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Prevalence and Clinical Attributes of Congenital Microcephaly — New York, 2013–2015

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Congenital Zika virus infection can cause microcephaly and other severe fetal neurological anomalies (*1*). To inform microcephaly surveillance efforts and assess ascertainment sources, the New York State Department of Health and the New York City Department of Health and Mental Hygiene sought to determine the prevalence of microcephaly in New York during 2013–2015, before known importation of Zika virus infections. Suspected newborn microcephaly diagnoses were identified from 1) reports submitted by birth hospitals in response to a request and 2) queries of a hospital administrative discharge database for newborn microcephaly diagnoses. Anthropometric measurements, maternal demographics, and pregnancy characteristics were abstracted from newborn records from both sources. Diagnoses were classified using microcephaly case definitions developed by CDC and the National Birth Defects Prevention Network (NBDPN) (*2*). During 2013–2015, 284 newborns in New York met the case definition for severe congenital microcephaly (prevalence = 4.2 per 10,000 live births). Most newborns with severe congenital microcephaly were identified by both sources; 263 (93%) were identified through hospital requests and 256 (90%) were identified through administrative discharge data. The proportions of newborns with severe congenital microcephaly who were black (30%) or Hispanic (31%) were higher than the observed proportions of black (15%) or Hispanic (23%) infants among New York live births. Fifty-eight percent of newborns with severe congenital microcephaly were born to mothers with pregnancy complications or who had in utero or perinatal infections or teratogenic exposures, genetic disorders, or family histories of birth defects.

Since early 2015, Zika virus has spread widely throughout the World Health Organization's Region of the Americas (*3*). Zika virus infection during pregnancy can cause severe birth defects, including microcephaly, with the highest risk for adverse pregnancy outcomes associated with infection during the first trimester (*1*,*4*). Most Zika virus infections have been imported into the continental United States, with almost all local transmission reported from Florida (*5*). New York has recorded the largest number of travel-associated Zika virus disease cases† in the continental United States; the majority of these have occurred in New York City. As of December 13, 2016, among 34 infants born in the continental United States

* These authors contributed equally to this report.

† Travelers returning from affected areas, their sexual contacts, or infants infected in utero.

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with Zika-associated birth defects, five (15%) were born in New York City (*5*,*6*).

During 2009–2013, population-based birth defects surveillance programs estimated the median prevalence of microcephaly in the United States to be approximately 7 per 10,000 live births; however, case-finding methods and clinical definitions of microcephaly varied among states (*7*). Until recently, a microcephaly case definition had not been standardized across jurisdictions. In the wake of rapidly spreading Zika virus infection and its impact on birth outcomes, NBDPN, in conjunction with CDC, developed case definitions for congenital microcephaly for use by state birth defects surveillance programs (*2*).

Surveillance of birth defects in New York is conducted by the New York Congenital Malformations Registry (the Registry), a surveillance system that receives reports from hospitals on major birth defects in infants and children diagnosed before the age of 2 years. The Registry requires a narrative description of birth defects along with *International Classification of Diseases, Ninth* and *Tenth Revisions, Clinical Modification* (ICD-9-CM and ICD-10-CM) codes, which allows more specific categorization of defects than that permitted by ICD-CM codes alone. To increase completeness of case ascertainment, the Registry conducts hospital audits and links to the Statewide Planning and Research Cooperative System (SPARCS) administrative discharge database. SPARCS is an administrative all-payer data-reporting system that collects information on hospital discharges, services, and treatments using ICD-CM codes. SPARCS requires monthly submission of billing data, which is beneficial for timely prospective surveillance; however, it does not collect narrative descriptions of birth defects (*8*,*9*). The contribution of hospital requests compared with querying administrative discharge databases to ascertain cases of microcephaly is unknown, but might inform prospective surveillance methods.

Although congenital microcephaly is a reportable birth defect and should be included in hospital reports to the Registry, because of concerns about timeliness and completeness of routine reporting, a query was sent to all 154 New York birth hospitals. Hospitals were asked to report all newborns who had a diagnosis code specifying microcephaly (ICD-9-CM code 742.1 or ICD-10-CM code Q02), born during 2013–2015 to women who resided in New York at the time of delivery. All birth hospitals responded, and 83 (54%) identified suspected cases of microcephaly. The SPARCS database was also queried for ICD-9-CM code 742.1 or ICD-10-CM code Q02. Charts were obtained for all newborns with suspected microcephaly and were reviewed by trained clinicians who abstracted birth measurements (head circumference, length, and weight), demographic information, and prespecified infant clinical characteristics, maternal conditions, and maternal/fetal exposures that might have associations with birth defects. Maternal conditions included preeclampsia, eclampsia, hypertension, and gestational diabetes. Prenatal exposures included in utero and perinatal infections (including infections with *Toxoplasma gondii*, rubella virus, cytomegalovirus, herpes

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simplex virus, human immunodeficiency virus, *Treponema pallidum*, and varicella, dengue, and lymphocytic choriomeningitis viruses), maternal consumption of alcohol, tobacco, illicit drugs and certain teratogenic medications (warfarin, retinoic acid, anticonvulsants, and angiotensin-converting enzyme [ACE] inhibitors), and environmental exposures (i.e., radiation, lead, and mercury). Information also was abstracted on any documented genetic anomalies such as trisomy, gene deletions or duplications, and genomic imprinting, and on family history of birth defects, and parental consanguinity.

Suspected congenital microcephaly was classified according to CDC/NBDPN case definitions (*2*). Overall microcephaly included all physician diagnoses of microcephaly, regardless of the head circumference percentile. Cases of severe congenital microcephaly were defined as the INTERGROWTH-21st[§] head circumference <3rd percentile for gestational age and sex. Statewide total and severe congenital microcephaly prevalence, and prevalence by health service area[¶] were calculated using the number of live births during 2013–2015 as the denominator. Maternal race/ethnicity data were obtained by matching with the New York State Department of Health and New York City Department of Health and Mental Hygiene vital records databases, and supplemented with race and ethnicity from SPARCS when data were missing from vital records.

A total of 529 suspected cases of microcephaly were identified from the two sources (Table 1). Of the total 529 suspected cases, 499 (94%) met the overall microcephaly case definition. Thirty (6%) did not meet a case definition because of misclassification (e.g., macrocephaly or microphallus), or because both a physician diagnosis and anthropometric information necessary to accurately categorize head circumference percentile were missing. Among the 499 newborns meeting the overall microcephaly case definition, the majority were identified by both sources; 470 (94%) were identified by hospital requests and 454 (91%) by SPARCS query. A subset of 284 (54%) newborns met the case definition for severe congenital microcephaly, 263 (93%) of whom were identified by hospital requests and 254 (90%) by SPARCS query.

During 2013–2015, the overall prevalence of microcephaly in New York was 7.4 per 10,000 live births, and the prevalence of severe congenital microcephaly was 4.2 per 10,000 live births, with elevated prevalence of severe congenital microcephaly noted in Western New York (7.2) and Finger Lakes (5.9) health service areas (Table 2). The majority of newborns with severe congenital microcephaly were in New York City (162, 57%), and the prevalence in New York City (4.8 per 10,000 live births) was similar to the statewide prevalence.

Approximately equal proportions of newborns with severe congenital microcephaly were Hispanic (31%), non-Hispanic white (30%), and non-Hispanic black (30%) (Table 3). The majority (165 of 284, 58%) of mothers of newborns with severe congenital microcephaly had a pregnancy risk factor or a birth risk factor, including 57 (20%) with a pregnancy complication, 46 (16%) with an in utero or perinatal infection, and 54 (19%) who consumed alcohol, tobacco, illicit drugs, or teratogenic medications during pregnancy. Smaller numbers of infants had a confirmed genetic anomaly (37, 13%), family history of birth defects (20, 7%), or were the result of parental consanguinity (7, 2%).

[§] http://intergrowth21.ndog.ox.ac.uk/.

[¶] A health service area is a single county or a cluster of counties that are relatively self-contained with respect to hospital care.

TABLE 1. Microcephaly case counts by source of information and National Birth Defects Prevention Network (NBDPN) case definition — New York, 2013–2015

Source of information	No. of suspected microcephaly cases	Confirmed* cases classified by NBDPN case definition	
		Overall microcephaly†	Severe congenital microcephaly§
		No. (%)	No. (%)
Hospital request or SPARCS database	**529**	**499 (100)**	**284 (100)**
Hospital request	495	470 (94)	263 (93)
SPARCS database	472	454 (91)	256 (90)

Abbreviation: SPARCS = Statewide Planning and Research Cooperative System.
* Confirmed by retrospective chart review.
† NBDPN case definition for overall microcephaly: all physician diagnoses of microcephaly, regardless of head circumference percentile.
§ NBDPN case definition for severe congenital microcephaly: head circumference <3rd percentile for gestational age and sex.

TABLE 2. Prevalence of severe congenital microcephaly,*,† by health service area — New York, 2013–2015

Health service area	No. of patients with microcephaly§	No. of births¶	No. of cases per 10,000 live births
All areas	**284**	**673,077**	**4.2**
Western New York	33	45,914	7.2
Finger Lakes	23	39,301	5.9
Central New York	16	45,412	3.5
NY-Penn	2	8,547	2.3
Northeastern New York	7	40,676	1.7
Mid-Hudson	22	70,512	3.1
New York City	162	336,047	4.8
Nassau-Suffolk	19	86,668	2.2

* Confirmed by retrospective chart review and classified by National Birth Defects Prevention Network (NBDPN) case definition.
† NBDPN case definition for severe congenital microcephaly: head circumference <3rd percentile for gestational age and sex.
§ Cases ascertained from 1) responses to a query of all 154 New York birth hospitals and 2) query of Statewide Planning and Research Cooperative System administrative discharge database for all newborns with diagnosis code specifying microcephaly (*International Classification of Diseases, Ninth Revision, Clinical Modification* code 742.1 or *International Classification of Diseases, Tenth Revision, Clinical Modification* code Q02), born during 2013–2015 to women who resided in New York at the time of delivery.
¶ Number of live births obtained from the New York State Department of Health Vital Records.

TABLE 3. Selected characteristics for cases (N = 284) of severe congenital microcephaly*,† — New York, 2013–2015

Characteristic	No. (%)
Infant	
Sex	
Female	163 (57)
Male	121 (43)
Gestational age	
Term (≥37 wks)	193 (68)
Preterm (<37 wks)	88 (31)
Missing	3 (1)
Birth weight	
Normal weight (>2,500 g)	116 (41)
Low birth weight (1,500–2,500 g)	138 (49)
Very low birth weight (<1,500 g)	30 (11)
Plurality	
Singleton	264 (93)
Twin	18 (6)
Triplet or more	2 (1)
Maternal	
Age group (yrs)	
<35	221 (78)
≥35	56 (20)
Missing	7 (2)
Race/Ethnicity§	
Hispanic	87 (31)
Black, non-Hispanic	84 (30)
White, non-Hispanic	84 (30)
Asian, non-Hispanic/Other/Missing	29 (10)
Received prenatal care	
Yes	241 (85)
No	7 (2)
Missing	36 (13)
Complications, exposures, genetic disorders, and family history¶	
None	119 (42)
Any	165 (58)
Pregnancy complications**	
Any	57 (20)
Preeclampsia	22 (8)
Gestational diabetes	12 (4)
In utero or perinatal infections	
Any infection††	46 (16)
Maternal herpes simplex virus	9 (3)
Infant cytomegalovirus infection	10 (4)
Teratogenic exposures	
Any	54 (19)
Alcohol	7 (2)
Tobacco	30 (11)
Illicit drugs	33 (12)
Teratogenic medications§§	3 (2)
Environmental exposure	
Any	1 (<1)
Radiation	0 (—)
Lead	1 (<1)
Mercury	0 (—)
Confirmed genetic anomaly in newborn¶¶	37 (13)
Family history of birth defects	20 (7)
Parental consanguinity	7 (2)

* Confirmed by retrospective chart review and classified by National Birth Defects Prevention Network (NBDPN) case definitions.
† NBDPN case definition for severe congenital microcephaly: head circumference <3rd percentile for gestational age and sex.
§ Maternal race and ethnicity variables primarily obtained from Vital Records and secondarily from the Statewide Planning and Research Cooperative System database.
¶ Not mutually exclusive.
** Including preeclampsia, eclampsia, hypertension, and gestational diabetes.
†† Including infections with *Toxoplasma gondii*, rubella virus, cytomegalovirus, herpes simplex virus, human immunodeficiency virus, *Treponema pallidum*, and varicella, dengue, and lymphocytic choriomeningitis viruses.
§§ Including warfarin, angiotensin-converting-enzyme (ACE) inhibitors, retinoic acid, and anticonvulsants.
¶¶ Documentation of any confirmed genetic anomaly such as trisomy, and gene deletions or duplications, or genomic imprinting.

Discussion

Before evidence of importation of Zika virus infections, the overall prevalence of microcephaly in New York was 7.4 per 10,000 live births, similar to national estimates for the period 2009–2013 reported recently (*7*), and the prevalence of severe congenital microcephaly was 4.2 per 10,000 live births. The findings in this report highlight the value of confirmation of severe congenital microcephaly using anthropometric measurements to apply the NBDPN case definitions. Use of standardized case definitions allows public health officials to estimate the baseline prevalence of severe congenital microcephaly, a condition that has been observed in infants with congenital Zika virus syndrome, so that comparisons over time and across jurisdictions are possible.

Use of administrative discharge data can enhance case finding for birth defects surveillance, although it is not yet available in many states and, when available, is not always utilized (*10*). Although the vast majority of 284 cases of severe congenital microcephaly were detected by requests to hospital facilities, administrative data identified an additional 7% of cases.

A substantial proportion of newborns with severe congenital microcephaly (42%) identified in this analysis did not have any known maternal conditions or maternal/fetal exposures documented in the newborn hospital record. When the race/ethnicity of mothers of infants with severe congenital microcephaly was compared with the race/ethnicity of live births statewide in New York during 2013–2015, a higher proportion of infants with severe congenital microcephaly were born to Hispanic (31% compared with 23%) and non-Hispanic black mothers (30% compared with 15%) and a lower proportion to non-Hispanic white mothers (30% compared with 48%).** Further investigation is needed to better understand risk factors for microcephaly and disparities in microcephaly prevalence (*7*).

** https://www.health.ny.gov/statistics/vital_statistics/docs/vital_statistics_annual_report_2014.pdf.

Summary

What is already known about this topic?

Zika virus infection during pregnancy can cause severe congenital microcephaly. In New York, the baseline prevalence of severe congenital microcephaly (defined by CDC and the National Birth Defects Prevention Network as head circumference <3rd percentile for gestational age and sex) has not been known.

What is added by this report?

During 2013–2015, before documentation of widespread introduction of imported Zika virus infection in the continental United States, the prevalence of severe congenital microcephaly in New York was 4.2 per 10,000 live births. Requests to birth hospitals identified 93% of cases, and statewide administrative discharge data identified 90% of cases.

What are the implications for public health practice?

Administrative data can enhance microcephaly case finding for birth defects surveillance programs. Cases of congenital microcephaly must be clinically confirmed using anthropometric measurements to determine whether they meet the case definition for severe congenital microcephaly. A baseline prevalence estimate of severe congenital microcephaly can enable estimation of risk attributable to Zika virus infection.

The findings in this report are subject to at least four limitations. First, case finding was limited to live births and did not include stillbirths and terminations, which can account for up to one third of birth outcomes in New York. Second, differences in technique and possible recording errors might have affected the accuracy of the anthropometric measurements documented in the newborn medical record. Third, documentation of various maternal and infant conditions and exposures might be incomplete in the newborn medical record and could result in underascertainment of these characteristics. Finally, although the possibility of Zika-associated microcephaly prior to 2016 cannot be excluded, it is unlikely to have contributed substantially to the prevalence of congenital microcephaly in New York during 2013–2015.

Collaboration between state and local health departments was essential for rapidly obtaining and validating medical records. In addition, increased collaboration and coordination between public health professionals and health care providers in improving processes for head circumference measurement and documentation of diagnoses can help improve accuracy of future estimates of microcephaly prevalence. Clinical documentation of maternal travel histories in the charts of newborns with birth defects will allow for retrospective identification of possible Zika virus exposure in utero. The 2013–2015 New York prevalence estimate of severe congenital microcephaly will enable comparison with future severe congenital microcephaly prevalence estimates and estimation of attributable risk after Zika virus importation.

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Elevated Blood Lead Levels Associated with Retained Bullet Fragments — United States, 2003–2012

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An estimated 115,000 firearm injuries occur annually in the United States, and approximately 70% are nonfatal (*1*). Retained bullet fragments (RBFs) are an infrequently reported, but important, cause of lead toxicity; symptoms are often nonspecific and can appear years after suffering a gunshot wound (*2*,*3*). Adult blood lead level (BLL) screening is most commonly indicated for monitoring of occupational lead exposure; routine testing of adults with RBFs is infrequent (*3*). States collaborate with CDC's National Institute for Occupational Safety and Health (NIOSH) to monitor elevated BLLs through the Adult Blood Lead Epidemiology and Surveillance (ABLES) program (*4*,*5*). To help assess the public health burden of RBFs, data for persons with BLLs ≥10 μg/dL reported to ABLES during 2003–2012 were analyzed. An RBF-associated case was defined as a BLL ≥10 μg/dL in a person with an RBF. A non-RBF–associated case was defined as a BLL ≥10 μg/dL without an RBF. During 2003–2012, a total of 145,811 persons aged ≥16 years with BLLs ≥10 μg/dL were reported to ABLES in 41 states. Among these, 457 RBF-associated cases were identified with a maximum RBF-associated BLL of 306 μg/dL. RBF-associated cases accounted for 0.3% of all BLLs ≥10 μg/dL and 4.9% of BLLs ≥80 μg/dL. Elevated BLLs associated with RBFs occurred primarily among young adult males in nonoccupational settings. Low levels of suspicion of lead toxicity from RBFs by medical providers might cause a delay in diagnosis (*3*). Health care providers should inquire about an RBF as the potential cause for lead toxicity in an adult with an elevated BLL whose lead exposure is undetermined.

At BLLs ≥10 μg/dL, hypertension, kidney dysfunction, possible subclinical neurocognitive deficits, and adverse reproductive outcomes (including spontaneous abortion and reduced birthweight) can occur (*6*,*7*). Decreased renal function has been documented in association with BLLs <5 μg/dL, and an increased risk for hypertension and essential tremor at BLLs <10 μg/dL (*8*).

States collaborate with NIOSH to conduct blood lead surveillance through the ABLES program (*4*). In 2009, for the purposes of surveillance and risk factor ascertainment, the Council of State and Territorial Epidemiologists (CSTE), NIOSH, and ABLES lowered the cutoff for an elevated BLL from ≥25 μg/dL to ≥10 μg/dL of lead in a venous sample of whole blood (*4*,*9*). In 2015, NIOSH and CSTE further reduced the case definition for an elevated BLL to 5 μg/dL (*4*). States participating in ABLES require health care providers and laboratories to report blood lead test results to the state health department. Certain states require all BLLs to be reported, whereas other states require reporting of BLLs ≥10, ≥25, or ≥40 μg/dL (*4*). States follow up to identify the industry in which the affected person is employed and determine whether the exposure source is occupational, nonoccupational, or both, and provide a short narrative describing the activity during which the lead exposure occurred. Screening for adult lead exposure focuses on settings where occupational lead exposure is likely; adults with RBFs are not routinely tested for lead (*3*).

CDC analyzed data for adults with BLLs ≥10 μg/dL reported by the ABLES program during 2003–2012. An RBF-associated case of elevated BLL was defined as a BLL ≥10 μg/dL in a person aged ≥16 years with ≥1 RBFs at the time of blood collection. A non-RBF–associated case was defined as a BLL ≥10 μg/dL in a person without an RBF or bullet fragment in a person aged ≥16 years. RBF cases were identified as persons coded with "retained bullets (gunshot wounds)" in the ABLES database. If a person had multiple blood lead tests during the study period (2003–2012), only the highest BLL was included. In 2003, a total of 36 states reported BLLs ≥25 μg/dL, and 20 of these states also reported BLLs 10–24 μg/dL. In 2012, 41 states reported BLLs ≥25 μg/dL, and 38 of these states also reported BLLs 10–24 μg/dL.

During 2003–2012, a total of 41 state ABLES programs reported 145,811 adults with elevated BLLs from all causes, including 349 (0.2%) with BLLs ≥80 μg/dL. RBF-associated cases accounted for 457 (0.3%) of adults with elevated BLLs, but 17 (4.9%) of adults with BLLs ≥80 μg/dL (Figure); the maximum recorded RBF-associated BLL was 306 μg/dL. Furthermore, RBF-associated cases were overrepresented among persons with BLLs ≥80 μg/dL, compared with non-RBF–associated cases: 17 (3.7%) of 457 patients with RBF-associated elevated BLLs had BLLs ≥80 μg/dL, compared with 332 (0.2%) of 145,354 patients with non-RBF–associated elevated BLLs.

Among 457 RBF-associated cases, 195 (42.7%) occurred among persons aged 16–24 years (Table), whereas only 11.8% (n = 17,151) of 145,354 non-RBF–associated cases occurred in this age group (Table). In contrast, 36,462 (25.1%) of

the non-RBF–associated cases occurred in persons aged 35–44 years (Table), compared with 72 (15.8%) of 457 RBF-associated cases (Table). Males accounted for 83.5% of RBF-associated cases and 89.9% of non-RBF–associated cases. Sex was not listed for two (0.4%) persons among RBF-associated cases and 1,837 (1.3%) among non-RBF–associated cases.

The majority of persons with RBF-associated elevated BLLs did not report an occupational exposure. Among the 457 RBF-associated cases for which exposure source was known, 446 (97.6%) were nonoccupational, two (0.4%) persons were employed in police protection or amusement and recreation industries, and nine (2.0%) had both occupational and nonoccupational exposures coded, although the occupation was not available. In contrast, among 77,770 (54%) non-RBF–associated cases with a known exposure source, 5,113 (6.6%) were nonoccupational and 261 (0.2%) had both occupational and nonoccupational exposures coded. Among 270 (59.1%) of 457 RBF-associated cases and 93,273 (64.2%) of 145,354 non-RBF–associated cases, the highest recorded BLL was 10–24 μg/dL.

Discussion

Symptoms resulting from elevated BLLs can vary widely and are often nonspecific, including fatigue, abdominal pain, and memory loss (*2*,*6*). As of 2004, fewer than 100 cases of lead toxicity caused by RBFs had been reported in the medical literature (*3*). During 2003–2012, elevated BLLs associated with RBFs constituted 0.3% of all elevated BLLs and 4.9% of BLLs ≥80 μg/dL. Elevated BLLs associated with RBFs occurred predominantly among males aged

FIGURE. Number of patients with and without a retained bullet fragment (RBF) among persons with blood lead levels ≥80 μg/dL — United States, 2003–2012

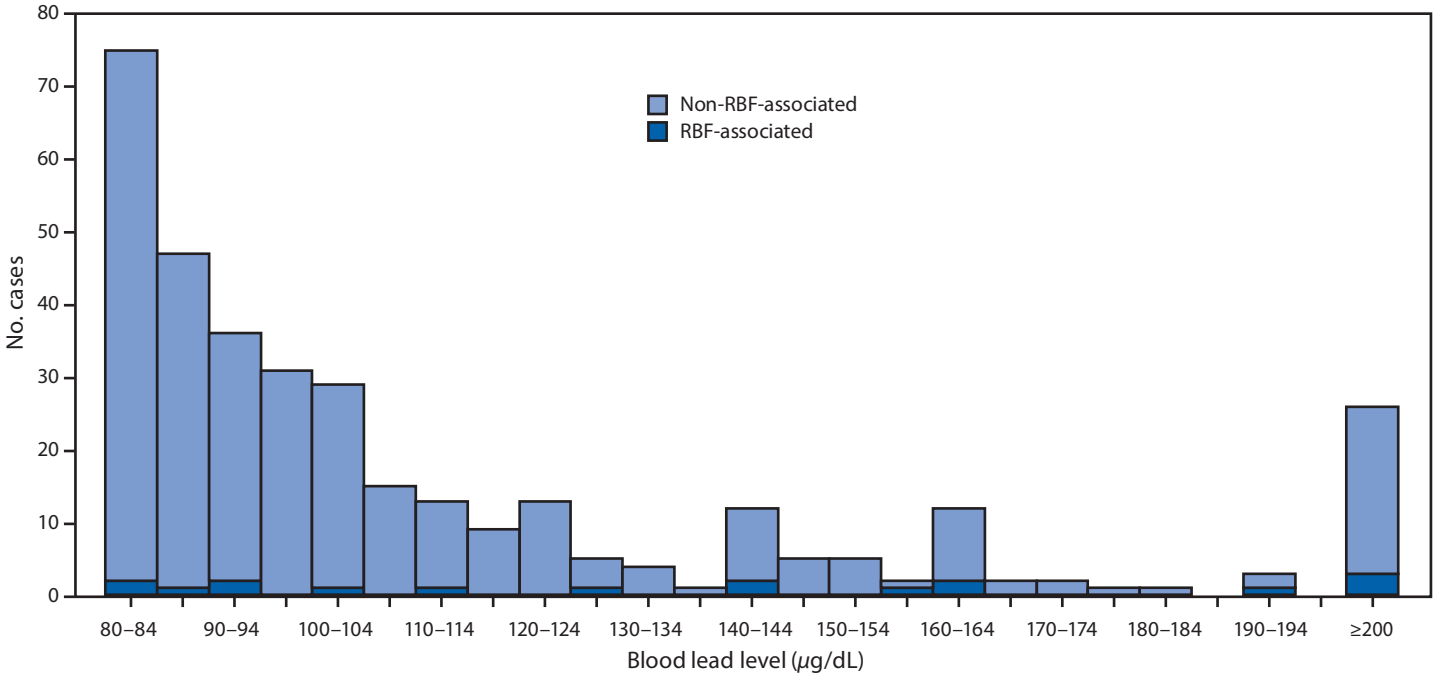

TABLE. Number of retained bullet fragment–associated cases, by age and highest reported blood lead level — United States, 2003–2012

	Blood lead level (μg/dL)							
	10–24	25–39	40–59	60–79	80–199	200–299	≥300	Total
Age group (yrs)	No. (%)	No. (%)	No. (%)	No. (%)	No. (%)	No. (%)	No. (%)	No. (%)
16–24	132 (48.9)	48 (41.4)	13 (30.9)	2 (16.7)	—	—	—	**195 (42.7)**
25–34	39 (14.4)	20 (17.2)	8 (19.0)	1 (8.3)	1 (7.1)	—	—	**69 (15.1)**
35–44	34 (12.6)	17 (14.7)	7 (16.7)	7 (58.3)	5 (35.7)	1 (50.0)	1 (100)	**72 (15.8)**
45–54	28 (10.4)	16 (13.8)	6 (14.3)	2 (16.7)	3 (21.4)	1 (50.0)	—	**56 (12.3)**
55–64	29 (10.7)	10 (8.6)	5 (11.9)	—	5 (35.7)	—	—	**49 (10.7)**
≥65	8 (3.0)	5 (4.4)	3 (7.1)	—	—	—	—	**16 (3.5)**
Total	**270 (59.1)**	**116 (25.4)**	**42 (9.2)**	**12 (2.6)**	**14 (3.1)**	**2 (<1)**	**1 (<1)**	**457 (100.0)**

16–24 years in nonoccupational settings. The population identified in this study differs from the population exposed to lead in occupational settings, where cases are identified through a mechanism of routine lead exposure screening. However, adult males without an occupational exposure, including those with RBFs, would likely only be screened if they seek care for symptoms related to elevated BLLs, or as part of routine care for other purposes, if suspicion is raised by a medical provider. In addition, a low index of suspicion of lead toxicity by medical providers might result in a delay in diagnosis, and patients might receive multiple incorrect diagnoses before receiving correct assessment and treatment (*2*). Furthermore, BLLs can fluctuate in persons with RBFs. A person with a low BLL at the time of testing can have an increase in BLL and become symptomatic when RBFs migrate, such as into a joint space (*3*,*10*).

The findings in this report are subject to at least four limitations. First, not all states report to ABLES, and persons with RBFs are often not tested; therefore, these data should be considered minimum estimates of the magnitude of the problem. Second, the reporting requirement varies by state and ranges from requiring reporting of all BLLs to only those ≥40 μg/dL. Third, before 2007, work-related RBFs were not systematically identified through ABLES; identification of adults at risk for lead exposure is limited primarily to certain groups at high risk and universal blood lead screening is not standard practice. Finally, only some states provided 10–24 μg/dL BLL data. The possibility exists that some reporting states might not have investigated patients with BLLs 10–24 μg/dL or determined the location where lead exposure occurred, thereby resulting in omission or misclassification of RBF cases.

Persons with elevated BLLs with an unknown exposure source can be queried about RBFs. Patients with RBFs might benefit from counseling on lead and its health effects, and the importance of baseline and periodic BLL monitoring (*6*,*7*).

Acknowledgments

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Summary

What is already known about this topic?

Gunshot wounds cause an estimated 115,000 injuries in the United States per year, approximately 70% of which are nonfatal. Bullet removal is not routinely indicated for victims of gunshot injuries with retained bullet fragments (RBFs) unless they are a cause of immediate morbidity. Symptoms of lead toxicity are often nonspecific and can appear years after the initial injury. States participating in the Adult Blood Lead Epidemiology and Surveillance (ABLES) program require health care providers and laboratories to report blood lead level (BLL) test results to the state health department. The primary focus of adult screening is to detect occupational exposure; RBFs are a less recognized potential source of lead exposure.

What is added by this report?

During 2003–2012, ABLES programs in 41 states reported 145,811 persons with BLLs ≥10 μg/dL. RBF-associated cases accounted for 457 (0.3%) of 145,811 persons with elevated BLLs. Among 349 persons with BLLs ≥80 μg/dL, 17 (4.9%) were RBF-associated; the maximum recorded RBF-associated BLL was 306 μg/dL. Elevated BLLs attributable to RBFs occurred primarily among males aged 16–24 years, whereas the greatest number of non-RBF–associated cases occurred among persons aged 35–44 years.

What are the implications for public health practice?

Persons with elevated BLLs with unknown lead exposure source should be asked about RBFs. Furthermore, baseline and intermittent BLL tests should be considered in persons with a history of RBFs.

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Advisory Committee on Immunization Practices Recommended Immunization Schedule for Children and Adolescents Aged 18 Years or Younger — United States, 2017

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On February 7, 2017, this report was posted as an MMWR Early Release on the MMWR website (https://www.cdc.gov/mmwr).

In October 2016, the Advisory Committee on Immunization Practices (ACIP) approved the Recommended Immunization Schedule for Children and Adolescents Aged 18 Years or Younger—United States, 2017. The 2017 child and adolescent immunization schedule summarizes ACIP recommendations, including several changes from the 2016 immunization schedules, in three figures, and footnotes for the figures. These documents can be found on the CDC immunization schedule website (https://www.cdc.gov/vaccines/schedules/index.html). These immunization schedules are approved by ACIP (https://www.cdc.gov/vaccines/acip/index.html), the American Academy of Pediatrics (https://www.aap.org), the American Academy of Family Physicians (https://www.aafp.org), and the American College of Obstetricians and Gynecologists (http://www.acog.org). Health care providers are advised to use the figures and the combined footnotes together. The full ACIP recommendations for each vaccine, including contraindications and precautions, can be found at https://www.cdc.gov/vaccines/hcp/acip-recs/index.html. Providers should be aware that changes in recommendations for specific vaccines can occur between annual updates to the childhood/adolescent immunization schedules. If errors or omissions are discovered within the child and adolescent schedule, CDC posts revised versions on the CDC immunization schedule website.*

Printable versions of the 2017 immunization schedules for children and adolescents aged 18 years or younger also are available at the website and ordering instructions for laminated versions and easy-to-read versions for parents also are available at the immunization schedule website.

For further guidance on the use of each vaccine included in the schedules, including contraindications and precautions, health care providers are referred to the respective ACIP vaccine recommendations at https://www.cdc.gov/vaccines/hcp/acip-recs/index.html.

Recommendations for routine use of vaccines in children, adolescents and adults are developed by the Advisory Committee on Immunization Practices (ACIP). ACIP is chartered as a federal advisory committee to provide expert external advice and guidance to the Director of the Centers for Disease Control and Prevention (CDC) on use of vaccines and related agents for the control of vaccine-preventable diseases in the civilian population of the United States. Recommendations for routine use of vaccines in children and adolescents are harmonized to the greatest extent possible with recommendations made by the American Academy of Pediatrics (AAP), the American Academy of Family Physicians (AAFP), and the American College of Obstetricians and Gynecologists (ACOG). Recommendations for routine use of vaccines in adults are harmonized with recommendations of AAFP, ACOG, and the American College of Physicians (ACP). ACIP recommendations approved by the CDC Director become agency guidelines on the date published in the Morbidity and Mortality Weekly Report *(*MMWR*). Additional information about ACIP is available at https://www.cdc.gov/vaccines/acip.*

Changes in the 2017 Child and Adolescent Immunization Schedule

Changes in the 2017 immunization schedules for children and adolescents aged 18 years or younger include new or revised ACIP recommendations for influenza (*1*); human papillomavirus (*2*); hepatitis B (*3*); *Haemophilus influenzae* type B (*4*); pneumococcal; meningococcal (*5*,*6*); and diphtheria and tetanus toxoids and acellular pertussis (*7*) vaccines.

Figure 1. Changes to the 2017 figure from the 2016 schedule† are as follows:

- The 16-year age column has been separated from the 17–18-year age column to highlight the need for a meningococcal conjugate vaccine booster dose at age 16 years.
- Live attenuated influenza vaccine (LAIV) has been removed from the influenza row.
- A blue bar was added for human papillomavirus vaccine (HPV) for children aged 9–10 years, indicating that persons in this age group may be vaccinated (even in the absence of a high-risk condition).

* CDC encourages organizations that previously have relied on copying the schedules to their websites instead to use syndication as a more reliable method for displaying the most current and accurate immunization schedules on an organization's website. Use of content syndication requires a one-time step that ensures an organization's website displays current schedules as soon as they are published or revised; instructions for the syndication code are available on CDC's website (https://www.cdc.gov/vaccines/schedules/syndicate.html). CDC also offers technical assistance for implementing this form of content syndication (e-mail request to ncirdwebteam@cdc.gov).

† Past immunization schedules are available at https://www.cdc.gov/vaccines/schedules/past.html.

Figure 3. A new figure, "Figure 3. Vaccines that might be indicated for children and adolescents aged 18 years or younger based on medical indications," has been added. The purpose of this figure is to do the following:

- Demonstrate most children with medical conditions can (and should) be vaccinated according to the routine child/adolescent immunization schedule.
- Indicate when a medical condition is a precaution or contraindication to vaccination.
- Indicate when additional doses of vaccines may be necessary because of a child's or adolescent's medical condition. Providers should consult the relevant footnotes for additional information.

Footnotes. Changes to the footnotes for the figures are as follows:

- The Hepatitis B vaccine (HepB) footnote was revised to reflect that the birth dose of HepB should be administered within 24 hours of birth.
- The diphtheria and tetanus toxoids and acellular pertussis vaccine (DTaP) footnote was revised to more clearly present recommendations following an inadvertently early administered fourth dose of DTaP.
- Within the *Haemophilus influenzae* type b vaccine (Hib) footnote, Comvax was removed from the routine vaccination portion of footnote. This vaccine has been removed from the market, and all available doses have expired. Additionally, Hiberix has been added to the list of vaccines that may be used for the primary vaccination series.
- Within the pneumococcal vaccine footnote, references to 7-valent pneumococcal conjugate vaccine (PCV7) have been removed. All healthy children who might have received PCV7 as part of a primary series have now aged out of the recommendation for pneumococcal vaccine.
- The influenza vaccine footnote has been updated to indicate that LAIV should not be used during the 2016–2017 influenza season.
- The meningococcal vaccines footnote has been updated to include recommendations for meningococcal vaccination of children with human immunodeficiency virus (HIV) infection and to reflect recommendations for the use of a 2-dose Trumenba (meningococcal B vaccine) schedule.
- The tetanus and diphtheria toxoids and acellular pertussis vaccine (Tdap) footnote for vaccination of pregnant adolescents between gestational weeks 27–36 has been updated to reflect a preference for vaccination earlier during this period. Currently available data suggest that vaccinating earlier in the 27 through 36–week period will maximize passive antibody transfer to the infant.
- The footnote for HPV vaccine has been updated to include the new 2-dose schedule for persons initiating the HPV vaccination series before age 15 years. In addition, bivalent HPV vaccine has been removed from the schedule. This vaccine has been removed from the U.S. market, and all available vaccine doses have expired.

Acknowledgments

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7. Updated ACIP statement on October 2016 diphtheria and tetanus toxoids and acellular pertussis vaccination recommendations (publication pending).

Advisory Committee on Immunization Practices Recommended Immunization Schedule for Adults Aged 19 Years or Older — United States, 2017

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On February 7, 2017, this report was posted as an MMWR *Early Release on the* MMWR *website (https://www.cdc.gov/mmwr).*

In October 2016, the Advisory Committee on Immunization Practices (ACIP) voted to approve the Recommended Adult Immunization Schedule for Adults Aged 19 Years or Older—United States, 2017. The 2017 adult immunization schedule summarizes ACIP recommendations in two figures, footnotes for the figures, and a table of contraindications and precautions for vaccines recommended for adults. These documents are available at https://www.cdc.gov/vaccines/schedules. The full ACIP recommendations for each vaccine can be found at https://www.cdc.gov/vaccines/hcp/acip-recs/index.html. The 2017 adult immunization schedule was also reviewed and approved by the American College of Physicians (https://www.acponline.org), the American Academy of Family Physicians (https://www.aafp.org), the American College of Obstetricians and Gynecologists (http://www.acog.org), and the American College of Nurse-Midwives (http://www.midwife.org).

A cover page has been added to the 2017 adult immunization schedule that contains information on select general principles pertinent to the adult immunization schedule, additional CDC resources, instructions for reporting vaccine adverse events related to vaccination and suspected cases of reportable vaccine-preventable diseases, and an ACIP-approved list of standardized acronyms for vaccines recommended for adults.* In addition, the table of contraindications and precautions for vaccines routinely recommended for adults, which was formerly a stand-alone document, has been incorporated into the adult immunization schedule.

Recommendations for routine use of vaccines in children, adolescents and adults are developed by the Advisory Committee on Immunization Practices (ACIP). ACIP is chartered as a federal advisory committee to provide expert external advice and guidance to the Director of the Centers for Disease Control and Prevention (CDC) on use of vaccines and related agents for the control of vaccine-preventable diseases in the civilian population of the United States. Recommendations for routine use of vaccines in children and adolescents are harmonized to the greatest extent possible with recommendations made by the American Academy of Pediatrics (AAP), the American Academy of Family Physicians (AAFP), and the American College of Obstetricians and Gynecologists (ACOG). Recommendations for routine use of vaccines in adults are harmonized with recommendations of AAFP, ACOG, and the American College of Physicians (ACP). ACIP recommendations approved by the CDC Director become agency guidelines on the date published in the Morbidity and Mortality Weekly Report *(*MMWR*). Additional information about ACIP is available at https://www.cdc.gov/vaccines/acip.*

Changes in the 2017 Adult Immunization Schedule

Changes in the 2017 adult immunization schedule from the previous year's schedule include new or revised ACIP recommendations for influenza, human papillomavirus, hepatitis B, and meningococcal vaccines:

Influenza vaccination (*1*). Changes are related to the low effectiveness of the live attenuated influenza vaccine (LAIV) (FluMist, MedImmune) against influenza A(H1N1)pdm09 in the United States during the 2013–2014 and 2015–2016 influenza seasons and revised recommendations for the use of influenza vaccine among patients with egg allergy. These changes are reflected in the 2017 adult immunization schedule as follows:

- LAIV should not be used during the 2016–2017 influenza season.
- Adults with a history of egg allergy who have only hives after exposure to egg should receive age-appropriate inactivated influenza vaccine (IIV) or recombinant influenza vaccine (RIV).
- Adults with a history of egg allergy with symptoms other than hives (e.g., angioedema, respiratory distress, lightheadedness, or recurrent emesis, or who required epinephrine or another emergency medical intervention) may receive age-appropriate IIV or RIV. The selected vaccine should be administered in an inpatient or outpatient medical setting and supervised by a health care provider who is able to recognize and manage severe allergic conditions.

* CDC encourages organizations that previously have relied on copying the adult immunization schedule on their websites to use syndication instead, as a more reliable method for displaying the most current and accurate adult immunization schedule. Use of content syndication requires a one-time step that ensures an organization's website displays the adult immunization schedule as soon as it is published or revised. The syndication code for the adult immunization schedule and instructions for its use can be found at https://www.cdc.gov/vaccines/schedules/syndicate.html. Requests for technical assistance for adult immunization schedule syndication can be sent to ncirdwebteam@cdc.gov.

Human papillomavirus vaccination (*2*). Healthy adolescents who start their human papillomavirus (HPV) vaccination series before age 15 years are recommended to receive 2 doses of HPV vaccine. Adults and adolescents who did not start their HPV vaccination series before age 15 years should receive 3 doses of HPV vaccine. Changes in recommendations in the adult immunization schedule include updates regarding HPV vaccination for adults who did not complete the HPV vaccination series as adolescents. These changes are described in the 2017 adult immunization schedule as follows:

- Adult females through age 26 years and adult males through age 21 years who have not received any HPV vaccine should receive a 3-dose series of HPV vaccine at 0, 1–2, and 6 months. Males aged 22 through 26 years may be vaccinated with a 3-dose series of HPV vaccine at 0, 1–2, and 6 months.
- Adult females through age 26 years and adult males through age 21 years (and males aged 22 through 26 years who may receive HPV vaccine) who initiated the HPV vaccination series before age 15 years and received 2 doses at least 5 months apart are considered adequately vaccinated and do not need an additional dose of HPV vaccine.
- Adult females through age 26 years and adult males through age 21 years (and males aged 22 through 26 years who may receive HPV vaccine) who initiated the HPV vaccination series before age 15 years and received only 1 dose, or 2 doses less than 5 months apart, are not considered adequately vaccinated and should receive 1 additional dose of HPV vaccine.

Hepatitis B vaccination (*3*). The ACIP updated chronic liver disease conditions for which a hepatitis B vaccine (HepB) series is recommended. This change is described in the 2017 adult immunization schedule as follows:

- Adults with chronic liver disease, including, but not limited to, hepatitis C virus infection, cirrhosis, fatty liver disease, alcoholic liver disease, autoimmune hepatitis, and an alanine aminotransferase (ALT) or aspartate aminotransferase (AST) level greater than twice the upper limit of normal should receive a HepB series.

Meningococcal vaccination (*4*,*5*). There are two changes in meningococcal vaccination recommendations for 2017. First, the ACIP recommended that adults with human immunodeficiency virus (HIV) infection receive a 2-dose primary series of serogroups A, C, W, and Y meningococcal conjugate vaccine (MenACWY). Second, the ACIP provided updated dosing guidance for one of the serogroup B meningococcal vaccines (MenB) (MenB-FHbp [Trumenba, Pfizer]). Three doses of MenB-FHbp should be administered at 0, 1–2, and 6 months to adults who are at increased risk for meningococcal disease, and those who are vaccinated during serogroup B meningococcal disease outbreaks. When MenB-FHbp is given to healthy adolescents and young adults who are not at increased risk for meningococcal disease, 2 doses of MenB-FHbp should be administered at 0 and 6 months (MenB-FHbp was previously recommended as a 3-dose series at 0, 2, and 6 months, consistent with the original vaccine licensure for this population). The dosing frequency and interval for the other MenB, MenB-4C (Bexsero, GlaxoSmithKline), have not changed: MenB-4C remains a 2-dose series, with doses administered at least 1 month apart. Either MenB vaccine can be used when vaccination is indicated. The change in ACIP recommendations on the use of MenB-FHbp does not imply a preference for one MenB over the other. These updates in meningococcal vaccination are reflected in the 2017 adult immunization schedule as follows:

- Adults with anatomical or functional asplenia or persistent complement component deficiencies should receive a 2-dose primary series of MenACWY, with doses administered at least 2 months apart, and be revaccinated every 5 years. They should also receive a series of MenB with either MenB-4C (2 doses administered at least 1 month apart) or MenB-FHbp (3 doses administered at 0, 1–2, and 6 months).
- Adults with HIV infection who have not been previously vaccinated should receive a 2-dose primary MenACWY vaccination series, with doses administered at least 2 months apart, and be revaccinated every 5 years. Those who previously received 1 dose of MenACWY should receive a second dose at least 2 months after the first dose. MenB is not routinely recommended for adults with HIV infection, because meningococcal disease in this population is caused primarily by serogroups C, W, and Y.
- Microbiologists who are routinely exposed to isolates of *Neisseria meningitidis* should receive 1 dose of MenACWY and be revaccinated every 5 years if the risk for infection remains, as well as either MenB-4C (2 doses administered at least 1 month apart) or MenB-FHbp (3 doses administered at 0, 1–2, and 6 months).
- Adults at risk because of a meningococcal disease outbreak should receive 1 dose of MenACWY if the outbreak is attributable to serogroup A, C, W, or Y; or, if the outbreak is attributable to serogroup B, either MenB-4C (2 doses administered at least 1 month apart) or MenB-FHbp (3 doses administered at 0, 1–2, and 6 months).

- Young adults aged 16 through 23 years (preferred age range is 16 through 18 years) who are healthy and not at increased risk for serogroup B meningococcal disease may receive either MenB-4C (2 doses administered at least 1 month apart) or MenB-FHbp (3 doses administered at 0, 1–2, and 6 months) for short-term protection against most strains of serogroup B meningococcal disease.

Notable changes to Figures 1 and 2. Changes in "Figure 1. Recommended immunization schedule for adults aged 19 years or older, by age group" and "Figure 2. Recommended immunization schedule for adults aged 19 years or older by medical condition and other indications" are as follows:

- In Figures 1 and 2, standardized acronyms for vaccines are used to promote simplicity and consistency, and their listing has been reordered. Ancillary information previously contained in the figures has been consolidated and moved to the cover page. Colored blocks instead of colored bars are used to denote indications. These figures must be used in conjunction with the footnotes, which contain important information for each vaccine and considerations for special populations.
- In Figure 2, the columns for medical conditions and other indications have been reordered to keep medical conditions together and special populations together. Additional footnotes mark appropriate columns of medical conditions and other indications to refer the reader to view relevant vaccine-specific information.
- In Figure 2, the color of the indication block for MenACWY for HIV infection has been changed to yellow (recommended for adults who meet the age requirement, lack documentation of vaccination, or lack evidence of past infection) from purple (recommended for adults with additional medical conditions or other indications).

Changes to footnotes.

- Footnotes are limited to the information pertaining to vaccines listed in Figures 1 and 2 and are organized by vaccine-specific information and considerations for special populations (e.g., pregnant women and adults with HIV infection). The footnote labeled "additional information," contained in previous versions of the adult immunization schedule, has been moved to the cover page. The footnote related to immunocompromising conditions has been removed, but vaccine-specific information on immunocompromising conditions has been added to the appropriate footnotes (e.g., the footnote for pneumococcal vaccination).
- The format for the footnotes has been condensed, simplified, and standardized. The format for pneumococcal; human papillomavirus; meningococcal; varicella; and measles, mumps, and rubella vaccination footnotes has undergone substantial revision.

Other changes. Lastly, the table of contraindications and precautions for vaccines routinely recommended for adults, which previously was a stand-alone document, has been incorporated into the adult immunization schedule. The content of the table has been consolidated and simplified.

More Information

Details on these updates and information on other vaccines recommended for adults are available online under Adult Immunization Schedule, United States, 2017 (https://www.cdc.gov/vaccines/schedules/hcp/adult.html) and in the Annals of Internal Medicine (*6*). The full ACIP recommendations for each vaccine are also available online (https://www.cdc.gov/vaccines/hcp/acip-recs/index.html).

Acknowledgments

Advisory Committee on Immunization Practices (ACIP member rosters are available online at https://www.cdc.gov/vaccines/acip/committee/members-archive.html); ACIP Adult Immunization Work Group.

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Vital Signs: Noise-Induced Hearing Loss Among Adults — United States 2011–2012

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Abstract

Introduction: The 2016 National Academies of Sciences report "Hearing Health Care for Adults: Priorities for Improving Access and Affordability" included a call to action for government agencies to strengthen efforts to collect, analyze, and disseminate population-based data on hearing loss in adults.

Methods: CDC analyzed the most recent available data collected both by questionnaire and audiometric tests of adult participants aged 20–69 years in the 2011–2012 National Health and Nutrition Examination Survey (NHANES) to determine the presence of audiometric notches indicative of noise-induced hearing loss. Prevalence of both unilateral and bilateral audiometric notches and their association with sociodemographics and self-reported exposure to loud noise were calculated.

Results: Nearly one in four adults (24%) had audiometric notches, suggesting a high prevalence of noise-induced hearing loss. The prevalence of notches was higher among males. Almost one in four U.S. adults who reported excellent or good hearing had audiometric notches (5.5% bilateral and 18.0% unilateral). Among participants who reported exposure to loud noise at work, almost one third had a notch.

Conclusions and Implications for Public Health Practice: Noise-induced hearing loss is a significant, often unrecognized health problem among U.S. adults. Discussions between patients and personal health care providers about hearing loss symptoms, tests, and ways to protect hearing might help with early diagnosis of hearing loss and provide opportunities to prevent harmful noise exposures. Avoiding prolonged exposure to loud environments and using personal hearing protection devices can prevent noise-induced hearing loss.

Introduction

Hearing plays an important role in communication, health, function, and quality of life. Hearing loss is the third most common chronic physical condition in the United States and is twice as prevalent as diabetes or cancer (*1*).

Untreated hearing loss is associated with decreased social, psychological, and cognitive functioning. Hearing ability is inversely associated with distress, somatization, depression, and loneliness among all age groups (*2*,*3*). The economic cost to society of age-related hearing loss has been estimated to be $297,000 over the lifetime of every affected person. Hearing loss is associated with low employment rates, lower worker productivity, and high health care costs. Adults with hearing loss are more likely to have low income and be unemployed or underemployed than adults with normal hearing (*2*,*3*). Nationally, the total cost of first-year hearing loss treatment is projected to increase fivefold between 2002 and 2030, from $8.2 billion to $51.4 billion (*4*).

Noise is the most common modifiable environmental cause of hearing loss among young and middle-aged adults, and the most common self-reported cause of hearing loss among men (*5*). In 2014, an estimated 21.0% of adults aged ≥18 years had difficulty following a conversation amid background noise, 11.2% had tinnitus (i.e., the perception of ringing in the ears or other sounds such as buzzing, hissing, and clicking), and 5.9% had sensitivity to everyday sounds (hyperacusis).* In addition to hearing loss, chronic exposure to noise has been associated with increased stress, anxiety, depression, blood pressure, heart disease incidence, distractibility, annoyance, tinnitus, hyperacusis, and other health problems (*6*).

The 2016 National Academies of Sciences report included a call to action for government agencies to strengthen efforts to collect, analyze, and disseminate population-based data on hearing loss in adults (*2*). CDC analyzed data from the

*National Health Interview Survey, 2014 data. https://www.cdc.gov/mmwr/preview/mmwrhtml/mm6437a8.htm.

Key Points

- Noise exposure at home and in the community can permanently damage hearing.
- Almost one in four adults who reported excellent to good hearing already have measurable hearing loss.
- The presence of noise-induced hearing loss increased from one in five among young adults aged 20–29 years to one in four among adults aged 50–59 years.
- Additional information is available at https://www.cdc.gov/vitalsigns.

2011–2012 National Health and Nutrition Examination Survey (NHANES) to estimate the prevalence of audiometric notches and exposure to noise among adults aged 20–69 years.

Methods

NHANES[†] is a continuous, cross-sectional health interview and examination survey designed to assess the health and functional status of the civilian, noninstitutionalized U.S. population. The 2011–2012 NHANES cycle included audiometric testing and hearing-related questions for a nationally representative sample of adults aged 20–69 years. Using the standard NHANES audiometric protocols, audiograms were analyzed using an algorithm (*7*) to identify high-frequency audiometric notches that suggest hearing loss caused by exposure to noise. An audiometric notch is a deterioration in the hearing threshold (the softest sound a person can hear). This study defined the presence of a high-frequency audiometric notch when any threshold at 3, 4, or 6 kHz exceeded the average threshold at 0.5 and 1 kHz by ≥15 decibel (dB) hearing level (HL) and the 8 kHz threshold was at least 5 dB HL lower (better) than the maximum threshold at 3, 4, or 6 kHz. Statistical analyses were weighted as recommended for NHANES data. Logistic regression was performed to evaluate the notch prevalence among age groups and its association with sociodemographic factors (sex, race/ ethnicity, education, income) and exposure to noise. NHANES 2011–2012 defined "loud" noise as when "you had to speak in a raised voice to be heard," and "very loud" as when "you have to shout in order to be understood by someone standing 3 feet away from you."

Results

During NHANES 2011–2012, a total of 3,583 participants aged 20–69 years had complete audiometric data (response rate 76.6%, among 4,677 participants who completed household interviews). The weighted prevalence of an audiometric notch among U.S. adults aged 20–69 years was 39.4 million or 24.4% (6.2% bilateral notch and 18.2% unilateral notch) (Table 1).

Differences were identified by age, sex, and race/ethnicity, and by whether participants were exposed to loud noise at work. The presence of an audiometric notch increased with age ($p<0.01$), ranging from 19.2% among persons aged 20–29 years to 27.3% among persons aged 50–59 years (Table 1). The prevalence of notches was consistently higher in males than in females for both reported work exposure to noise and for no reported work exposure to noise (Table 2). This was true for both unilateral and bilateral notches (Figure).

Twenty-one million U.S. adults (19.9%) who reported no exposure to loud or very loud noise at work had an audiometric notch (bilateral or unilateral) (Table 1). Persons exposed to loud noise at work were twice as likely to have bilateral or unilateral notches (Table 1) than those not exposed. However, 23.5% of persons who self-reported excellent or good hearing (irrespective of noise exposure reported) had bilateral or unilateral notches (5.5% and 18.0%, respectively) (Table 1). These numbers were higher (31.0%) among persons reporting exposure to noise at work and lower (20.1%) among those who were not exposed to noise at work (Table 2). Seventy percent of persons exposed to loud noise in the past 12 months never or seldom wore hearing protection.

Conclusions and Comments

Noise-induced hearing loss is a significant health problem among U.S. adults, is more prevalent among males, and increases with age. Persons with auditory damage caused by noise frequently do not recognize it; one in four U.S. adults who reported excellent or good hearing had an audiometric notch. Among persons who reported work exposure to loud noise, one third had a bilateral or unilateral notch.

Noise exposure is the second most common cause of acquired hearing loss (after aging) (*8*). An estimated 24% of hearing loss in the United States has been attributed to workplace exposures (*9*). Noise exposure is associated with numerous adverse health effects, and reducing noise exposure is likely to improve health. A recent study suggested that reducing environmental noise exposure might save lives by decreasing the prevalence of cardiovascular heart disease (*10*). Avoiding exposure to loud environments and effective use of personal hearing protection devices (earplugs or earmuffs) have been shown to prevent hearing loss (*3*). Evidence also exists that stronger occupational regulation leads to decreased noise levels (*11*). Persons who already have impaired hearing from noise exposure can benefit from clinical rehabilitation, such as amplification through hearing aids, learning to read lips, and other compensation strategies (*2*). Use of technology, such as smart phone apps to measure sound level, provides new ways of informing decisions and actions.[§]

[†] https://www.cdc.gov/nchs/nhanes/.

[§] https://blogs.cdc.gov/niosh-science-blog/2014/04/09/sound-apps/.

TABLE 1. Percentages of adults aged 20–69 years with an audiometric notch* in one ear (unilateral notch) or both ears (bilateral notch), by selected characteristics — National Health and Nutrition Examination Survey, United States, 2011–2012

	Bilateral or unilateral notch		Bilateral notch		Unilateral notch	
Characteristic (No.)	**% (SE)**	**OR (95% CI)**	**% (SE)**	**OR (95% CI)**	**% (SE)**	**OR (95% CI)**
Overall (3,583)	24.4 (1.73)	—	6.2 (0.57)	—	18.2 (1.32)	—
Sex						
Male (1,841)	31.6 (1.89)	Referent	8.6 (0.76)	Referent	23.0 (1.53)	Referent
Female (1,742)	17.0 (1.90)	0.44 (0.35–0.56)	3.7 (0.95)	0.35 (0.19–0.66)	13.3 (1.23)	0.48 (0.40–0.57)
Age group (yrs)						
20–29 (803)	19.2 (2.34)	Referent	4.2 (1.31)	Referent	14.9 (1.95)	Referent
30–39 (721)	24.9 (2.95)	1.40 (0.98–2.00)	4.6 (0.84)	1.16 (0.50– 2.67)	20.4 (2.65)	1.47 (0.99–2.17)
40–49 (682)	29.0 (2.86)	1.72 (1.28–2.31)	7.70 (1.31)	2.07 (1.05–4.09)	21.3 (2.21)	1.62 (1.22–2.16)
50–59 (715)	27.3 (2.05)	1.58 (1.04–2.42)	8.7 (1.56)	2.27 (0.92–5.56)	18.7 (2.21)	1.39 (0.86–2.24)
60–69 (662)	20.6 (2.99)	1.09 (0.66–1.82)	5.3 (0.91)	1.28 (0.52–3.16)	15.3 (2.76)	1.04 (0.59–1.85)
Race/Ethnicity						
White, non-Hispanic (1,240)	24.0 (2.08)	Referent	6.5 (0.67)	Referent	17.6 (0.67)	Referent
Black, non-Hispanic (996)	21.1 (1.54)	0.85 (0.64–1.13)	3.6 (0.47)	0.54 (0.35–0.82)	17.5 (1.62)	0.96 (0.72–1.28)
Mexican American (381)	31.8 (3.12)	1.48 (1.06–2.05)	11.1 (2.63)	1.93 (1.09–3.42)	20.6 (2.21)	1.31 (0.94–1.83)
Education						
Less than high school (690)	29.7 (3.91)	1.49 (1.00–2.21)	8.1 (2.09)	1.75 (0.89–3.42)	21.6 (3.24)	1.41 (0.92–2.15)
Completed high school (737)	28.4 (2.87)	1.40 (1.10–1.77)	8.4 (0.86)	1.78 (1.26–2.51)	20.0 (2.43)	1.28 (0.98–1.68)
More than high school (2,156)	22.1 (1.63)	Referent	5.1 (0.60)	Referent	17.0 (1.24)	Referent
Poverty income ratio						
≤1 (848)	22.9 (1.81)	1.17 (0.87–1.58)	5.3 (0.80)	0.90 (0.49–1.62)	17.6 (1.62)	1.29 (0.92–1.80)
>1 to <5 (1,876)	27.0 (2.02)	1.46 (1.13–1.89)	6.7 (1.01)	1.20 (0.65–2.23)	20.3 (1.31)	1.57 (1.14–2.17)
≥5 (607)	20.2 (1.94)	Referent	6.1 (1.19)	Referent	14.1 (1.98)	Referent
Self-reported work exposure to noise†						
No (2,360)	19.9 (2.04)	Referent	5.1 (0.73)	Referent	14.8 (1.53)	Referent
Yes (1,223)	32.6 (2.48)	1.95 (1.40–2.72)	8.2 (1.09)	1.91 (1.17–3.11)	24.4 (2.20)	1.96 (1.37–2.81)
Self-reported hearing status§						
Excellent or good (2,953)	23.5 (1.92)	Referent	5.5 (0.63)	Referent	18.0 (1.57)	Referent
Little, moderate, or a lot of trouble hearing (626)	28.3 (2.99)	1.29 (0.91–1.82)	9.0 (1.53)	1.73 (1.07– 2.78)	19.4 (2.66)	1.15 (0.74–1.79)

Abbreviations: CI = confidence interval; dB = decibel; OR = odds ratio; SE = standard error.

* An audiometric notch is a deterioration in the hearing threshold (the softest sound a person can hear). An audiometric notch is present when one or more of the thresholds at 3–4, or 6 kHz exceeds the pure-tone average of the 0.5 and1 kHz thresholds by 15 dB hearing level (HL) or more, and the 8 kHz threshold is at least 5 dB HL lower (better) than the highest threshold in the 3–6 kHz range. Audiograms were not accepted if the test and retest results were greater of 10 dB. The average 1-kHz frequency was the value used in this study. Participants were excluded if they had partial audio exam, ear compliance ≤0.2mL or pressure more negative than -150 dekapascals (daPa) (normal air pressure is approximately equal on both sides of the tympanic membrane [zero daPa]).

† Persons with no work exposure to noise included both those who reported off-work exposure to noise (e.g. noise from power tools, lawn mowers, farm machinery, cars, trucks, motorcycles, motor boats or music for 10 or more hours a week) and those who did not report exposure to off-work noise. Persons with work exposure to noise reported exposure to loud or very loud noise at work.

§ Participants were asked: "Which statement best describes your hearing (without a hearing aid)? Would you say your hearing is excellent, good, that you have a little trouble, moderate trouble, a lot of trouble, or are you deaf?"

Noise reduction and avoidance can prevent hearing loss or slow its progression. This can be accomplished by avoiding high volumes on personal listening devices; reducing listening time to high volumes of music; taking breaks from exposure; requesting lower volumes in public settings (restaurants, movie theaters); using quieter products (e.g., household appliances, power tools, recreational vehicles); reducing equipment noise by replacing worn or unbalanced machine parts; moving as far as possible from the loudest sound-producing source, such as loudspeakers or cannons at college stadiums; and using hearing protection devices (*2,3*). Hearing protectors need to fit well to reduce noise exposure effectively.

Noise exposure at younger ages needs particular attention. Damage to hearing accumulates over time so that hazardous exposure that begins earlier in life has the potential to be more damaging as persons age. The high prevalence of audiometric notches (one in five) among persons aged 20–29 years suggests that early life interventions need to be developed.

Hearing screenings can help reduce delays in diagnosis and improve access to hearing aids for those with hearing loss, thus improving health-related quality of life (*12*), yet a 2014 report found that only 46.0% of adults who had any trouble hearing had seen a health care professional about their hearing in the past 5 years (*5*). Hearing loss often progresses for years before being self-perceived or diagnosed (*13,14*). Talking to one's personal health care provider about hearing loss symptoms, tests, and ways to protect hearing, might support early diagnosis and access to hearing rehabilitation if needed.

TABLE 2. Percentages of adults aged 20–69 years with an audiometric notch* in one ear (unilateral notch) or both ears (bilateral notch), by reported work exposure to noise status,† and selected characteristics — National Health and Nutrition Examination Survey, United States, 2011–2012

	No reported work exposure to noise (n = 2,360)				Work exposure to noise (n = 1,223)			
	Bilateral or unilateral notch		Bilateral notch	Unilateral notch	Bilateral or unilateral notch		Bilateral notch	Unilateral notch
Characteristic	% (SE)	OR (95% CI)	% (SE)	% (SE)	% (SE)	OR (95% CI)	% (SE)	% (SE)
Overall	**19.9 (2.04)**	—	**5.1 (0.73)**	**14.8 (1.53)**	**32.6 (2.48)**	—	**8.2 (1.09)**	**24.44 (2.20)**
Sex								
Male	24.7 (2.61)	Referent	7.2 (1.22)	17.6 (2.20)	39.1 (2.24)	Referent	10.2 (1.24)	28.9 (2.18)
Female	16.6 (2.17)	0.61 (0.44–0.83)	3.7 (0.89)§	12.9 (1.53)§	18.3 (3.65)	0.35 (0.22–0.55)	3.7 (1.99)§	14.6 (3.52)§
Age group (yrs)								
20–29	17.6 (2.91)	Referent	3.6 (1.69)	14.0 (1.78)	22.9 (5.07)	Referent	5.7 (2.21)	17.2 (4.67)§
30–39	18.6 (2.82)	1.07 (0.65–1.77)	3.4 (0.94)	15.2 (2.47)	37.3 (4.97)	2.00 (1.15–3.47)	6.9 (1.34)	30.4 (4.91)§
40–49	25.0 (3.74)	1.56 (0.91–2.68)	7.9 (1.95)	17.1 (3.05)	36.0 (3.46)	1.90 (1.05–3.43)	7.4 (2.37)	28.7 (1.66)
50–59	20.3 (3.04)	1.19 (0.73–1.95)	6.1 (1.43)	14.2 (2.46)	35.8 (2.73)	1.88 (1.01–3.50)	11.8 (2.60)	24.0 (2.87)
60–69	17.7 (3.06)	1.01 (0.59–1.72)	4.5 (1.12)	13.2 (2.91)	27.3 (5.23)	1.26 (0.60–2.66)	7.34 (1.57)	19.92 (5.37)
Race/Ethnicity								
White, non-Hispanic	19.4 (2.85)	Referent	5.1 (0.95)	14.3 (2.19)	31.9 (2.60)	Referent	8.7 (1.50)	23.2 (2.24)
Black, non-Hispanic	17.7 (1.47)	0.89 (0.58–1.38)	3.3 (0.56)	14.4 (1.40)	28.6 (2.62)	0.86 (0.64–1.14)	4.2 (1.14)§	24.4 (2.79)
Mexican American	24.2 (3.86)	1.39 (0.85–2.29)	8.7 (2.81)	14.8 (1.53)	43.0 (4.45)	1.61 (1.16–2.28)	14.8 (3.16)§	28.2 (3.58)§
Education								
Less than high school	22.0 (2.78)	1.17 (0.81–1.69)	8.2 (1.80)§	13.8 (2.41)	37.6 (6.52)	1.50 (0.89–2.53)	8.0 (3.26)	29.5 (5.43)
Completed high school	20.7 (3.70)	1.08 (0.73–1.61)	5.7 (1.65)	15.0 (2.87)	37.6 (4.06)	1.50 (0.98–2.32)	11.6 (2.42)§	26.0 (3.01)
More than high school	19.4 (2.07)	Referent	4.5 (0.85	14.9 (1.62)	28.6 (2.45)	Referent	6.7 (1.01)	21.9 (2.24)
Poverty income ratio								
≤1	21.2 (1.76)	1.27 (0.94–1.72)	4.2 (0.78)	17.0 (1.56)	25.9 (3.24)	0.81 (0.33–1.99)	7.3 (1.60)	18.5 (3.22)
>1 to <5	20.8 (3.04)	1.24 (0.93–1.65)	5.2 (1.18)	15.6 (2.29)	35.8 (2.65)	1.30 (0.61–2.77)	8.8 (2.05)	27.0 (2.23)
≥5	17.5 (1.64)	Referent	5.7 (1.27)	11.8 (1.80)	30.1 (7.64)	Referent	7.7 (3.41)	22.4 (7.87)
Self-reported hearing status¶								
Excellent or good	20.1 (2.25)	Referent	5.0 (0.77)	15.0 (1.68)	31.0 (3.24)	Referent	6.6 (1.22)	24.4 (2.99)
Little, moderate, or lot of trouble	18.9 (3.94)	0.93 (0.51–1.69)	5.4 (2.26)	13.4 (3.10)	36.8 (2.36)	1.30 (0.93–1.81)	12.1 (2.01)§	24.7 (2.69)

Abbreviations: CI = confidence interval; dB = decibel; OR = odds ratio; SE = standard error.

* An audiometric notch is a deterioration in the hearing threshold (the softest sound a person can hear). An audiometric notch is present when one or more of the thresholds at 3, 4, or 6 kHz exceeds the pure-tone average of the 0.5 and1 kHz thresholds by ≥15 dB hearing level (HL), and the 8 kHz threshold is at least 5 dB HL lower (better) than the highest threshold in the 3–6 kHz range. Audiograms were not accepted if the test and retest results were greater of 10 dB. The average 1-kHz frequency was the value used in this study. Participants were excluded if they had partial audio exam, ear compliance ≤0.2mL or pressure more negative than -150 dekapascals (daPa) (normal air pressure is approximately equal on both sides of the tympanic membrane [zero daPa]).

† Persons with no work exposure to noise included both those who reported off-work exposure to noise (e.g. noise from power tools, lawn mowers, farm machinery, cars, trucks, motorcycles, motor boats or music for 10 or more hours a week) and those who did not report exposure to off-work noise. Persons with work exposure to noise reported exposure to loud or very loud noise at work.

§ Statistical difference at p<0.5 compared with the referent group.

¶ Participants were asked: "Which statement best describes your hearing (without a hearing aid)? Would you say your hearing is excellent, good, that you have a little trouble, moderate trouble, a lot of trouble, or are you deaf?"

During routine exams, primary care providers can examine patients' hearing; ask about patients' hearing and noise exposures and inform them about the benefits of hearing protection; monitor patients with hearing loss symptoms, recommend or provide hearing tests when indicated; and counsel patients with hearing loss (*2*,*8*,*15*). Studies indicate, however, that 40%–77% of primary care providers have not asked about or screened for hearing loss (*16*,*17*). Patients reporting hearing-related symptoms (*15*) or risk factors such as noise exposure need to be referred for objective hearing assessment.¶,** Although there is currently a lack of data to support the benefits of regular hearing screening in adults aged >50 years, the American Speech-Language-Hearing Association†† recommends that adults be screened at least every decade through age 50 years and every 3 years thereafter. *Healthy People 2020*§§ includes objectives to increase the proportion of adults who have had a hearing examination in the past 5 years and to

¶ U.S. Preventive Services Task Force. Report no. 11-05153-EF-1. Hearing loss in older adults: screening. https://www.uspreventiveservicestaskforce.org/Page/Document/RecommendationStatementFinal/hearing-loss-in-older-adults-screening.

** NIOSH. Criteria for a recommended standard — occupational noise exposure: revised criteria. Publication No. 98–126. https://www.cdc.gov/niosh/docs/98-126/pdfs/98-126a.pdf.

†† http://www.asha.org/uploadedFiles/aud/InfoSeriesAudScreen.pdf.

§§ https://www.healthypeople.gov/2020/topics-objectives/topic/physical-activity/objectives?topicId=33.

increase the number referred by their health care provider for hearing evaluation and treatment.

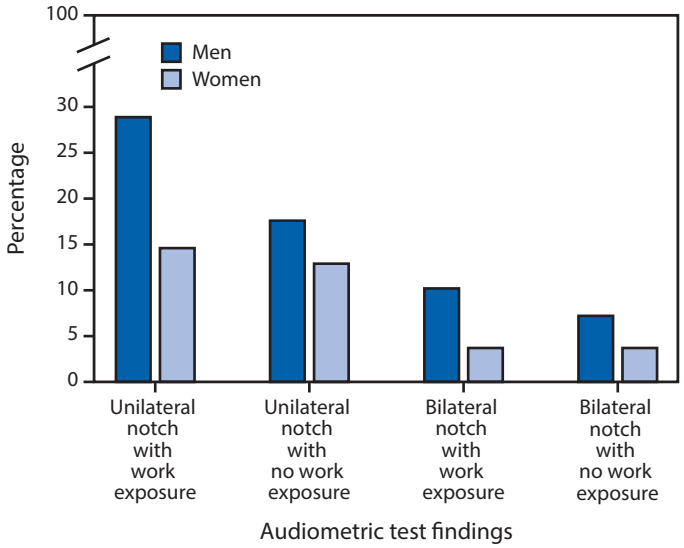
Although there are no federal regulations regarding exposure to nonoccupational noise, a 1974 Environmental Protections Agency report[¶¶] identified 70 dB over 24 hours (75 dB over 8 hours) as the average exposure limit for intermittent environmental noise. World Health Organization (WHO) 1999 Guidelines for Community Noise[***] recommend avoiding noise exposure levels that exceed 70 dB(A)[†††] over a 24-hour period or 85 dB(A) over a 1-hour period. CDC's National Institute for Occupational Safety and Health (NIOSH) has established an 8-hour, time-weighted average 85 dB(A) recommended exposure limit to protect most workers from developing hearing loss from noise exposure over a 40-year career. However, at that sound pressure level [85 dB(A) time-weighted average], approximately 8% of workers could still develop hearing loss, and thus NIOSH recommends that hearing protection be worn whenever noise levels exceed 85 dB(A), regardless of the length of exposure.

The U.S. Department of Health and Human Services (DHHS) and WHO are raising awareness about noise-induced hearing loss. DHHS is collecting data on hearing status and risk factors, as well as developing guidelines on hearing aids. WHO is developing guidelines on noise exposure. Other public entities, such as states and counties, partner with community groups to reduce noisy environments and use evidence to inform policies that decrease noise exposures. Other ways to reduce environmental noise exposure include using sound-absorbent materials in office buildings and public venues, erecting highway barriers, and passing noise ordinances. Managers and owners of public venues can decrease the loudest sound levels at those locations to help decrease noise exposure.

Study Limitations

The findings in this report are subject to at least two limitations. First, this is a report of audiometric notches as a proxy for noise-induced hearing loss, and it is possible that some of the hearing loss observed through this method could be caused by factors other than noise. Second, establishing prevalence rates of hearing damage attributed to risk factors such as noise is confounded by multiple data limitations, such as reliance on self-reported rather than measured noise exposures, complexity of categorizing hearing loss; and co-occurrence of risk factors, including genetic predisposition, and aging.

FIGURE. Percentage of persons with unilateral (in one ear) and bilateral (both ears) audiometric notches* in audiograms among adults aged 20–69 years who reported exposure to loud or very loud noise at work† and those who reported no noise exposure at work, by sex — National Health and Nutrition Examination Survey, United States, 2011–2012



* An audiometric notch is a deterioration in the hearing threshold (the softest sound a person can hear).

† Persons with no noise exposure at work included both persons who reported off-work exposure to noise (e.g., noise from power tools, lawn mowers, farm machinery, automobiles, trucks, motorcycles, motor boats, or music for 10 or more hours a week) and persons who did not report exposure to off-work noise.

Data Needs

This study examines evidence of hearing loss related to noise exposure in a single NHANES 2-year data cycle. It does not provide a longitudinal assessment of persons over time, nor does it compare the results of hearing examinations across different NHANES cycles. A need exists for longitudinal data that measure cumulative effects of noise exposure on hearing over time. These data also show high prevalence of audiometric notches in young adults. Recent studies have shown an increase in the number of young persons exposed to loud noise and music via personal listening devices and at entertainment venues. Future work is needed on early life exposure to noise and its relation to hearing later in life.

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National Center for Health Statistics, National Institutes of Health's National Institute on Deafness and Other Communication Disorders, audiologists from the National Institute for Occupational Safety and Health.

¶¶ https://nepis.epa.gov/Exe/ZyPDF.cgi/2000L3LN.PDF?Dockey=2000L3LN.PDF.

*** http://www.euro.who.int/en/health-topics/environment-and-health/noise/publications.

††† dBA indicates A-weighted decibels, an expression of the relative loudness of sounds in air as perceived by the human ear. In the A-weighted system, the decibel values of sounds at low frequencies are reduced, compared with unweighted decibels, in which no correction is made for audio frequency.

[1]Office of Science, National Center for Environment Health, CDC; [2]Division for Toxicology and Human Health Services, Agency for Toxic Substances and Disease Registry, Atlanta, Georgia; [3]National Institute on Deafness and Other Communication Disorders, National Institutes of Health, Bethesda, Maryland; [4]Office of the Director, National Center for Environment Health, CDC; [5]Division of Emergency and Environmental Health Services, National Center for Environment Health, CDC; [6]National Institute for Occupational Safety and Health, CDC.

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Notes from the Field

Mortality Associated with Hurricane Matthew — United States, October 2016

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After 3 days as a Category 3 and 4 hurricane in Haiti and Bahamas, Hurricane Matthew moved along the coast of the southeastern United States during October 6–8, 2016 (*1*). Early on October 8, the storm made landfall southeast of McClellanville, South Carolina, as a Category 1 hurricane with sustained winds of approximately 75 mph, leading to massive coastal and inland flooding, particularly in North Carolina and South Carolina (*2*). Florida, Georgia, North Carolina, South Carolina, and Virginia made major disaster declarations; approximately 2 million persons were under evacuation orders in Florida, Georgia, North Carolina, and South Carolina (*3*). In response to the hurricane, CDC activated the Emergency Operations Center Incident Management System, tracked online media reports of Hurricane Matthew–associated deaths, and contacted states for confirmation of deaths. This report summarizes state-confirmed Hurricane Matthew–associated deaths that occurred during October 1-October 21 in Florida, Georgia, North Carolina, and South Carolina.

Forty-three hurricane-associated deaths were reported in four states; the median decedent age was 58 years (range = 9–92 years) (Table). Drowning was the most common cause of death, accounting for 23 (54%) deaths. Among all deaths, 26 (60%) occurred in North Carolina; 18 (69%) of these were drowning deaths associated with a motor vehicle. Twelve deaths occurred in Florida, including five that resulted from injuries during prestorm preparation or poststorm cleanup (e.g., a fall from a ladder or roof). A child's death in Florida resulted from carbon monoxide poisoning related to indoor generator use.

Despite public health warnings to avoid flood waters, among all 23 hurricane-related drownings, 18 deaths (78%) occurred in motor vehicles (e.g., vehicle driven into standing water, vehicle swept away by water, or person found in car). As little as 6 inches of water might result in loss of control of a vehicle, and 2 feet of water can carry most cars away (*4*). An evaluation of public health messages to drivers about avoiding flood waters might inform future prevention measures. Evaluation of the public's reception and response to those messages, as well as an assessment of ascertainment of child deaths in disaster settings, might inform future prevention measures. Mortality surveillance after disasters plays a critical role in evaluating the causes, manners, and circumstances of deaths, and data can be used to guide prevention messages during the response and recovery period and to prevent deaths during future public health emergencies (*5*).

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TABLE. Characteristics of reported deaths related to Hurricane Matthew for all deaths including drowning — North Carolina, Florida, Georgia, and Virginia, October 2016

Characteristic	North Carolina (n = 26) No. (%)*	Florida (n = 12) No. (%)	Georgia (n = 3) No. (%)	Virginia (n = 2) No. (%)	Total (n = 43) No. (%)
Sex					
Male	18 (69)	9 (75)	3 (100)	2 (100)	**32 (74)**
Female	8 (31)	3 (25)	0	0	**11 (26)**
Age group (yrs)					
≤17	0	1 (8)	0	0	**1 (2)**
18–64	14 (54)	5 (42)	2 (67)	2 (100)	**23 (54**
≥65	11 (42)	6 (50)	1 (33)	0	**18 (42)**
Unknown	1 (4)	0	0	0	**1 (2)**
Cause of death					
Drowning	22 (85)	0	0	1 (50)	**23 (54)**
Trauma	2 (8)	8 (67)	3 (100)	1 (50)	**14 (33)**
Exacerbation of condition†	1 (4)	1 (8)	0	0	**2 (5)**
Electrocution	0	2 (17)	0	0	**2 (5)**
CO poisoning	0	1 (8)	0	0	**1 (2)**
Fire	1 (4)	0	0	0	**1 (2)**
Directly related mechanism of death§					
Vehicle drowning	18 (69)	0	0	0	**18 (42)**
Non-vehicle drowning	4 (15)	0	0	0	**5 (12)**
Tree-related trauma	1 (4)	2 (17)	2 (67)	0	**5 (12)**
Indirectly related mechanism of death§					
Vehicle crash injury	1 (4)	1 (8)	1 (33)	1 (50)	**4 (9)**
Preparation/repair injury	0	5 (42)	0	0	**5 (12)**
Electrocution	0	2 (17)	0	0	**2 (5)**
Medical exacerbation	1 (4)	1 (8)	0	0	**2 (5)**
CO poisoning	0	1 (8)	0	0	**1 (2)**
Fire	1 (4)	0	0	0	**1 (2)**

Abbreviation: CO = carbon monoxide.

* Percentages might not sum to 100% because of rounding.

† Exacerbation of a person's preexisting medical condition because of storm-related power failure.

§ A direct death is defined as a death caused by environmental forces of the hurricane and direct consequences of these forces, whereas an indirect death is caused by unsafe or unhealthy conditions as a result of loss/disruption of usual services, personal loss, or lifestyle disruption.

Announcement

Federally Assisted Housing Standards for Blood Lead Levels Aligned with CDC-Recommended Threshold

On January 13, 2017, the U.S. Department of Housing and Urban Development (HUD) lowered the threshold of lead in young children's blood that triggers interventions to evaluate and control exposure hazards from 20 μg/dL to 5 μg/dL, matching the reference level used by CDC (*1*). The rule includes a process to continue HUD alignment with any future updates to CDC's reference level (*1*).

There is no known safe level of childhood lead exposure (*2*). Lead exposure can affect nearly every body system (*2*). Even low blood lead levels can damage a child's brain and nervous system, slow growth and development, cause hearing and speech problems, and affect intelligence quotient (IQ), academic achievement, and behavior (*3*). Lead poisoning also places a social and economic burden on families, communities, and the nation, estimated at $192–270 billion over the lifetime of the cohort of U.S. children aged ≤6 years (*3*). Lead control programs are highly cost effective: for every dollar spent, $17–$221 is returned in health benefits, increased IQ, higher lifetime earnings and tax revenue, reduced spending on special education, and reduced criminal activity (*3*).

Despite significant reductions in lead poisoning over the last several decades, homes remain the primary sources of childhood lead exposure. Approximately 24 million U.S. homes contain deteriorated lead-based paint and lead-contaminated house dust (*4*); even conservative estimates suggest that >535,000 children aged <5 years have blood lead levels high enough to damage their health (*5*). HUD estimates that 57,000 housing units affected by the rule have lead-based paint hazards and are occupied by children aged <6 years (*6*).

Additional information about childhood lead poisoning prevention is available at https://www.cdc.gov/nceh/lead/.

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Announcement

Release of National Association of State Public Health Veterinarians' 2016 Compendium of Animal Rabies Prevention and Control

The 2016 Compendium of Animal Rabies Prevention and Control was released in the March 1, 2016 issue of the Journal of the American Veterinary Medical Association (*1*). The Compendium's national recommendations for the prevention and control of animal rabies are intended to serve as a basis for an effective rabies control program in the United States. These recommendations facilitate standardization of control procedures across jurisdictions and are reviewed annually and updated as necessary. This announcement of the recommendations facilitates their adoption by increasing awareness among public health agencies and practitioners and makes more readily available a link to statutes and regulations in certain jurisdictions that refer directly to the Compendium language published in *MMWR*.

The 2016 Compendium is an update and supersedes recommendations made in previous versions (*2*). Several modifications were made, including explicit encouragement of interdisciplinary approaches to rabies control, recommendations to collect and report additional data elements on rabid domestic animals to the national level, and updates to the list of marketed animal rabies vaccines.

The 2016 Compendium also includes important changes to the recommended management of dogs and cats exposed to rabies and a reduction of the recommended quarantine period for certain species. These recommendations are based on a combination of research indicating rapid and robust anamnestic response to booster doses of rabies vaccine, observational evidence of rabies incubation periods in exposed dogs and cats, and expert opinion. These particular recommendations are as follows: 1) dogs and cats that have never been vaccinated should either be euthanized immediately or vaccinated within 96 hours of the exposure and placed in strict quarantine for 4 months (a reduction from 6 months in previous recommendations); 2) dogs and cats that are overdue for a booster vaccination (and have appropriate documentation of prior rabies vaccination) should receive a booster vaccination within 96 hours of rabies exposure and be kept under owner observation for 45 days; and 3) dogs and cats that are overdue for booster vaccination (and do not have documentation of prior vaccination) may be treated as unvaccinated or undergo serologic monitoring to document an anamnestic response after receipt of a rabies booster vaccination.

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Erratum

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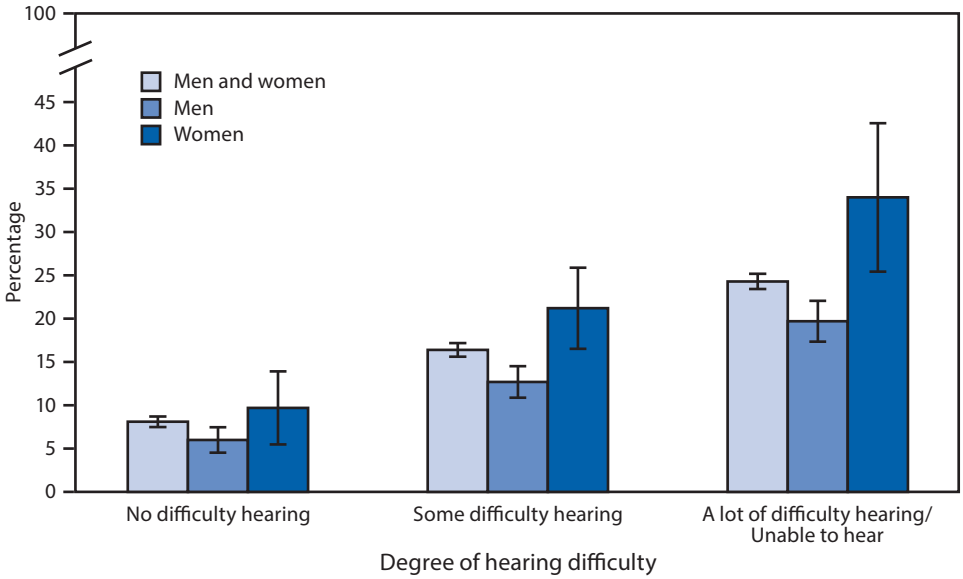
In the cover box "National Black HIV/AIDS Awareness Day — February 7, 2017," on page 97, the second sentence of the second paragraph should have read, "Among blacks living with diagnosed HIV infection in 2013, 54% were **retained in** care (two or more CD4 or viral load tests ≥3 months apart) and 49% had a suppressed viral load (<200 copies/mL at most recent test) (*2*)."

QuickStats

FROM THE NATIONAL CENTER FOR HEALTH STATISTICS

Percentage* of Adults Aged ≥45 Years Who Found It Very Difficult or Were Unable to Go Shopping or Attend Movies or Sporting Events,† by Degree of Hearing Difficulty§ and Sex — National Health Interview Survey,¶ United States, 2014–2015



* With 95% confidence intervals indicated with error bars.

† Based on a question that asked "By yourself, and without using any special equipment (such as a cane or wheelchair), how difficult is it for you to go out to things like shopping, movies, or sporting events?" Response categories consisted of "not at all difficult," "only a little difficult," "somewhat difficult," "very difficult," "can't do at all," or "do not do this activity." For this figure, response categories "very difficult" and "can't do at all" are combined.

§ Based on a question that asked "Do you have difficulty hearing, even when using a hearing aid? Would you say no difficulty, some difficulty, a lot of difficulty, or are you unable to do this?" Response categories "a lot of difficulty" and "unable to do this" are combined for this figure.

¶ Estimates are based on household interviews of a sample of the civilian, noninstitutionalized U.S. population, are shown for a sample of adults aged ≥45 years, and are age-adjusted to the projected 2000 U.S. population as the standard population using three age groups: 45–64, 65–74, and ≥75 years.

During 2014–2015, adults aged ≥45 years were more likely to find it difficult or be unable to go shopping or go to movies or sporting events as hearing difficulties increased (even with the use of a hearing aid), from 8.1% among those with no difficulty hearing to 16.4% among those with some difficulty hearing, and to 24.3% among those with a lot of difficulty hearing or who were unable to hear. This relationship was found for both men and women. Women were more likely than men to report limitations in these activities at each level of hearing difficulty.

Source: National Health Interview Survey, 2014–2015. https://www.cdc.gov/nchs/nhis/index.htm.

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