Prevalence of Household Firearms and Firearm-Storage Practices in the 50 States and the District of Columbia: Findings From the Behavioral Risk Factor Surveillance System, 2002

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ABSTRACT. *Objectives.* **To examine the prevalence of household firearms and firearm-storage practices in the 50 states and the District of Columbia and estimate the number of children exposed to unsafe storage practices.**

Methods. **We analyzed data from the 2002 cross-sectional Behavioral Risk Factor Surveillance System survey of 240 735 adults from randomly selected households with telephones in the 50 states and the District of Columbia.**

Results. **Nationally, 32.6% of adults reported that firearms were kept in or around their home. The prevalence of adults with household firearms ranged from 5.2% in the District of Columbia to 62.8% in Wyoming (median: 40.8%). The prevalence of adults with loaded household firearms ranged from 1.6% in Hawaii, Massachusetts, and New Jersey to 19.2% in Alabama (median: 7.0%), and the prevalence of adults with loaded and unlocked household firearms ranged from 0.4% in Massachusetts to 12.7% in Alabama (median: 4.2%). Among adults with children and youth <18 years old, the prevalence of loaded household firearms ranged from 1.0% to 13.4% (median: 5.3%), and the prevalence of loaded and unlocked household firearms ranged from 0.3% to 7.3% (median: 2.3%); in each instance, Massachusetts had the lowest prevalence and Alabama had the highest. Findings indicate that ~1.69 million (95% confidence interval: 1.57–1.82 million) children and youth in the United States <18 years old are living with loaded and unlocked household firearms.**

Conclusions. **Substantial state variations exist in the prevalence of household firearms and firearm-storage practices. It is vital that surveillance systems such as the Behavioral Risk Factor Surveillance System continue to monitor the prevalence of household firearms and firearm-storage practices so that future interventions to promote safe storage of firearms can be evaluated and more widely implemented based on their efficacy.** ***Pediatrics*** **2005;116:e370–e376. URL: www.pediatrics.org/cgi/doi/10.1542/peds.2005-0300;** ***firearms, children, youth, behavior, risk taking, telephone, BRFSS.***

ABBREVIATIONS. BRFSS, Behavioral Risk Factor Surveillance System; CI, confidence interval.

Firearm-related injuries remained the second leading cause of injury mortality in 2002, accounting for 30 242 firearm-related deaths.[1] Of all firearm injury deaths, 56.6% were suicides, 39.1% were homicides, 2.5% were unintentional, and an additional 1.8% were legal interventions or of undetermined intent.[1] Furthermore, ~1400 firearm deaths were among persons <18 years old.[2] In addition, for every firearm-related death, ~4.6 persons in this same population received nonfatal firearm-related injuries.[3] In 1997, the estimated lifetime costs of medically treated gunshot injuries in the United States totaled $1.9 billion, of which $0.9 billion was paid by the US government.[4]

Unintentional injuries, suicide, and homicide among youth may happen because young persons are able to access an improperly stored household firearm.[5–10] Approximately 90% of fatal firearm incidents involving children occur within the home, and according to a study of children and youth aged 0 to 14 years by Wintemute et al[8], 40% of firearm incidents involve a firearm stored in the room in which the shooting occurs. Miller et al[7] found that twice as many firearm deaths among children and youth <18 years old occur in states with the highest proportion of people living in households with loaded firearms. In addition, Grossman et al[9] reported that safe storage practices, including keeping firearms stored unloaded, locked, or separate from ammunition, are associated with significant reductions in the risk of unintentional injuries and suicides among children and youth. The National Rifle Association,[11] medical organizations,[12–15] and public health agencies[16,17] all support safe firearm-storage practices in homes with children and youth. For example, the American Academy of Pediatrics recommends that if families must have firearms in their homes, the firearms should be stored locked, unloaded, and separate from locked ammunition.[12] Efforts to promote proper storage of firearms in homes may help reduce the risk of both fatal and nonfatal injury.[6,7,9,10,16,18–21]

Despite the fact that national estimates on the

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prevalence of household firearms and their manner of storage are available,[21–23] limited information exists regarding these estimates at the state level.[22,24–27] Thus, the purposes of this study were threefold: to estimate (1) the prevalence of adults with household firearms and their firearm-storage practices at the state level; (2) the prevalence of loaded and of loaded and unlocked household firearms among adults with children and youth <18 years old at the state level; and (3) by state the number of children and youth exposed to these firearm-storage practices.

METHODS

The Behavioral Risk Factor Surveillance System (BRFSS) is a state-based surveillance system operated by state health departments in collaboration with the US Centers for Disease Control and Prevention. A detailed description of the survey methods used by BRFSS is available elsewhere.[28–30] Briefly, the primary purpose of BRFSS is to provide state-specific estimates of behaviors that relate to the leading causes of morbidity and mortality in the United States. Trained interviewers collect data on a monthly basis by using an independent probability sample of households with telephones among the noninstitutionalized US population aged ≥18 years. Individual respondents are selected randomly from all adults living in a household. All BRFSS questionnaires and data are available on the Internet (www.cdc.gov/brfss). Because the BRFSS is a surveillance system, the Centers for Disease Control and Prevention's Institutional Review Board has determined that the BRFSS is exempt from its review.

In 2002, all 50 states and the District of Columbia participated, and 240 735 persons aged ≥18 years completed the interview. Firearm-storage questions were added to the BRFSS for the first time in all 50 states and the District of Columbia in 2002. We limited our analyses to the 223 819 BRFSS respondents (88 928 men and 134 891 women) who answered all survey questions on household firearms and who reported whether their households included children and youth <18 years old. Respondents were excluded if they had unknown responses or refused to answer the questions. The median response rate, based on the number of individuals actually reached by telephone, was 76.7% (range: 62.5% [in California] to 99.8% [in Minnesota]).[31] The more conservative response-rate formula based on Council of American Survey and Research Organizations' guidelines produced a median response rate of 58.3% (range: 42.2% [in New Jersey] to 82.6% [in Minnesota]).[31]

Survey Questions and Definitions of Firearm-Storage Practices

The interviewer began the firearm section of the survey by first informing the respondent that "the next three questions are about firearms. We are asking these in a health survey because of our interest in firearm-related injuries. Please include weapons such as pistols, shotguns, and rifles; but not BB guns, starter pistols, or guns that cannot fire. Include those kept in a garage, outdoor storage area, or motor vehicle." Presence of firearms in the home was assessed by asking the respondent, "Are any firearms kept in or around your home?" Firearm-storage patterns were derived from 2 questions: "Are any of these firearms now loaded?" and "Are any of these loaded firearms also unlocked? By 'unlocked' we mean you do not need a key or combination to get the gun or to fire it. We don't count a safety as a lock." We created 3 firearm-storage pattern categories: "any household firearm" (yes/no), "loaded household firearm" (yes/no), and "loaded and unlocked household firearm" (yes/no). However, the state of California used a different set of firearm questions than the other states, and as a result, we were only able to create 2 categories for California: "any household firearm" and "loaded and unlocked household firearm."

Statistical Analyses

Both SAS (SAS Institute, Cary, NC) and SUDAAN (Research Triangle Institute, Research Triangle Park, NC) were used in all analyses to account for the complex sampling design and to calculate 95% confidence intervals (CIs). BRFSS data were directly weighted for the probability of selection of a telephone number, the number of adults in a household, and the number of telephones in a household. Finally, data were poststratified to adjust for nonresponse and noncoverage of households without telephones and to force the sum of the weighted frequencies to equal each state's adult population (ie, final weight). These data are representative of >200 million US adults in 2002 (117 million adults without children and youth <18 years old and 83 million adults with children and youth <18 years old). Data from all states are pooled to produce nationally representative estimates.

We first estimated the national and state prevalence of adults with household firearms; second, we estimated the national and state prevalence of adults with any loaded household firearms and any loaded and unlocked household firearms. Next, among adults with children and youth <18 years old, we estimated the national and state prevalence of loaded household firearms and loaded and unlocked household firearms. Finally, to estimate the number of children and youth <18 years old who were exposed to loaded firearms and to loaded and unlocked firearms among households with children and youth, we used the following formula: number of children and youth = [(final weight/number of adults in a household) × a] × b, where a equals the percentage of households with children and youth in which firearms were stored loaded or loaded and unlocked, and b equals the average number of children in households in which firearms were stored loaded or loaded and unlocked.

RESULTS

Nationally, 32.6% (95% CI: 32.2–32.9%) of adults reported that firearms were kept in or around their home. The prevalence of adults with household firearms ranged from 5.2% in the District of Columbia to 62.8% in Wyoming (median: 40.8%) (Table 1).

The national prevalence of adults with loaded household firearms and with loaded and unlocked household firearms was 7.6% (95% CI: 7.5–7.8%) and 4.3% (95% CI: 4.2–4.5%), respectively. The prevalence of adults with loaded household firearms ranged from 1.6% in Hawaii, Massachusetts, and New Jersey to 19.2% in Alabama (median: 7.0%), and the prevalence of adults with loaded and unlocked household firearms ranged from 0.4% in Massachusetts to 12.7% in Alabama (median: 4.2%).

Nationally, among adults with children and youth <18 years old, 5.5% (95% CI: 5.3–5.8%) reported having loaded household firearms and 2.5% (95% CI: 2.3–2.6%) reported having loaded and unlocked household firearms. Among adults with children and youth, the prevalence of loaded household firearms ranged from 1.0% in Massachusetts to 13.4% in Alabama (median: 5.3%), and the prevalence of loaded and unlocked household firearms ranged from 0.3% in Massachusetts to 7.3% in Alabama (median: 2.3%) (Table 2). In 7 states (Alabama, Alaska, Arkansas, Georgia, Louisiana, Mississippi, and Montana), the prevalence of loaded household firearms among adults with children and youth was ≥10%; in 6 states (Alabama, Alaska, Arkansas, Idaho, Montana, and Wyoming), the prevalence of loaded and unlocked household firearms among adults with children and youth was >5%.

Although household firearms were less likely to be stored loaded or loaded and unlocked among adults with children and youth than among adults overall, an estimated 1 692 610 children and youth (95% CI: 1 569 320–1 815 910) in the United States were living in households with loaded and unlocked firearms (Table 2). The 6 states with >75 000 children and

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TABLE 1. Prevalence Estimates of Adults With Household Firearms, Loaded Household Firearms, and Loaded and Unlocked Household Firearms, 2002

State	Any Household Firearm, % (95% CI)	Loaded Household Firearm, % (95% CI)	Loaded and Unlocked Household Firearm, % (95% CI)
Alabama	57.2 (55.1–59.4)	19.2 (17.4–20.9)	12.7 (11.2–14.1)
Alaska	60.6 (57.7–63.4)	15.0 (12.9–17.1)	10.8 (8.9–12.6)
Arizona	36.2 (33.4–39.0)	11.3 (9.4–13.2)	7.6 (6.2–9.0)
Arkansas	58.3 (56.4–60.2)	15.9 (14.5–17.3)	10.4 (9.2–11.6)
California*	19.5 (18.0–21.0)	NA	2.2 (1.7–2.7)
Colorado	34.5 (32.8–36.2)	6.9 (6.0–7.8)	4.2 (3.5–4.9)
Connecticut	16.2 (15.0–17.4)	2.1 (1.6–2.6)	1.0 (0.7–1.3)
Delaware	26.7 (24.8–28.7)	6.5 (5.3–7.7)	3.4 (2.5–4.3)
District of Columbia	5.2 (3.8–6.6)	1.9 (1.1–2.6)	0.8 (0.4–1.2)
Florida	26.0 (24.7–27.4)	8.8 (7.9–9.7)	4.9 (4.3–5.5)
Georgia	41.0 (39.1–42.9)	13.4 (12.2–14.7)	7.5 (6.6–8.5)
Hawaii	9.7 (8.7–10.6)	1.6 (1.2–2.1)	1.0 (0.6–1.3)
Idaho	56.8 (55.0–58.6)	11.8 (10.7–12.9)	7.9 (6.9–8.8)
Illinois	19.7 (18.0–21.4)	2.7 (2.0–3.3)	1.4 (0.9–1.9)
Indiana	39.0 (37.6–40.5)	9.3 (8.4–10.2)	5.7 (5.0–6.4)
Iowa	44.0 (42.1–46.0)	3.9 (3.1–4.7)	2.5 (1.9–3.1)
Kansas	43.7 (42.0–45.4)	6.8 (6.0–7.7)	4.1 (3.4–4.8)
Kentucky	48.0 (46.0–50.0)	12.2 (10.9–13.5)	6.6 (5.6–7.6)
Louisiana	45.6 (43.9–47.3)	13.1 (12.0–14.3)	7.2 (6.3–8.1)
Maine	41.1 (38.8–43.3)	3.2 (2.4–4.0)	2.0 (1.4–2.6)
Maryland	22.1 (20.6–23.6)	3.9 (3.1–4.6)	2.3 (1.7–2.9)
Massachusetts	12.8 (11.7–13.8)	1.6 (1.2–2.0)	0.4 (0.2–0.6)
Michigan	40.3 (38.7–41.9)	5.6 (4.8–6.4)	3.2 (2.7–3.8)
Minnesota	44.7 (43.0–46.4)	3.4 (2.7–4.0)	2.3 (1.8–2.8)
Mississippi	54.3 (52.4–56.3)	15.9 (14.5–17.3)	8.9 (7.8–9.9)
Missouri	45.4 (43.4–47.4)	9.9 (8.7–11.1)	5.5 (4.6–6.4)
Montana	61.4 (59.2–63.7)	12.8 (11.3–14.2)	8.6 (7.4–9.8)
Nebraska	42.1 (40.3–43.8)	4.0 (3.3–4.7)	2.3 (1.7–2.8)
Nevada	31.5 (29.2–33.8)	9.1 (7.7–10.5)	5.6 (4.5–6.6)
New Hampshire	30.5 (29.0–32.1)	3.9 (3.3–4.6)	2.1 (1.7–2.6)
New Jersey	11.3 (9.6–13.1)	1.6 (1.1–2.1)	0.9 (0.5–1.3)
New Mexico	39.6 (37.8–41.3)	10.0 (9.0–10.9)	6.6 (5.8–7.4)
New York	18.1 (16.7–19.4)	2.3 (1.7–2.8)	1.3 (0.9–1.7)
North Carolina	40.8 (38.9–42.7)	11.5 (10.3–12.6)	6.8 (5.9–7.7)
North Dakota	54.3 (52.2–56.3)	3.3 (2.6–4.0)	2.0 (1.5–2.5)
Ohio	32.1 (30.3–33.9)	5.4 (4.6–6.3)	3.6 (2.9–4.3)
Oklahoma	44.6 (43.1–46.1)	13.0 (12.0–13.9)	7.7 (6.9–8.5)
Oregon	39.8 (37.7–41.8)	10.3 (9.1–11.5)	7.1 (6.1–8.1)
Pennsylvania	36.5 (35.3–37.6)	5.4 (4.9–6.0)	3.5 (3.1–3.9)
Rhode Island	13.3 (11.9–14.7)	2.1 (1.4–2.8)	1.5 (0.8–2.1)
South Carolina	45.0 (43.0–47.1)	13.5 (12.0–14.9)	8.1 (7.0–9.1)
South Dakota	59.9 (58.3–61.6)	6.0 (5.2–6.8)	4.1 (3.5–4.8)
Tennessee	46.4 (44.3–48.4)	12.0 (10.7–13.3)	6.6 (5.6–7.5)
Texas	35.9 (34.5–37.4)	12.2 (11.3–13.2)	7.9 (7.1–8.7)
Utah	45.3 (43.1–47.5)	5.4 (4.5–6.3)	3.3 (2.6–3.9)
Vermont	45.5 (43.8–47.2)	3.7 (3.0–4.5)	2.4 (1.9–2.9)
Virginia	35.9 (33.9–38.0)	8.6 (7.4–9.8)	5.0 (4.1–5.9)
Washington	36.2 (34.4–38.0)	7.1 (6.2–8.0)	4.3 (3.6–5.0)
West Virginia	57.9 (55.9–59.8)	9.4 (8.2–10.5)	5.5 (4.6–6.3)
Wisconsin	44.3 (42.5–46.2)	3.4 (2.7–4.1)	2.2 (1.6–2.8)
Wyoming	62.8 (60.8–64.7)	12.8 (11.4–14.1)	8.3 (7.3–9.4)
Median	40.8	7.0	4.2
Range	5.2–62.8	1.6–19.2	0.4–12.7

Data are based on self-reports. NA indicates not available.
* California's firearm questions differed from those of other states.

youth living in households with loaded and unlocked firearms were Alabama, California, Florida, Georgia, North Carolina, and Texas.

DISCUSSION

To our knowledge, this is one of the first studies to comprehensively examine both the prevalence of adults with household firearms and firearm-storage patterns at the state level. Our study findings are similar to national studies that have shown that, regardless of whether children and youth live in the home, approximately one third of US homes contain firearms.[21–23] According to our study, during 2002, an estimated 33% of all adults lived in households with firearms, and an estimated 4% of adults lived in households with firearms stored in the least safe manner (ie, loaded and unlocked). Household firearms were less likely to be stored in an unsafe manner by adults with children and youth <18 years old; nonetheless, >1.6 million children lived in households with loaded and unlocked firearms.

We found substantial state variations in the prev-

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TABLE 2. Prevalence Estimates of Loaded Household Firearms and Loaded and Unlocked Household Firearms Among Adults With Children and Youth <18 Years Old and the Estimated Number of Children and Youth Living With Loaded and Loaded and Unlocked Firearms, 2002

State	Loaded Household Firearm, % ± 95% CI	Estimated No. of Children and Youth Living with Loaded Firearms, *N* (95% CI)	Loaded and Unlocked Household Firearm, % ± 95% CI	Estimated No. of Children and Youth Living with Loaded and Unlocked Firearms, *N* (95% CI)
Alabama	13.4 ± 2.5	145 560 (113 730–177 380)	7.3 ± 2.0	76 110 (54 630–97 590)
Alaska	10.7 ± 2.8	19 970 (14 480–25 470)	6.6 ± 2.4	12 380 (7670–17 090)
Arizona	7.1 ± 2.1	108 630 (74 080–143 180)	4.4 ± 1.8	67 980 (38 480–97 480)
Arkansas	11.6 ± 2.1	80 080 (63 690–96 480)	6.6 ± 1.7	40 500 (29 610–51 400)
California*	NA	NA	1.0 ± 0.6	84 440 (37 890–130 990)
Colorado	4.0 ± 1.1	43 300 (30 850–55 750)	1.9 ± 0.8	17 820 (10 110–25 540)
Connecticut	1.8 ± 0.7	18 150 (9280–27 020)	0.5 ± 0.3	3390 (850–5930)
Delaware	4.6 ± 1.4	7910 (4960–10 860)	2.0 ± 1.0	2890 (1400–4380)
District of Columbia	1.9 ± 1.6	1420 (230–2610)	0.6 ± 0.7	660 (0–1450)
Florida	6.5 ± 1.4	248 430 (186 560–310 300)	3.2 ± 1.0	128 860 (80 580–177 150)
Georgia	10.3 ± 1.6	228 650 (189 220–268 080)	4.9 ± 1.1	104 700 (78 130–131 270)
Hawaii	1.2 ± 0.5	4040 (1790–6300)	0.6 ± 0.3	1650 (840–2470)
Idaho	9.1 ± 1.5	30 740 (25 360–36 120)	5.2 ± 1.2	17 030 (12 960–21 090)
Illinois	2.2 ± 0.9	70 620 (36 590–104 650)	1.0 ± 0.7	28 650 (7080–50 230)
Indiana	7.8 ± 1.3	111 810 (91 480–132 140)	3.8 ± 0.9	51 410 (37 990–64 840)
Iowa	2.1 ± 1.0	16 100 (7370–24 840)	1.4 ± 0.8	10 080 (2860–17 290)
Kansas	5.5 ± 1.2	40 540 (30 290–50 800)	2.4 ± 0.8	16 330 (9830–22 820)
Kentucky	9.6 ± 2.0	94 600 (73 690–115 500)	4.3 ± 1.4	37 460 (26 970–47 950)
Louisiana	10.0 ± 1.7	113 360 (90 900–135 820)	4.4 ± 1.2	54 630 (37 130–72 140)
Maine	1.8 ± 1.1	6030 (2180–9890)	0.9 ± 0.8	2260 (400–4110)
Maryland	3.6 ± 1.2	42 860 (27 070–58 650)	1.8 ± 0.9	20 820 (9240–32 390)
Massachusetts	1.0 ± 0.5	15 680 (8260–23 100)	0.3 ± 0.2	4880 (800–8970)
Michigan	4.0 ± 1.1	104 160 (73 680–134 630)	1.9 ± 0.8	49 560 (28 050–71 070)
Minnesota	2.7 ± 1.0	30 560 (17 640–43 480)	1.8 ± 0.8	19 770 (9110–30 430)
Mississippi	11.1 ± 1.9	87 350 (70 220–104 470)	4.7 ± 1.2	36 780 (26 470–47 090)
Missouri	7.1 ± 1.8	80 400 (60 150–100 650)	3.0 ± 1.2	35 180 (21 420–48 950)
Montana	11.1 ± 2.3	22 500 (17 660–27 340)	6.4 ± 1.7	11 700 (8420–14 980)
Nebraska	3.2 ± 1.1	12 070 (7520–16 620)	1.7 ± 0.8	7170 (3400–10 930)
Nevada	5.9 ± 1.7	36 220 (24 260–48 180)	2.6 ± 1.1	14 560 (7510–21 610)
New Hampshire	2.8 ± 0.9	7750 (5360–10 150)	1.1 ± 0.6	2530 (1240–3820)
New Jersey	1.2 ± 0.6	23 150 (10 870–35 420)	0.5 ± 0.4	7710 (1900–13 520)
New Mexico	7.5 ± 1.4	34 850 (27 850–41 850)	4.0 ± 1.0	16 190 (11 960–20 410)
New York	1.8 ± 0.7	95 640 (50 910–140 370)	1.0 ± 0.5	52 430 (19 490–85 370)
North Carolina	7.7 ± 1.7	168 360 (126 570–210 160)	3.8 ± 1.2	82 110 (51 760–112 450)
North Dakota	2.4 ± 1.0	3730 (1980–5470)	1.6 ± 0.8	2880 (1270–4500)
Ohio	2.9 ± 1.0	83 050 (52 380–113 730)	1.4 ± 0.7	33 610 (14 860–52 350)
Oklahoma	8.9 ± 1.3	78 680 (64 780–92 570)	4.4 ± 0.9	40 560 (29 790–51 330)
Oregon	6.1 ± 1.6	57 990 (41 620–74 370)	3.0 ± 1.1	26 550 (15 520–37 570)
Pennsylvania	4.0 ± 0.8	113 360 (88 180–138 530)	2.0 ± 0.6	54 500 (37 990–71 010)
Rhode Island	1.8 ± 0.9	4720 (2290–7150)	0.6 ± 0.5	1950 (150–3740)
South Carolina	8.9 ± 1.8	83 610 (64 840–102 380)	4.4 ± 1.3	42 200 (28 850–55 550)
South Dakota	3.8 ± 1.1	9390 (4830–13 950)	2.3 ± 0.9	6000 (1750–10 250)
Tennessee	9.7 ± 2.0	136 340 (104 570–168 100)	3.5 ± 1.3	43 370 (27 530–59 210)
Texas	8.1 ± 1.3	434 300 (348 180–520 410)	4.2 ± 0.9	199 670 (152 140–247 190)
Utah	4.3 ± 1.1	28 090 (19 750–36 420)	2.1 ± 0.8	11 910 (6380–17 430)
Vermont	3.2 ± 1.0	4220 (2740–5690)	1.5 ± 0.8	1660 (780–2530)
Virginia	6.3 ± 1.4	121 210 (88 320–154 090)	2.9 ± 0.9	49 210 (32 570–65 850)
Washington	5.0 ± 1.4	70 710 (50 350–91 060)	1.8 ± 0.8	24 790 (14 240–35 340)
West Virginia	6.4 ± 1.7	27 030 (19 400–34 660)	3.1 ± 1.2	10 690 (6510–14 870)
Wisconsin	2.8 ± 1.3	41 140 (22 590–59 700)	1.3 ± 1.0	14 940 (4570–25 320)
Wyoming	9.4 ± 1.9	12 640 (9750–15 530)	5.1 ± 1.4	7540 (5100–9970)
Median	5.3	42 000	2.3	19 770
Range	1.0–13.4	1420–434 300	0.3–7.3	660–199 670

Data are based on self-reports. NA indicates not available.
* California's questions to assess loaded and unlocked firearms differed from those of other states.

alence of adults with household firearms, from 10% in Hawaii to 63% in Wyoming (the prevalence in the District of Columbia was 5%). Furthermore, among adults with children and youth, a >24-fold difference was found between Massachusetts and Alabama in the percentage of loaded and unlocked household firearms. Few national studies have reported population-based representative estimates of firearm-storage patterns. In a 1993 report, the US Department of Justice estimated that 49% of homes in the United States had household firearms,[32] a level of firearm ownership typically reported in the 1980s and early 1990s.[23,33] Using this national estimate and data from his study, Hemenway et al[34] estimated that 10% of US homes had a firearm that was currently loaded and unlocked; this finding is more than double our estimate using a more direct approach (4.3%). The difference between our estimates may be a result of a secular decline in the proportion of households that reported having firearms and,

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hence, the proportion of households that were likely to engage in unsafe storage practices. In addition, it is also possible that a proportion of the households that formerly stored firearms loaded and unlocked have since implemented safe storage practices in their homes.

These findings are consistent with an earlier BRFSS study conducted using 1991–1995 data from 21 states.[26] Specifically, Powell et al[26] reported that the prevalence of adults with household firearms ranged from 12% in New Jersey to 57% in Idaho. For these 21 states, our 2002 prevalence estimates ranged from 11% in New Jersey to 58% in West Virginia (Idaho: 57%). For 18 states, the authors reported that the prevalence of children living in households with a loaded firearm ranged from 2% in Connecticut and Delaware to 12% in Mississippi. For these same states, our prevalence estimates ranged from 1% in New Jersey to 11% in Mississippi.

Our study had some limitations. First, because BRFSS excludes households without telephones, our findings may have overestimated the prevalence of firearms in households, because low income is associated with both lack of telephone service and a lower prevalence of firearms.[35] Second, although the validity of self-reported firearm storage is not known, previous studies suggest that self-reports of firearm ownership are valid.[36,37] However, our findings represent self-reports of the presence of a household firearm, not firearm ownership. Nevertheless, the interviews were conducted with a randomly selected adult in the home. As a result, some participants may not have known about a firearm that was kept by another household member.[38–40] For example, female respondents in particular have been shown to underreport firearms in the home. Likewise, female respondents who are aware of a household firearm kept by their spouse may be less likely to know how it is stored.[38,39] Thus, we may have underestimated firearm prevalence and unsafe storage practices in US households.

Our estimates on the prevalence of household firearms also lacked an appraisal of the types of firearms available (ie, handgun or long gun). For example, adults keeping a handgun for protection may be more apt to store it loaded, whereas adults keeping a rifle for sport may keep it locked and unloaded until needed.[34,41,42] The population characteristics of adults owning only a handgun may also differ from adults owning only a long gun. In addition, as mentioned previously, California used a different set of questions to assess both firearm prevalence and loaded and unlocked firearms. Thus, comparison of California's firearm prevalence estimates to that of the other 49 states and the District of Columbia should be done cautiously.

These results demonstrate the wide range of household firearm prevalence and storage of household firearms among the states, and we estimate that >1.6 million children live in homes with firearms stored in the least safe manner. A better understanding of firearm owners' attitudes, beliefs, and gun-storage behaviors is needed to effectively develop and evaluate community-based education programs that promote safe firearm storage.[43] In addition, there is an absence of direct empirical evidence on how firearm safety technologies (ie, locking, protection, sensor and tracking technology) impact injury.[27] These state-level prevalence estimates of household firearms and storage practices will permit future assessment of changes in the risk profile of US households as firearm safety technologies and strategies to encourage safe firearm storage are developed, implemented, and evaluated.[22,27]

Public health measures are needed to encourage the safe storage of household firearms. Such measures could include counseling of parents by primary care providers, especially pediatricians, regarding safe firearm storage.[12,15,44] However, although studies have shown that parents are open to screening and counseling about firearm storage and safety,[5,45,46] these services are rarely performed.[47,48] There is also conflicting evidence on the effectiveness of parental safe–firearm-storage counseling.[5,45,46,49,50] Other strategies to decrease child access to firearms in the home may include child-access–prevention laws, currently in place in 18 states, specifically designed to limit children's access to and use of firearms in the home[18,51]; safe firearm-storage–promotion programs[52,53]; and the provision of safety devices.[43,54] These and other measures may help reduce the number of children exposed to unsafe firearm-storage practices and, in turn, decrease the number of firearm-related injuries and deaths among children and youth. However, many of these prevention strategies have not been based on preliminary effectiveness data, nor have they been evaluated adequately, generally because of scant funding for evaluation of these programs.[27] It is crucial that firearm-injury-prevention programs incorporate evaluation into implementation efforts and that a sustained body of research be developed to study the effects of prevention programs on the rates of firearm-related morbidity and mortality.[27]

It is important to identify, implement, and evaluate effective methods to prevent firearm-related morbidity and mortality—from counseling youth and adults with depressive symptoms, to evaluating firearm safety technologies, to a variety of safe storage options. This is of utmost importance for the most vulnerable segments of our population—children and youth, persons with depressive symptoms, and those who have threatened suicide. Surveillance systems such as the BRFSS can be used to effectively monitor the prevalence of household firearms and firearm-storage practices so that future interventions to promote safe storage of firearms can be evaluated and more widely implemented based on their efficacy.

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REFERENCES

1. Kochanek KD, Murphy SL, Anderson RN, Scott C. Deaths: final data for 2002. *Natl Vital Stat Rep*. 2004;53(5):1–115. Available at: www.cdc.gov/nchs/data/nvsr/nvsr53/nvsr53_05acc.pdf. Accessed January 19, 2005
2. Centers for Disease Control and Prevention. WISQARS injury mortality reports, 2000–2002. Atlanta, GA: National Center for Injury Prevention and Control, Centers for Disease Control and Prevention; 2004. Available at: www.cdc.gov/ncipc/wisqars. Accessed January 19, 2005
3. US Consumer Product Safety Commission. National Electronic Injury Surveillance System (NEISS) on-line: 2002. Available at: www.cpsc.gov/library/neiss.html. Access January 19, 2005
4. Cook PJ, Ludwig J. *Gun Violence: The Real Costs*. New York, NY: Oxford University Press; 2000
5. Coyne-Beasley T, Schoenbach VJ, Johnson RM. "Love our kids, lock your guns": a community-based firearm safety counseling and gun lock distribution program. *Arch Pediatr Adolesc Med*. 2001;155:659–664
6. Grossman DC, Reay DT, Baker SA. Self-inflicted and unintentional firearm injuries among children and adolescents: the source of the firearm. *Arch Pediatr Adolesc Med*. 1999;153:875–878
7. Miller M, Azrael D, Hemenway D, Vriniotis M. Firearm storage and unintentional firearm deaths: results from the 2002 Behavioral Risk Factor Surveillance System. Available at: apha.confex.com/apha/132am/techprogram/paper_79234.htm. Accessed January 19, 2005
8. Wintemute GJ, Teret SP, Kraus JF, Wright MA, Bradfield G. When children shoot children. 88 unintended deaths in California. *JAMA*. 987;257:3107–3109
9. Grossman DC, Mueller BA, Riedy C, et al. Gun storage practices and risk of youth suicide and unintentional firearm injuries. *JAMA*. 2005;293:707–714
10. Cummings P, Grossman DC, Rivara FP, Koepsell TD. State gun safe storage laws and child mortality due to firearms. *JAMA*. 1997;278:1084–1086
11. National Rifle Association. *Parents' Guide to Gun Safety*. Fairfax, VA; National Rifle Association: 2004. Available at: www.nrahq.org/safety/eddie/infoparents.asp. Accessed January 19, 2005
12. American Academy of Pediatrics. Firearm-related injuries affecting the pediatric population. *Pediatrics*. 2000;105:888–895
13. American Medical Association. *H-145.997. Firearms as a Public Health Problem in the United States—Injuries and Death*. Chicago, IL: American Medical Association; 1999. Available at: www.ama-assn.org/apps/pf_new/pf_online?f_n=browse&doc=policyfiles/HnE/H-145.997.HTM. Accessed January 19, 2005
14. American Academy of Family Physicians. Firearms/handgun firearms, handguns and assault weapons. Available at: www.aafp.org/x6823.xml. Accessed January 19, 2005
15. American College of Physicians. Firearm injury prevention. *Ann Intern Med*. 1998;128:236–241
16. US Department of Health and Human Services. *Healthy People 2010: Understanding and Improving Health*. 2nd ed. Washington, DC: US Government Printing Office; 2000. Available at: www.healthypeople.gov/Document/tableofcontents.htm#under. Accessed January 19, 2005
17. US Preventive Services Task Force. Violent behavior and firearms. In: *Guide to Clinical Preventive Services*. Washington, DC: US Department of Health and Human Services, Office of Disease Prevention and Health Promotion; 1996. Available at: www.ncbi.nlm.nih.gov/books/bv.fcgi?rid=hstat6.section.5699#6139. Accessed January 19, 2005
18. Webster DW, Vernick JS, Zeoli AM, Manganello JA. Association between youth-focused firearm laws and youth suicides. *JAMA*. 2004;292:594–601
19. Shenassa ED, Rogers ML, Spalding KL, Roberts MB. Safer storage of firearms at home and risk of suicide: a study of protective factors in a nationally representative sample. *J Epidemiol Community Health*. 2004;58:841–848
20. Institute of Medicine. *Reducing Suicide: A National Imperative*. Washington, DC: National Academies Press; 2002
21. Stennies G, Ikeda R, Leadbetter S, Houston B, Sacks J. Firearm storage practices and children in the home, United States, 1994. *Arch Pediatr Adolesc Med*. 1999;153:586–590
22. Johnson RM, Coyne-Beasley T, Runyan CW. Firearm ownership and storage practices, U.S. households, 1992–2002. A systematic review. *Am J Prev Med*. 2004;27:173–182
23. Schuster MA, Franke TM, Bastian AM, Sor S, Halfon N. Firearm storage patterns in US homes with children. *Am J Public Health*. 2000;90:588–594
24. Miller M, Hemenway D, Azrael D. Firearms and suicide in the northeast. *J Trauma*. 2004;57:626–632
25. Miller M, Azrael D, Hemenway D. Rates of household firearm ownership and homicide across US regions and states, 1988–1997. *Am J Public Health*. 2002;92:1988–1993
26. Powell KE, Jacklin BC, Nelson DE, Bland S. State estimates of household exposure to firearms, loaded firearms, and handguns, 1991 through 1995. *Am J Public Health*. 1998;88:969–972
27. National Research Council. *Firearms and Violence: A Critical Review*. Washington, DC: National Academies Press; 2005
28. Mokdad AH, Stroup DF, Giles WH; Behavioral Risk Factor Surveillance Team. Public health surveillance for behavioral risk factors in a changing environment: recommendations from the Behavioral Risk Factor Surveillance Team. *MMWR Recomm Rep*. 2003;52(RR-9):1–12
29. Holtzman D. The Behavioral Risk Factor Surveillance System. In: Blumenthal DS, DiClemente RJ, eds. *Community-Based Health Research: Issues and Methods*. New York, NY: Springer Publishing Company, Inc; 2004:115–131
30. Centers for Disease Control and Prevention. *Behavioral Risk Factor Surveillance System Operational and User's Guide*. Atlanta, GA: US Department of Health and Human Services; 2005. Available at: www.cdc.gov/brfss/pdf/userguide.pdf. Accessed March 22, 2005
31. Centers for Disease Control and Prevention. *2002 Behavioral Risk Factor Surveillance System Summary Data Quality Report*. Atlanta, GA: Centers for Disease Control and Prevention; 2003. Available at: www.cdc.gov/brfss/technical_infodata/pdf/2002SummaryDataQualityReport.pdf. Accessed January 19, 2005
32. US Department of Justice, Bureau of Justice Statistics. *Sourcebook of Criminal Justice Statistics*. Washington, DC: US Department of Justice; 1993
33. Kleck G. *Targeting Guns: Firearms and Their Control*. New York, NY: Aldine De Gruyter; 1997
34. Hemenway D, Solnick SJ, Azrael DR. Firearm training and storage. *JAMA*. 1995;273:46–50
35. Thornberry OT, Massey JT. Trends in United States telephone coverage across time and subgroups. In: Groves RM, Biemer PP, Lyberg LE, Massey JT, Nichols WL, eds. *Telephone Survey Methodology*. New York, NY: John Wiley & Sons; 1988:25–49
36. 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
37. 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
38. 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
39. Nelson DE, Powell K, Johnson CJ, Mercy J, Grant-Worley JA. Household firearm storage practices: do responses differ by whether or not individuals ever use firearms? *Am J Prev Med*. 1999;16:298–302
40. Ludwig J, Cook PJ, Smith TW. The gender gap in reporting household gun ownership. *Am J Public Health*. 1998;88:1715–1718
41. Forjuoh SN, Coben JH, Dearwater SR. Firearm ownership and storage practices in Pennsylvania homes. *Inj Prev*. 1996;2:278–282
42. Wiktor SZ, Gallaher MM, Baron RC, Watson ME, Sewell CM. Firearms in New Mexico. *West J Med*. 1994;161:137–139
43. McGee KS, Coyne-Beasley T, Johnson RM. Review of evaluations of educational approaches to promote safe storage of firearms. *Inj Prev*. 2003;9:108–111
44. Bass JL. TIPP–the first ten years. *Pediatrics*. 1995;95:274–275
45. Kruesi MJ, Grossman J, Pennington JM, Woodward PJ, Duda D, Hirsch JG. Suicide and violence prevention: parent education in the emergency department. *J Am Acad Child Adolesc Psychiatry*. 1999;38:250–255
46. Albright TL, Burge SK. Improving firearm storage habits: impact of brief office counseling by family physicians. *J Am Board Fam Pract*. 2003;16:40–46
47. Barkin S, Duan N, Fink A, Brook RH, Gelberg L. The smoking gun: do clinicians follow guidelines on firearm safety counseling? *Arch Pediatr Adolesc Med*. 1998;152:749–756
48. Olson LM, Christoffel KK, O'Connor KG. Pediatricians' experience with

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and attitudes toward firearms. Results of a national survey. *Arch Pediatr Adolesc Med.* 1997;151:352–359
49. Grossman DC, Cummings P, Koepsell TD, et al. Firearm safety counseling in primary care pediatrics: a randomized, controlled trial. *Pediatrics.* 2000;106:22–26
50. Stevens MM, Olson AL, Gaffney CA, Tosteson TD, Mott LA, Starr P. A pediatric, practice-based, randomized trial of drinking and smoking prevention and bicycle helmet, gun, and seatbelt safety promotion. *Pediatrics.* 2002;109:490–497
51. Hahn RA, Bilukha OO, Crosby A, et al. First reports evaluating the effectiveness of strategies for preventing violence: firearm laws. Findings from the Task Force on Community Preventive Services. *MMWR Recomm Rep.* 2003;52(RR-14):11–20
52. Meyer G, Roberto AJ, Atkin CK. A radio-based approach to promoting gun safety: process and outcome evaluation implications and insights. *Health Commun.* 2003;15:299–318
53. Horn A, Grossman DC, Jones W, Berger LR. Community based program to improve firearm storage practices in rural Alaska. *Inj Prev.* 2003;9:231–234
54. Coyne-Beasley T, McGee KS, Johnson RM, Bordley WC. The association of handgun ownership and storage practices with safety consciousness. *Arch Pediatr Adolesc Med.* 2002;156:763–768

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