Reexamining the Association Between Child Access Prevention Gun Laws and Unintentional Shooting Deaths of Children

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ABSTRACT. *Context.* **A previous study estimated that child access prevention (CAP) laws, which hold adults criminally liable for unsafe firearm storage in the environment of children, were associated with a 23% decline in unintentional firearm mortality rates among children.**

Objective. **To reassess the effects of CAP laws and more fully examine the consistency of the estimated law effects across states.**

Design. **A pooled time-series study of unintentional firearm mortality among children from 1979 through 1997.**

Setting. **The 50 states and the District of Columbia.**

Participants. **All children <15 years.**

Main Outcome Measures. **Rates of unintentional deaths attributable to firearms.**

Results. **When the effects of all 15 state CAP laws enacted before 1998 were aggregated, the laws were associated with a 17% decline unintentional firearm death rates among children. The laws' effects were not equal across states. Florida's CAP law was associated with a 51% decline; however, there were no statistically significant aggregate or state-specific law effects in the other 14 states with CAP laws.**

Conclusions. **Florida's CAP law—1 of only 3 such laws allowing felony prosecution of violators—appears to have significantly reduced unintentional firearm deaths to children. However, there is no evidence of effects in the other 14 states with CAP laws.** ***Pediatrics* 2000;106:1466–1469;** ***child access prevention laws, unintentional firearms deaths.***

ABBREVIATIONS. CAP, child access prevention laws; IRR, incidence rate ratio; CI, 95% confidence interval; LR, likelihood ratio.

In the United States in 1997, 142 children between 0 and 14 years old died and many more suffered nonfatal injuries from unintentional shootings.[1] The rate of unintentional firearm deaths to children is 9 times higher in the United States than in 25 other industrialized countries combined.[2] Storing firearms in the home unloaded and securely locked up can potentially prevent many of these incidents and possibly prevent some adolescent suicides as well. Recent surveys indicate that 33% to 40% of US households have a gun in them,[3–5] and 1 in 5 gun owners report keeping at least 1 gun loaded and unlocked.[3,5] The American Academy of Pediatrics recommends pediatricians counsel parents about risks associated with keeping guns in the home and how to store guns safely when they are in the environment of children.[6] But most pediatricians do not routinely counsel parents about firearm risks,[7,8] and the only evaluation of such counseling did not find significant effects on gun ownership or gun storage.[9]

Gun-related deaths and injuries involving children have motivated legislators in 17 US states to pass laws that make a gun owner criminally liable if his or her gun is not stored safely and a child uses it to injure himself or others. These laws are commonly referred to as child access prevention (CAP) laws. The US Congress recently considered legislation that would include penalties of up to 1 year in prison and a fine of up to $10 000 for gun owners who do not take appropriate measures to prevent unsupervised child access to the gun if an injury or death occurs.[10]

Cummings et al[11] estimated the effects of the 12 state CAP laws that went into effect before January 1994, and concluded that these laws were associated with a 23% reduction in unintentional gunshot deaths among children <15 years old. Although often not mentioned when the study is referenced in scientific journals,[12] prevention guidelines,[13] or news stories,[14] data from this study indicated that statistically significant reductions associated with the CAP laws were limited to the subgroup of 3 states in which violation of the law was a felony.

The current study more fully examines the interstate variability in CAP law effects on unintentional firearm deaths and the influence of a single state on the aggregate estimate of the effects of the laws. Compared with the previous study, this study includes 3 additional years of data, 3 additional states that adopted CAP laws, and, consequently, more than twice as many child-years of exposure to CAP laws.

METHODS

Data on the annual number of unintentional gunshot deaths among children 0 to 14 years old and on population demographics were obtained for each state and the District of Columbia from the Compressed Mortality Files of the National Center for Health Statistics for the years 1979 through 1997.[1] We included in the analyses deaths for which a medical examiner or coroner assigned an external cause of death code within the range of E922.0 to E922.9[15] for accidental injuries caused by a firearm missile.

Our evaluation strategy sought to contrast within-state changes in childhood unintentional firearm death rates between states that adopted CAP laws with changes in states that had not adopted a CAP law. As is common for policy impact studies of this type, we

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estimated the effect of CAP laws using regression models that included an explanatory variable set equal to 0 when there was no law and equal to 1 when the law was in effect in a given state and year. When the effective date of a law was not January 1, the value of the CAP law variable was set equal to the proportion of days of that year in which the law was in effect. Incidence rate ratios (IRRs) were estimated to contrast changes in childhood unintentional firearm death rates from prelaw to postlaw periods between states that adopted a CAP law from those that did not pass such a law. An IRR for the CAP law that is <1.0 indicates rates were lower than would have been expected had the law not been implemented. IRRs that are >1.0 indicate higher than expected rates. For ease of interpretation, IRR estimates were converted to the percentage change in childhood unintentional firearm death rates associated with the CAP laws.

The models also included dichotomous indicator variables for each state. Including these so-called fixed effects for states in the models results in all variables being measured as deviations from the state's average for the study period, and enables the law variable to isolate within-state changes associated with the law. Year dummy variables were also used to control for temporal variation observed across states, irrespective of their CAP law status, attributable to unmeasured factors (eg, prevalence of gun ownership). Changes in state population distributions for age, sex, and race were examined as potential confounders.

Because annual rates of unintentional gunshot deaths among children can vary widely from year to year in states with small populations, we used negative binomial regression models to estimate the effects of CAP laws. This procedure allows for possible overdispersion that could violate the restrictive assumptions of the Poisson distribution.[16]

We examined the consistency in the estimated CAP law effects across states by allowing the effect of the law to vary by state. The likelihood ratio statistic was used to test the equality of the laws' effects across states.[17] In addition, we tested the sensitivity of the aggregate law estimate to the experience in any single state by fitting 15 models, each of which excluded the observations from a different 1 of the 15 states with a CAP law. Autocorrelation coefficients were calculated for the Pearson residuals for lags of 1 to 5 years to determine if there was autocorrelation in the model residuals.

RESULTS

Aggregate Effects of CAP Laws

Using the same data and methods used by Cummings et al,[11] we first replicated their findings. As was the case in the previous study, the age, sex, and race distributions did not confound the CAP law estimates; therefore, we did not control for these variables in the final models. When the 3 most recent years (1995–1997) of data and 3 new state CAP laws were added, and a more precise measure of the time period in which the laws were in effect was used, CAP laws were associated with an overall 17% decrease (95% confidence interval [CI]: −29%, −3%) in rates of unintentional shooting deaths among children 0 to 14 years old (Table 1). There was statistically significant difference in CAP law effects between states that allowed for felony prosecution of law violators versus states where unlawful gun storage was a misdemeanor offense (likelihood ratio [LR] $\chi^2 = 6.75$; $df = 1$; $P = .01$). In the 3 states in which a CAP law violation can be prosecuted as a felony (Florida, Connecticut, and California), there was a 31% decrease (95% CI: −44%, −15%) associated with the law. However, there was no change in the rate of unintentional gun deaths to children associated with CAP laws with only misdemeanor penalties (95% CI: −19%, +22%).

Variability of CAP Law Effects Across States

When CAP law effects were allowed to vary across the 15 states, the state-specific law effect estimates were not homogeneous (LR $\chi^2 = 25.43$; $df = 14$; $P = .03$; Table 1). Florida's CAP law was associated with a 51% decline (95% CI: −75%, −31%) in the rate of unintentional firearm deaths to children 0 to 14 years old. No other state CAP law effect was statistically significant at the .10 level. The estimated CAP law effect in Florida translates into 52 fewer children killed by unintentional shootings during the 8.25 years of postlaw follow-up than would have been expected without the law, an average of 6.2 children's lives saved per year the law was in effect.

When data for Florida were excluded from the analyses, there were no statistically significant aggregate law effects in the remaining 14 states that adopted CAP laws (−5%; 95% CI: −20%, +12%) or in the other 2 other states with felony penalties (−14%; 95% CI: −33%, +10%). Furthermore, when Florida was excluded from the analyses, there was no statistically significant difference in the state-specific law effects among the 14 other CAP-law states (LR $\chi^2 = 12.63$; $df = 13$; $P = .48$). Excluding the effects of any single CAP law state other than Florida did not have a significant impact on the aggregate estimate of the laws' effect.

DISCUSSION

The prior evaluation of CAP laws[11] is commonly cited as evidence that these laws have reduced rates of unintentional firearm deaths to children. The caveat that significant reductions were observed only among the group of 3 states that allowed for felony

TABLE 1. Estimated Change in the Rate of Unintentional Firearm Deaths Among Children 0 to 14 Years Old Associated With the Adoption of CAP Gun Storage Laws, and Tests for Equality of Law Effects

	Estimated Change Associated With CAP Law	95% CI	Significance Level
All CAP laws	−17%	(−29%, −3%)	.018
Felony CAP law	−31%	(−44%, −15%)	.001
Misdemeanor CAP law	0%	(−19%, +22%)	.981
Equality of effects test: LR $\chi^2 = 6.75$; $df = 1$; $P = .01$.			
Florida CAP law	−51%	(−75%, −31%)	<.001
Other 14 CAP laws	−5%	(−20%, +12%)	.522
Equality of effects test: all 15 CAP laws: LR $\chi^2 = 25.43$; $df = 14$; $P = .03$.			
14 CAP laws other than Florida's: LR $\chi^2 = 12.63$; $df = 13$; $P = .48$.			

prosecution of safe CAP law violators is often ignored.[12–14] We found an unusually dramatic law effect in 1 of these 3 states (Florida) that was largely responsible for both the law effects within the subset of states with felony CAP laws, and for the aggregate effect across the 15 states with CAP laws. Our tests of the equality of state-specific effects indicated that the 51% reduction in unintentional firearm deaths to children associated with Florida's CAP law was unique. When Florida was excluded from the analyses, there were no statistically significant aggregate or state-specific CAP law effects on childhood unintentional firearm death rates among the other 14 states that had adopted CAP laws.

There are 3 noteworthy limitations about the data used in both this study and in the previous evaluation. First, longitudinal data on gun storage practices, the behavior targeted by the law, are not available. Second, available data on mortality from unintentional shootings do not include data about the person who pulled the trigger, such as the shooter's age. Finally and perhaps most importantly, some medical examiners code deaths in which someone shoots another person as homicides if the shooter intentionally pulls the trigger, regardless of the shooter's intention to harm the victim.[18] Scenarios in which someone apparently does not realize a gun is loaded and shoots himself or herself or someone else are coded as suicides or homicides by some medical examiners and as unintentional firearm deaths by others. Thus, death certificate coding practices for such incidents are likely to vary across place and time. Measurement error introduced by inconsistent death certificate coding or by inadequate specificity of our outcome measure could bias estimates of CAP law effects in an unknown direction and reduce their precision.

With those caveats, there are at least 2 possible interpretations of our findings. One, based on the lack of a statistically significant CAP law effect in 14 of the 15 states that adopted these laws, is that CAP laws are ineffective in reducing unintentional firearm deaths to children. But this interpretation requires one to dismiss the very substantial decline (−51%) associated with the adoption of Florida's CAP law that is measured with 8 years of postlaw data and attribute it to unmeasured confounders or to normal statistical variation in trends. The very high level of statistical significance of Florida's CAP law effect ($P < .001$) and our inability to identify any obvious unmeasured confounder that might explain the dramatic decline in Florida causes us to doubt this interpretation.

Perhaps the most plausible interpretation of our findings is that there was indeed something unique about Florida's experience with their CAP law that was responsible for its sharp decline in childhood unintentional shooting deaths. Necessary data are not available to explore all feasible explanations for our findings; however, at least 3 factors distinguish Florida and its law from the other states with CAP laws. First, Florida was the first state to implement a CAP law. Because groundbreaking events tend to be viewed as being particularly newsworthy,[19] news coverage of Florida's law may have been substantially greater than was the case in the other states that adopted CAP laws. The amount and intensity of the news coverage may also have been greater in Florida than in the other states because of 8 highly-publicized unintentional child shootings in Florida during the 2 weeks before the law's passage.[20] If this was the case, Florida's law may have led to more public awareness than was the case in other states.

Second, Florida's law allows for the stiffest penalties of any of the state laws that were subsequently passed. Both our study and the previous evaluation found the beneficial effects of CAP laws were limited to states that allow for felony prosecution of violators. One way in which the possibility of felony prosecution may lead to greater law effectiveness is by increasing public awareness of the law. Because most news is event-based,[19] postenactment publicity about a law may be dependent on news coverage of law violators being prosecuted. Indeed, the first case prosecuted under Florida's law received extensive news coverage by local, regional, and national outlets.[21] But prosecutors may be reluctant to prosecute cases in which the most serious violation is only a misdemeanor.[22]

Finally, Florida prelaw rates of unintentional firearm deaths to children 0 to 14 years old were higher than all but 2 of the other states (Texas and Nevada) that passed CAP laws. Many of the states that did not experience statistically significant reductions in childhood unintentional firearm deaths after introducing a CAP law had very low rates before the laws were enacted. The low prelaw rates in these states may create a floor effect that make it more difficult to achieve statistically significant reductions than in states such as Florida with much higher baseline rates of childhood unintentional firearm deaths.[23]

Keeping guns securely locked up and unloaded has the potential to reduce the risk of both intentional and unintentional shootings by children and adolescents, and may also reduce the availability of guns to criminals by reducing firearm thefts. But there are significant barriers to changing unsafe gun storage practices including the perceived need by some gun owners to keep guns firing-ready for potential defensive use,[24,25] unrealistic perceptions about children's and adolescents' ability to always follow safety rules concerning guns,[26,27] and the difficulty in avoiding occasional carelessness. In light of these barriers to safe gun storage, it may be prudent to also require guns to have built-in safety features such as magazine safeties that prevent a pistol from firing when its ammunition magazine is removed[28] and devices that prevent unauthorized users from firing the gun.[29]

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Orey M. *Wall Street Journal.* June 16, 2000

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