

State expansion of Supplemental Nutrition Assistance Program eligibility and rates of firearm-involved deaths in the United States

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ABSTRACT

Introduction Poverty is a consistent correlate of firearm-involved mortality, yet little work has considered the effects of social and economic policies on these deaths. This study examined associations of state elimination of the asset test and increases in the income limit for Supplemental Nutrition Assistance Program (SNAP) eligibility with rates of firearm-involved suicide and homicide deaths in the United States.

Methods This ecological repeated cross-sectional study used 2015–2019 data from the SNAP Policy Database and death certificate data from the National Vital Statistics System. The exposures were (1) state elimination of the asset test for SNAP eligibility and (2) state elimination of the asset test and increases in the income limit for SNAP eligibility, compared with (3) state adoption of neither policy. The outcomes were firearm-involved suicide deaths and firearm-involved homicide deaths. The research team conducted mixed-effects regressions to estimate associations.

Results State elimination of the asset test for SNAP eligibility (incidence rate ratio (IRR), 0.67; 95% CI, 0.48 to 0.91) and state adoption of both eliminating the asset test and increasing the income limit for SNAP eligibility (IRR, 0.68; 95% CI, 0.49 to 0.92) were associated with decreased rates of firearm-involved suicide deaths compared with state adoption of neither policy. There were no associations with state firearm-involved homicide rates.

Conclusions SNAP is an important social safety net programme that addresses food insecurity, and the present results suggest it may also contribute to reducing firearm-involved suicide.

INTRODUCTION

Firearm-involved injuries are a rising cause of death in the United States. Between 2001 and 2021, the age-adjusted rate of firearm-involved deaths increased from 10.3 to 14.6 per 100 000 population, accounting for approximately 17 million years of potential life lost during this time.¹ Firearm-involved mortality—including firearm-involved suicide and homicide deaths—disproportionately burdens communities in poverty.^{2–3} In response to this growing public health issue, scholars have evaluated the effects of various firearm policies, including minimum age restrictions for firearm purchase and possession,^{4–5} child access prevention laws^{6–7} and extreme risk protection orders,⁵ on firearm injury and death. Considerably less work has considered the effects of income support

WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ Poverty is a consistent correlate of firearm-involved mortality, yet little work has considered the effects of social and economic policies on firearm deaths.

WHAT THIS STUDY ADDS

⇒ The Supplemental Nutrition Assistance Program is an important social safety net programme that addresses food insecurity, and the present results suggest it may also contribute to reducing firearm-involved suicide.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

⇒ Firearms are a large and persistent contributor to mortality, and the present results add to a small but growing body of evidence that social and economic support policies may be an important component to preventing firearm deaths.

policies on firearm deaths,⁸ despite the strong and consistent association of poverty with firearm-involved mortality.^{2–9} Evaluating the potential for poverty-alleviation programmes to also reduce firearm-involved deaths may expand opportunities for preventing violence and promoting safety at the population level.

Geographically dense food insecurity is a poverty indicator associated with firearm violence.^{10–11} Strain theories offer one rationale for why dense food insecurity is associated with firearm mortality. This class of theories posits that societies create conflicting and competing pressures often concentrated on systemically oppressed groups, and some individuals then react to the strains imposed by their environments.^{12–14} Regarding firearm-involved suicide deaths, the strain theory of suicide proposes that relative deprivation—in which individuals living in densely food-insecure areas, for example, are aware that they are disadvantaged as compared with others not experiencing these hardships—is one major source of strain that can contribute to psychological distress and increased risk for suicide death.¹² Regarding firearm-involved homicides, Agnew's general strain theory suggests that strains most conducive to crime, including homicide, are (1) high in magnitude, (2) perceived as unjust, (3) associated with low social control and (4) creating pressure for criminal coping.¹⁵ Living in areas with dense food insecurity likely meets



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these four strain characteristics, as concentrated food insecurity: (1) severely harms the health of individuals and their households,¹⁶ (2) reflects legacies of structural racism,¹⁷ (3) is associated with low social cohesion and social control¹⁸ and (4) is associated with community crime and violence.^{11 19} Moreover, areas with concentrated food insecurity experience deficits in other resources, including quality childcare, safe recreation and employment opportunities, creating a context of multiple unjust, conflicting and competing strains.^{17 20}

Even though research shows an association between dense food insecurity and violence and theoretical frameworks provide a rationale regarding why these associations exist, studies have yet to evaluate the effect of addressing food insecurity on firearm violence. In a scoping review, Rowhani-Rahbar and colleagues found only four studies that examined the association between income support policies and firearm violence, all of which found reductions in firearm violence in the context of income support policies.⁸ Though not an inclusion criterion of the review, all studies focused on interpersonal firearm violence (ie, homicide), and no studies assessed the associations of such policies with firearm-involved suicides.⁸ Following strain theory rationale, interventions that decrease strain and alleviate deprivation—including concentrated food insecurity—may prevent firearm-involved homicides,¹⁵ and interventions that relieve relative deprivation may prevent firearm-involved suicides.¹² As the largest programme addressing food insecurity in the United States, the Supplemental Nutrition Assistance Programme (SNAP) has the potential to alleviate the strain and deprivation associated with food insecurity. Indeed, prior research shows that SNAP participation reduces poverty^{21 22} and food security^{22 23} and improves physical and psychological health.^{22 24}

Although the federal government establishes baseline SNAP eligibility criteria, states have the option to adopt policies that expand SNAP eligibility, thereby increasing the number of households eligible to receive a monthly benefit to assist with the cost of food. A key policy states can adopt is broad-based categorical eligibility (BBCE).²⁵ Under BBCE, states can increase the income limit for SNAP eligibility from 130% to up to 200% of the federal poverty level and/or eliminate the asset test used to determine SNAP eligibility.²⁵ Research shows that state adoption of these policies is associated with an increase in the number of households enrolled in SNAP,^{26 27} decreases in state-level poverty and food insecurity^{26 28} and decreases in rates of poor mental health, suicidal ideation and suicide deaths (including all mechanisms) among adults.²⁴ Yet, associations between state expansions to SNAP eligibility and firearm-involved suicide and homicide deaths remain unknown. These death rates have steadily increased over the past couple of decades,¹ and identifying if state expansions to SNAP eligibility are associated with fewer firearm-involved suicide and homicide deaths may inform efforts to reverse these trends.

The research team conducted the present study to examine the associations between state elimination of the asset test and state increases in the income limit for SNAP eligibility under BBCE with rates of firearm-involved homicide and suicide deaths. Given that dense food insecurity may be a strain that increases risk for suicide and violence and state expansions to SNAP eligibility are associated with decreases in food insecurity, the team hypothesised that state adoption of these policies would be associated with decreased rates of firearm-involved suicide and homicide deaths.

METHODS

Study sample

This repeated cross-sectional study used 2015–2019 data from the SNAP Policy Database and the National Vital Statistics System (NVSS). The SNAP Policy Database is available online from the US Department of Agriculture (USDA)²⁹ and provides data on state adoption of various SNAP policies through 2016. The team updated data on state adoption of BBCE policies using the SNAP State Options Reports³⁰ and communication with the USDA and state SNAP agencies. NVSS data are available online and provide data on causes of death for US residents based on death certificates.³¹

Measures

Exposures were state elimination of the asset test for SNAP eligibility, state increases in the income limit for SNAP eligibility and state adoption of both policies under BBCE. The team determined the year(s) states had each policy for 2015–2019 from the updated SNAP Policy Database. The team categorised state-years as having eliminated the asset test only, increased the income limit only or adopted both policies. There were only 10 state-years in which only the income limit for SNAP eligibility was increased; the team excluded these 10 state-years (representing two states, Michigan and Texas) from analyses because a sample size of 10 would provide unreliable estimates for the association of this single policy with firearm-involved deaths (online supplemental eTables 1 and 4). Thus, analyses compared state-years with the asset test eliminated and state-years with both policies (ie, asset test eliminated and income limit increased) to state-years with neither policy.

Outcomes were the number of firearm-involved suicide deaths (underlying cause of death International Classification of Diseases-Tenth Revision [ICD-10] codes: X72–X74) and firearm-involved homicide deaths (underlying cause of death ICD-10 codes: U01.4, X93–X95) by state and year.³²

Using existing evidence and theoretical expectations, the team created a conceptual diagram of variables likely to operate in the association between state elimination of the asset test and state increases in the income limit for SNAP eligibility under BBCE with rates of firearm-involved deaths (online supplemental eFigure 1). Based on this diagram, multivariable analyses adjusted for time-varying measures by state and year of the underlying state policy context (state minimum wage, refundable earned income tax credit, maximum Temporary Assistance for Needy Families benefit for a family of three, Medicaid expansion, recreational marijuana legalisation and number of restrictive firearm policies) and state economic conditions (percent population unemployed and median household income). The team obtained these data from the University of Kentucky National Welfare Database,³³ the RAND Corporation³⁴ and the US Census Bureau Small Area Income and Poverty Estimates.³⁵

Statistical analysis

The team compared the incidence of the two firearm-involved death outcomes (firearm-involved suicide and homicide deaths) by the three SNAP eligibility policy categories (state elimination of the asset test only, state elimination of the asset test and increases in the income limit, or neither state elimination of the asset test nor state increases in the income limit).

Mixed-effects regressions estimated associations between the SNAP eligibility policy categories and rates of the firearm death rate outcomes using a log link and negative binomial distribution to generate incidence rate ratios (IRRs) and 95% confidence

intervals (CIs). Analyses included state random effects to allow for variability among states in baseline rates of firearm-involved deaths and account for repeated measures within states over time. All models included an offset term defined as the natural log of the total population to account for differences in population size by state-year. The team calculated both unadjusted and adjusted estimates, with adjusted estimates including all covariates described above as well as a categorical variable for time (ie, calendar year) for potential confounding by secular trends. For IRRs <1.0, the formula $[(1/IRR)-1]*100\%$ calculated estimated reductions. The team performed all data analyses in R V.4.2.2 using the glmmTMB package V.1.1.7.³⁶

In alignment with best practice guidance, the team interpreted results using the magnitude of the point estimate for the IRRs and the width and location of the corresponding 95% CI.³⁷ The Institutional Review Board at the University of North Carolina at Chapel Hill (IRB #21-2494) and the Institutional Review Board at the University of Michigan (IRB #00234650) considered this study exempt from review.

Sensitivity analyses included alternative specifications for the policy exposure variable. These analyses included the 10 state-years with an increased income limit only. The team also conducted a negative control analysis with the outcome of unintentional injury deaths (underlying cause of death ICD-10 codes: V01-X59, Y85-Y86), to evaluate the potential for unmeasured confounding. Unintentional injury deaths serve as a negative control in this study as these deaths do not involve the hypothesised associations between state SNAP policy adoption and firearm-involved suicide and homicide deaths, but unintentional injury deaths very likely involve the same sources of bias (eg, similar potential confounders) that may exist in the associations of interest.

Public involvement

The public was not involved in formulating the research questions, developing measures, or informing the design of this study.

RESULTS

From 2015 to 2019, the annual number of firearm deaths per 100 000 population, for suicide and homicide, was relatively stable (figure 1). Firearm-involved suicide and homicide rates during this time were 7.21 and 4.33, respectively, per 100 000 population. With respect to SNAP policy adoptions, four states that had already eliminated the asset test newly increased SNAP income eligibility between 2015 and 2019. No other changes in state elimination of the asset test or state increases in the income limit occurred during the study period (online supplemental eTable 1).

State-years in which the state had both eliminated the asset test and increased the income eligibility limit had lower median firearm-involved suicide rates compared with state-years that had neither policy. Median firearm-involved suicide rates were similar between state-years in which the state had only eliminated the asset test and state-years that had neither SNAP eligibility policy (figure 1). State elimination of the asset test only (adjusted IRR (aIRR), 0.67; 95% CI, 0.48 to 0.91) and adoption of both policies (aIRR, 0.68; 95% CI, 0.49 to 0.92) were associated with decreased rates of firearm-involved suicide deaths compared with state adoption of neither policy in both adjusted and unadjusted models (figure 2; online supplemental eTable 2). The rate of firearm deaths was 49% lower in states that eliminated the asset test and 47% lower in states that adopted both policies compared with states with neither policy.

State-years in which the state had both eliminated the asset test and increased the income eligibility limit had lower median firearm-involved homicide rates compared with state-years that had neither policy. State-years in which the state had only eliminated the asset test for SNAP eligibility had higher median firearm-involved homicide rates compared with state-years that had neither policy (figure 1). In both unadjusted and adjusted models, adoptions of these SNAP policies were not associated with firearm-involved homicide rates (figure 2; online supplemental eTable 2; aIRR 0.87 and 95% CI 0.55 to 1.38 for state elimination of the asset test and aIRR 0.99 and 95% CI 0.63 to 1.55 for state adoption of both policies compared with state adoption of neither policy).

Results from sensitivity analyses that included the 10 state-years in which only the income limit was increased were similar to the analyses that excluded these states. State elimination of the asset test only and adoption of both policies were associated with lower rates of firearm-involved suicide deaths but not associated with changes in rates of firearm-involved homicide deaths (online supplemental eTable 3). In the negative control analysis, neither state elimination of the asset test only nor adoption of both policies was associated with rates of unintentional injury deaths (online supplemental eTable 4).

DISCUSSION

State expansion of SNAP eligibility was associated with a decrease in the rate of firearm-involved suicide deaths. As such, there was partial support for the hypotheses, whereby state expansion of SNAP eligibility was associated with decreased rates of firearm-involved suicide deaths but not firearm-involved homicide deaths. According to the strain theory of suicide, the findings support the idea that state expansion of SNAP eligibility may address relative deprivation and in turn prevent a subset of firearm-involved suicide deaths on a scale observable at the population level.¹² Yet the expansion of SNAP eligibility may be insufficient to address the multiple compounding strains that are precursors to firearm-involved homicides.¹⁵

In the United States, suicide deaths account for more than half of all firearm-involved deaths, and firearms are the most common method of death by suicide.¹ In 2021, rates of firearm-involved suicide deaths were the highest documented since the early 1990s.³⁸ Thus, identifying strategies to reduce firearm-involved suicides is a critical public health priority. Prior research indicates that by expanding the number of households eligible for food purchasing assistance through SNAP, state elimination of the asset test and increases in the income limit for SNAP eligibility contribute to decreases in poverty and food insecurity,^{26 28} key risk factors for poor mental health.^{39 40} In fact, recent research shows that state adoption of these policies is associated with decreased rates of poor mental health and suicidal ideation among adults at the population level.²⁴ By addressing food insecurity, a source of strain that is an important risk factor for poor mental health and suicidal ideation, state adoption of policies that expand SNAP eligibility may help decrease rates of firearm-involved suicide deaths.

State expansion of SNAP eligibility was not associated with changes in rates of firearm-involved homicide deaths. Although dense food insecurity is associated with higher rates of firearm violence,¹¹ state expansion of SNAP eligibility may be insufficient to immediately address the multiple compounding sources of strain contributing to risk for firearm-involved homicides.¹³ The association of food insecurity with firearm-involved homicide is likely complex,¹³ and multiple supportive social and economic

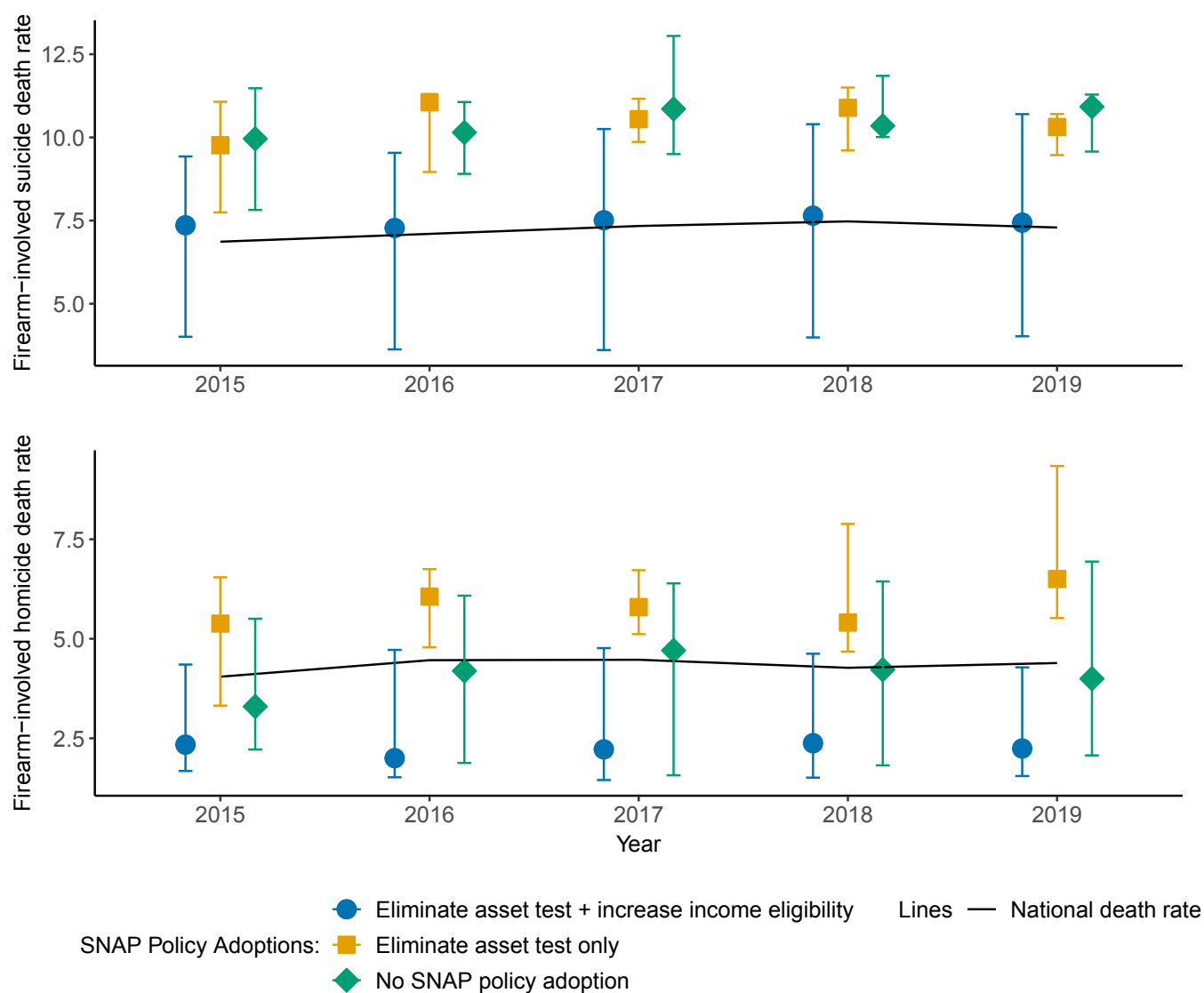


Figure 1 Number of firearm-involved suicide deaths and firearm-involved homicide deaths per 100 000 population among all states (black trend line) and median number of deaths among states that (1) eliminated the asset test for Supplemental Nutrition Assistance Program (SNAP) eligibility and increased the income limit for SNAP eligibility (blue circles), (2) eliminated the asset test only (orange squares) and (3) neither eliminated the asset test nor increased the income limit for SNAP eligibility (green diamonds), 2015–2019. Dots indicate median deaths per 100 000 population. Error bars provide IQR range around the median. SNAP, Supplemental Nutrition Assistance Program.

policies as well as collaboration between public health, social service, and law enforcement agencies may be needed to reduce rising rates of firearm-involved homicide deaths in the United States.³⁸ It may also be that state expansions of SNAP eligibility have a lagged association with rates of firearm-involved homicides, not modelled in the present analyses. Future work should continue to develop and test theories that comprehensively explain the association between poverty and firearm mortality with the goal of informing effective policy and programmatic intervention strategies to equitably reduce this mortality burden.

Limitations

This study is not without limitations. First, most states did not change their SNAP eligibility policy categories during the study period. Thus, there was little prepolicy time to leverage in analyses, and estimates of associations between state expansion of SNAP eligibility under BBCE and firearm-involved violence

heavily rely on between-state comparisons. Although multivariable analyses adjusted for a comprehensive set of potential confounders, there may be unmeasured confounding. However, we found no association of state expansion of SNAP eligibility with a negative control outcome of unintentional injury deaths, providing support that results may be internally valid. Second, this study was ecological and thus was subject to the ecological fallacy; the results do not allow for causal inferences regarding the potential impact of SNAP participation on firearm-involved death at the individual level. Third, the study population included all individuals and was not limited to only those eligible for SNAP. Results may be an underestimate of associations among those who are eligible for and thus will benefit from participating in SNAP. For example, prior research found that state Medicaid expansion was associated with decreased rates of suicide deaths among all non-elderly adults; however, this decrease was larger when limited to non-elderly adults

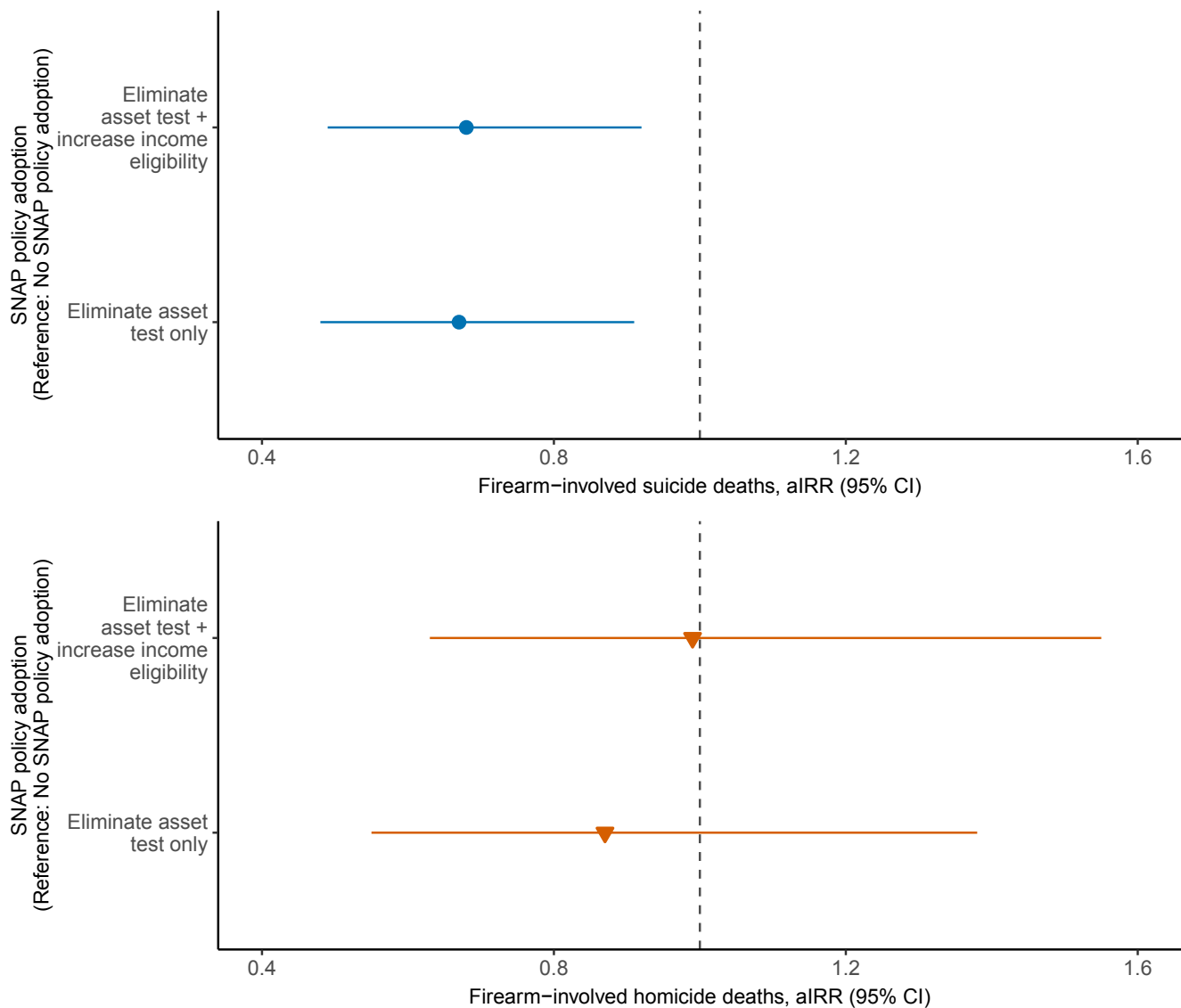


Figure 2 Adjusted incidence rate ratios (aIRR) and 95% CIs from mixed effects models of the associations between state elimination of the asset test and state increases in the income limit for Supplemental Nutrition Assistance Program (SNAP) eligibility with firearm-involved suicide deaths (blue circles) and homicide deaths (red triangles), 2015–2019. *Note:* aIRR adjusted for state minimum wage, refundable earned income tax credit, maximum Temporary Assistance for Needy Families benefit for a family of three, per cent population unemployed, median household income, number of restrictive firearm laws and calendar year. aIRR, adjusted incidence rate ratio; SNAP, Supplemental Nutrition Assistance Program.

with less than a college education, a population more likely to become eligible for Medicaid under expansion.⁴¹ Future analyses that consider state SNAP participation rates would provide additional insights into the associations between state SNAP eligibility policies and firearm violence.

CONCLUSIONS

There is an urgent public health need to identify effective strategies that prevent firearm-involved deaths in the United States. Firearms are a large and persistent contributor to mortality, and the present results add to a small but growing body of evidence that social and economic support policies may be an important component to preventing firearm deaths at the population level.⁸ SNAP is an important social safety net programme that addresses food insecurity, and results suggest it may also alleviate strain

caused by relative deprivation and reduce the risk of firearm-involved suicide.

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