counties for 2010, 2013, 2016, and 2018

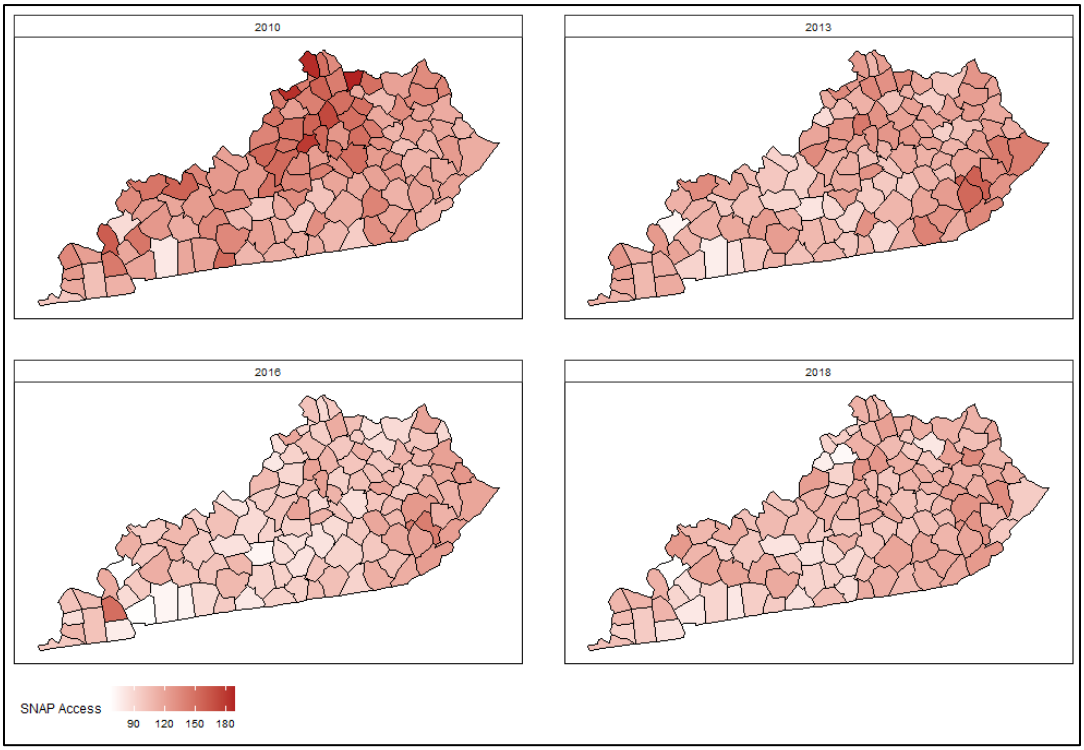


Figure 9. Conceptual model for present study, using the socio-ecological perspective where suicidal behavior and mortality at the individual level is impacted by inter-personal family relationships, community factors and state policy

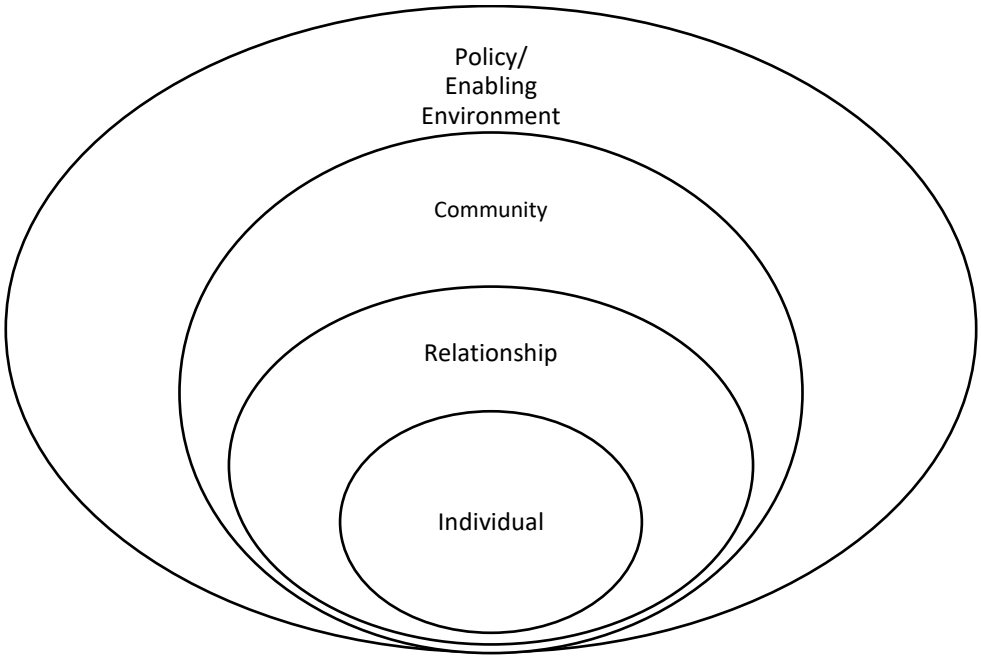


Figure 10. Flow diagram for national-wide study analytic sample

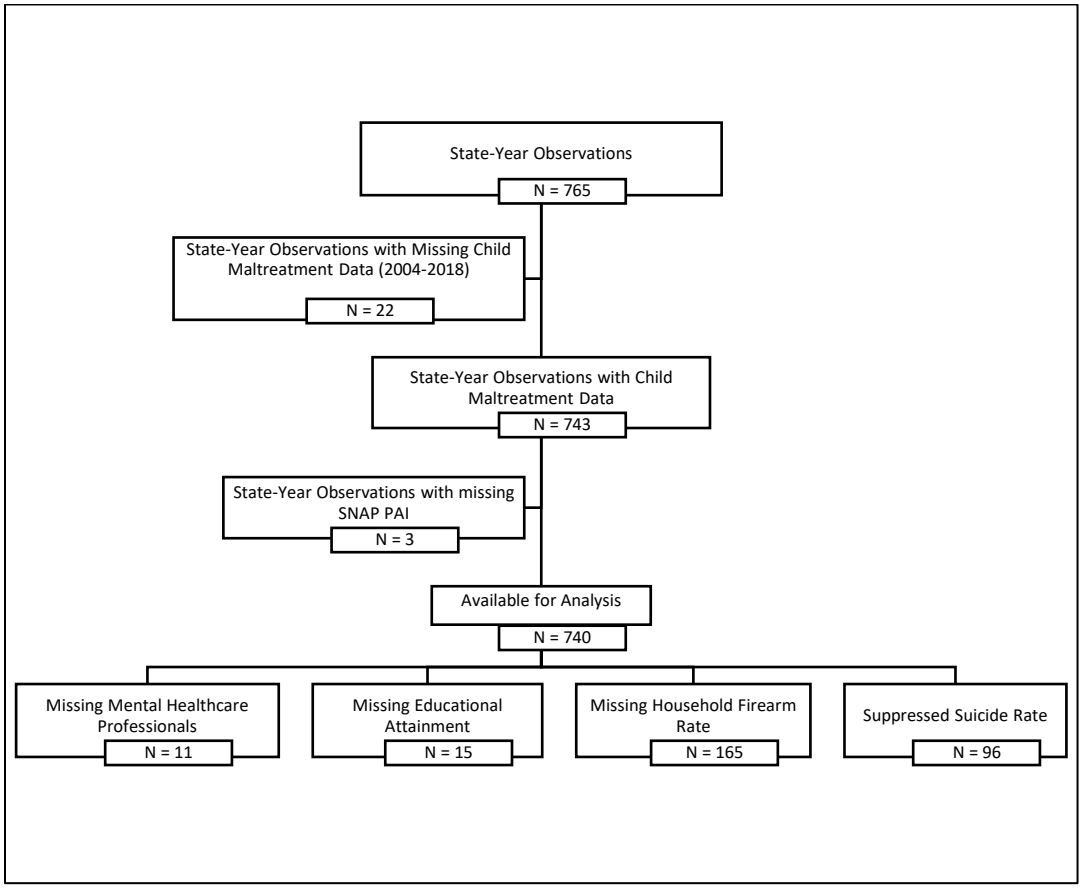


Figure 11. Author's analysis of suicide rates per 100,000 and child maltreatment rates per 1,000 among adolescents aged 10-19 years, by state for 2005-2019

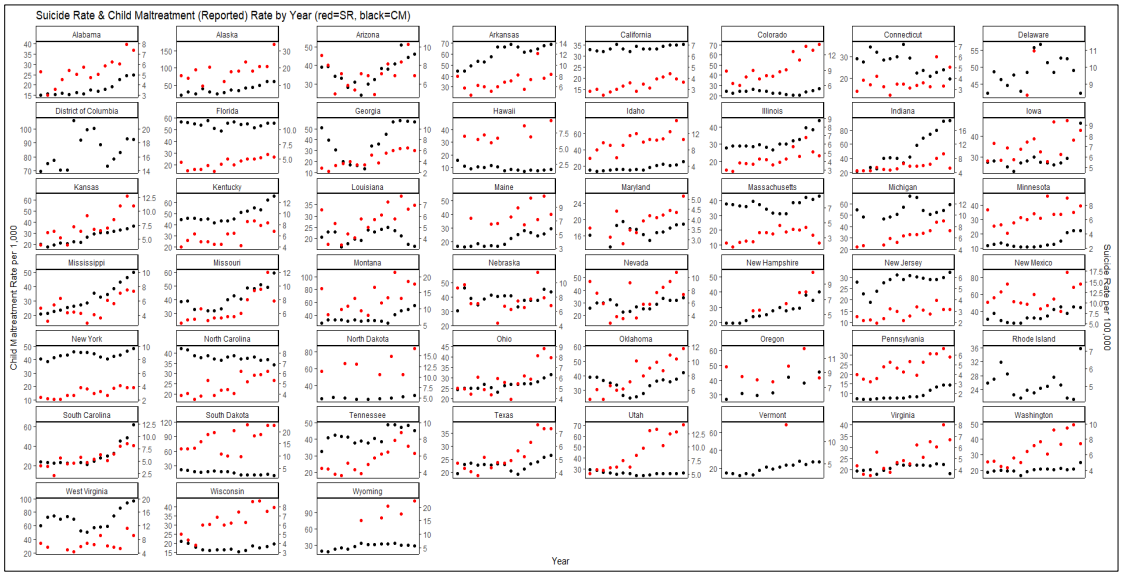


Figure 12. Flow diagram for Kentucky study analytic sample

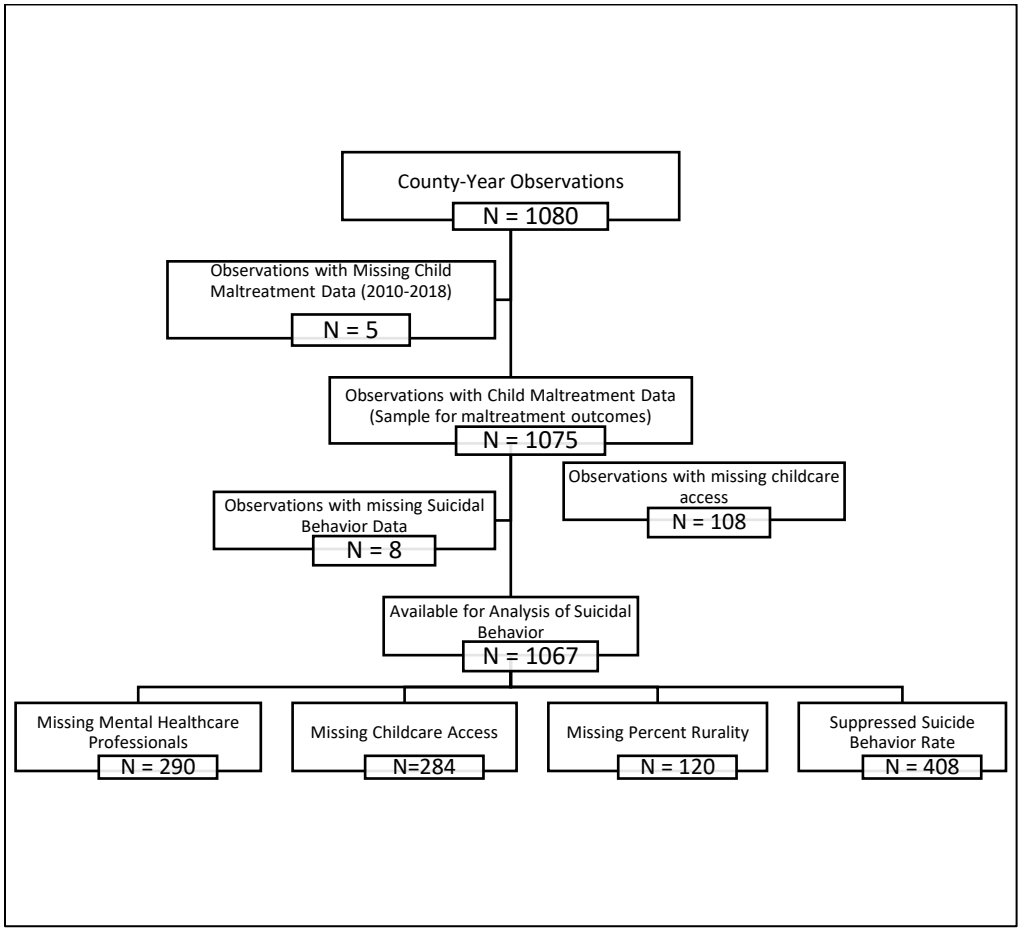


Figure 13. Author's analysis of median pediatric suicide behavior and attempt rates per 1,000 children under 19 years in Kentucky counties between 2011 and 2019

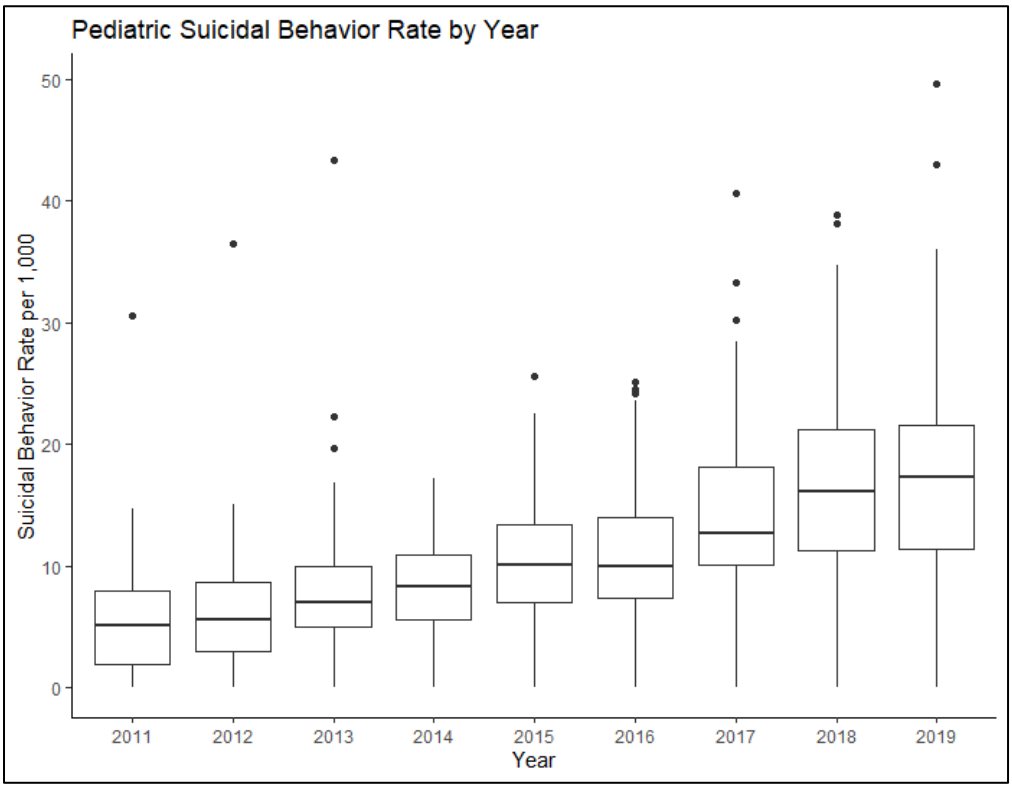
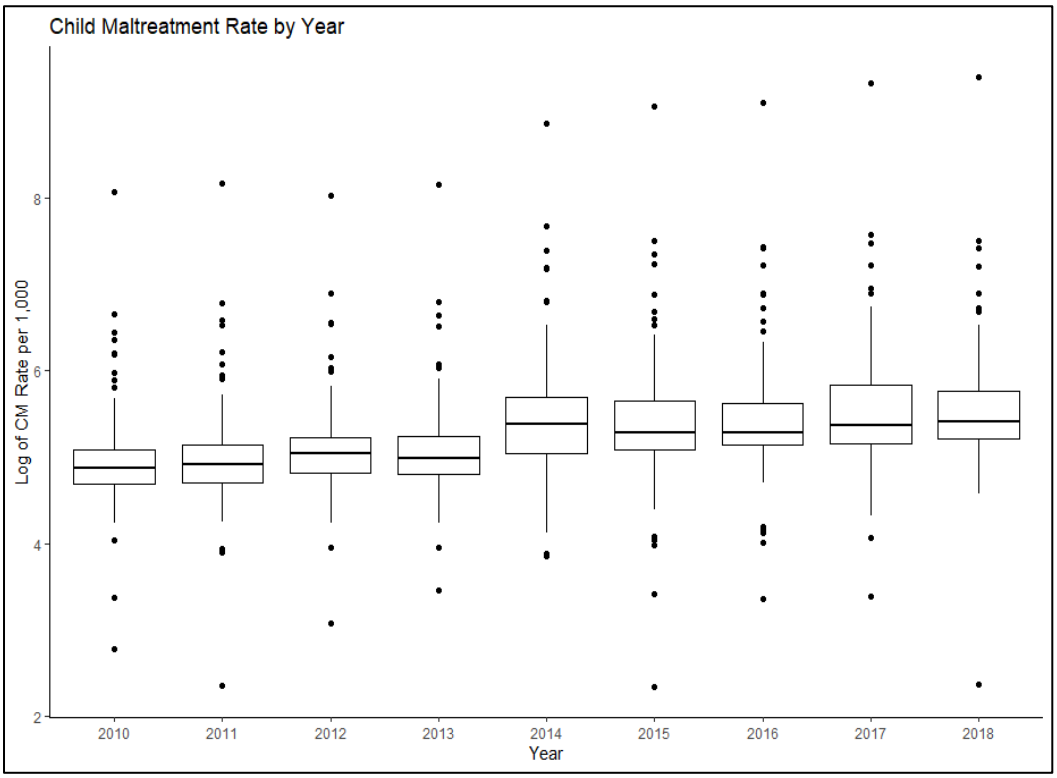


Figure 14. Author's analysis of median child maltreatment rates per 1,000 children under 19 (presented as the natural log of the rate) in Kentucky between 2010 and 2018



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APPENDIX

National Child Abuse and Neglect Data System (NCANDS)

Child maltreatment rates per 100,000 children were defined based on the National Child Abuse and Neglect Data System (NCANDS) data system for neglect, physical, emotional, and sexual abuse among adolescents 10 to 19 years old in each state for 2000-2019. Child maltreatment rates for 10-19 year olds by county, state, quarter and year will be drawn from the National Child Abuse & Neglect Data System, based on the reported date of instances of maltreatment. Substantiated means the level of evidence necessary by state law is met, while indicated means the level of evidence is not met, but there is sufficient reason to suspect the child was maltreated. For this analysis, all reported incidents were included.

NCANDS includes Physical abuse, Physical neglect, Medical neglect, Sexual abuse, Psychological or emotional maltreatment, Sex trafficking, Other, and Unknown or missing. However, this study only includes the categories for Neglect, and physical, emotional and sexual abuse. Each report-child pair was included as an incident of maltreatment and the denominator for the overall rate was based on the denominator based on census and intercensal estimates as with adolescent suicide rates, along with a rate for each type of abuse. Duplicate records from the same day and for the same child will be deleted.

The report date variable is reported as either the 8th or 23rd day of the month, and all following dates are adjusted to maintain the original time interval. If there are fewer than 1,000 records in the county of investigation and assessment, the variable is recoded to mask the information, and similarly, race and ethnicity is masked when too few records exist at the county level.

The variables of primary interest included the state/territory, report ID, child ID, county of investigation/assessment, report date, report disposition, report disposition date, child age at report (year), child sex, child race/ethnicity (set of binary variables for each race/ethnicity), maltreatment (1-4) type, and the maltreatment (1-4) disposition level.

Substantiated or Indicated Child Maltreatment

The regression analysis was repeated using substantiated and indicated child maltreatment. The SNAP Program Access Index was significantly associated with decreases in child maltreatment, similar to analysis using reported child maltreatment rates. Limiting analysis to substantiated or indicated child maltreatment reports reduced the impact of the presence of a refundable state Earned Income Tax Credit (Supplemental Table 3). Similarly, the impact of policy and substantiated or indicated child maltreatment report rates on suicide mortality rates were similar to those using reported child maltreatment (Supplemental Table 4).

CURRICULUM VITAE

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EDUCATION

UNIVERSITY OF LOUISVILLE Louisville, KY
PhD Public Health Sciences in Epidemiology & Population Health August 2023

UNIVERSITY OF LOUISVILLE Louisville, KY
Master of Science in Biostatistics December 2014
Master Research Project: *Assessing Risk of Breast Cancer Recurrence Using Expression of Nuclear Receptor Superfamily Genes*

UNIVERSITY OF ROCHESTER Rochester, NY
Bachelor of Arts in Economics May 2006
Concentration: Statistics

ACADEMIC POSITIONS

NORTON CHILDREN'S RESEARCH INSTITUTE
AFFILIATED WITH THE UNIVERSITY OF LOUISVILLE SCHOOL OF MEDICINE
Louisville, KY
Child and Adolescent Health Research Design and Support
Sr Biostatistician 2021 – present

I lead a team of statisticians in providing statistical analysis for pediatric research in many areas of study, including psychotropic medications, antibiotic prescribing, and service utilization. We work with clinicians to clearly define research aims, design study methodology, implement a statistical analysis plan and write the sections for methods and results that lead to publication and novel contributions to the medical and public health fields.

Additionally, I contribute study design and statistical planning support to clinicians and researchers, helping with proposal and grant writing. This includes identifying the study population and an optimal outcome measurement, along with statistical methodology and sample size estimation. As a voting member of the executive committee, I participate in the decisions regarding which projects would benefit from our team's assistance and estimate the time and personnel that would be required.

UNIVERSITY OF LOUISVILLE Louisville, KY
Department of Pediatrics
Biostatistician II 2015 – 2021

My role is to lead a team of statisticians in providing statistical analysis for pediatric research in many areas of study, including psychotropic medications, antibiotic prescribing, and service utilization. We work with clinicians to clearly define research

aims, design study methodology, and implement a statistical analysis plan that leads to publication and novel contributions to the medical and public health fields. As a voting member of the executive committee, I participate in the decisions regarding which projects would benefit from our team's assistance and estimate the time and personnel that would be required.

I have experience with relevant statistical methods, including longitudinal analysis and multi-site studies, and common forms of data including administrative claims data, health care cost data, and survey data. This allows me to guide my team in determining the best course to take in any given analysis and share my data visualization expertise, necessary for communicating and disseminating the results of our research.

School of Public Health and Information Sciences

Master Research Project in Biostatistics Fall 2013

Funded Research

ECHO OIF; Porter (PI) Sept 2021 – Aug 2023
Effects of Racism on Neurocognitive Development of Black Children
The purpose of this project is to assess the effect of racism and discrimination on neurocognitive development of Black children, by using extant data available through the ECHO collaboration.

RWJF Aligning Systems for Health; Creel (PI) May 2020 – October 2022
Women in Recovery: System Alignment for Optimal Outcomes
Studying Freedom House's collaborative approach to cross-sector alignment in Kentucky to improve outcomes for pregnant and parenting women in recovery.

NICHD (IDeA State Grant); Sullivan/Watson (Co-PI's) Jan 2019 – present
IDeA State Network Grant: The Kentucky Pediatric Clinical Trials Rural/Urban Partnership
The goal of this grant is to provide medically underserved/rural populations access to state-of-the-art clinical trials, applying findings from relevant pediatric cohort studies to children in IDeA states, and building pediatric research capacity at a national level; and providing professional development to train the next generation of clinician scientists.

Kentucky Medicaid; Davis (PI) July 2016 – June 2022
Safeguarding Medication Use and Improving Care Delivery for Children Receiving Kentucky Medicaid
The purpose of this project is to plan interventions to reduce the prescribing of various classes of medication and improve health care quality for children receiving Kentucky Medicaid.

SEER Medicare; Egger (PI) June 2018 – June 2022
Treatment of advanced cancer and associated costs in the Medicare population in the United States. The purpose of this project is to assess the costs of treatment for late stage cancer and the benefits in terms of quantity and quality of life gained.

Kentucky Medicaid; Eastep (PI) Jan 2018 – Dec 2018

Trends in Prescription Opioid Patterns Among Children Enrolled in Kentucky Medicaid: A Review from 2012 to 2016. The purpose of this project is to describe the trends in prescription opioid medications dispensed to children enrolled in KY Medicaid.

Modified ACE Survey; Pendleton (PI) Feb 2017 – Dec 2018
The Pediatric Primary Care Resiliency Project: Breaking the Cycle of Toxic Stress. The purpose of this project is to assess the stress in which patients at the UofL Pediatrics Downtown Clinic live and attempt to mediate the effects.

PUBLICATIONS

PEER REVIEWED JOURNALS

https://www.ncbi.nlm.nih.gov/myncbi/yana.feygin.1/bibliography/public/

Wattles, B. A., **Feygin, Y.**, Jawad, K. S., Stevenson, M. D., Vidwan, N. K., Blatt, D. B., ... & Smith, M. J. (2023). Use of the Child Opportunity Index to Examine Racial Variations in Outpatient Antibiotic Prescribing to Children. The Journal of Pediatrics, 113572.

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CONFERENCE PUBLICATIONS AND PRESENTATIONS

Feygin YB, Duncan SD, Shipley M, …, Creel LM. The Importance of the Healthcare Sector in a Rural Network of Organizations Supporting Women in Recovery. Poster presentation at: Academy Health Annual Research Meeting; June 2023; Seattle, WA.

Feygin YB, DuPre NC, Creel LM, Wallis AB, Baumgartner R, Peiper N. The Role of Child Maltreatment in the Association between Earned Income Tax Policies and Adolescent Suicide Mortality: A Mediation Analysis. Poster presentation at: Academy Health Annual Research Meeting; June 2023; Seattle, WA.

Feygin YB, DuPre NC, Creel LM, Wallis AB, Baumgartner R, Peiper N. The Role of Child Maltreatment in the Association between Earned Income Tax Policies and Adolescent Suicide Mortality: A Mediation Analysis. Poster presentation at: Society for Epidemiologic Research Annual Meeting; June 2023; Portland, OR.

Davis DW, Jawad K, **Feygin YB**, Stevenson MD, Wattles B, Porter JM, Jones VF. Do various neighborhood disadvantage indices equally predict child chronic health conditions? Poster presentation at: Pediatric Academic Societies Meeting; April 2023; Washington, DC.

Porter JM, **Feygin YB**, Jones VF, Davis DW, Stevenson MD, Ziegler C, Wosu A, O'Shea M, Rose T, Morales S. Perceived discrimination and neurocognitive development among black and white children: An analysis from ECHO cohorts. Poster presentation at: Pediatric Academic Societies Meeting; April 2023; Washington, DC.

Hart R, **Feygin YB**, Kluthe T, Rao S, Baumer-Mouradian S. Emergency Departments: A Missed Opportunity to Address Pediatric Vaccine Disparities. Poster presentation at: Pediatric Academic Societies Meeting; April 2023; Washington, DC.

Porter, J., Jawad, K., Davis, DW., Jones, FV., **Feygin, Y**. Parents' Perceptions of Medical Provider Encounters and Access to Care by Race/Ethnicity from the National Survey of Children's Health. Poster presentation at: American Academy of Pediatrics National Conference & Exhibition; October 2022; Anaheim, CA.

Pendleton, A., Morris, M., **Feygin, Y.** Understanding ACEs and Social Care Needs to Build Community Connections in Primary Care. Poster presentation at: American Academy of Pediatrics National Conference & Exhibition; October 2022; Anaheim, CA.

Coriell, M., Jawad, K., **Feygin, Y.**, Watson, S., Stevenson, M., Wattles, B., Jones, VF., Porter, J., Davis, DW. Neighborhood Disadvantage, Childhood Opportunity Index, and Glycemic Control for Children with Type 1 Diabetes. Poster presentation at: American Academy of Pediatrics National Conference & Exhibition; October 2022; Anaheim, CA.

Van Hersh, A., Jawad, K., **Feygin, Y.**, Johnsrude, C., Dasgupta, S. Electrocardiogram Abnormalities in Patients with Acute Covid-19 Infection: What is its significance? Poster presentation at: American Academy of Pediatrics National Conference & Exhibition; October 2022; Anaheim, CA.

Wattles, B., **Feygin, Y.**, Jawad, K., Stevenson, M., Vidwan, N., Blatt, D., Davis, DW., Creel, LM., Porter, J., Jones, VF., Smith, M. Use of the Child Opportunity Index to Examine Racial Disparities in Outpatient Antibiotic Prescribing to Children. Poster presentation at: Pediatric Antimicrobial Stewardship Conference; June 2022; St. Louis, MO.

Creel, LM., Davis, DW., Shipley, M., **Feygin, Y.**, Downs, C., Cole Hall, T., Hoskins, S., Duncan, SD. The Role of Organizational Alignment in Improving Service Delivery and Outcomes for Families Impacted by Substance Use. Poster presentation at: Academy Health Annual Research Meeting; June 2022; Washington, DC.

Duncan, SD., Jackson, C., Bhadury, S., **Feygin, Y.**, Kong, M., Jawad, KS., Creel, LM. Using Queuing Theory to Determine Optimal Obstetrical Bed Numbers. Poster presentation at: Academy Health Annual Research Meeting; June 2022; Washington, DC.

Fischer, H., Schweinhart, S., **Feygin, Y.**, Duncan, S. Potential Cost Savings Associated With Bubble Continuous Positive Airway Pressure In Neonates: A Retrospective Study. Poster presentation at: Pediatric Academic Societies Meeting; April 2022; Denver, CO.

Sikes, K., Hart, R., **Feygin, Y.**, Penrod, C. Effect of an Evaluation Algorithm on CT Utilization in Identifying Appendicitis in Children. Poster presentation at: Pediatric Academic Societies Meeting; April 2022; Denver, CO.

Jackson, C., Duncan, SD., Bhadury, S., **Feygin, Y.**, Creel, LM., Kong, M., Jawad, KS. Using Queuing Theory to Determine Optimal NICU Bed Numbers. Poster presentation at: Pediatric Academic Societies Meeting; April 2022; Denver, CO.

Duncan, SD., Creel, LM., Bhadury, S., Jackson, C., Jawad, KS., **Feygin, Y.**, Kong, M. Using Queuing Theory to Determine Optimal Obstetrical Bed Numbers. Poster presentation at: Pediatric Academic Societies Meeting; April 2022; Denver, CO.

Duncan, SD., Bhadury, S., Creel, LM., **Feygin, Y.**, Jawad, KS., Kong, M. Declining Access to Obstetrical Beds in Rural Kentucky. Poster presentation at: Pediatric Academic Societies Meeting; April 2022; Denver, CO.

Creel, LM., Davis, DW., Shipley, M., **Feygin, Y.**, Downs, C., Cole Hall, T., Hoskins, S., Duncan, SD. The Role of Organizational Alignment in Improving Service Delivery and Outcomes for Families Impacted by Substance Use. Poster presentation at: Pediatric Academic Societies Meeting; April 2022; Denver, CO.

Eastep, K., Stevenson, M., **Feygin, Y.**, Webb, A., Anderson, B. Synthetic Opioid Ingestions in Young Children: Trends from a State Poison Control Center. Poster presentation at: Pediatric Academic Societies Meeting; April 2022; Denver, CO.

Feygin, Y.B., Lohr, W.D., Le, J., Jones, V.F., … & Davis, D.W. Long-term follow-up of preschool-age children diagnosed with a serious emotional disturbance in 2012. Virtual poster presentation at: Pediatric Academic Societies Meeting; May 2021.

Green, J., Bryant, K., Boland, L., …, **Feygin, Y.B.**, Bhadury, S., Espinosa, C. Increased NICU mupirocin use drives MRSA mupirocin resistance but not transmission or invasive infection. Virtual poster presentation at: Pediatric Academic Societies Meeting; May 2021.

Feygin, Y.B., Little, B., Creel, L.M., Kong, M., Jawad, K., Sun, J., … & Davis, D.W. Medication Misuse and Suicidal Behavior in Adolescents. Accepted as poster presentation at: Pediatric Academic Societies Meeting; May 2020; Philadelphia, Pennsylvania. Conference cancelled.

Davis, D.W., Jawad, K., **Feygin, Y.B.**, Lohr, W.D., Creel, L., Pasquenza, N., … & Le, J. Differential Diagnosis and Treatment of Severe Mental Health in Children by Health Professional Shortage Areas and Demographic Characteristics. Poster presentation at: Pediatric Academic Societies Meeting; May 2020; Philadelphia, Pennsylvania. Conference cancelled.

Springate Spalding, J., **Feygin, Y.**, Kong, M., Sun, J., Creel, L.M., Jawad, K., Duncan, S. An Epidemiologic Survey of Neonatal Intensive Care Unit Capacity and Utilization in Kentucky, 1999-2018. Poster presentation at: Pediatric Academic Societies Meeting; May 2020; Philadelphia, Pennsylvania. Conference cancelled.

Wattles B., Jawad K., Vidwan N., Espinosa C., **Feygin Y.**, Kong, M., … & Smith, M. Hepatitis A vaccination in the pediatric Kentucky Medicaid population. Poster presentation at: Pediatric Academic Societies Meeting; May 2020; Philadelphia, Pennsylvania. Conference cancelled.

Pendleton A., Morris M., **Feygin Y.**, Pasquenza N. Associations among parent and child ACEs with social care needs in pediatric primary care. Poster presentation at: Pediatric Academic Societies Meeting; May 2020; Philadelphia, Pennsylvania. Conference cancelled. This peer-reviewed abstract was disseminated on 4/2020 to PAS 2020 Meeting Program Guide-PAS2020: 2848.783.

Trace, M., Brothers, K.B., Calhoun, A.W., Craft, L.T., Davis, D.W., **Feygin, Y.B.**, … & Williams, P.G. ADHD Practice Patterns: A Survey of Kentucky Pediatric Providers. Poster presentation at: Pediatric Academic Societies Meeting; May 2020; Philadelphia, Pennsylvania. Conference cancelled.

Davis, D.W., Lohr, W.D., **Feygin, Y.B.**, Creel, L., Jawad, K., Jones, F., … & Pasquenza, N. Psychotropic Polypharmacy Use for Children Receiving Medicaid and Those in Foster Care. Poster presentation at: Society for Developmental and Behavioral Pediatrics Meeting; October 2020; Virtual conference.

Davis, D.W., Jawad, K., **Feygin, Y.B.**, Lohr, W.D., Creel, L., Pasquenza, N., … & Le, J. Differential Diagnosis and Treatment of Severe Mental Health in Children by Health Professional Shortage Areas and Demographic Characteristics. Poster presentation at: Society for Developmental and Behavioral Pediatrics Meeting; October 2020; Virtual conference.

Trace, M., Brothers, K.B., Calhoun, A.W., Craft, L.T., Davis, D.W., **Feygin, Y.B.**, … & Williams, P.G. ADHD Practice Patterns: A Survey of Kentucky Pediatric Providers. Poster presentation at: Society for Developmental and Behavioral Pediatrics Meeting; October 2020; Virtual conference.

Miller, E.R., **Feygin, Y.B.**, Devlin, L.A. Methicillin Resistant Staph Aureus Colonization Rates in Newborns Admitted to the NICU for Treatment of Neonatal Opioid Withdrawal Syndrome. Poster presentation at: Southern Society for Pediatric Research Meeting; February 2020; Virtual conference.

Feygin, Y., Jawad, K., Lohr, W.D., Williams, P.G., Yan, X., Davis, D.W., Creel, L.M. Identifying Autism Spectrum Disorder in Administrative Data: A Comparison of Three Methods. Poster presentation at: Pediatric Academic Societies Meeting; April 2019; Baltimore, Maryland.

Creel, L.M., **Feygin, Y.**, Davis, D.W., Stevenson, M.D., Pasquenza, N., Myers, J., Smith, M., Liu, G.C., Lohr, W.D., Jawad, K., Woods, C. Gaps in Medicaid Coverage from 2012 to 2017 among Thirteen Pediatric Age-Based Cohorts in Kentucky. Oral presentation at: Pediatric Academic Societies Meeting; April 2019; Baltimore, Maryland.

Watson, S., **Feygin, Y.**, Vaughn, V.M., Wintergerst, K., Liu, G.C., Cai, L. Zinc in Youth with Type 1 Diabetes: A systematic review and meta-analysis. Poster presentation at: Pediatric Academic Societies Meeting; April 2019; Baltimore, Maryland.

Davis, D.W., **Feygin, Y.,** Creel, L.M., Kong, M., Jawad, K., Sun, J., Lohr, W.D., Blum, N., Le, J., Williams, P.G., Jones, V.F., Pasquenza, N. Use of Stimulants and Alpha-2 Agonists for Treating ADHD in Preschool-age Children receiving Medicaid from 2012-2017. Oral presentation at: Pediatric Academic Societies Meeting; April 2019; Baltimore, Maryland.

Davis, D.W., Jawad, K., **Feygin, Y.**, Creel, L.M., Kong, M., Sun, J., Lohr, W.D., Williams, P.G., Jones, V.F., Pasquenza, N., Liu, G. Disparities in Rates of ADHD Diagnosis and Treatment by Race/Ethnicity in Youth receiving Kentucky Medicaid in 2017. Poster presentation at: Pediatric Academic Societies Meeting; April 2019; Baltimore, Maryland.

Eastep, K. A., Seaman, C.N., Jawad, K., Stevenson, M.D., **Feygin, Y.**, Yan, X., Kong, M., Myers, J., Wattles, B., Anderson, B. Geographic Patterns in Prescription Opioids and Opioid Abuse in the Pediatric Population: A Review of a Recent Kentucky Cohort. Poster presentation at: Pediatric Academic Societies Meeting; April 2019; Baltimore, Maryland.

Eastep, K. A., Stevenson, M.D., **Feygin, Y.**, Yan, X., Kong, M., Jawad, K., Myers, J., Wattles, B. A., Anderson, B. Opioid Prescriptions Among Children Enrolled in Kentucky Medicaid: A Review of a Recent Cohort. Oral presentation at: Pediatric Academic Societies Meeting; April 2019; Baltimore, Maryland.

Clemons, R., Myers, J., Jawad, K., **Feygin, Y.**, Sikes, K., Caperell, K. The Impact of Converting a Power Plant From Coal to Natural Gas on Pediatric Acute Asthma. Oral presentation at: Pediatric Academic Societies Meeting; April 2019; Baltimore, Maryland.

Wattles, B.A., Vidwan, N., Sun, J., **Feygin, Y.**, Kong, M., Creel, L.M., Woods, C., Smith, M. Outpatient antibiotic prescribing in a cohort of children with 5 years continuous enrollment in Kentucky Medicaid. Oral presentation at: Pediatric Academic Societies Meeting; April 2019; Baltimore, Maryland.

Rydzewska, M., Sun, J., Kong, M., **Feygin, Y.,** Duncan, S. Rates and risk factors for the healthcare utilization of Neonatal Intensive Care Unit graduates within seven days post discharge. Poster presentation at: Pediatric Academic Societies Meeting; April 2019; Baltimore, Maryland.

Jonnala, R., Matta, J., Johnsrude, C., **Feygin, Y.**, Lau, K.C. Utility of ambulatory ECG monitoring in symptomatic pediatric patients without known heart disease. Poster presentation at: Pediatric Academic Societies Meeting; April 2019; Baltimore, Maryland.

Burton, C., Furlong-Dillard, J., Jawad, K., **Feygin, Y.**, Berkenbosch, J., Tzanetos, D. T. A Descriptive Analysis of Viscoelastic testing in Pediatric ECMO Patients Using the Pediatric ECMO Outcomes Registry. Poster presentation at The Extracorporeal Life Support Organization (ELSO) Conference, September 2019.

Tryon, C., Calhoun, A., **Feygin, Y.**, Berkenbosch, J. Impact of Age on Procedural Sedation Practices and Outcomes: A report from the PSRC. Presented at Society of Critical Care Congress 2019.

Lohr, W. D., **Feygin, Y.**, Jawad, K., Creel, L., Le, J. F., Pasquenza, N., & Davis, D. W. (2019). 5.20 Concurrent Antipsychotic Medication Use in Low-Income Children and Children in Foster Care. *Journal of the American Academy of Child & Adolescent Psychiatry*, *58*(10), S251-S252.

Rydzewska, M., Sun, J., Kong, M., **Feygin, Y.**, & Duncan, S. (2019, February). Rates and Risk Factors for the Healthcare Utilization of the Neonatal Intensive Care Unit Graduates within the First Two Years of Life. *Journal of Investigative Medicine* (Vol. 67, No. 2, pp. 426-426).

Smith, M., Vidwan, N., Wattles, B., Ghosal, S., **Feygin, Y.**, Creel, L., ... & Woods, C. (2018, November). 281. Cefdinir Prescribing Increased in Low-Income Children in Kentucky From 2012 to 2016. In *Open Forum Infectious Disease*s (Vol. 5, No. suppl_1, pp. S116-S116). US: Oxford University Press. https://doi.org/10.1093/ofid/ofy210.292.

Lohr, W. D., **Feygin, Y. B.**, Le, J. F., Ghosal, S., Creel, L., Myers, J., & Davis, D. W. (2018). 4.14 Impact of Language Disorder on Prescribing Patterns and Healthcare Utilization Among Low-Income Children With ADHD. *Journal of the American Academy of Child & Adolescent Psychiatry*, 57(10), S209.

Davis, D., Creel, L.M., **Feygin, Y.**, Ghosal, S., Williams, P., Jones, V., Pasquenza, N., Lohr, W.D., & Le, J. ADHD Diagnosis and Stimulant Use for Preschool Children on Medicaid. Poster presentation at: Pediatric Academic Societies Meeting; May 2018; Toronto, Canada.

Myers, J., Jawad, K., **Feygin, Y.**, Creel, L.M., Espinosa, C., Kong, M., & Duncan, S. Social Inequality's Impact on the Rate of Neonatal Abstinence Syndrome among Low-Income Children. Poster presentation at: Pediatric Academic Societies Meeting; May 2018; Toronto, Canada.

Lohr, W.D., Ghosal, S., **Feygin, Y.**, Davis, D., Creel, L.M., Pasquanza, N., & Myers, J. Predicting Duration of High Level Psychotropic Polypharmacy in Children in Foster Care. Oral presentation at: Pediatric Academic Societies Meeting; May 2018; Toronto, Canada.

Lohr, W.D., Ghosal, S., **Feygin, Y.**, Davis, D., Creel, L.M., Pasquanza, N., & Myers, J. The Duration of Antipsychotic Prescribing in Very Young Low-Income Children. Poster presentation at: Pediatric Academic Societies Meeting; May 2018; Toronto, Canada.

Jennifer F. Le, William David Lohr, **Yana B. Feygin**, Liza M. Creel, Natalie Pasquenza, Allan Mark Josephson, Deborah W. Davis. Examining Trends and Interactions in the Diagnoses of Pediatric Bipolar Disorders and Disruptive Mood Dysregulation Disorder (DMDD) in Kentucky Children and Adolescents Receiving Medicaid. Journal of the American Academy of Child & Adolescent Psychiatry, Vol 56, Issue 10, Supp, 2017, Pg S208, ISSN 0890-8567, https://doi.org/10.1016/j.jaac.2017.09.166.6.51.

Creel, L.M., Benitez, J., Davis, D., Lohr, W.D., **Feygin, Y.,** Smith, M., & Liu, G. Achieving Quality Outcomes in Youth Prescribed Antipsychotic Medications: What Matters? Oral Presentation in the Child Health Services Interest Group Meeting at: Academy Health Annual Research Meeting; June 2017; New Orleans, LA.

Davis, D., Creel, L.M., Benitez, J., Lohr, W.D., **Feygin, Y.,** Smith, M., & Liu, G. Achieving Quality Outcomes in Youth Prescribed Antipsychotic Medications: What Matters? Oral Presentation at: Pediatric Academic Societies Annual Conference; May 2017; San Francisco, CA.

Lohr, W. D., Le, J. F., **Feygin, Y. B.**, Davis, D. W., Creel, L. M., Josephson, A. M., ... & Pasquenza, N. (2017). 6.51 Prevalence of Opioid Use Disorders in Youth Receiving Kentucky Medicaid. Journal of the American Academy of Child & Adolescent Psychiatry, 56(10), S294.

Lohr, W. D., Le, J. F., **Feygin, Y. B.,** Creel, L. M., Stevenson, M., Josephson, A. M., ... & Davis, D. W. (2017). 3.19 Children in Foster Care on High-Level Polypharmacy. Journal of the American Academy of Child & Adolescent Psychiatry, 56(10), S208-S209.

Smith, M., Vidwan, N., **Feygin, Y.,** Myers, J., & Woods, C. (2016, December). Antibiotic Prescribing in the Pediatric Kentucky Medicaid Population. In Open Forum Infectious Diseases (Vol. 3, No. suppl_1). Oxford University Press.

Lohr, W. D., **Feygin, Y.,** Smith, M. J., Davis, D. W., Stevenson, M. D., Liu, G. C., ... & Myers, J. (2016). 4.9 EMERGENCY DEPARTMENT UTILIZATION IS INCREASED BY FOSTER CARE AND POLYPHARMACY. Journal of the American Academy of Child & Adolescent Psychiatry, 55(10), S165.

PROFESSIONAL AFFILIATIONS

- Fellow, Governor's Commonwealth Institute for Parent Leadership (Fall 2015)
- Member, Kentucky Academy of Science
- Member, Kentucky Public Health Association

INDUSTRY POSITIONS

My previous experience as an industry financial analyst, allows me to work cleanly, efficiently, and ask the relevant questions necessary for transforming the given data into valuable information.

TIME WARNER CABLE (formerly INSIGHT COMMUNICATIONS) Louisville, KY
Financial Analyst Feb 2012 – Oct 2013

In this role, I managed multiple competing projects and initiatives in reporting from several departments working with leadership and peers as appropriate. I collaborated regularly with peers and departmental leadership to build and maintain reporting mechanisms for monitoring several logistic issues, including sale completion rates. During the transition of merging with TWC, I took a proactive approach in sharing information and solving problems by building queries in PeopleSoft and Hyperion reports to collect data, reconciling and remapping account structures, correcting errors and eliminating inefficiencies. I worked independently and efficiently to update and automate commission reporting to decrease process time and increase accuracy in pay for approximately 150 employees by building an Access database to handle and calculate product installation data.

REPUBLIC BANK & TRUST Louisville, KY
Credit Analyst Oct 2011 – Feb 2012

I conducted financial analysis including ratio analysis, peer and industry comparisons as available, and analyzed the financial condition of any guarantors to rate the credit worthiness and make recommendations to the Special Asset Committee/Loan Review for review of potentially troubled credits. Additionally, I prepared narrative analysis of findings and drafted credit memorandum/loan presentation for lenders while maintaining average turnaround time for credit analyses at four days or less, translating analytical information into key insights.