

Unintentional Firearm Injury Deaths Among Children and Adolescents Aged 0–17 Years — National Violent Death Reporting System, United States, 2003–2021

Rebecca F. Wilson, PhD¹; Sasha Mintz, MPH²; Janet M. Blair, PhD¹; Carter J. Betz, MS¹; Abby Collier, MS²; Katherine A. Fowler, PhD¹

Abstract

In the United States, unintentional injury is the fourth leading cause of death among infants (i.e., children aged <1 year) and is the top cause of death among children and adolescents aged 1–17 years; firearms are a leading injury method. Unsecured firearms (e.g., unlocked and loaded) are associated with risk for unintentional childhood firearm injury death. Data recorded during 2003–2021 by the National Violent Death Reporting System (NVDRS) from 49 states, the District of Columbia, and Puerto Rico were used to characterize unintentional firearm injury deaths of U.S. infants, children, and adolescents aged 0–17 years (referred to as children in this report). NVDRS identified 1,262 unintentional firearm injury deaths among children aged 0–17 years: the largest percentage (33%) of these deaths were among children aged 11–15 years, followed by 29% among those aged 0–5 years, 24% among those aged 16–17 years, and 14% among persons aged 6–10 years. Overall, 83% of unintentional firearm injury deaths occurred among boys. The majority (85%) of victims were fatally injured at a house or apartment, including 56% in their own home. Approximately one half (53%) of fatal unintentional firearm injuries to children were inflicted by others; 38% were self-inflicted. In 9% of incidents, it was unknown whether the injury was self- or other-inflicted. Approximately two thirds (67%) of shooters were playing with or showing the firearm to others when it discharged. Overall, firearms used in unintentional injury deaths were often stored loaded (74%) and unlocked (76%) and were most commonly accessed from nightstands and other sleeping areas (30%). Unintentional firearm injury deaths of children are preventable. Secured firearm storage practices (e.g., storing firearms locked, unloaded, and separate from ammunition) have been identified as protective factors against child firearm injuries and deaths, underscoring

the importance of policymakers, health care professionals (e.g., pediatricians), and others partnering with parents, caregivers, and firearm owners to promote secure firearm storage.

Introduction

In the United States, unintentional injury is the fourth leading cause of death among infants (i.e., children aged <1 year) and is the top cause of death among children and adolescents aged 1–17 years; firearms are a leading injury method.* Unsecure firearm storage practices (e.g., storing firearms unlocked and loaded) are associated with risk for unintentional and intentional (i.e., suicide) firearm injuries and deaths among children and adolescents (*1*). Most unintentional firearm injuries among children occur within the home, with firearms predominantly originating in the child's home (*1,2*).

* <https://wisqars.cdc.gov/fatal-leading>

INSIDE

- 1346 Suicide Rates by Industry and Occupation — National Vital Statistics System, United States, 2021
- 1351 Notes from the Field: Transmission of Mpox to Nonsexual Close Contacts — Two U.S. Jurisdictions, May 1–July 31, 2022
- 1353 Notes from the Field: COVID-19 Pandemic-Related Changes in Blood Lead Screening — Chicago, Illinois, 2017–2022
- 1355 QuickStats

Continuing Education examination available at https://www.cdc.gov/mmwr/mmwr_continuingEducation.html



U.S. Department of Health and Human Services
Centers for Disease Control and Prevention

In 2021, approximately 30 million children lived in homes with firearms, including 4.6 million in households reporting storing firearms loaded and unlocked (3). CDC analyzed unintentional firearm injury deaths among infants, children, adolescents aged 0–17 years (referred to as children in this report) in the United States to examine their characteristics.

Methods

Data from CDC's National Violent Death Reporting System (NVDRS) for 49 states, District of Columbia, and Puerto Rico[†] for 2003–2021 were analyzed. NVDRS is a state-based active surveillance system linking information from death certificates, law enforcement reports, and coroner or medical examiner records into one incident. Trained abstractors enter information into a web-based system using standardized coding guidance from CDC. Additional details on methodology

[†] Data from 49 states, District of Columbia, and Puerto Rico that reported information to NVDRS during 2003–2021 were included in this analysis. These jurisdictions included Alaska, Maryland, Massachusetts, New Jersey, Oregon, South Carolina, and Virginia (2003–2021); Colorado, Georgia, North Carolina, Oklahoma, Rhode Island, and Wisconsin (2004–2021); Kentucky, New Mexico, and Utah (2005–2021); Ohio (2011–2021); Michigan (2014–2021); New York (2015–2018 and 2020–2021); Hawaii (2015, 2016, and 2019); Arizona, Connecticut, Kansas, Maine, Minnesota, New Hampshire, and Vermont (2015–2021); Illinois, Indiana, Iowa, Pennsylvania, and Washington (2016–2021); California, Delaware, District of Columbia, Nevada, Puerto Rico, and West Virginia (2017–2021); Alabama, Louisiana, Missouri, and Nebraska (2018–2021); Montana, North Dakota, and Wyoming (2019–2021); and Arkansas, Idaho, Mississippi, South Dakota, Tennessee, and Texas (2021).

are available from NVDRS.[§] An unintentional firearm injury death is defined in NVDRS as one “resulting from a penetrating injury or gunshot wound from a weapon that uses a powder charge to fire a projectile[¶] when there was a preponderance of evidence that the shooting was not intentionally directed at the victim.” Fatal unintentional firearm injury cases for this study were identified based on the following manners of death: 1) unintentional firearm injury deaths, 2) homicides, and 3) undetermined intent deaths. *International Classification of Diseases, Tenth Revision* underlying cause of death codes W32, W33, W34, and Y86 were used to identify potential cases. Cases were excluded if the method of injury was a nonfirearm weapon type or nonpowder BB or pellet gun, or if the case did not meet NVDRS case definition for an unintentional firearm injury death. Age categories used in this study were selected based on the age-related risk of fatal unintentional firearm injury in children.^{**} A qualitative review of free text fields (e.g., law enforcement narratives) was completed by two reviewers to enhance completeness and accuracy of data. Each reviewer assessed a random sample of 5% of the other

[§] <https://www.cdc.gov/violenceprevention/pdf/nvdrs/nvdrsCodingManual.pdf>

[¶] Excludes nonpowder guns such as BB or pellet guns and air or gas rifles. The NVDRS case definition for unintentional firearm deaths corresponds to *International Classification of Diseases, Tenth Revision* underlying cause of death codes W32, W33, W34, and Y86. <https://www.cdc.gov/violenceprevention/pdf/nvdrs/nvdrsCodingManual.pdf>

^{**} <https://wisqars.cdc.gov/fatal-reports>

The *MMWR* series of publications is published by the Office of Science, Centers for Disease Control and Prevention (CDC), U.S. Department of Health and Human Services, Atlanta, GA 30329-4027.

Suggested citation: [Author names; first three, then et al., if more than six.] [Report title]. *MMWR Morb Mortal Wkly Rep* 2023;72:[inclusive page numbers].

Centers for Disease Control and Prevention

Mandy K. Cohen, MD, MPH, *Director*
Debra Houry, MD, MPH, *Chief Medical Officer and Deputy Director for Program and Science*
Paul Muntner, PhD, MHS, *Acting Director, Office of Science*

MMWR Editorial and Production Staff (Weekly)

Charlotte K. Kent, PhD, MPH, *Editor in Chief*
Rachel Gorwitz, MD, MPH, *Acting Executive Editor*
Jacqueline Gindler, MD, *Editor*
Cynthia Ogden, PhD, MRP, *Guest Science Editor*
Paul Z. Siegel, MD, MPH, *Associate Editor*
Mary Dott, MD, MPH, *Online Editor*
Terisa F. Rutledge, *Managing Editor*
Teresa M. Hood, MS, *Lead Technical Writer-Editor*
Witt Callaway, MA, Glenn Damon,
Jacqueline Farley, MS, Tiana Garrett, PhD, MPH,
Ashley Morici, Stacy Simon, MA,
Morgan Thompson, Suzanne Webb, PhD, MA,
Technical Writer-Editors

Martha F. Boyd, *Lead Visual Information Specialist*
Alexander J. Gottardy, Maureen A. Leahy,
Stephen R. Spriggs, Armina Velarde, Tong Yang,
Visual Information Specialists
Quang M. Doan, MBA, Phyllis H. King,
Terraye M. Starr, Moua Yang,
Information Technology Specialists

Symone Hairston, MPH,
Acting Lead Health Communication Specialist
Kiana Cohen, MPH,
Leslie Hamlin, Lowery Johnson,
Health Communication Specialists
Dewin Jimenez, Will Yang, MA,
Visual Information Specialists

MMWR Editorial Board

Matthew L. Boulton, MD, MPH
Carolyn Brooks, ScD, MA
Virginia A. Caine, MD
Jonathan E. Fielding, MD, MPH, MBA

Timothy F. Jones, MD, *Chairman*
David W. Fleming, MD
William E. Halperin, MD, DrPH, MPH
Jewel Mullen, MD, MPH, MPA
Jeff Niederdeppe, PhD
Patricia Quinlisk, MD, MPH

Patrick L. Remington, MD, MPH
Carlos Roig, MS, MA
William Schaffner, MD
Morgan Bobb Swanson, MD, PhD

reviewer's cases, reconciling all discrepancies until 100% agreement was reached. Descriptive analyses were conducted using SAS (version 9.4; SAS Institute). This activity was reviewed by CDC, deemed not research, and was conducted consistent with applicable federal law and CDC policy.^{††}

Results

Sex, Age Group, and Race and Ethnicity of Decedents

During 2003–2021, a total of 1,262 fatal unintentional firearm injury cases^{§§} among children aged 0–17 years were identified in NVDRS (Figure). A majority (83.1%) of these deaths occurred among boys (Table 1). Children aged 0–5 years accounted for 29.1% of unintentional firearm injury deaths, followed by those aged 6–10 years (14.0%), 11–15 years (33.0%), and 16–17 years (23.9%). A majority of victims were in one of the following three racial and ethnic groups: non-Hispanic Black or African American (39.9%), Hispanic or Latino (10.7%), and non-Hispanic White (42.2%).

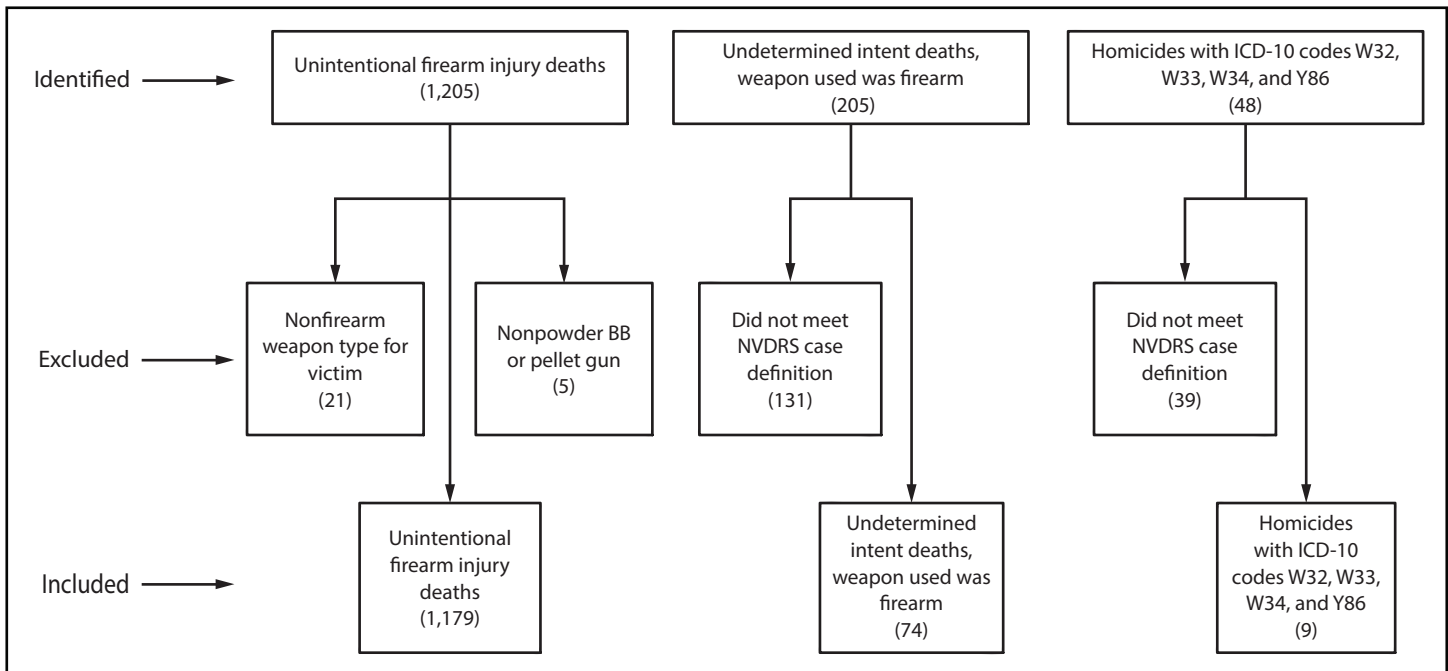
^{††} 45 C.F.R. part 46; 21 C.F.R. part 56; 42 U.S.C. Sect. 241 (d), 5 U.S.C. Sect. 552a, 44 U.S.C. Sect. 3501 et seq.

^{§§} The final sample of included cases comprised 93.4% (1,179) of unintentional firearm injury deaths as identified by NVDRS; 5.9% (74) undetermined intent deaths by firearm; and 0.7% (nine) homicides with *International Classification of Diseases, Tenth Revision* codes W32, W33, W34, and Y86.

Shooter Characteristics in Unintentional Firearm Injury Deaths Among Children

Approximately one half (52.9%) of fatal unintentional firearm injuries among children were inflicted by another person; this proportion was highest among victims aged 6–10 years (64.2%), followed by those aged 11–15 years (61.4%), and aged 16–17 years (60.0%). Self-inflicted injuries accounted for 37.8% of childhood unintentional firearm injury deaths overall; the proportion of injuries that were self-inflicted was highest among children aged 0–5 years (57.8%). In 9.4% of incidents, it was unknown whether the injury was self- or other-inflicted (Table 1). Among fatal unintentional firearm injuries inflicted by another, in those cases for which the sex and age of the shooter were known, 93.9% of shooters were male and 75.2% were aged 2–17 years. Most shooters of children aged 6–10, 11–15, and 16–17 years were aged 11–17 years (63.4%), whereas children aged 0–5 years were most frequently shot by another child in their own age group (37.2%). When the shooter's relationship to the child victim was known, 41.7% of victims were shot by a friend or acquaintance (including 55.2% of victims aged 11–15 years and 68.9% of victims aged 16–17 years); 31.8% of victims were shot by a sibling (including 59.0% of victims aged 0–5 years and 53.9% of victims aged 6–10 years); 11.8% were shot by another relative (e.g., cousin); and 7.3% were shot by a parent.

FIGURE. Identification of unintentional firearm injury deaths among children and adolescents aged 0–17 years (N = 1,262) — National Violent Death Reporting System, United States, 2003–2021*



Abbreviations: ICD-10 = *International Classification of Diseases, Tenth Revision*; NVDRS = National Violent Death Reporting System.

* The final sample of included cases comprised 93.4% of unintentional firearm injury deaths as identified by NVDRS; 5.9% undetermined intent deaths by firearm; and 0.7% homicides with ICD-10 codes W32, W33, W34, and Y86 bringing the total case count of unintentional firearm injury deaths to 1,262.

TABLE 1. Number and percentage* of unintentional firearm injury deaths among children and adolescents aged 0–17 years, by victim's sex and race and ethnicity; shooter; and shooter's age, sex, and relationship to the victim (N = 1,262) — National Violent Death Reporting System, United States,† 2003–2021

Characteristic	Victim age group,§ yrs, no. (column %*)				Total
	0–5	6–10	11–15	16–17	
Victim sex					
Boy	285 (77.7)	134 (76.1)	361 (86.6)	269 (89.1)	1,049 (83.1)
Girl	82 (22.3)	42 (23.9)	56 (13.4)	33 (10.9)	213 (16.9)
Total (row %)	367 (29.1)	176 (14.0)	417 (33.0)	302 (23.9)	1,262 (100.0)
Victim race and ethnicity					
A/PI	5 (1.4)	1 (0.6)	2 (0.5)	2 (0.7)	10 (0.8)
AI/AN	6 (1.6)	11 (6.3)	17 (4.1)	13 (4.3)	47 (3.7)
Black or African American	179 (48.8)	78 (44.3)	133 (31.9)	113 (37.4)	503 (39.9)
White	137 (37.3)	67 (38.1)	206 (49.4)	122 (40.4)	532 (42.2)
Hispanic or Latino¶	24 (6.5)	18 (10.2)	49 (11.8)	44 (14.6)	135 (10.7)
Two or more, other, unspecified race	16 (4.4)	1 (0.6)	10 (2.4)	8 (2.7)	35 (2.8)
Total (row %)	367 (29.1)	176 (14.0)	417 (33.0)	302 (23.9)	1,262 (100.0)
Shooter**					
Self-inflicted	212 (57.8)	44 (25.0)	122 (29.3)	99 (32.8)	477 (37.8)
Inflicted by other person	117 (31.9)	113 (64.2)	256 (61.4)	181 (60.0)	667 (52.9)
Unknown who inflicted	38 (10.4)	19 (10.8)	39 (9.4)	22 (7.3)	118 (9.4)
Total (row %)	367 (29.1)	176 (14.0)	417 (33.0)	302 (23.9)	1,262 (100.0)
Shooter age when injuries inflicted by another, age group, yrs					
2–5	35 (37.2)	10 (11.0)	3 (1.5)	0 (—)	48 (9.5)
6–10	27 (28.7)	21 (23.1)	14 (6.9)	1 (0.8)	63 (12.4)
11–17	8 (8.5)	45 (49.5)	146 (72.3)	71 (59.2)	270 (53.3)
≥18	24 (25.5)	15 (16.5)	39 (19.3)	48 (40.0)	126 (24.9)
Total (row %)	94 (18.5)	91 (18.0)	202 (39.8)	120 (23.7)	507 (100.0)
Shooter sex when injuries inflicted by another					
Female	9 (9.2)	6 (5.8)	10 (4.3)	11 (7.1)	36 (6.1)
Male	89 (90.8)	97 (94.2)	223 (95.7)	144 (93.0)	553 (93.9)
Total (row %)	98 (16.6)	103 (17.5)	233 (39.6)	155 (26.3)	589 (100.0)
Shooter relationship to victim					
Acquaintance or friend	2 (2.0)	9 (8.8)	132 (55.2)	104 (68.9)	247 (41.7)
Sibling	59 (59.0)	55 (53.9)	57 (23.9)	17 (11.3)	188 (31.8)
Other relative (e.g., cousin or uncle)	11 (11.0)	22 (21.6)	24 (10.0)	13 (8.6)	70 (11.8)
Parent	22 (22.0)	10 (9.8)	10 (4.2)	1 (0.7)	43 (7.3)
Other person known to victim (e.g., babysitter)	5 (5.0)	5 (4.9)	8 (3.4)	5 (3.3)	23 (3.9)
Current dating partner	0 (—)	0 (—)	4 (1.7)	10 (6.6)	14 (2.4)
Other (e.g., stranger)	1 (1.0)	1 (1.0)	4 (1.7)	1 (0.7)	7 (1.2)
Total (row %)	100 (16.9)	102 (17.2)	239 (40.4)	151 (25.5)	592 (100.0)

Abbreviations: AI/AN = American Indian or Alaska Native; A/PI = Asian or Pacific Islander.

* Percentages might not sum to 100 because of rounding. Except where noted, the denominator excluded those unintentional firearm injury deaths where characteristics were missing or unknown. Percentages are column percentages, unless otherwise noted.

† Data from 49 states, District of Columbia, and Puerto Rico that reported information to the National Violent Death Reporting System during 2003–2021 were included in this analysis. These jurisdictions included Alaska, Maryland, Massachusetts, New Jersey, Oregon, South Carolina, and Virginia (2003–2021); Colorado, Georgia, North Carolina, Oklahoma, Rhode Island, and Wisconsin (2004–2021); Kentucky, New Mexico, and Utah (2005–2021); Ohio (2011–2021); Michigan (2014–2021); New York (2015–2018 and 2020–2021); Hawaii (2015, 2016, and 2019); Arizona, Connecticut, Kansas, Maine, Minnesota, New Hampshire, and Vermont (2015–2021); Illinois, Indiana, Iowa, Pennsylvania, and Washington (2016–2021); California, Delaware, District of Columbia, Nevada, Puerto Rico, and West Virginia (2017–2021); Alabama, Louisiana, Missouri, and Nebraska (2018–2021); Montana, North Dakota, and Wyoming (2019–2021); and Arkansas, Idaho, Mississippi, South Dakota, Tennessee, and Texas (2021).

§ Age categories were selected based on the age-related risk for fatal unintentional firearm injury in children.

¶ Hispanic or Latino (Hispanic) persons might be of any race but were categorized as Hispanic; all racial groups were non-Hispanic.

** Coroner or medical examiner and law enforcement narratives were reviewed to enhance data completeness and accuracy of this variable.

Location of Injury, Precipitating Circumstances, and Incident Characteristics

The majority (85.5%) of victims were fatally injured at a house or apartment, including 55.6% in their own home (Table 2). Among all child victims of unintentional fatal firearm injuries, the most common precipitating circumstances were the shooter playing with or showing the firearm to another person (66.6%); unintentionally pulling the trigger (21.3%); thinking the firearm was unloaded, the safety was engaged, or the magazine was disengaged (20.5%); and mistaking the firearm for a toy (10.6%; most commonly among children aged 0–5 years [28.0%]) (Table 2). In approximately one third (34.1%) of all incidents, another child or other children were present or witnessed the fatal event. Nearly one half (44.6%) of firearms inflicting the fatal injury belonged to a parent of the shooter. Among incidents with known storage information, firearms used to inflict the fatal injury were stored loaded and unlocked in 73.8% and 76.2% of incidents, respectively. Among firearms that were stored unlocked and for which loaded status was known, 90.6% were stored loaded. When stored unlocked, the most common places from which the firearm was accessed were inside or on top of a nightstand, under a mattress or bed pillow, or on top of a bed (30.0%); on top of a shelf or inside a closet (18.6%); and inside a vehicle (12.5%). Handguns accounted for 74.0% of firearms used in unintentional firearm injury deaths of children.

Discussion

In this analysis, most unintentional firearm injury deaths among children occurred in homes, and firearms used most often belonged to the parent of the shooter. Approximately one half of fatal injuries were inflicted by others, but consistent with other studies (4), injuries to children aged 0–5 years were disproportionately self-inflicted. Firearms used to inflict fatal unintentional injuries were frequently stored both loaded and unlocked, factors that have previously been associated with firearm injuries and deaths of children (1). These results underscore the importance of 1) promoting secure firearm storage practices (e.g., storing firearms locked, unloaded, and separate from ammunition) and parental supervision (especially when a firearm is in the home), and 2) parents and caregivers asking about the presence of unsecured firearms in other homes their children visit and play^{¶¶} as strategies to prevent unintentional firearm injuries and deaths. A recent study found that among firearm owners who reported not locking all firearms, almost one half believed locks were unnecessary or that a locked

firearm might impede quick access in an emergency (5). This might partly explain why unsecured firearms in this study were most commonly accessed from a nightstand or other sleeping areas. Previous research found that parents often inaccurately predict their child's knowledge of household firearm storage location and subsequent anticipated behavior if they should encounter a firearm (6,7). Additional findings from previous research indicate that many parents who own firearms incorrectly believe that their child can differentiate between a toy and a real firearm, and many trust that if their child encountered a real firearm, they would avoid it and tell an adult (7). In the current analysis, across all age groups, approximately two thirds of shooters were playing with or showing the firearm to another person when it discharged, and 10.6% of all children mistook the firearm for a toy (including approximately one quarter of those aged 0–5 years). These findings underscore the fact that parents' reliance on children's ability to distinguish between real and toy firearms and to not handle a firearm if they encountered one is insufficient to prevent unintentional firearm injury deaths of children.

Approximately three quarters of victims in this study were shot by another child, most commonly a friend, acquaintance, or sibling. Further, other children were present during or witnessed the fatal event in approximately one third of all incidents. Studies show that children exposed to firearm violence might experience poor mental health outcomes (e.g., anxiety) (8), further underscoring the importance of preventing unintentional firearm injury deaths among children and providing support for those involved in these incidents when they do occur.

When firearms are in the home, organizations have recommended storing them locked, unloaded, and separate from ammunition as effective strategies to prevent child firearm injuries and deaths.^{***} In addition, some states have enacted child access prevention (CAP) laws to hold firearm owners liable when a child gains access to an unsecured firearm.^{†††} While some research suggests CAP laws might be effective in preventing unintentional firearm injuries and deaths of children,^{§§§} other research has raised questions about awareness of the policies and the modest effects on secure firearm storage (9). Policymakers, health care professionals (including pediatricians), and others can partner with parents, caregivers, and firearm owners to better understand and address barriers to adoption of secure firearm storage practices.

*** <https://www.cdc.gov/violenceprevention/firearms/fastfact.html>

††† <https://everytownresearch.org/rankings/law/secure-storage-or-child-access-prevention-required/>

§§§ <https://www.rand.org/research/gun-policy/analysis/child-access-prevention/unintentional-injuries.html>

¶¶ <https://www.healthychildren.org/English/safety-prevention/at-home/Pages/Handguns-in-the-Home.aspx>

TABLE 2. Number and percentage* of unintentional firearm injury deaths of children and adolescents aged 0–17 years, by precipitating circumstances and incident characteristics (N = 1,262) — National Violent Death Reporting System, United States,† 2003–2021

Precipitating circumstance and incident characteristic	Victim's age group, yrs, no. (column %) [§]				Total
	0–5	6–10	11–15	16–17	
Precipitating circumstance[¶]	311 (27.8)	156 (13.9)	380 (33.9)	273 (24.4)	1,120 (100.0)
Playing with firearm, showing firearm to others	207 (66.6)	102 (65.4)	255 (67.1)	182 (66.7)	746 (66.6)
Unintentionally pulled trigger	61 (19.6)	29 (18.6)	88 (23.2)	60 (22.0)	238 (21.3)
Thought firearm was unloaded, safety engaged, or magazine disengaged	17 (5.5)	26 (16.7)	113 (29.7)	74 (27.1)	230 (20.5)
Firearm mistaken for a toy	87 (28.0)	24 (15.4)	7 (1.8)	1 (0.4)	119 (10.6)
Hunting or target shooting	3 (1.0)	16 (10.3)	46 (12.1)	20 (7.3)	85 (7.6)
Firearm was defective or malfunctioned or was fired when dropped, holstering, or operating safety lock	12 (3.9)	12 (7.7)	32 (8.4)	24 (8.8)	80 (7.1)
Firearm fired while loading, unloading, or cleaning	9 (2.9)	12 (7.7)	35 (9.2)	22 (8.1)	78 (7.0)
Other context of injury or mechanism of injury (e.g., celebratory firing of firearm)	90 (28.9)	38 (24.4)	97 (25.5)	74 (27.1)	299 (26.7)
Incident characteristic					
Firearm storage (locked status)**					
Unlocked	252 (95.5)	76 (73.1)	129 (61.4)	51 (57.3)	508 (76.2)
Locked	3 (1.1)	7 (6.7)	19 (9.1)	5 (5.6)	34 (5.1)
NA (e.g., firearm discharged during hunting)**	9 (3.4)	21 (20.2)	62 (29.5)	33 (37.1)	125 (18.7)
Total (row %)	264 (39.6)	104 (15.6)	210 (31.5)	89 (13.3)	667 (100.0)
Firearm storage (loaded status)**					
Loaded	199 (96.6)	67 (68.4)	111 (59.7)	51 (56.7)	428 (73.8)
Unloaded	0 (—)	12 (12.2)	11 (5.9)	5 (5.6)	28 (4.8)
NA (e.g., firearm discharged during hunting)**	7 (3.4)	19 (19.4)	64 (34.4)	34 (37.8)	124 (21.4)
Total (row %)	206 (35.5)	98 (16.9)	186 (32.1)	90 (15.5)	580 (100.0)
Firearm storage (both loaded and unlocked status)^{††}					
Loaded and unlocked	190 (99.0)	57 (81.4)	87 (82.1)	43 (89.6)	377 (90.6)
Total (row %)	192 (46.2)	70 (16.8)	106 (25.5)	48 (11.5)	416 (100.0)
Owner of firearm used in the fatal event					
Parent of the shooter	125 (60.4)	41 (47.1)	66 (36.7)	16 (19.5)	248 (44.6)
Shooter	13 (6.3)	13 (14.9)	33 (18.3)	42 (51.2)	101 (18.2)
Other family member (e.g., cousin)	44 (21.3)	17 (19.5)	28 (15.6)	4 (4.9)	93 (16.7)
Friend or acquaintance	6 (2.9)	7 (8.1)	17 (9.4)	8 (9.8)	38 (6.8)
Stranger	1 (0.5)	2 (2.3)	8 (4.4)	4 (4.9)	15 (2.7)
Other (e.g., mother's boyfriend)	18 (8.7)	7 (8.1)	28 (15.6)	8 (9.8)	61 (11.0)
Total (row %)	207 (37.2)	87 (15.7)	180 (32.4)	82 (14.8)	556 (100.0)
Location where shooter accessed firearm used in fatal event^{§§}					
Inside or on top of nightstand, under mattress or pillow, or on top of bed	70 (33.5)	15 (26.8)	22 (25.3)	6 (24.0)	113 (30.0)
On top of shelf or inside a closet	30 (14.4)	17 (30.4)	20 (23.0)	3 (12.0)	70 (18.6)
Inside a vehicle	25 (12.0)	6 (10.7)	9 (10.3)	7 (28.0)	47 (12.5)
Inside a handbag, backpack, gym bag, purse, or clothing	16 (7.7)	4 (7.1)	9 (10.3)	4 (16.0)	33 (8.8)
On top of coffee table, kitchen table, refrigerator, or inside kitchen drawer	20 (9.6)	3 (5.4)	7 (8.1)	2 (8.0)	32 (8.5)
Inside room in house (unspecified where in room, but firearm stored unlocked)	13 (6.2)	6 (10.7)	5 (5.8)	1 (4.0)	25 (6.6)
Under couch, chair, or couch pillow	17 (8.1)	1 (1.8)	1 (1.2)	0 (—)	19 (5.0)
Behind furniture or leaning against something	9 (4.3)	1 (1.8)	6 (6.9)	1 (4.0)	17 (4.5)
Other container (e.g., shoebox or Tupperware)	9 (4.3)	1 (1.8)	3 (3.5)	0 (—)	13 (3.5)
Other location (e.g., inside a shed)	0 (—)	2 (3.6)	5 (5.8)	1 (4.0)	8 (2.1)
Total (row %)	209 (55.4)	56 (14.9)	87 (23.1)	25 (6.6)	377 (100.0)
Location where injury occurred					
House or apartment	328 (92.9)	146 (85.9)	335 (82.5)	228 (80.3)	1,037 (85.5)
Natural area	4 (1.1)	14 (8.2)	33 (8.1)	15 (5.3)	66 (5.4)
Motor vehicle	12 (3.4)	4 (2.4)	11 (2.7)	16 (5.6)	43 (3.5)
Other location	9 (2.6)	6 (3.5)	27 (6.7)	25 (8.8)	67 (5.5)
Total (row %)	353 (29.1)	170 (14.0)	406 (33.5)	284 (23.4)	1,213 (100.0)

See table footnotes on the next page.

TABLE 2. (Continued) Number and percentage* of unintentional firearm injury deaths of children and adolescents aged 0–17 years, by precipitating circumstances and incident characteristics (N = 1,262) — National Violent Death Reporting System, United States,† 2003–2021

Precipitating circumstance and incident characteristic	Victim's age group, yrs, no. (column %) [§]				
	0–5	6–10	11–15	16–17	Total
Event characteristic					
Injured at victim's home	259 (75.1)	95 (58.3)	190 (47.6)	112 (41.0)	656 (55.6)
Total (row %)	345 (29.2)	163 (13.8)	399 (33.8)	273 (23.1)	1,180 (100.0)
Stolen firearm					
Firearm used to inflict fatal injury was listed or reported as stolen	11 (7.3)	1 (1.4)	23 (13.6)	24 (25.5)	59 (12.2)
Total (row %)	150 (31.0)	71 (14.7)	169 (34.9)	94 (19.4)	484 (100.0)
Violence exposure					
Other child or children present or witnessed fatal incident ^{¶¶}	128 (34.9)	82 (46.6)	145 (34.8)	75 (24.8)	430 (34.1)
Total (row %)	367 (29.1)	176 (14.0)	417 (33.0)	302 (23.9)	1,262 (100.0)
Type of firearm used in fatal event					
Handgun	265 (88.6)	94 (64.0)	236 (65.4)	184 (74.8)	779 (74.0)
Long gun (i.e., rifles, shotguns, or miscellaneous long guns) other	34 (11.4)	53 (36.1)	125 (34.6)	62 (25.2)	274 (26.0)
Total (row %)	299 (28.4)	147 (14.0)	361 (34.3)	246 (23.4)	1,053 (100.0)

Abbreviations: NA = not applicable; NVDRS = National Violent Death Reporting System.

* Percentages might not sum to 100% because of rounding. Except where noted, the denominator excluded those unintentional firearm injury deaths where characteristics were missing or unknown. Percentages are column percentages unless otherwise noted.

† Data from 49 states, District of Columbia, and Puerto Rico that reported information to NVDRS during 2003–2021 were included in this analysis. These jurisdictions included Alaska, Maryland, Massachusetts, New Jersey, Oregon, South Carolina, and Virginia (2003–2021); Colorado, Georgia, North Carolina, Oklahoma, Rhode Island, and Wisconsin (2004–2021); Kentucky, New Mexico, and Utah (2005–2021); Ohio (2011–2021); Michigan (2014–2021); New York (2015–2018 and 2020–2021); Hawaii (2015, 2016, and 2019); Arizona, Connecticut, Kansas, Maine, Minnesota, New Hampshire, and Vermont (2015–2021); Illinois, Indiana, Iowa, Pennsylvania, and Washington (2016–2021); California, Delaware, District of Columbia, Nevada, Puerto Rico, and West Virginia (2017–2021); Alabama, Louisiana, Missouri, and Nebraska (2018–2021); Montana, North Dakota, and Wyoming (2019–2021); and Arkansas, Idaho, Mississippi, South Dakota, Tennessee, and Texas (2021).

§ Age categories were selected based on the age-related risk for fatal unintentional firearm injury among children.

¶ Includes unintentional firearm injury deaths with one or more precipitating circumstances; circumstances were unknown in 142 incidents. Total numbers do not equal the sums of the columns because more than one circumstance could have been present per decedent.

** Coroner or medical examiner and law enforcement narratives were reviewed to enhance data completeness and accuracy of this variable. An example of NA is when a child died from firearm-related injuries during a hunting-related accident or target shooting, etc.; therefore, the firearm was loaded, unlocked, or loaded and unlocked due to active use.

†† Denominator excludes incidents where firearm stored locked or loaded was NA (e.g., firearm discharged during hunting or target shooting). Among firearms that were stored unlocked and for which loaded status was known, 90.6% were stored loaded. Among firearms that were stored unlocked and for which loaded status was known, 9.4% were stored unloaded.

§§ A free-text field called “gun access narrative” is collected in NVDRS to characterize where and from whom firearms used in deaths in the system were obtained. Broad categories were created to categorize information regarding location from which the firearm was accessed for purposes of this study. Coroner or medical examiner and law enforcement narratives were reviewed to enhance data completeness and accuracy of this variable. Denominator includes incidents during which firearm access information was known and firearm was stored unlocked.

¶¶ “Other child(ren) present and or witnessed the fatal incident” circumstance has been collected in NVDRS for decedents since data year 2019. Coroner or medical examiner and law enforcement narratives were reviewed for 2003–2018 for all unintentional firearm injury deaths of children aged 0–17 years to enhance completeness of this variable for all years of the study. Guidance used to code this variable was obtained from pages 63–64 of the NVDRS coding manual version 6.0 (<https://www.cdc.gov/violenceprevention/pdf/nvdrs/nvdrsCodingManual.pdf>). The denominator for this variable included those unintentional firearm injury deaths where “Other child(ren) present and or witnessed” was missing and unknown.

Limitations

The findings in this report are subject to at least four limitations. First, NVDRS data abstractors are limited to the information included in investigative reports, which might not include sufficient detail to identify all characteristics and circumstances for all decedents. In particular, information regarding firearm storage or access is often incomplete. Second, states and jurisdictions joined NVDRS in different years, so data were unavailable from all recipients for all years of this study, limiting the ability to capture all unintentional firearm injury deaths for the entire study period. Third, this report summarizes data from 49 states, the District of Columbia, and Puerto Rico (data for Florida are excluded because the data

did not meet the completeness threshold for circumstances in NVDRS), thereby limiting the generalizability of these findings. Finally, unintentional firearm injury deaths might be misclassified on death certificates, leading to potential under- or over-ascertainment. However, NVDRS has been found to better identify these incidents than do death certificates alone (10).

Implications for Public Health Practice

Unintentional firearm injury deaths of children are preventable. Secure firearm storage practices (e.g., firearm stored locked, unloaded, and separate from ammunition) have been identified as protective factors against unintentional and intentional (i.e., suicides) firearm injuries and deaths of children (1),

References

Summary

What is already known about this topic?

Unintentional injury is a leading cause of death among U.S. children and adolescents aged 0–17 years, and firearms are a leading injury method.

What is added by this report?

Approximately one half of unintentional firearm injury deaths among children and adolescents occurred at their home; playing with or showing the firearm to another person was the most common precipitator. Overall, firearms used in unintentional injury deaths were often stored both loaded and unlocked and were commonly accessed from nightstands and other sleeping areas.

What are the implications for public health practice?

Unintentional firearm injury deaths are preventable. Securing firearms (e.g., locked, unloaded, and separate from ammunition) is protective against unintentional firearm injury deaths among children and adolescents, underscoring the importance of promoting secure firearm storage.

highlighting the important role of policymakers, health care professionals and others in partnering with parents, caregivers, and firearm owners to promote secure firearm storage.

Acknowledgments

Violent death reporting system programs and entities that provide data to the National Violent Death Reporting System, including vital registrars, coroners, medical examiners, and law enforcement agencies.

Corresponding author: Rebecca F. Wilson, ysp2@cdc.gov.

¹Division of Violence Prevention, National Center for Injury Prevention and Control, CDC; ²National Center for Fatality Review and Prevention, Michigan Public Health Institute, Okemos, Michigan.

All authors have completed and submitted the International Committee of Medical Journal Editors form for disclosure of potential conflicts of interest. No potential conflicts of interest were disclosed.

1. Grossman DC, Mueller BA, Riedy C, et al. Gun storage practices and risk of youth suicide and unintentional firearm injuries. *JAMA* 2005;293:707–14. PMID:15701912 <https://doi.org/10.1001/jama.293.6.707>
2. 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;153:875–8. PMID:10437764 <https://doi.org/10.1001/archpedi.153.8.875>
3. Miller M, Azrael D. Firearm storage in US households with children: findings from the 2021 National Firearm Survey. *JAMA Netw Open* 2022;5:e2148823. PMID:35191973 <https://doi.org/10.1001/jamanetworkopen.2021.48823>
4. Fowler KA, Dahlberg LL, Haileyesus T, Gutierrez C, Bacon S. Childhood firearm injuries in the United States. *Pediatrics* 2017;140:e20163486. PMID:28630118 <https://doi.org/10.1542/peds.2016-3486>
5. Anestis MD, Moceri-Brooks J, Johnson RL, et al. Assessment of firearm storage practices in the US, 2022. *JAMA Netw Open* 2023;6:e231447. PMID:36862408 <https://doi.org/10.1001/jamanetworkopen.2023.1447>
6. Baxley F, Miller M. Parental misperceptions about children and firearms. *Arch Pediatr Adolesc Med* 2006;160:542–7. PMID:16651499 <https://doi.org/10.1001/archpedi.160.5.542>
7. Jackman GA, Farah MM, Kellermann AL, Simon HK. Seeing is believing: what do boys do when they find a real gun? *Pediatrics* 2001;107:1247–50. <https://doi.org/10.1542/peds.107.6.1247>
8. Holloway K, Cahill G, Tieu T, Njoroge W. Reviewing the literature on the impact of gun violence on early childhood development. *Curr Psychiatry Rep* 2023;25:273–81. PMID:37233973 <https://doi.org/10.1007/s11920-023-01428-6>
9. Miller M, Zhang W, Rowhani-Rahbar A, Azrael D. Child access prevention laws and firearm storage: results from a national survey. *Am J Prev Med* 2022;62:333–40. PMID:35190100 <https://doi.org/10.1016/j.amepre.2021.09.016>
10. Barber C, Hemenway D. Too many or too few unintentional firearm deaths in official U.S. mortality data? *Accid Anal Prev* 2011;43:724–31. PMID:21376860 <https://doi.org/10.1016/j.aap.2010.10.018>

Suicide Rates by Industry and Occupation — National Vital Statistics System, United States, 2021

Aaron Sussell, PhD¹; Cora Peterson, PhD²; Jia Li, MS³; Arialdi Miniño, MPH⁴; Kenneth A. Scott, PhD⁵; Deborah M. Stone, ScD²

Abstract

The suicide rate among the U.S. working-age population has increased approximately 33% during the last 2 decades. To guide suicide prevention strategies, CDC analyzed suicide deaths by industry and occupation in 49 states, using data from the 2021 National Vital Statistics System. Industry (the business activity of a person's employer or, if self-employed, their own business) and occupation (a person's job or the type of work they do) are distinct ways to categorize employment. The overall suicide rates by sex in the civilian noninstitutionalized working population were 32.0 per 100,000 among males and 8.0 per 100,000 among females. Major industry groups with the highest suicide rates included Mining (males = 72.0); Construction (males = 56.0; females = 10.4); Other Services (e.g., automotive repair; males = 50.6; females = 10.4); Arts, Entertainment, and Recreation (males = 47.9; females = 15.0); and Agriculture, Forestry, Fishing, and Hunting (males = 47.9). Major occupation groups with the highest suicide rates included Construction and Extraction (males = 65.6; females = 25.3); Farming, Fishing, and Forestry (e.g., agricultural workers; males = 49.9); Personal Care and Service (males = 47.1; females = 15.9); Installation, Maintenance, and Repair (males = 46.0; females = 26.6); and Arts, Design, Entertainment, Sports, and Media (males = 44.5; females = 14.1). By integrating recommended programs, practices, and training into existing policies, workplaces can be important settings for suicide prevention. CDC provides evidence-based suicide prevention strategies in its Suicide Prevention Resource for Action and Critical Steps Your Workplace Can Take Today to Prevent Suicide, NIOSH Science Blog.

Introduction

In 2021, a total of 37,602 persons (17.8 per 100,000 population) of working age (16–64 years, employed or unemployed) in the United States died by suicide, a rate increase of approximately 33% since 2001 (13.4).^{*} To guide suicide prevention strategies among the working-age population, CDC analyzed 2021 suicide deaths by industry and occupation.

^{*}<https://bit.ly/46GuCMA>

Methods

Data Source

The 2021 National Vital Statistics System (NVSS) restricted-use mortality file includes 37,435 suicide decedents aged 16–64 years who resided and died in one of 49 states (death certificate reporting from Rhode Island and the District of Columbia did not include usual industry and occupation) (1). This report includes 30,015 decedents (80.2% of total) whose usual industry or occupation reported on the death certificate was not military, nonpaid (i.e., homemaker, volunteer, student, retired, did not work, child, disabled, patient, or inmate), or unclassifiable (7,420). Industry (the business activity of a person's employer or, if self-employed, their own business) and occupation (a person's job or the type of work they do) are distinct ways to categorize employment (2). Major industry and occupation classifications encompass all jobs in the U.S. economy; detailed industry and occupation groups are subcategories of major groups that define job types with more specificity.

Data Analyses

Population estimates for rate denominators were states' civilian, noninstitutionalized, currently employed, working population counts for persons aged 16–64 years from the 2021 American Community Survey Public Use Microdata Sample. Replicate weight standard errors for those counts were used to calculate 95% CIs. Rates were calculated by sex for major and detailed industry and occupational groups with ≥20 decedents and compared with the total sex-specific civilian noninstitutionalized working population. Industry and occupational groups with suicide rates significantly ($\alpha = 0.05$) higher by sex than the respective total civilian noninstitutionalized working population (all industries or all occupations combined) were identified as having elevated rates when the lower end of the group's 95% CI exceeded the study population rate point estimate. This analysis used the population rate point estimates for males and females as constant comparative values, in keeping with a previously published report, so that all comparisons used common points of reference (3). Rates were not calculated for “not specified” and “other general” industry groups because of inadequate alignment with available data on

working population size. U.S. Census Bureau 2012 industry and occupation codes as reported in 2021 NVSS were matched to U.S. Census Bureau 2017 industry and 2018 occupation codes as reported in the 2021 American Community Survey using standard definitions (4). Statistical analyses were conducted using SAS software (version 9.4; SAS Institute). This activity was reviewed by CDC, deemed research not involving human subjects, and was conducted consistent with applicable federal law and CDC policy.[†]

Results

Suicide Rates by Major Industry and Occupation Groups

The overall 2021 suicide rate per 100,000 in the U.S. civilian noninstitutionalized working population was 32.0 among males and 8.0 among females. Compared with the entire civilian noninstitutionalized working population, suicide rates for males, females, or both were elevated in nine of 20 major industry groups: Mining (males = 72.0); Construction (males = 56.0; females = 10.4); Other Services (e.g., automotive repair; males = 50.6; females = 10.4); Arts, Entertainment, and Recreation (males = 47.9; females = 15.0); Agriculture, Forestry, Fishing, and Hunting (males = 47.9); Transportation and Warehousing (males = 35.5); Administrative and Support and Waste Management and Remediation Services (males = 35.2); Accommodation and Food Services (males = 34.7; females = 11.1); and Health Care and Social Assistance (females = 8.5) (Table 1). Suicide rates by sex were elevated in 12 of 22 major occupational groups: Construction and Extraction (males = 65.6; females = 25.3); Farming, Fishing, and Forestry (e.g., agricultural workers; males = 49.9); Personal Care and Service (males = 47.1; females = 15.9); Installation, Maintenance, and Repair (males = 46.0; females = 26.6); Arts, Design, Entertainment, Sports, and Media (males = 44.5; females = 14.1); Building and Grounds Cleaning and Maintenance (males = 37.6); Production (males = 36.0); Transportation and Material Moving (males = 34.9); Protective Service (males = 34.8; females = 11.6); Food Preparation and Serving Related (females = 10.6); Healthcare Practitioners and Technical (females = 9.4); and Sales and Related (females = 8.9) (Table 2).

Suicide Rates by Detailed Industry Groups

Among 254 detailed industry groups, suicide rates were elevated for males, females, or both in 31 groups (Table 1). The five detailed industry groups with the highest suicide rates among males were Aerospace Products and Parts Manufacturing (147.5 per 100,000 population); Performing Arts, Spectator

Sports, and Related Industries (126.2); Logging (113.8); Fishing, Hunting, and Trapping (111.7); and Coal Mining (83.9). Among females, the five detailed industry groups with the highest rates were Performing Arts, Spectator Sports, and Related Industries (46.5); Drinking Places, Alcoholic Beverages (28.7); Specialized Design Services (20.7); Beauty Salons (17.3); and Nail Salons and Other Personal Care Services (14.7).

Suicide Rates by Detailed Occupation Groups

Among 492 detailed occupation groups, suicide rates were elevated for males, females, or both in 60 of those groups (Table 2). The five detailed occupational groups with the highest suicide rates among males were Agricultural and Food Scientists (173.1); Logging Workers (161.1); Musicians, Singers, and Related Workers (138.7); Fishing and Hunting Workers (130.6); and Other Extraction Workers (128.7). Among females, the five detailed occupational groups with the highest rates were Artists and Related Workers (45.3); Construction Laborers (38.6); Chefs and Head Cooks (32.9); Massage Therapists (25.8); and Bartenders (23.8). Rates for all major and detailed groups are available (Supplementary Table 1, <https://stacks.cdc.gov/view/cdc/136410>) (Supplementary Table 2, <https://stacks.cdc.gov/view/cdc/136411>).

Discussion

Similar to an analysis of 32 states using the 2016 National Violent Death Reporting System, the current report identified suicide rates for males, females, or both in multiple major industry groups that were higher than in the total civilian noninstitutionalized working population. These industry groups included Mining; Construction; Other Services (e.g., automotive repair); Arts, Entertainment, and Recreation; Agriculture, Forestry, Fishing, and Hunting. Major occupational groups with elevated rates include Construction and Extraction; Farming, Fishing, and Forestry (e.g., agricultural workers); Personal Care and Service; Installation, Maintenance, and Repair; Arts, Design, Entertainment, Sports, and Media (3). Although relative comparisons of suicide rates in this manner can be useful for prevention purposes, these results should not overshadow the larger context that the suicide rate in the U.S. working-age population overall has increased by approximately one third during the last 2 decades, pointing to the need for more research on causal factors and workplace- and community-based prevention. Suicide risk is associated with low-skilled jobs (5), lower educational attainment (6), lower absolute and relative socioeconomic status (7), work-related access to lethal means of suicide (8), and job stress, including

[†] 45 C.F.R. part 46; 21 C.F.R. part 56; 42 U.S.C. Sect. 241(d), 5 U.S.C. Sect. 552a, 44 U.S.C. Sect. 3501 et seq.

TABLE 1. Suicide rates,* by sex, for 20 major industry groups and detailed groups with rates higher than all industries combined — National Vital Statistics System, United States,† 2021

Industry group [§]	Rate (95% CI)	
	Males	Females
All industries	32.0 (31.6–32.4)	8.0 (7.8–8.2)
Accommodation and food services	34.7 (32.9–36.4) [¶]	11.1 (10.2–12.1) [¶]
Drinking places and alcoholic beverages	56.5 (35.7–85.8) [¶]	28.7 (16.7–46.6) [¶]
Restaurants and other food services	34.6 (32.7–36.5) [¶]	11.3 (10.3–12.3) [¶]
Administrative and support and waste management and remediation services	35.2 (33.2–37.2) [¶]	6.8 (5.7–7.8)
Investigation and security services	44.7 (38.9–50.5) [¶]	9.4 (5.3–15.8)
Landscaping services	52.3 (47.8–56.7) [¶]	—**
Agriculture, forestry, fishing, and hunting	47.9 (44.0–51.8) [¶]	10.9 (7.5–15.4)
Crop production	46.2 (41.0–51.4) [¶]	9.2 (5.3–15.0)
Fishing, hunting, and trapping	111.7 (68.3–174.3) [¶]	—
Logging	113.8 (77.8–161.7) [¶]	—
Arts, entertainment, and recreation	47.9 (44.3–51.6) [¶]	15.0 (12.8–17.1) [¶]
Performing arts, spectator sports, and related industries ^{††}	126.2 (113.3–139.2) [¶]	46.5 (38.0–55.0) [¶]
Construction	56.0 (54.4–57.6) [¶]	10.4 (8.5–12.3) [¶]
Education services	11.6 (10.6–12.7)	4.0 (3.6–4.4)
Finance and insurance	16.6 (15.2–18.0)	5.7 (4.9–6.4)
Health care and social assistance	20.9 (19.5–22.2)	8.5 (8.1–9.0) [¶]
Home health care services	32.4 (23.0–44.5)	10.3 (8.3–12.2) [¶]
Hospitals ^{††}	22.1 (19.9–24.4)	11.8 (10.9–12.8) [¶]
Nursing care facilities (skilled nursing facilities)	27.4 (19.9–36.9)	12.6 (10.5–14.7) [¶]
Information	22.5 (20.2–24.8)	8.0 (6.1–10.2)
Management of companies and enterprises	—	—
Manufacturing	29.8 (28.7–30.9)	6.5 (5.8–7.3)
Aerospace products and parts manufacturing	147.5 (116.8–178.2) [¶]	—
Ship and boat building	46.0 (32.4–63.6) [¶]	—
Mining	72.0 (64.0–80.0) [¶]	—
Coal mining	83.9 (50.2–133.1) [¶]	—
Oil and gas extraction and support activities for mining [§]	73.9 (63.8–84.0) [¶]	—

poor supervisory and colleague support, low job control, and job insecurity (9). Starting in 2020, CDC included data on decedents' usual industry and occupation from death certificates in the publicly available NVSS, providing important opportunities to monitor and address preventable mortality in the U.S. working population.

Limitations

The findings in this report are subject to at least four limitations. First, this study did not address confounding factors other than sex (e.g., age, race and ethnicity, educational attainment, and other nonwork factors) that might account for different suicide rates among and within industry or occupational groups. Second, this report addressed suicide only

TABLE 1. (Continued) Suicide rates,* by sex, for 20 major industry groups and detailed groups with rates higher than all industries combined — National Vital Statistics System, United States,† 2021

Industry group [§]	Rate (95% CI)	
	Males	Females
Other services (except public administration)	50.6 (48.0–53.2) [¶]	10.4 (9.3–11.5) [¶]
Automotive repair and maintenance	77.7 (72.1–83.2) [¶]	—
Barber shops	56.7 (36.2–85.5) [¶]	—
Beauty salons	38.8 (22.4–63.4)	17.3 (14.4–20.3) [¶]
Car washes	49.6 (34.7–69.0) [¶]	—
Commercial and industrial machinery and equipment repair and maintenance	81.7 (70.0–93.3) [¶]	—
Nail salons and other personal care services	55.2 (38.2–77.6) [¶]	14.7 (10.4–20.4) [¶]
Personal and household goods repair and maintenance	53.8 (37.0–76.1) [¶]	—
Other personal services	32.4 (21.4–47.5)	12.6 (8.3–18.4) [¶]
Private households	69.9 (42.6–109.3) [¶]	8.9 (6.1–12.5)
Professional, scientific, and technical services	20.2 (19.1–21.3)	8.0 (7.3–8.8)
Legal services	23.7 (19.7–27.7)	10.6 (8.2–13.5) [¶]
Specialized design services	40.4 (27.4–57.8)	20.7 (13.6–30.3) [¶]
Veterinary services	42.1 (25.5–66.1)	12.8 (8.9–17.8) [¶]
Public administration	25.8 (24.2–27.5)	6.7 (5.8–7.6)
Real estate and rental and leasing	22.7 (20.1–25.3)	8.2 (6.6–9.8)
Retail trade	23.4 (22.4–24.5)	8.1 (7.5–8.8)
Transportation and warehousing	35.5 (33.9–37.1) [¶]	8.6 (7.3–9.9)
Services incidental to transportation	40.8 (35.5–46.2) [¶]	11.0 (6.3–18.0)
Truck transportation	52.4 (48.8–56.1) [¶]	11.5 (7.1–17.9)
Warehousing and storage	46.5 (41.0–51.9) [¶]	9.9 (6.4–14.7)
Utilities	34.2 (30.5–37.9)	10.8 (6.8–16.4)
Wholesale trade	14.5 (12.9–16.0)	3.8 (2.6–5.4)
Recyclable material merchant wholesalers	56.7 (33.6–90.7) [¶]	—

* Rates are per 100,000 civilian, noninstitutionalized working persons aged 16–64 years from the 2021 American Community Survey.

† Rhode Island and the District of Columbia are not included.

§ U.S. Census Bureau 2017 industry titles are from the 2021 American Community Survey unless otherwise noted. U.S. Census Bureau codes 0370 and 0490 were combined because nearly all workers classified as 0490 work in oil and gas extraction, and they are the majority of workers in that industry.

¶ Rates are significantly ($\alpha = 0.05$) higher than the total civilian noninstitutionalized working population (all industries or occupations combined) and were identified as having elevated rates when the lower end of the group's 95% CI exceeded the study population rate point estimate. Caution should be taken when interpreting rate point estimates for detailed groups with wide 95% CIs, which can be due to relatively low numbers of decedents and working populations.

** Rate was not calculated if industry or occupation group codes were irreconcilable between data sources; the group was a composite category with low specificity (e.g., "Not Specified Retail Trade"), number of deaths was fewer than 20, or population estimate was unavailable.

†† This is a U.S. Census Bureau 2012 industry title.

among decedents with classifiable paid employment reported on the death certificate; previous research has shown that job reporting on death certificates is associated with decedents' sociodemographic characteristics (10). Third, this analysis did not address suicide among decedents with military employment nor decedents aged ≥ 65 years. Finally, the numerator and

TABLE 2. Suicide rates,* by sex, for 22 major occupation groups and detailed groups with rates higher than all occupations combined — National Vital Statistics System, United States,† 2021

Occupation group [§]	Rate (95% CI)	
	Males	Females
All occupations	32.0 (31.6–32.4)	8.0 (7.8–8.2)
Architecture and engineering	21.9 (20.1–23.7)	7.5 (5.2–10.6)
Surveyors, cartographers, and photogrammetrists	119.4 (66.7–199.7) [¶]	—**
Arts, design, entertainment, sports, and media	44.5 (41.0–48.0) [¶]	14.1 (12.2–16.0) [¶]
Artists and related workers	93.3 (76.2–110.5) [¶]	45.3 (31.0–64.2) [¶]
Entertainers and performers, sports and related workers, all other ^{††}	114.5 (61.5–197.2) [¶]	—
Musicians, singers, and related workers ^{††}	138.7 (113.0–164.4) [¶]	—
Writers and authors	53.1 (34.4–79.1) [¶]	22.8 (13.8–35.9) [¶]
Building and grounds cleaning and maintenance	37.6 (35.3–39.8) [¶]	7.5 (6.3–8.7)
First-line supervisors of landscaping, lawn service, and groundskeeping workers	55.7 (39.3–77.0) [¶]	—
Grounds maintenance workers ^{††}	46.7 (42.6–50.9) [¶]	—
Business and financial operations	13.5 (12.4–14.7)	4.6 (4.0–5.2)
Community and social services	17.9 (15.0–20.9)	8.1 (6.8–9.5)
Social workers [¶]	29.7 (18.9–44.8)	12.0 (9.0–15.7) [¶]
Computer and mathematical	16.1 (14.9–17.3)	4.9 (3.7–6.4)
Construction and extraction	65.6 (63.7–67.6) [¶]	25.3 (18.2–34.3) [¶]
Brickmasons, blockmasons, and stonemasons	63.1 (45.5–85.6) [¶]	—
Carpenters	69.4 (64.2–74.6) [¶]	—
Carpet, floor, and tile installers and finishers	49.5 (33.5–71.1) [¶]	—
Construction equipment operators	58.6 (50.3–66.9) [¶]	—
Construction laborers	91.0 (86.0–95.9) [¶]	38.6 (22.0–63.7) [¶]
Derrick, rotary drill, and service unit operators, oil and gas	116.8 (60.0–208.0) [¶]	—
Earth drillers, except oil and gas ^{††}	64.4 (33.1–115.3) [¶]	—
Electricians	52.1 (47.1–57.1) [¶]	—
First-line supervisors of construction trades and extraction workers	61.7 (55.0–68.4) [¶]	—
Glaziers	69.6 (39.3–115.6) [¶]	—
Painters and paperhangers	44.1 (37.8–50.4) [¶]	—
Pipelayers, plumbers, pipefitters, and steamfitters ^{††}	49.4 (43.5–55.3) [¶]	—
Roofers	79.9 (66.5–93.2) [¶]	—
Structural iron and steel workers	86.1 (57.2–125.3) [¶]	—
Other extraction workers	128.7 (83.4–190.7) [¶]	—
Education, training, and library	11.2 (9.8–12.5)	4.1 (3.6–4.6)
Farming, fishing, and forestry	49.9 (44.2–55.5) [¶]	—
Fishing and hunting workers	130.6 (78.8–205.8) [¶]	—
Logging workers	161.1 (106.8–234.7) [¶]	—
Miscellaneous agricultural workers	38.1 (32.5–43.6) [¶]	—
Food preparation and serving related	32.2 (30.3–34.2)	10.6 (9.6–11.6) [¶]
Bartenders	47.0 (33.5–64.5) [¶]	23.8 (16.3–33.7) [¶]
Chefs and head cooks	66.5 (57.2–75.7) [¶]	32.9 (19.8–52.0) [¶]
Cooks	35.9 (32.4–39.4) [¶]	7.7 (5.6–10.3)
Waiters and waitresses	32.4 (27.3–37.6)	16.2 (13.8–18.5) [¶]
Healthcare practitioners and technical	22.0 (20.0–23.9)	9.4 (8.7–10.2) [¶]
Health practitioner support technologists and technicians ^{††}	25.0 (17.6–34.5)	10.8 (8.1–14.1) [¶]
Registered nurses	28.4 (22.9–33.9)	11.3 (10.0–12.5) [¶]
Healthcare support	19.7 (16.4–22.9)	7.9 (7.0–8.7)
Massage therapists	—	25.8 (16.2–39.5) [¶]
Nursing, psychiatric, and home health aides ^{††}	38.2 (28.4–50.4)	11.2 (9.5–12.9) [¶]
Personal care aides	32.8 (24.3–43.6)	10.9 (8.9–12.9) [¶]

TABLE 2. (Continued) Suicide rates,* by sex, for 22 major occupation groups and detailed groups with rates higher than all occupations combined — National Vital Statistics System, United States,† 2021

Occupation group [§]	Rate (95% CI)	
	Males	Females
Installation, maintenance, and repair	46.0 (44.0–48.1) [¶]	26.6 (18.0–38.2) [¶]
Automotive body and related repairers	68.5 (49.6–92.6) [¶]	—
Automotive service technicians and mechanics	80.6 (74.0–87.2) [¶]	—
Bus and truck mechanics and diesel engine specialists	40.1 (32.8–47.5) [¶]	—
Computer, automated teller, and office machine repairers	65.7 (46.9–90.0) [¶]	—
Heating, air conditioning, and refrigeration mechanics and installers	50.4 (43.3–57.4) [¶]	—
Industrial and refractory machinery mechanics	39.8 (33.1–46.6) [¶]	—
Millwrights	73.2 (45.1–113.4) [¶]	—
Legal	20.5 (17.2–23.8)	8.0 (6.1–10.4)
Life, physical, and social science	21.9 (18.7–25.0)	7.0 (5.1–9.4)
Agricultural and food scientists	173.1 (94.1–294.6) [¶]	—
Management	21.1 (20.2–22.1)	5.8 (5.2–6.3)
Construction managers	41.1 (36.6–45.6) [¶]	—
Farmers, ranchers, and other agricultural managers	52.1 (44.8–59.4) [¶]	—
Food service managers	38.2 (32.3–44.0) [¶]	12.3 (8.7–16.9) [¶]
Office and administrative support	23.2 (21.8–24.7)	6.8 (6.3–7.2)
Postal service clerks	58.2 (32.2–98.5) [¶]	—
Personal care and service	47.1 (42.3–52.0) [¶]	15.9 (14.3–17.4) [¶]
Animal caretakers	32.2 (17.6–55.1)	14.2 (8.9–21.7) [¶]
Barbers	58.8 (38.4–86.9) [¶]	—
Hairdressers, hairstylists, and cosmetologists	37.7 (19.8–66.2)	17.0 (13.8–20.2) [¶]
Personal care and service workers, all other ^{††}	95.4 (59.2–146.9) [¶]	—
Production	36.0 (34.4–37.6) [¶]	8.0 (6.9–9.2)
Machinists	62.5 (53.4–71.6) [¶]	—
Production workers, all other ^{††}	35.0 (31.1–38.8)	13.0 (9.0–18.2) [¶]
Welding, soldering, and brazing workers	81.9 (73.8–89.9) [¶]	—
Protective service	34.8 (32.4–37.3) [¶]	11.6 (8.8–14.9) [¶]
Bailiffs, correctional officers, and jailers ^{††}	41.3 (33.5–49.0) [¶]	—
Security guards and gambling surveillance officers	46.3 (40.7–51.8) [¶]	10.7 (6.2–17.5)
Sales and related	25.7 (24.5–26.9)	8.9 (8.2–9.6) [¶]
Retail salespersons	44.3 (40.6–47.9) [¶]	15.1 (13.0–17.3) [¶]
Transportation and material moving	34.9 (33.6–36.1) [¶]	8.8 (7.6–10.0)
Crane and tower operators	63.4 (39.7–97.1) [¶]	—
Driver/Sales workers and truck drivers	33.2 (31.2–35.3)	15.9 (10.6–23.1) [¶]
Laborers and freight, stock, and material movers, hand	68.7 (64.9–72.5) [¶]	17.9 (14.4–21.4) [¶]

* Rates are per 100,000 civilian, noninstitutionalized working persons aged 16–64 years from the 2021 American Community Survey.

† Rhode Island and the District of Columbia are not included.

§ U.S. Census Bureau 2018 occupation titles are from the 2021 American Community Survey unless otherwise noted.

¶ Rates are significantly ($\alpha = 0.05$) higher than the total civilian noninstitutionalized working population (all industries or occupations combined) and were identified as having elevated rates when the lower end of the group's 95% CI exceeded the study population rate point estimate. Caution should be taken when interpreting rate point estimates for detailed groups with wide 95% CIs, which can be due to relatively low numbers of decedents and working populations.

** Rate was not calculated if industry or occupation group codes were irreconcilable between data sources; the group was a composite category with low specificity (e.g., "Not Specified Retail Trade"), number of deaths was fewer than 20, or population estimate was unavailable.

†† This is a U.S. Census Bureau 2012 occupation title.

Summary

What is already known about this topic?

The 2021 suicide rate among U.S. persons of working age is approximately 33% higher than it was 2 decades ago.

What is added by this report?

Data from 49 states were used to calculate suicide rates by sex for all major and detailed industry and occupational groups. Major industry groups with the highest suicide rates included Mining; Construction; Other Services; Arts, Entertainment, and Recreation; and Agriculture, Forestry, Fishing, and Hunting. Major occupation groups with higher suicide rates included Construction and Extraction; Farming, Fishing, and Forestry; Personal Care and Service; Installation, Maintenance, and Repair; and Arts, Design, Entertainment, Sports, and Media.

What are the implications for public health practice?

Variations in suicide rates indicate risk disparities by workers' industry and occupation. Workplaces can be important settings for suicide prevention. CDC provides evidence-based suicide prevention strategies in its Suicide Prevention Resource for Action and Critical Steps Your Workplace Can Take Today to Prevent Suicide, National Institute for Occupational Safety and Health Science Blog.

denominator data were not a direct match for rate calculation; death certificates reflect decedents' usual industry and occupation, whereas available population size data refer to the number of workers by current job.

Public Health Implications

Variations in suicide rates indicate risk disparities by workers' industry and occupation. Workplaces can integrate evidence-based suicide prevention strategies and training into existing policies and procedures, such as limiting access to lethal means, providing peer support, increasing access to mental health services, and reducing stigma to encourage easier access to quality care. Suicide is preventable through a comprehensive public health approach that addresses the many factors associated with suicide, including those associated with industry and occupation. CDC provides guidance in its Suicide Prevention Resource for Action (<https://www.cdc.gov/suicide/resources/prevention.html>) and Critical Steps Your Workplace Can Take Today to Prevent Suicide, NIOSH Science Blog (<https://blogs.cdc.gov/niosh-science-blog/2023/03/15/preventing-workplace-suicide>). For persons in crisis, help is available through the Substance Abuse and Mental Health Services Administration's 988 Suicide and Crisis Lifeline (<https://www.988lifeline.org>) or by texting or calling 988).

Corresponding author: Aaron Sussell, als7@cdc.gov.

¹Spokane Mining Research Division, National Institute for Occupational Safety and Health, CDC; ²Division of Injury Prevention, National Center for Injury Prevention and Control, CDC; ³Division of Field Studies and Engineering, National Institute for Occupational Safety and Health, CDC; ⁴Division of Vital Statistics, National Center for Health Statistics, CDC; ⁵Western States Division, National Institute for Occupational Safety and Health, CDC.

All authors have completed and submitted the International Committee of Medical Journal Editors form for disclosure of potential conflicts of interest. No potential conflicts of interest were disclosed.

References

1. CDC. Public use data file documentation—mortality multiple cause-of-death: industry and occupation data as applicable to mortality vital statistics, 2020: history, background, and control tables. Hyattsville, MD: US Department of Health and Human Services, CDC, National Center for Health Statistics; 2020. Accessed February 15, 2022. https://www.cdc.gov/nchs/nvss/mortality_public_use_data.htm
2. US Bureau of Labor Statistics. Labor force statistics from the current population survey: concepts and definitions. Washington, DC: US Department of Labor; 2023. Accessed April 3, 2023. <https://www.bls.gov/cps/definitions.htm#occupation>
3. Peterson C, Sussell A, Li J, Schumacher PK, Yeoman K, Stone DM. Suicide rates by industry and occupation—National Violent Death Reporting System, 32 states, 2016. *MMWR Morb Mortal Wkly Rep* 2020;69:57–62. PMID:31971929 <https://doi.org/10.15585/mmwr.mm6903a1>
4. US Census Bureau. Industry and occupation code lists & crosswalks. Washington, DC: US Department of Commerce, US Census Bureau; 2023. Accessed January 9, 2023. <https://www.census.gov/topics/employment/industry-occupation/guidance/code-lists.html>
5. Milner A, Page A, LaMontagne AD. Long-term unemployment and suicide: a systematic review and meta-analysis. *PLoS One* 2013;8:e51333. PMID:23341881 <https://doi.org/10.1371/journal.pone.0051333>
6. Phillips JA, Hempstead K. Differences in U.S. suicide rates by educational attainment, 2000–2014. *Am J Prev Med* 2017;53:e123–30. PMID:28756896 <https://doi.org/10.1016/j.amepre.2017.04.010>
7. Daly MC, Wilson DJ, Johnson NJ. Relative status and well-being: evidence from U.S. suicide deaths. *Rev Econ Stat* 2013;95:1480–500. https://doi.org/10.1162/REST_a_00355
8. Milner A, Witt K, Maheen H, LaMontagne AD. Access to means of suicide, occupation and the risk of suicide: a national study over 12 years of coronial data. *BMC Psychiatry* 2017;17:125. PMID:28376757 <https://doi.org/10.1186/s12888-017-1288-0>
9. Milner A, Witt K, LaMontagne AD, Niedhammer I. Psychosocial job stressors and suicidality: a meta-analysis and systematic review. *Occup Environ Med* 2018;75:245–53. PMID:28851757 <https://doi.org/10.1136/oemed-2017-104531>
10. Peterson C, Schumacher PK, Steege AL. Demographic considerations in analyzing decedents by usual occupation. *Am J Ind Med* 2020;63:663–75. PMID:32445511 <https://doi.org/10.1002/ajim.23123>

Notes from the Field

Transmission of Mpox to Nonsexual Close Contacts — Two U.S. Jurisdictions, May 1–July 31, 2022

Ebony S. Thomas, MPH¹; Zachary J. Madewell, PhD¹; William L. Still, MS²; Julia Rowse, MPH²; Brandon Shapiro, MS²; Emily Gately, MPH³; Julie Shaffner, MS, MPH⁴; Anil T. Mangla, PhD²; Jessica N. Ricaldi, MD, PhD¹

During the 2022 multinational mpox outbreak, U.S. mpox cases primarily occurred among adult gay, bisexual, and other men who have sex with men (1). Among all cases, 94% of patients reported exposure through sexual or other intimate contact (1). Currently, little is known about less common nonsexual mpox transmission. A systematic review of mpox transmission in countries with endemic mpox in Central Africa found that the secondary attack rate among unvaccinated household contacts ranged from 0% to 11%, with a pooled estimate of 8% (2). A better understanding of the risk for nonsexual transmission during the current outbreak in countries where mpox is not endemic is important for developing and implementing future prevention and control strategies.

Investigation and Outcomes

Data Collection and Analysis

During August–September 2022, CDC requested that U.S. jurisdictions submit aggregate or deidentified individual-level data on the number of reported nonsexual contacts* of mpox patients with cases occurring during May 1–July 31. Most jurisdictions either reported no nonsexual contacts during the specified period or were unable to categorize contacts as nonsexual because of contact tracing limitations. Two jurisdictions, Tennessee and the District of Columbia (DC), reported aggregate data on the number of adult and pediatric nonsexual contacts identified during May 1–July 31, 2022. Data on the number of mpox patients' nonsexual contacts interviewed and the exposure location were reported by DC. The exposure locations for nonsexual contacts of Tennessee patients were not reported. The secondary attack rate among nonsexual close contacts was defined as the percentage of nonsexual close contacts of mpox patients who became symptomatic within 21 days of exposure to the primary patient. Descriptive statistics were performed using SAS software (version 9.4; SAS

Institute). This activity was reviewed by CDC, deemed not research, and was conducted consistent with applicable federal law and CDC policy.[†]

Characteristics of Cases and Contacts

During May 1–July 31, a total of 278 mpox cases were reported by the two jurisdictions, and 662 nonsexual contacts of these patients were identified (average = 2.4 nonsexual contacts per patient) (Table). Among 563 nonsexual close contacts reported by DC, 162 (28.8%) were interviewed after exposure. The primary exposure settings for nonsexual contacts in DC were large gatherings (e.g., festivals) (230; 40.9%), unknown settings (119; 21.1%), place of employment (71; 12.6%), or home (44; 7.8%). Nine (secondary attack rate = 1.6%) nonsexual close contacts in DC experienced signs and symptoms within 21 days after exposure to the primary patient; five of these exposed persons who experienced signs and symptoms 21 days after exposure to the primary patient had received postexposure mpox vaccine before symptom onset.

None of the 99 nonsexual contacts identified in Tennessee were interviewed ≥21 days after exposure. One of these contacts (secondary attack rate = 1.0%), who had received postexposure vaccination, experienced symptom onset within 21 days of exposure to the primary patient. Overall, a total of 10 persons

[†] 45 C.F.R. part 46.102(l)(2), 21 C.F.R. part 56; 42 U.S.C. Sect. 241(d); 5 U.S.C. Sect. 552a; 44 U.S.C. Sect. 3501 et seq.

TABLE. Number of mpox cases and nonsexual contacts — District of Columbia and Tennessee, May 1–July 31, 2022

Characteristic	Jurisdiction		
	Total	DC	Tennessee
Mpox patients, no.	278	252	26
Nonsexual close contacts, no. (average no. per primary patient)	662 (2.4)	563 (2.2)	99 (3.8)
Nonsexual contacts per patient, mean	2.4	2.2	3.8
Nonsexual contacts interviewed ≥21 days after exposure, no. (%) [*]	162 (24.5)	162 (28.8)	0 (—)
Reported nonsexual contact exposure setting, no. (%)^{*,†}			
Large gatherings (e.g., festivals)	NA	230 (40.9)	NA
Unknown	NA	119 (21.1)	NA
Place of employment	NA	71 (12.6)	NA
Home	NA	44 (7.8)	NA
Secondary attack rate, no. (%) of secondary cases [§]	10 (1.5)	9 (1.6)	1 (1.0)

Abbreviations: DC = District of Columbia; NA = not available.

^{*} Percentage of nonsexual contacts reported by primary patient.

[†] This information is available for DC patients only.

[§] Percentage of nonsexual contacts with symptom onset ≤21 days after exposure to the primary patient.

* Nonsexual contact was defined as exposure to respiratory droplets from someone with mpox, direct contact with contaminated items, or nonintimate skin-to-skin contact with an mpox patient, and no reported sexual contact with an mpox patient during the preceding 3 weeks.

who reported nonsexual close contact with an mpox patient experienced symptoms within 21 days after exposure (secondary attack rate = 1.5%).

Limitations

The findings in this report are subject to at least six limitations. First, age-specific information was not reported for nonsexual contacts; therefore, this report cannot distinguish between pediatric and adult nonsexual contacts. Second, fewer than one half of nonsexual contacts in one jurisdiction were interviewed after exposure, which might have resulted in underreporting of secondary cases. Third, type of contact was self-reported, which might be subject to recall or social desirability bias. Fourth, data were incomplete for many nonsexual close contacts. Fifth, the first 2 months (May–June) of the 3-month study period included the period before availability of postexposure prophylaxis had been expanded, and mpox cases might have overidentified close contacts to facilitate receipt of postexposure mpox vaccination, potentially artificially inflating close contact numbers. Finally, because this investigation did not collect mpox laboratory test results for nonsexual close contacts who became symptomatic 21 days after exposure to the primary case, the secondary attack rate might be inflated.

Preliminary Conclusions and Actions

Although sexual or intimate contact was the primary mode of transmission in the 2022 multinational mpox outbreak, limited nonsexual transmission also occurred. The secondary attack rate reported from this investigation is consistent

with that reported among nonsexual contacts in regions with endemic mpox (2). Monitoring of nonsexual contacts for mpox signs and symptoms is warranted after a known exposure to an mpox patient. Nonsexual contacts of mpox patients should be educated about prevention methods and steps to take should they experience signs and symptoms after exposure (3). Ongoing collection and analysis of data from nonsexual close contacts by state and local health departments and CDC, including factors associated with an increased risk for infection and behaviors that increase the risk for transmission, can help guide development and implementation of recommendations.

Corresponding author: Ebony S. Thomas, htt7@cdc.gov.

¹CDC Multinational Monkeypox Response Team; ²District of Columbia Department of Public Health; ³Tennessee Department of Public Health; ⁴Division of State and Local Readiness, Center for Preparedness and Response, CDC.

All authors have completed and submitted the International Committee of Medical Journal Editors form for disclosure of potential conflicts of interest. No potential conflicts of interest were disclosed.

References

1. Philpott D, Hughes CM, Alroy KA, et al.; CDC Multinational Monkeypox Response Team. Epidemiologic and clinical characteristics of monkeypox cases—United States, May 17–July 22, 2022. *MMWR Morb Mortal Wkly Rep* 2022;71:1018–22. PMID:35951487 <https://doi.org/10.15585/mmwr.mm7132e3>
2. Beer EM, Rao VB. A systematic review of the epidemiology of human monkeypox outbreaks and implications for outbreak strategy. *PLoS Negl Trop Dis* 2019;13:e0007791. PMID:31618206 <https://doi.org/10.1371/journal.pntd.0007791>
3. CDC. Mpox: if you're a close contact. Atlanta, GA: US Department of Health and Human Services, CDC; 2023. Accessed March 30, 2023. <https://www.cdc.gov/poxvirus/mpox/prevention/close-contact.html>

Notes from the Field

COVID-19 Pandemic-Related Changes in Blood Lead Screening — Chicago, Illinois, 2017–2022

Hillary Spencer, MD^{1,2}; Emile Jorgensen, MPH²;
Jennifer Seo, MD, JD²; Candice Robinson, MD²

Lead is an environmental hazard that can cause serious harm to young children. Early childhood lead exposure can damage the brain and nervous system, slow growth and development, and cause hearing and speech problems (1). Screening for elevated blood lead levels (BLL) is essential for routine care of young children. At the onset of the COVID-19 pandemic, substantial disruptions to health care access occurred for routine, preventive care (2). At the onset of the pandemic (January–May 2020), 34% fewer U.S. children aged <6 years received blood lead level testing than during the same months in 2019 (3). The Chicago Department of Public Health (CDPH) characterized patterns of blood lead testing among young children in Chicago from the onset of the pandemic in 2019 through 2022.

Investigation and Outcomes

All children residing in Chicago should be screened for their BLL at age 12, 24, and 36 months (4). Illinois requires that all BLL results be reported to the state surveillance system; data are shared with CDPH.* The current analysis included all BLL test results from Chicago residents aged 11–48 months, to include recommended screening ages and a makeup period given potential delayed screening at the onset of the pandemic. March–September was selected as the comparison period to account for observed seasonality of lead testing,[†] effects of the stay-at-home mandate, and the largest disruptions to health care during the first year of the pandemic. The total number of lead tests performed during March–September was divided by the American Community Survey 5-year population estimate of children aged <5 years.[§] The average during 2017–2019 was assigned as the prepandemic baseline. The effect was evaluated geographically by assigning community areas (77 static administrative units were defined by the city for

long-term statistical and tracking purposes[¶]) as low, medium, or high risk for BLLs exceeding the Blood Lead Reference Value on the basis of historic lead levels (average rank during 2010–2018). Within each of the three risk categories, the total decrease was calculated as well as the median decrease of the community areas making up each risk category (from 2019 to 2022**). This activity was reviewed by CDC, deemed not research, and was conducted consistent with applicable federal law and CDC policy^{††}

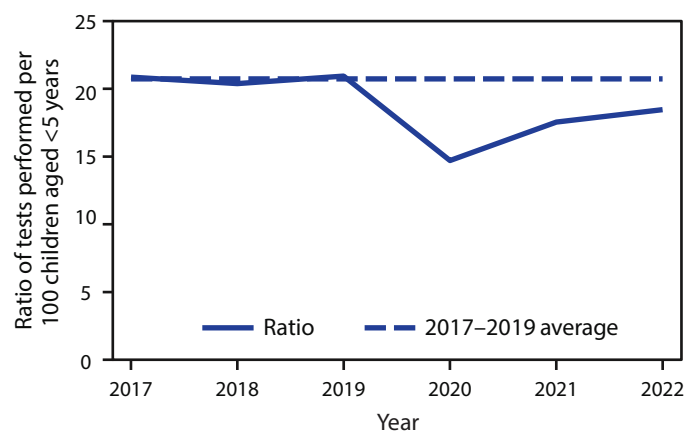
The ratio of BLL tests performed among Chicago children aged 11–48 months per 100 children aged <5 years in 2020 (14.7) was 29.1% lower than the annual average during 2017–2019 (20.7) (Figure). The ratio increased during 2021 (17.5) and 2022 (18.5) but remained 15.4% and 10.6% lower than during the 2017–2019 baseline, respectively. The prepandemic testing ratio was highest among the 25 community areas with the highest risk for BLLs exceeding the Blood Lead Reference Value; the decrease in testing was also greater in these highest risk areas (total decrease = 18%; median decrease = 17.7%) than in the 25 at medium risk (total = 10.1%; median = 7.6%) and the 24 at low risk (total = 8.8%; median = 7.7%).

* Three community areas were excluded from this analysis: two because of a limited population and one because of historical reporting errors.

** The population denominator for community areas used was the 2021 5-year estimate (2017–2021), because the population change is not uniform across community areas.

†† 45 C.F.R. part 46, 21 C.F.R. part 56; 42 U.S.C. Sect. 241(d); 5 U.S.C. Sect. 552a; 44 U.S.C. Sect. 3501 et seq.

FIGURE. Blood lead level testing* among children aged 11–48 months — Chicago, Illinois, 2017–2022



* During March–September.

* <https://dph.illinois.gov/content/dam/soi/en/web/idph/files/77-iac-845.pdf>

† In typical years, an increase in lead tests is observed in late summer and a decrease in early winter, likely reflecting the school-year cycle because blood lead testing is required for entry into child care facilities, preschools, and kindergarten.

§ The 2022 American Community Survey was not yet available. The citywide population of children aged <5 years in 2022 was extrapolated from the preceding years (2017–2021) to account for the change in population.

Preliminary Conclusions and Analysis

BLL testing in young children decreased at the pandemic onset in 2020. Testing increased in 2021 and again in 2022 but did not return to prepandemic baseline in Chicago. Community areas with the highest average rank of BLLs exceeding the Blood Lead Reference Value during 2010–2018 were most affected by pandemic-related decreases in testing. Pandemic-related changes in blood lead testing might have exacerbated longstanding health inequities. The most affected community areas should receive increased attention to promote BLL testing among children at the highest risk for lead exposure. It is important for jurisdictions to evaluate pandemic-related changes in blood lead testing for young children and consider including geographic or demographic unit analyses to assess impact on the most vulnerable communities.

Corresponding author: Hillary Spencer, hillary.spencer@illinois.gov.

¹Epidemic Intelligence Service, CDC; ²Chicago Department of Public Health, Chicago, Illinois.

All authors have completed and submitted the International Committee of Medical Journal Editors form for disclosure of potential conflicts of interest. Emile Jorgensen reports being an executive board member of the labor union, AFSCME Council 31, Local 505, which includes receiving a stipend of \$80 per month beginning in 2021.

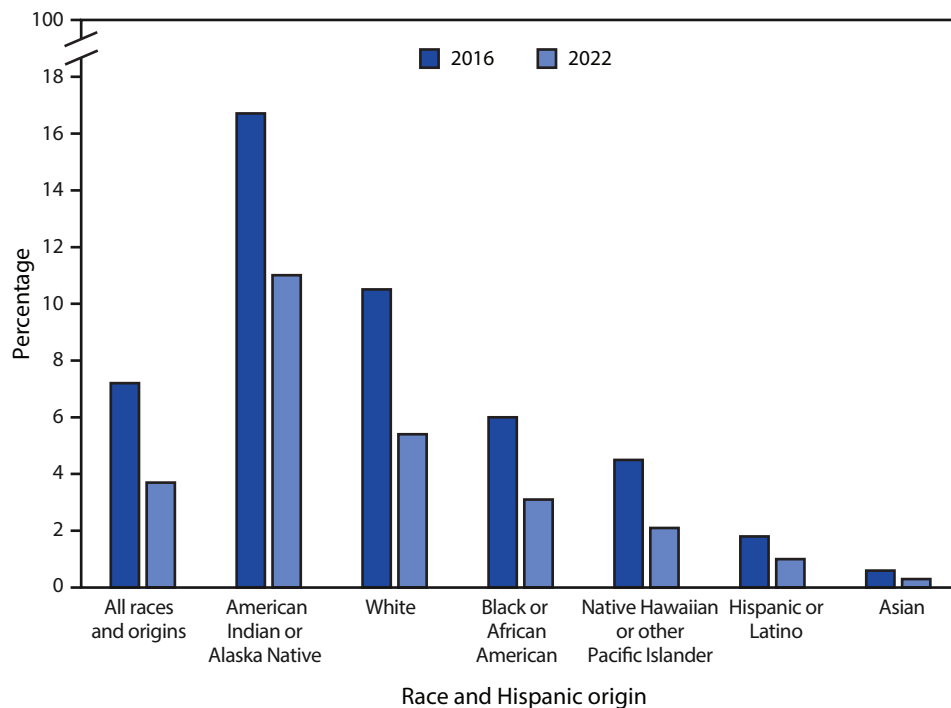
References

1. CDC. Health effects of lead exposure. Atlanta, GA: US Department of Health and Human Services, CDC; 2022. Accessed January 6, 2023. <https://www.cdc.gov/nceh/lead/prevention/health-effects.htm>
2. Lebrun-Harris LA, Sappenfield OR, Warren MD. Missed and delayed preventive health care visits among US children due to the COVID-19 pandemic. *Public Health Rep* 2022;137:336–43. PMID:34969335 <https://doi.org/10.1177/00333549211061322>
3. Courtney JG, Chuke SO, Dyke K, et al. Decreases in young children who received blood lead level testing during COVID-19—34 jurisdictions, January–May 2020. *MMWR Morb Mortal Wkly Rep* 2021;70:155–61. PMID:33539334 <https://doi.org/10.15585/mmwr.mm7005a2>
4. Illinois Department of Public Health Lead Program. Childhood blood lead evaluation and testing recommendations. Springfield, IL: Illinois Department of Public Health Lead Program; 2019. <https://dph.illinois.gov/content/dam/soi/en/web/idph/files/forms/childleadevaluationtestingrecommendations.pdf>

QuickStats

FROM THE NATIONAL CENTER FOR HEALTH STATISTICS

Percentage of Women Who Smoked* Cigarettes During Pregnancy, by Race and Hispanic Origin† — National Vital Statistics System, United States, 2016 and 2022



* Smoking is self-reported by the mother.

† Race groups are single-race, non-Hispanic; persons of Hispanic or Latino origin can be of any race. "All races and origins" includes all race and Hispanic origin groups including those not shown separately.

The percentage of women who smoked cigarettes at any time during pregnancy declined from 7.2% to 3.7% from 2016 to 2022. Smoking during pregnancy declined in each race and Hispanic-origin group during this period. Percentages declined from 16.7% to 11.0% among non-Hispanic American Indian or Alaska Native women, from 10.5% to 5.4% among non-Hispanic White women, from 6.0% to 3.1% among non-Hispanic Black or African American women, from 4.5% to 2.1% among non-Hispanic Native Hawaiian or other Pacific Islander women, from 1.8% to 1.0% among Hispanic or Latino women, and from 0.6% to 0.3% among non-Hispanic Asian women.

Source: National Center for Health Statistics, National Vital Statistics System, Natality Data File, 2022. <https://www.cdc.gov/nchs/nvss/births.htm>

Reported by: Joyce A. Martin, MPH, jcm9@cdc.gov.

For more information on this topic, CDC recommends the following link: https://www.cdc.gov/tobacco/basic_information/health_effects/pregnancy/

The *Morbidity and Mortality Weekly Report (MMWR)* Series is prepared by the Centers for Disease Control and Prevention (CDC) and is available free of charge in electronic format. To receive an electronic copy each week, visit *MMWR* at <https://www.cdc.gov/mmwr/index.html>.

Readers who have difficulty accessing this PDF file may access the HTML file at <https://www.cdc.gov/mmwr/index2023.html>. Address all inquiries about the *MMWR* Series to Editor-in-Chief, *MMWR* Series, Mailstop V25-5, CDC, 1600 Clifton Rd., N.E., Atlanta, GA 30329-4027 or to mmwrq@cdc.gov.

All material in the *MMWR* Series is in the public domain and may be used and reprinted without permission; citation as to source, however, is appreciated.

MMWR and *Morbidity and Mortality Weekly Report* are service marks of the U.S. Department of Health and Human Services.

Use of trade names and commercial sources is for identification only and does not imply endorsement by the U.S. Department of Health and Human Services.

References to non-CDC sites on the Internet are provided as a service to *MMWR* readers and do not constitute or imply endorsement of these organizations or their programs by CDC or the U.S. Department of Health and Human Services. CDC is not responsible for the content of these sites. URL addresses listed in *MMWR* were current as of the date of publication.

ISSN: 0149-2195 (Print)