State Estimates of Household Exposure to Firearms, Loaded Firearms, and Handguns, 1991 through 1995

Kenneth E. Powell, MD, MPH, Beth C. Jacklin, MPH, David E. Nelson, MD, MPH, and Shayne Bland, MS

ABSTRACT

Objectives. Variations among states in household exposure to firearms, loaded firearms, and handguns were examined.

Methods. Data from the Behavioral Risk Factor Surveillance System in 22 states were used to estimate the prevalence of adults and children exposed to household firearms.

Results. The prevalence of adults living in households with firearms ranged from 12% to 57%; the corresponding ranges were 1% to 23% for loaded firearms and 5% to 36% for handguns. The prevalence of children less than 18 years of age living in households with loaded firearms ranged from 2% to 12%.

Conclusions. Important variations among states exist in the prevalence of adults and children living in households with firearms, loaded firearms, and handguns. (*Am J Public Health.* 1998;88:969–972)

Introduction

In 1994, 38 505 people died in the United States as a result of firearm injuries, and approximately 100 000 nonfatal firearm injuries were treated in US hospital emergency departments.[1,2] Firearms are associated with about 60% of suicides and 70% of homicides.[1] Among young people 10 to 14 and 15 to 24 years of age, firearms are the second most common cause of death, exceeded only by unintentional injuries.[3]

The type of firearm and the manner in which it is stored are related to the likelihood that a firearm will be linked to an injury. Recent data, for example, indicate that handguns, which constitute about one third of the firearms in the United States,[4] account for 70% to 90% of fatal firearm injuries.[5–7] Handguns also are about 5 times more likely to be kept loaded than long guns.[4]

Efforts to reduce the incidence of firearm injuries should be guided by, among other things, information about the number, manner of storage, and type of firearms. National,[8] state,[9–13] and local[14,15] surveys indicate geographic variations in the prevalence of households with firearms, rates ranging from 25% in San Diego to 53% in Louisiana. To examine variation in state and regional exposure to household firearms, we analyzed data from 22 population-based state surveys estimating the prevalence of adults living in households with firearms, loaded firearms, and handguns. We also estimated the number of children living in households with loaded firearms.

Methods

Data were obtained from 1991 through 1995 surveys of the Behavioral Risk Factor Surveillance System. (Details have been published elsewhere.[16,17]) Briefly, state health departments conduct monthly telephone surveys of randomly selected persons 18 years old and older. Over the 5-year study period, 22 states asked about household firearms (Table 1). We analyzed data from all states except Louisiana, whose data had already been published.[12] The median sample size was 2061, the median response rate[18] was 66.9%, the median proportion of homes with telephones was 95.6%, and the median refusal rate for the firearm section was 2.0%. For states that asked firearm questions in more than 1 year, we used the most recent data.

Twelve states collected data in 1995 using identical questions. Prior to that year, states developed firearm questions independently, and there was variability in wording (survey questions are available from the authors). Respondents commonly were asked 1 of 3 types of questions: Was there a firearm in the household? (21 states); Was there a loaded firearm in the household? (21 states); or Was there a handgun in the household? (10 states). For our analyses, if any firearm was a handgun, the household was considered to have a handgun. If any firearm was stored loaded, the household was considered to have a loaded firearm. Data were stratified by age, sex, race/ethnicity, education, income, metropolitan status,[19] and (1993 through 1995 only) presence of children less than 18 years of age in the household.

Estimates were weighted to each state's adult population, and we excluded unknown or missing data from all analyses. SUDAAN[20] was used to calculate standard errors and 95% confidence intervals. Estimates for subpopulations were not reported if denominators contained fewer than 100 respondents. We used 1990 census data[21] to estimate the number of children exposed to loaded household firearms.[11]

At the time of the study, Kenneth E. Powell and Beth C. Jacklin were with the Division of Violence Prevention, National Center for Injury Prevention and Control, Centers for Disease Control and Prevention, Atlanta, Ga. Dr. Powell is now an epidemiological and public health consultant in Atlanta; Ms. Jacklin is with the Norfolk County Attorney's Office, Quincy, Mass. David E. Nelson and Shayne Bland are with the Division of Adult and Community Health, National Center for Chronic Disease Prevention and Health Promotion, Centers for Disease Control and Prevention.

Requests for reprints should be sent to Rachel Lysne, Mailstop K-60, National Center for Injury Prevention and Control, CDC, 4770 Buford Hwy, Atlanta, GA 30341-3724.

This paper was accepted October 9, 1997.

Results

Among 21 states, the prevalence of adults living in households with firearms ranged from 12% in New Jersey to 57% in Idaho, and the prevalence of adults living in households with loaded firearms ranged from 1% in Rhode Island to 23% in Louisiana and Mississippi (Table 1). Among 18 states, the prevalence of children less than 18 years of age living in households with loaded firearms ranged from 2% in Connecticut and Delaware to 12% in Kansas and Mississippi. Among 10 states, the prevalence of adults living in households with handguns ranged from 5% in Rhode Island to 36% in Louisiana.

Living in homes with firearms was least common in the Northeast and most common in the South. Living in homes with loaded firearms was least common in the Northeast and most common in the South and the West. Intraregional, state-specific estimates differed severalfold (Table 1). For example, the prevalence of adults living in households with firearms ranged from 12% to 41% in the Northeast and from 30% to 57% in the West. In the Midwest, the prevalence of children living in households with loaded firearms ranged from 3% to 12%.

Despite these differences in prevalence among states, patterns of household and personal characteristics of adults in households with firearms were similar. For example, men were significantly more likely than women to live in households with firearms and households with handguns in all states, and they were significantly more likely to live in households with loaded firearms in 19 of 20 states (New Jersey was the exception) (Table 2). Similarly, in many states, living in nonmetropolitan households, having higher incomes, and being White were independently associated with living in a house with firearms, loaded firearms, and handguns. Adults living in households with and without children less than 18 years of age were equally likely to have firearms. However, adults living in households with children were less likely to have loaded firearms and handguns (Table 2).

A few situations in which the state-specific pattern differed from the general pattern were noted. For example, contrary to the case in other states, non-Whites in Michigan were significantly more likely than Whites to live in households with loaded firearms and handguns. Michigan, Wisconsin, and Rhode Island were the only states (out of 10) in which the prevalence of adults living in households with handguns was less than half of all households with firearms.

TABLE 1—Prevalence of Adults Living in Households with Any Firearms, Adults and Children Living in Households with Loaded Firearms, and Adults Living in Households with Handguns, by State: 1991 through 1995

Region, State, and Year of Survey	Any Household Firearm, % (95% CI)	Loaded Household Firearm		Any Household Handgun, % (95% CI)
		Adults, % (95% CI)	Children, % (95% CI)	
Northeast				
Connecticut (1995)	18 (16, 20)	4 (3, 5)	2 (1, 3)	. . .
Delaware (1995)	28 (26, 30)	6 (5, 7)	2 (1, 3)	. . .
New Jersey (1995)	12 (10, 14)	4 (3, 5)	3 (2, 4)	. . .
New York (1995)	14 (12, 16)	5 (4, 6)	4 (3, 5)	. . .
Pennsylvania (1994)	41 (39, 14)	4 (3, 5)	4 (3, 5)	22 (20, 24)
Rhode Island (1991)	14 (11, 17)	1 (1,1)	. . .	5 (3, 7)
Midwest				
Indiana (1995)	40 (38, 42)	11 (10, 12)	9 (7, 11)	. . .
Kansas (1995)	41 (38, 44)	10 (8, 12)	12 (9, 15)	. . .
Michigan (1992)	46 (44, 48)	6 (5, 7)	. . .	18 (16, 20)
Wisconsin (1994)	49 (46, 52)	4 (3, 5)	3 (2, 4)	20 (17, 23)
South				
Kentucky (1995)	49 (46, 52)	15 (13, 17)	8 (6, 10)	31 (29, 33)
Louisiana[b] (1992)	53	23	. . .	36
Mississippi (1995)	55 (52, 58)	23 (21, 25)	12 (10, 14)	. . .
Oklahoma (1992)	54 (51, 57)	. . .	. . .	36 (33, 39)
West Virginia (1995)	51 (49, 53)	13 (11, 15)	9 (7, 11)	. . .
West				
Arizona (1995)	33 (30, 36)	15 (13, 17)	10 (8, 12)	. . .
California (1994)	30 (28, 32)	8 (7, 9)	5 (4, 6)	21 (19, 23)[a]
Colorado (1993)	38 (35, 41)	9 (8, 10)	5 (3, 7)	25 (23, 27)
Idaho (1995)	57 (54, 60)	15 (13, 17)	10 (8, 12)	. . .
New Mexico (1995)	43 (41, 45)	17 (15, 19)	8 (6, 10)	. . .
Oregon (1993)	49 (47, 51)	14 (13, 15)	9 (7, 11)	30 (28, 32)
Washington (1994)	. . .	15 (14, 16)	9 (7, 11)	. . .

Note. CI = confidence interval.
[a]Handgun data are from 1994 for Kentucky and from 1993 for California.
[b]Louisiana data are unweighted.

Discussion

Recent surveys indicate that about 35% of adults in the United States live in households with 1 or more firearms,[4,22,23] about 20% live in households with handguns,[4] and about 12% live in households with loaded firearms.[4,24] Our data from 22 state-specific surveys are consistent with these national estimates but demonstrate that state-specific prevalence estimates range widely around the national average. Previous surveys have indicated that male, White, nonmetropolitan, and wealthier residents are more likely to live in households with firearms, findings generally exhibited by the individual states as well. However, departures from the general pattern were noted in the present study (e.g., the racial pattern in Michigan and the relatively low prevalence of handguns in Michigan, Wisconsin, and Rhode Island), indicating the value of state and local surveys.

In most states, adults living with children were less likely than those living without children to reside in households with handguns and loaded firearms. Nevertheless, the prevalence of children living in households with a loaded firearm ranged from 2% to 12% in the 18 states for which we could make an estimate, representing a total of more than 1.5 million children. Surveys of families visiting a pediatrician have yielded similar prevalences.[25,26] Although unintentional firearm fatalities among children younger than 15 years of age account for less than 1% of all firearm fatalities,[1] they are among the most tragic and the most preventable, and most of them occur in the home.[27–29]

There are limitations to our report, and variation among the states in the wording of questions seems most important. The 12 states collecting data in 1995 used identical questions; prior to 1995; however, differences existed. For example, when asking about firearms in the household, some states inquired simply whether a "gun" was present. Others asked about "any kind" of firearm. Some limited the query to "work-

TABLE 2—Associations between Demographic Characteristics of Adults with Any Household Firearm, Any Loaded Household Firearm, and Any Handgun

Demographic Characteristic	Any Household Firearm		Loaded Household Firearm		Any Household Handgun	
	Median OR (Range)	States with Significant Differences,[a] % (no.)	Median OR (Range)	States with Significant Differences,[a] % (no.)	Median OR (Range)	States with Significant Differences,[a] % (no.)
Sex						
Male	1.9 (1.7–2.3)	100 (20)	2.3 (1.8–3.7)	95 (19)	1.7 (1.3–3.6)	100 (9)
Female (referent)	. . .	. . .	. . .	. . .	. . .	. . .
Metropolitan status						
Nonmetropolitan	1.9 (1.2–3.2)	89 (18)	1.4 (0.9–2.5)	28 (18)	1.8 (1.3–2.1)	100 (8)
Metropolitan[b] (referent)	. . .	. . .	. . .	. . .	. . .	. . .
Income, $						
35 000+	2.7 (1.3–4.5)	85 (20)	1.6 (0.9–3.7)	42 (19)	2.3 (0.7–3.7)	89 (9)
15 000–34 999	1.9 (0.8–2.9)	75 (20)	1.5 (0.9–3.8)	21 (19)	1.9 (0.5–2.1)	78 (9)
<15 000 (referent)	. . .	. . .	. . .	. . .	. . .	. . .
Race/ethnicity						
White non-Hispanic	2.1 (1.1–4.1)	84 (19)	1.7 (0.4–2.5)	39 (18)	1.5 (0.7–4.3)	44 (9)
Other (referent)	. . .	. . .	. . .	. . .	. . .	. . .
Children in household						
Yes	1.1 (0.8–1.3)	0 (17)	0.6 (0.4–1.0)	67 (18)	0.8 (0.7–1.0)	50 (6)
No (referent)	. . .	. . .	. . .	. . .	. . .	. . .
Age, y						
18–34	1.2 (0.6–2.0)	20 (20)	1.4 (0.5–3.6)	16 (19)	1.0 (0.7–2.8)	11 (9)
35–64	1.4 (0.8–3.5)	40 (20)	1.4 (0.7–2.4)	32 (19)	1.2 (0.8–3.2)	11 (9)
65+ (referent)	. . .	. . .	. . .	. . .	. . .	. . .
Education						
Less than high school	1.4 (0.7–1.9)	25 (20)	1.2 (0.7–1.6)	5 (19)	1.1 (0.0–1.6)	22 (9)
High school diploma	1.3 (0.8–1.9)	45 (20)	1.2 (0.9–1.8)	11 (19)	1.4 (0.9–1.4)	22 (9)
More than high school (referent)	. . .	. . .	. . .	. . .	. . .	. . .

Note. OR = odds ratio.
[a]Significant difference between referent and comparison group means that the 95% confidence interval for the odds ratio excludes 1.0.
[b]Within a metropolitan statistical area.

ing" or "operable" firearms. BB guns were specifically excluded by 1 state but usually not mentioned. Because the differences among the reported prevalences in this study generally were large and did not vary systematically with the wording of questions, it seems unlikely that the state-to-state variation was due solely to phraseology.

Another possible limitation is the reliance on self-reported data. The literature contains little information about the reliability and validity of responses to questions about firearms, although the extant data suggest that most individuals respond truthfully.[15,30]

In summary, there is appreciable variation among states in the prevalence of household exposure to firearms, loaded firearms, and handguns. Data from these 22 state surveys are consistent with information from national surveys concerning demographic subgroups but indicate that local patterns of ownership and storage often differ from the national average. As more state and local data about the prevalence, types, and storage of firearms become available, they will further our understanding of the causes of fatal and nonfatal firearm injuries, and they can guide state and local policymakers in their efforts to reduce such injuries. □

Acknowledgments

We are grateful for the encouragement and support of the following Behavioral Risk Factor Surveillance System state coordinators: Mary Adams, MPH, Connecticut; Brian Bender, Arizona; George Boeselager, MS, New Jersey; Karen Bramblett, Kentucky; Fred Breukelman, Delaware; Eleanor Cautley, MS, Wisconsin; Nancy Costello, MPA, Indiana; Bonnie Davis, PhD, California; Joyce Grant-Worley, MS, Oregon; Neil Hann, MPH, Oklahoma; Jana Hesser, PhD, Rhode Island; Kirsten Holm, MA, Washington; Wayne Honey, New Mexico; Christopher Johnson, MPH, Idaho; Fred King, West Virginia; Marilyn Leff, MSPH, Colorado; Susan Loyd, Mississippi; Linda Ames Mann, Pennsylvania; Harry McGee, MPH, Michigan; Thomas A. Melnik, DrPH, New York; and Michael Perry, Kansas. We also thank Ellen Jones and Chris Maylahn for their help with early versions of this paper.

References

1. *National Summary of Injury Mortality Data, 1988–1994.* Atlanta, Ga: US Dept of Health and Human Services, Centers for Disease Control and Prevention; 1996.
2. Annest JL, Mercy JA, Gibson DR, Ryan GW. National estimates of nonfatal firearm-related injuries: beyond the tip of the iceberg. *JAMA.* 1995;273:1749–1754.
3. *1994: 10 Leading Causes of Death.* Atlanta, Ga: US Dept of Health and Human Services, Centers for Disease Control and Prevention; 1996.
4. Cook PJ, Ludwig J. *Guns in America: National Survey on Private Ownership and Use of Firearms.* Washington, DC: National Institute of Justice; 1997.
5. Hargarten SW, Karlson TA, O'Brien M, Hancock J, Quebbeman E. Characteristics of firearms involved in fatalities. *JAMA.* 1996; 275:42–45.
6. Kellerman AL, Reay DT. Protection or peril? An analysis of firearm-related deaths in the home. *N Engl J Med.* 1986;314:1557–1560.
7. Lee RK, Waxweiler RJ, Dobbins JG, Paschetag T. Incidence rates of firearm injuries in Galveston, Texas, 1979–1981. *Am J Epidemiol.* 1991;134:511–521.
8. Maguire K, Pastore AL, eds. *Sourcebook of Criminal Justice Statistics 1994.* Washington, DC: US Dept of Justice, Bureau of Justice Statistics; 1995.
9. Chaterjee BF, Imm P. Firearms prevalence and storage practices in Wisconsin households. *Wis Med J.* 1996;95:286–291.

10. Forjuoh SN, Coben JH, Dearwater SR. Firearm ownership and storage practices in Pennsylvania homes. *Inj Prev.* 1996;2:278–282.
11. Nelson DE, Grant-Worley JA, Powell K, Mercy J, Holtzman D. Population estimates of household firearm storage practices and firearm carrying in Oregon. *JAMA.* 1996; 275:1744–1748.
12. Wall JL. Firearm ownership and storage in Louisiana. In: *Louisiana's Behavioral Risks, Special Report 1994.* Monroe, La: Center for Business and Economic Research, Northeast Louisiana University; 1994.
13. Wiktor SZ, Gallaher MM, Baron RC, Watson ME, Sewell CM. Firearms in New Mexico. *West J Med.* 1994;161:137–139.
14. Morrison TC, Hofstetter CR, Hovell MF. Firearm ownership and safety practices: a random-digit dial survey of San Diego. *Am J Prev Med.* 1995;11:364–370.
15. Rafferty AP, Thrush JC, Smith PK, McGee HB. Validity of a household gun question in a telephone survey. *Public Health Rep.* 1995; 110:282–288.
16. Frazier EL, Franks AL, Sanderson LM. Using behavioral risk factor surveillance data. In: *Using Chronic Disease Data: A Handbook for Public Health Practitioners.* Atlanta, Ga: Centers for Disease Control and Prevention; 1992.
17. Siegal PZ, Frazier EL, Mariolis P, Brackbill RM, Smith C. Behavioral risk factor surveillance, 1991: monitoring progress toward the nation's year 2000 objectives. *CDC Surveillance Summary.* 1993;42(SS-4):1–21.
18. White AA. Response rate calculation in RDD telephone health surveys: current practices. In: *Proceedings of the American Statistical Association, Section on Survey Research Methods.* Washington, DC: American Statistical Association; 1983:277–282.
19. *1990 Census of Population and Housing, Supplementary Reports, Metropolitan Areas as Defined by the Office of Management and Budget.* Washington, DC: US Bureau of the Census; 1993.
20. Shah BV. *Software for Survey Data Analysis (SUDAAN) Version 6.10.* Research Triangle Park, NC: Research Triangle Institute; 1993.
21. *1990 Census of Population: Summary Social, Economic, and Housing Characteristics, United States.* Washington, DC: US Dept of Commerce, Economics and Statistics Administration; 1992.
22. Ikeda RM, Dahlberg LL, Sacks JJ, Mercy JA, Powell KE. Estimating intruder-related firearm retrievals in US households, 1994. *Violence Vict.* 1997:12:363–372.
23. Kleck G, Gertz M. Armed resistance to crime: the prevalence and nature of self-defense with a gun. *J Criminal Law Criminology.* 1995; 86:150–187.
24. Hemenway D, Solnick SJ, Azrael DR. Firearm training and storage. *JAMA.* 1995; 273:46–50.
25. Goldberg BW, Borstel ER, Dennis LK, Wall E. Firearm injury risk among primary care patients. *J Fam Pract.* 1995;41:158–162.
26. Senturia YD, Christoffel KK, Donovan M. Children's household exposure to guns: a pediatric practice-based survey. *Pediatrics.* 1994;93:469–475.
27. Beaver BL, Moore VL, Peclet M, Haller AJ, Smialek J, Hill JL. Characteristics of pediatric firearm injuries. *J Pediatr Surg.* 1990;25: 97–100.
28. Martin JR, Sklar DP, McFeeley P. Accidental firearm fatalities among New Mexico children. *Ann Emerg Med.* 1991;20:58–61.
29. Wintemute GJ, Teret SP, Draus JF, Wright MA, Bradfield G. When children shoot children: 88 unintended deaths in California. *JAMA.* 1987;257:3107–3109.
30. Kellermann AL, Rivara FP, Banton J, Reay D, Fligner CL. Validating survey responses to questions about gun ownership among owners of registered handguns. *Am J Epidemiol.* 1990;131:1080–1084.

Errata

In: Cuckle H. Rational Down syndrome screening policy. *Am J Public Health.* 1998;88:558–559.
The academic degree listed for the author should have been DPhil, not MA, MSc.

In: Wittkowski KM, Susser E, Dietz K. The protective effect of condoms and nonoxynol-9 against HIV infection. *Am J Public Health.* 1998;88;590–596.
Dr. Wittkowski's e-mail address was incorrect; the correct address is kmw@uni-tuebingen.de.
In Table 1, the number of individuals given in the lower left cell of the table should have been 22, not 2.
In the formula for adjusting sample size computations (fourth line on page 592), the superscript 9 at the end of the formula should have been a prime. The formula should have read

$$(n_X^*, n_U^*)' = (n_X - x, n_U + x)'$$

In the formula for measuring ordinal data (bottom of column 2, page 592), the equal sign at the end of the formula should have been subscript. The formula should have read

$$s_i' = 1 - \mathrm{var}_{r \epsilon Q S} r_i / \mathrm{var}_{i=1}^{n} i.$$

In: Karim QA, Karim SSA, Coovadia HM, Susser M. Informed consent for HIV testing in a South African hospital: is it truly informed and truly voluntary? *Am J Public Health.* 1998;88:637–640.
There were no dates given for the data presented in tables 1 through 3. The data are from the period November 1991 to mid-March 1992.
For reference 12, the publisher is McGraw Hill, Rodney M. Coe; the place of publication is New York, NY.
For reference 13, the publisher is Free Press.