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State-level homicide victimization rates in the US in relation to survey measures of household firearm ownership, 2001–2003

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Abstract

Two of every three American homicide victims are killed with firearms, yet little is known about the role played by household firearms in homicide victimization. The present study is the first to examine the cross sectional association between household firearm ownership and homicide victimization across the 50 US states, by age and gender, using nationally representative state-level survey-based estimates of household firearm ownership. Household firearm prevalence for each of the 50 states was obtained from the 2001 Behavioral Risk Factor Surveillance System. Homicide mortality data for each state were aggregated over the three-year study period, 2001–2003. Analyses controlled for state-level rates of aggravated assault, robbery, unemployment, urbanization, per capita alcohol consumption, and a resource deprivation index (a construct that includes median family income, the percentage of families living beneath the poverty line, the Gini index of family income inequality, the percentage of the population that is black and the percentage of families headed by a single female parent). Multivariate analyses found that states with higher rates of household firearm ownership had significantly higher homicide victimization rates of men, women and children. The association between firearm prevalence and homicide victimization in our study was driven by gun-related homicide victimization rates; non-gun-related victimization rates were not significantly associated with rates of firearm ownership. Although causal inference is not warranted on the basis of the present study alone, our findings suggest that the household may be an important source of firearms used to kill men, women and children in the United States.

Keywords: Homicide; Firearms; Guns; Violence; Epidemiology; USA

Introduction

Approximately two in three homicide victims in the US are killed with guns(Centers for Disease Control and Prevention), yet the role of household firearms in homicide victimization has not been well characterized. Case-control studies suggest that the presence of a gun in the home is a risk factor for homicide in the home (Kellermann et al., 1993), that the risk is higher for women than for men (Bailey et al., 1997a, b), and that when any family member purchases a handgun all members of the household are at increased risk of homicide victimization (Cummings, Koepsell, Grossman, Savarino, & Thompson, 1997). Limitations of existing case–control studies include not controlling for (1) possible differential recall of firearm ownership by

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cases compared to controls, and (2) possible reverse causation—i.e. gun ownership may sometimes be a response to an increased risk of homicide victimization (Hemenway, 2004; Hepburn & Hemenway, 2004; National Research Council, 2005).

Most (Brearly, 1932; Brill, 1977; Cook, 1979; Duggan, 2001; Lester, 1988, 1990; Seitz, 1972), but not all, (Kaplan & Geling, 1998; Kleck & Patterson, 1993) ecologic studies have found a positive association between various measures of firearm availability and overall rates of homicide. Among nationally representative studies, those using surveys to estimate household firearm ownership have been limited to evaluating variation across the 9 US Census regions. With only 9 units of observation, these studies have not been able to control for potential ecologic confounders. Until now, for state, city and county analyses, researchers have been forced to use proxies of firearm ownership (Duggan, 2001; Miller, Azrael, & Hemenway, 2002; Price, Thompson, & Dake, 2004), the use of which has been criticized by a recent NAS report as possibly introducing bias (National Research Council, 2005). It is only since the 2001, Behavioral Risk Factor Surveillance System (2001) added questions about household firearm ownership that large-scale survey data have been available on household firearm ownership for all 50 states. The present investigation is the first nationally representative study to use state-level, survey-based estimates of household firearm ownership to examine the association between household gun ownership and homicide rates.

Methods

In this analysis, outcomes are state-level rates of homicide, firearm homicide and non-firearm homicide, aggregated over the 3-year study period, 2001–2003. Homicide mortality data for each state were obtained through the CDC's Web-based Injury Statistics Query and Reporting System (Centers for Disease Control and Prevention). Homicide data, grouped by firearm (ICD-10 E-codes X93-X95) and non-firearm methods (E-codes X85-X92, X96-Y09, Y87.1), were further stratified by gender and age (5–14, 15–17, 18–34, and 35 years of age and older). Non-firearm homicide from terrorism (E-code U01.1) was excluded from analyses. Mortality data are aggregated (2001–2003) to provide a sufficient number of observations to allow comparisons across age and gender sub-groupings. Gun-related deaths of undetermined intent constituted less than 3% of all gun-related deaths and were excluded from the analyses.

The key independent variable of interest is household firearm prevalence. State level data on the percentage of individuals living in households with firearms were obtained from the 2001 Behavioral Risk Factor Surveillance System (BRFSS). The BRFSS, the world's largest telephone survey (over 200,000 adult respondents annually), is an ongoing data collection program sponsored by the Centers for Disease Control and Prevention (CDC), with all 50 states participating. Data were representative of the US in 2001 at the state and national level. BRFSS questionnaires and data are available on the Internet at www.cdc.gov/brfss; the BRFSS uses a complex sampling and weighting scheme described in detail elsewhere . Firearm prevalence estimates presented exclude respondents who did not know or refused to answer the BRFSS firearm questions (fewer than 4% of all respondents). The verbatim firearm question and the preface to the questions reads: "The next question is about firearms, including weapons such as pistols, shotguns, and rifles; but not BB guns, starter pistols, or guns that cannot fire. Are any firearms now kept in or around your home? Include those kept in a garage, outdoor storage area, car, truck, or other motor vehicle."

Multivariate analyses adjust for several potential confounders previously identified in the literature: rates of aggravated assault and robbery (Hsieh & Pugh, 1993), urbanization (Fingerhut, Ingram, & Feldman, 1992), unemployment (Karpati, Galea, Awerbuch, & Levins, 2002; Reed, Smith, Helmer, Lancaster, & Carman, 2003), alcohol use (Goodman et al., 1986), the percentage of the population 18–34 years of age (Gastil, 1971; Land, McCall, & Cohen, 1990; Loftin & Hill, 1974), the percentage divorced (Land et al., 1990), and a binary indicator variable for living in the southern census region (Gastil, 1971; Huff-Corzine, Corzine, & Moore, 1986; Land et al., 1990). In addition, we use principal components analysis (Wall, Rechtsteiner, & Rocha, 2003) to generate a "resource deprivation index", a construct originally described by Land et al. (1990) to have an invariant relationship with homicide rates across time and space. As in Land et al. (1990), our resource deprivation index includes three income variables (median family income, the percentage of families living beneath the poverty line, and the Gini index of family income inequality)