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Lung Cancer Incidence in Nonmetropolitan and Metropolitan Counties — United States, 2007–2016

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Lung and bronchus (lung) cancer is the leading cause of cancer death in the United States (*1*). In 2016, 148,869 lung cancer deaths were reported.* Most lung cancers can be attributed to modifiable exposures, such as tobacco use, secondhand smoke, radon, and asbestos (*1*). Exposure to lung cancer risk factors vary over time and by characteristics such as sex, age, and nonmetropolitan or metropolitan residence that might affect lung cancer rates (*1*,*2*). A recent report found that lung cancer incidence rates were higher and decreased more slowly in nonmetropolitan counties than in metropolitan counties (*3*). To examine whether lung cancer incidence trends among nonmetropolitan and metropolitan counties differed by age and sex, CDC analyzed data from U.S. Cancer Statistics during 2007–2016, the most recent years for which data are available. During the 10-year study period, lung cancer incidence rates were stable among females aged <35, 45–64, and ≥75 years in nonmetropolitan counties, were stable among females aged <35 years in metropolitan counties, and decreased in all other groups. Overall, among males, lung cancer incidence rates decreased from 99 to 82 per 100,000 in nonmetropolitan areas and from 83 to 63 in metropolitan areas; among females, lung cancer incidence rates decreased from 61 to 58 in nonmetropolitan areas and from 57 to 50 in metropolitan areas. A comprehensive approach to lung cancer prevention and control includes such population-based strategies as screening for tobacco dependence, promoting tobacco cessation, implementing comprehensive smoke-free laws, testing all homes for radon and using proven methods to lower high radon levels, and reducing exposure to lung carcinogens such as asbestos (*1*). Increasing the implementation of these strategies, particularly among persons living in nonmetropolitan counties, might help to reduce disparities in the decline of lung cancer incidence.

Data on new cases of invasive lung cancers† diagnosed during 2007–2016 were obtained from U.S. Cancer Statistics. During this 10-year period, data from all registries met data quality criteria,§ but county-level data were not available for Kansas and Minnesota; therefore, data in this report cover approximately 97% of the U.S. population. The U.S. Department of Agriculture Economic Research Service 2013 vintage rural-urban continuum classification scheme was used to categorize county of residence at diagnosis as nonmetropolitan (rural-urban continuum codes 4–9) or metropolitan (rural-urban continuum codes 1–3).¶

Calculation of annual incidence rates per 100,000 persons used modified annual population estimates in the denominator and was age-adjusted by the direct method to the 2000 U.S.

* https://www.cdc.gov/cancer/uscs.

† http://www.iacr.com.fr/index.php?option=com_content&view=category&layout=blog&id=100&Itemid=577.

§ https://www.cdc.gov/cancer/uscs/technical_notes/criteria/index.htm.

¶ https://www.ers.usda.gov/data-products/rural-urban-continuum-codes.

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standard population.** Rates were examined by sex, age group, and nonmetropolitan or metropolitan county status. Rate ratios were calculated to test whether sex-, age- and year-specific rates in nonmetropolitan counties differed from those in metropolitan counties; rates were considered significantly different ($p<0.05$) if the 95% confidence interval (CI) for the rate ratio excluded one. Annual percentage change (APC) was used to quantify the change in incidence over time and was calculated using least-squares regression. A two-sided t-test was used to determine whether APC was significantly different from zero. Rates were considered to increase if APC >0 ($p<0.05$) and to decrease if APC <0 ($p<0.05$); otherwise rates were considered stable. Absolute change was calculated as the difference in incidence from 2007 to 2016. To allow for informal comparisons, without specifying a referent group, 95% CIs for rates and APCs are presented. Analyses were performed using SEER*Stat software (version 8.3.6; National Cancer Institute).

From 2007 to 2016, lung cancer incidence rates declined in both nonmetropolitan and metropolitan counties among both males and females, but the rate of decline differed by sex and rural-urban status. In 2007, lung cancer incidence rates among males in nonmetropolitan counties (99 per 100,000) were 60% higher than that among females in nonmetropolitan counties (61 per 100,000); in 2016, the rate among males (82 per 100,000) in nonmetropolitan counties was 40% higher than that of females in nonmetropolitan counties (58 per 100,000) (Figure 1).

In metropolitan areas, incidence rates declined more sharply among both males (APC = –2.9%) and females (–1.5%) than it did among males (–2.1%) and females (–0.5%) in nonmetropolitan areas (Figure 1). Lung cancer incidence rates decreased among males in all age groups in both nonmetropolitan and metropolitan counties. Among males, the largest declines were among those aged 45–54 years in metropolitan counties (APC = –5.2%) and those aged 35–44 years in nonmetropolitan counties (APC = –5.0%) (Table). Lung cancer incidence rates also decreased among females in metropolitan counties for most age groups, except those aged <35 years; the largest decline was among females aged 35–44 years in metropolitan counties (APC = –5.0%). Among females in nonmetropolitan counties, incidence rates declined among those aged 35–44 years (APC = –3.6%) and 65–74 years (APC = –1.3%) and were stable in all other age groups (Table).

In 2016, among persons aged ≥55 years, the highest lung cancer incidence rates were observed among men in nonmetropolitan counties (Figure 2). Among persons aged 35–54 years, rates in nonmetropolitan and metropolitan counties did not differ by sex but were higher in nonmetropolitan counties than in metropolitan counties. Rates were higher among women aged 35–64 years in nonmetropolitan counties than among men in metropolitan counties (Figure 2).

** https://seer.cancer.gov/popdata.

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Discussion

Although lung cancer incidence rates declined among males and females living in nonmetropolitan and metropolitan areas during 2007–2016, the smallest decrease occurred among females living in nonmetropolitan counties, who also experienced high incidence in some age groups. During this 10-year period, the highest overall lung cancer incidence rates were observed among males in nonmetropolitan counties. National Health Interview Survey 2017 data indicate that, compared with adults living in metropolitan areas, those living in nonmetropolitan areas reported a higher prevalence of current cigarette smoking (23% versus 13%) and a lower prevalence of quit attempts (50% versus 56%) and successful cessation (5% versus 9%) (*4*).

Lung cancer prevention and control is a comprehensive approach and includes strategies such as screening for tobacco dependence, promoting tobacco cessation, implementing comprehensive smoke-free laws, testing all homes for radon and using proven methods to lower high radon levels, and reducing exposure to lung carcinogens such as asbestos (*1*). The U.S. Preventive Services Task Force recommends that clinicians screen all adults for tobacco use at each office visit and refer or provide behavioral and pharmacotherapy smoking cessation interventions as indicated.†† Lung cancer screening is recommended for adults at high risk for developing lung cancer because of their age and cigarette smoking history. Screening efforts can identify lung cancer in its early stages and provide an important opportunity to promote tobacco smoking cessation.

Summary

What is already known about this topic?

Preventing cigarette smoking and exposure to secondhand smoke, radon, and asbestos might reduce lung cancer risk. Exposure to some risk factors might vary by characteristics such as sex, age, and urban or rural residence, which might affect the occurrence of new lung cancers.

What is added by this report?

During 2007–2016, lung cancer incidence rates decreased more in metropolitan than nonmetropolitan counties, more among males than females, and more among middle-aged adults than older adults.

What are the implications for public health practice?

Accelerating implementation of proven strategies to reduce exposure to lung cancer risk factors, particularly among females living in nonmetropolitan areas, might prevent lung cancer and decrease disparities.

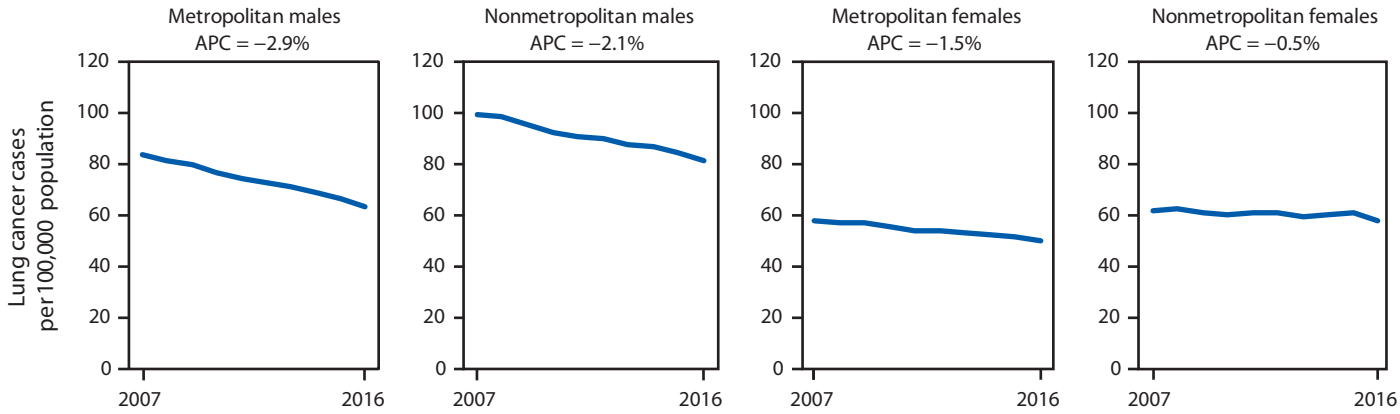
However, access to these preventive services might be more limited in nonmetropolitan areas, where a higher percentage of residents aged <65 years report being uninsured compared with those in metropolitan areas (*4*).

CDC's National Comprehensive Cancer Control Program§§ funds state, tribal, local, and territorial comprehensive cancer control programs that pool resources to lower the number of persons affected by types of cancer with the highest burden in a given community, including lung cancer. These programs advance their priorities through evidence-based interventions

†† https://www.uspreventiveservicestaskforce.org/Page/Name/recommendations.

§§ https://www.cdc.gov/cancer/ncccp/index.htm.

FIGURE 1. Trends* in lung cancer incidence rates† in nonmetropolitan and metropolitan counties,§ by sex — United States,¶ 2007–2016



Abbreviation: APC = annual percentage change.

* Trends were measured with APC in rates; all APCs were significantly different from zero (p<0.05).

† Per 100,000 persons and age-adjusted to the 2000 U.S. standard population.

§ The U.S. Department of Agriculture Economic Research Service 2013 vintage rural-urban continuum codes were used to categorize county residence at time of cancer diagnosis as nonmetropolitan (codes 4–9) or metropolitan (codes 1–3). https://www.ers.usda.gov/data-products/rural-urban-continuum-codes.

¶ Cancer incidence data were compiled from 49 cancer registries that meet the data quality criteria for all invasive cancer sites combined, representing approximately 97% of the U.S. population. (County-level data were not available for Kansas and Minnesota.)

TABLE. Number and rate* of lung cancer cases, absolute rate change, and annual percentage change (APC) in rates in nonmetropolitan and metropolitan counties† by sex and age at diagnosis — United States, § 2007–2016

	2007			2016			Change in rate 2007–2016	
Sex, county status, age group (yrs)	No.	Rate (95% CI)	RR	No.	Rate (95% CI)	RR	Absolute rate change	APC
Males								
Metropolitan total	**91,100**	**83.1 (82.6 to 83.7)**	**1.00**	**89,260**	**63 (62.6 to 63.4)**	**1.00**	**−20.2**	**−2.9 (−3.2 to −2.7)¶**
<35	215	0.4 (0.3 to 0.4)	1.00	226	0.3 (0.3 to 0.4)	1.00	0.0	−1.6 (−3.2 to −0.1)¶
35–44	1,261	7.0 (6.7 to 7.4)	1.00	749	4.4 (4.1 to 4.8)	1.00	−2.6	−4.8 (−6.1 to −3.5)¶
45–54	8,310	46.5 (45.5 to 47.5)	1.00	5,239	28.4 (27.6 to 29.2)	1.00	−18.1	−5.2 (−5.8 to −4.5)¶
55–64	20,371	159.1 (156.9 to 161.3)	1.00	20,914	126.4 (124.7 to 128.2)	1.00	−32.6	−2.4 (−2.9 to −2.0)¶
65–74	28,977	410.8 (406.0 to 415.6)	1.00	31,887	304.7 (301.4 to 308.1)	1.00	−106.1	−3.2 (−3.4 to −3.0)¶
≥75	31,966	572.4 (566.1 to 578.7)	1.00	30,245	449.1 (444.0 to 454.2)	1.00	−123.3	−2.5 (−2.8 to −2.2)¶
Nonmetropolitan total	**24,166**	**99.0 (97.7 to 100.3)**	**1.19****	**23,712**	**81.5 (80.5 to 82.6)**	**1.29****	**−17.4**	**−2.1 (−2.3 to −1.9)¶**
<35	46	0.5 (0.4 to 0.7)	1.37	26	0.3 (0.2 to 0.4)	0.80	−0.2	−3.9 (−6.8 to −0.9)¶
35–44	283	9.6 (8.5 to 10.8)	1.36**	163	6.5 (5.5 to 7.5)	1.46**	−3.1	−5.0 (−6.4 to −3.6)¶
45–54	2,058	61.5 (58.9 to 64.3)	1.32**	1,428	47.3 (44.9 to 49.9)	1.67**	−14.2	−2.8 (−3.6 to −1.9)¶
55–64	5,562	205.4 (200.1 to 210.9)	1.29**	5,657	182.1 (177.4 to 186.9)	1.44**	−23.3	−1.1 (−1.6 to −0.7)¶
65–74	8,395	496.3 (485.7 to 507.1)	1.21**	8,810	396.7 (388.4 to 405.2)	1.30**	−99.6	−2.5 (−2.7 to −2.2)¶
≥75	7,822	632.6 (618.6 to 646.8)	1.11**	7,628	528.5 (516.7 to 540.5)	1.18**	−104.1	−1.9 (−2.1 to −1.7)¶
Females								
Metropolitan total	**80,316**	**57.3 (56.9 to 57.7)**	**1.00**	**86,220**	**49.7 (49.3 to 50)**	**1.00**	**−7.6**	**−1.5 (−1.7 to −1.3)¶**
<35	216	0.4 (0.3 to 0.4)	1.00	226	0.3 (0.3 to 0.4)	1.00	0.0	−1.2 (−2.9 to 0.5)
35–44	1,343	7.4 (7.0 to 7.8)	1.00	832	4.8 (4.5 to 5.2)	1.00	−2.5	−5.0 (−5.9 to −4.2)¶
45–54	7,495	40.2 (39.3 to 41.1)	1.00	5,756	30.2 (29.4 to 31.0)	1.00	−10.0	−3.0 (−3.8 to −2.1)¶
55–64	16,489	118.2 (116.4 to 120.0)	1.00	19,150	106.9 (105.4 to 108.4)	1.00	−11.3	−0.9 (−1.7 to −0.1)¶
65–74	24,723	294.7 (291.1 to 298.4)	1.00	29,402	242.4 (239.7 to 245.3)	1.00	−52.3	−2.1 (−2.3 to −1.8)¶
≥75	30,050	343.4 (339.5 to 347.3)	1.00	30,854	320.2 (316.6 to 323.8)	1.00	−23.2	−0.8 (−1.2 to −0.5)¶
Nonmetropolitan total	**17,694**	**61.2 (60.3 to 62.2)**	**1.07****	**18,920**	**57.9 (57.1 to 58.8)**	**1.17****	**−3.3**	**−0.5 (−0.8 to −0.2)¶**
<35	33	0.4 (0.3 to 0.5)	1.05	36	0.4 (0.3 to 0.6)	1.18	0.0	−0.6 (−5.2 to 4.2)
35–44	317	11.0 (9.9 to 12.3)	1.50**	187	7.8 (6.7 to 9.0)	1.61**	−3.3	−3.6 (−5.1 to −2.2)¶
45–54	1,712	51.9 (49.5 to 54.4)	1.29**	1,490	50.1 (47.6 to 52.7)	1.66**	−1.8	−0.6 (−1.6 to 0.5)
55–64	3,788	136.5 (132.2 to 141.0)	1.16**	4,584	142.8 (138.7 to 147.1)	1.34**	6.3	0.7 (−0.2 to 1.6)
65–74	5,962	320.3 (312.2 to 328.5)	1.09**	6,673	280.5 (273.8 to 287.4)	1.16**	−39.8	−1.3 (−1.7 to −0.9)¶
≥75	5,882	318.0 (309.9 to 326.3)	0.93**	5,950	309.9 (302.0 to 317.9)	0.97**	−8.2	0.0 (−0.5 to 0.4)

Abbreviations: CI = confidence interval; RR = rate ratio.

* Per 100,000 persons; overall rates were age-adjusted to the 2000 U.S. standard population.

† The U.S. Department of Agriculture Economic Research Service 2013 vintage rural-urban continuum codes were used to categorize county residence at time of cancer diagnosis as nonmetropolitan (codes 4–9) or metropolitan (codes 1–3). https://www.ers.usda.gov/data-products/rural-urban-continuum-codes.

§ Cancer incidence data were compiled from 49 cancer registries that meet the data quality criteria for all invasive cancer sites combined, representing approximately 97% of the U.S. population. (County-level data were not available for Kansas and Minnesota.)

¶ APC was significantly different from zero at p<0.05. Trends were measured with APC in rates and were considered to increase or decrease if p<0.05; otherwise rates were considered stable.

** Sex-, age-, and year-specific rates in nonmetropolitan counties were significantly different from rates in metropolitan counties.

that include primary prevention and early detection. Examples of lung cancer prevention strategies are promoting tobacco-free living for all persons (*5*) and reducing exposure to indoor radon (*6*). An important step in implementing interventions for the early detection of lung cancer is assessing a community's capacity to meet screening needs. For example, Maine's Comprehensive Cancer Control Program identified lung cancer screening facilities in nonmetropolitan and metropolitan areas and is working to address screening barriers (*7*). Another approach is using patient navigators and community health workers to address health care barriers (e.g., financial hardships, lack of or inadequate health insurance coverage, and lack of transportation) (*8*). CDC, along with the Appalachian Regional Commission, has funded research to more fully understand how patient navigation can help cancer survivors in nonmetropolitan areas have better access to cancer care,¶¶ which can then inform the development of culturally relevant training for patient navigators.

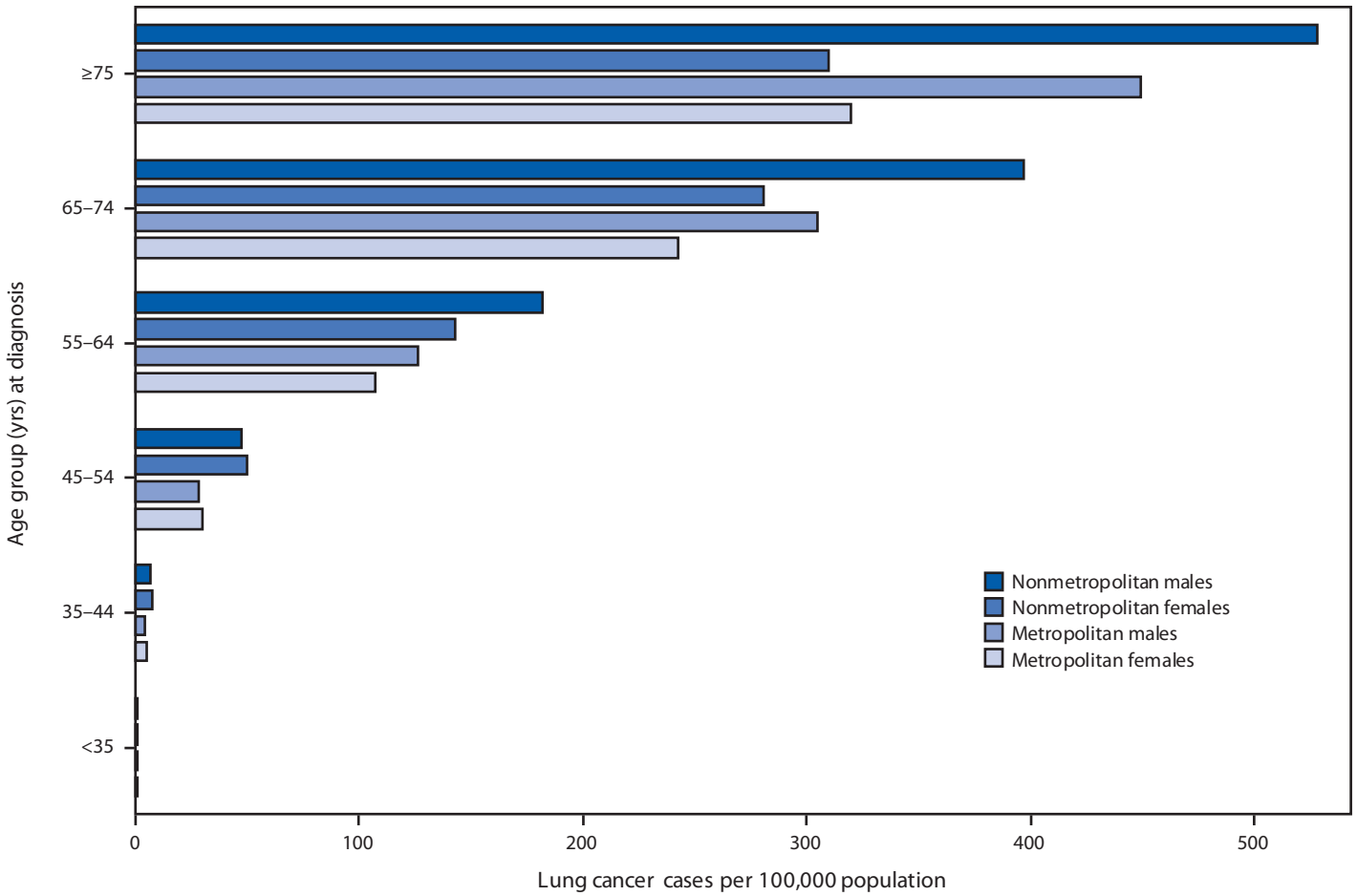
Although cigarette smoking is the primary cause of lung cancer, other risk factors, which may differ by geographic region, include use of other smoking tobacco products and exposure to secondhand smoke, indoor radon, and asbestos (*1*). In some states, rural areas may be less likely to have strong smoke-free laws or barrier-free access to tobacco cessation programs.***

Approximately 10%–15% of lung cancers are estimated to occur among persons who have never smoked cigarettes (*9*). Regardless of smoking status, lung cancer survivors might

¶¶ https://www.cecentral.com/node/1466.

*** https://www.cdc.gov/tobacco/disparities/geographic/index.htm.

FIGURE 2. Rate* of lung cancer in nonmetropolitan and metropolitan counties,† by sex and age at diagnosis — United States,§ 2016



* Per 100,000 persons and age-adjusted to the 2000 U.S. standard population.
† The U.S. Department of Agriculture Economic Research Service 2013 vintage rural-urban continuum codes were used to categorize county residence at time of cancer diagnosis as nonmetropolitan (codes 4–9) or metropolitan (codes 1–3) (https://www.ers.usda.gov/data-products/rural-urban-continuum-codes).
§ Cancer incidence data were compiled from 49 cancer registries that meet the data quality criteria for all invasive cancer sites combined, representing approximately 97% of the U.S. population. (County-level data were not available for Kansas and Minnesota.)

experience blame, stigma, and other negative reactions associated with their lung cancer diagnosis (*10*). A qualitative analysis found that lung cancer survivors believed the stigma translated into a lack of public empathy, and they desired increased public support (*10*). Public health programs such as CDC's National Comprehensive Cancer Control Program are focused on cancer survivorship and can work to reduce stigma by educating the public and implementing programs to address the needs of lung cancer survivors.

The findings in this report are subject to at least two limitations. First, delays in cancer reporting might result in an underestimation of incidence. Second, incidence was not determinable by county classification for all states; therefore, these results might not apply to states excluded from the analyses.

During 2007–2016, lung cancer incidence rates declined overall in nonmetropolitan and metropolitan counties; however, rates decreased more in metropolitan than in nonmetropolitan counties, more among males than among females, and more among persons aged 35–54 years than among those aged ≥55 years. As a result, differences in lung cancer incidence rates between males and females narrowed with decreasing age, but disparities by rural-urban status persisted. A comprehensive approach to lung cancer prevention and control includes such population-based strategies as screening for tobacco dependence, promoting tobacco cessation, implementing comprehensive smoke-free laws, testing all homes for radon and using proven methods to lower high radon levels, and reducing exposure to lung carcinogens such as asbestos (*1*). Increasing the implementation of proven population-based lung cancer prevention and control strategies, particularly among persons living in nonmetropolitan areas, might help to reduce disparities in the decline of lung cancer incidence.

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Vital Signs: Estimated Proportion of Adult Health Problems Attributable to Adverse Childhood Experiences and Implications for Prevention — 25 States, 2015–2017

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Abstract

Introduction: Adverse childhood experiences, such as violence victimization, substance misuse in the household, or witnessing intimate partner violence, have been linked to leading causes of adult morbidity and mortality. Therefore, reducing adverse childhood experiences is critical to avoiding multiple negative health and socioeconomic outcomes in adulthood.

Methods: Behavioral Risk Factor Surveillance System data were collected from 25 states that included state-added adverse childhood experience items during 2015–2017. Outcomes were self-reported status for coronary heart disease, stroke, asthma, chronic obstructive pulmonary disease, cancer (excluding skin cancer), kidney disease, diabetes, depression, overweight or obesity, current smoking, heavy drinking, less than high school completion, unemployment, and lack of health insurance. Logistic regression modeling adjusting for age group, race/ethnicity, and sex was used to calculate population attributable fractions representing the potential reduction in outcomes associated with preventing adverse childhood experiences.

Results: Nearly one in six adults in the study population (15.6%) reported four or more types of adverse childhood experiences. Adverse childhood experiences were significantly associated with poorer health outcomes, health risk behaviors, and socioeconomic challenges. Potential percentage reductions in the number of observed cases as indicated by population attributable fractions ranged from 1.7% for overweight or obesity to 23.9% for heavy drinking, 27.0% for chronic obstructive pulmonary disease, and 44.1% for depression.

Conclusions and implications for public health practice: Efforts that prevent adverse childhood experiences could also potentially prevent adult chronic conditions, depression, health risk behaviors, and negative socioeconomic outcomes. States can use comprehensive public health approaches derived from the best available evidence to prevent childhood adversity before it begins. By creating the conditions for healthy communities and focusing on primary prevention, it is possible to reduce risk for adverse childhood experiences while also mitigating consequences for those already affected by these experiences.

Introduction

Healthy child development contributes to overall population health and prosperity. Decades of research have shown that exposure to violence in childhood (e.g., physical, sexual, or psychological) and witnessing potentially traumatic experiences in the home (e.g., intimate partner violence, mental illness, or substance misuse), collectively referred to as adverse childhood experiences, can have profound and lasting negative effects on health and social outcomes (*1*–*8*). Given the connection between adverse childhood experiences and health, preventing these experiences is strategic for reducing several of the leading causes of adult morbidity and mortality.

Adverse childhood experiences are common and have important implications for health and well-being (*6*,*9*). Whereas everyone is at risk for adverse childhood experiences, numerous studies have documented inequities in such experiences attributed to the historical, social, and economic environments in which some families live (*9*–*11*).

Exposure to adverse childhood experiences can be traumatic, evoking toxic stress responses that have immediate and

Summary

What is already known about this topic?

Adverse childhood experiences are common and are associated with many poor health and life outcomes in adulthood.

What is added by this report?

Nearly 16% of adults in the study population reported four or more types of adverse childhood experiences, which were significantly associated with poorer health outcomes, health risk behaviors, and socioeconomic challenges. Population attributable fractions representing potential percentage reductions in outcomes ranged from 1.7% for overweight or obesity to 44.1% for depression.

What are the implications for public health practice?

Using the best available evidence to create safe, stable, nurturing relationships and environments can prevent adverse childhood experiences and could potentially prevent adult chronic conditions, depression, health risk behaviors, and negative socioeconomic outcomes.

long-term adverse physiologic and psychologic impacts. These adverse childhood experiences can derail optimal health and development by altering gene expression, brain connectivity and function, immune system function, and organ function (*8*). Adverse childhood experiences can also compromise development of healthy coping strategies, which can affect health behaviors, physical and mental health, life opportunities, and premature death (*1–8*,*12*). Adverse childhood experiences have been linked to increased risk for alcohol and substance use disorders, suicide, mental health conditions, heart disease, other chronic illnesses, and health risk behaviors throughout life. Adverse childhood experiences have also been linked to reduced educational attainment, employment, and income, which directly and indirectly affect health and well-being (*1–8*). At least five of the 10 leading causes of death have been associated with exposure to adverse childhood experiences, including several contributors to declines in life expectancy (*6*,*13*).

Adverse childhood experiences are preventable (*14–16*). Randomized controlled and matched-group trials have demonstrated 48%–52% reductions in rates of child abuse and neglect associated with preschool enrichment and early childhood home visitation programs (*14*,*15*). Preventing adverse childhood experiences is critical to addressing multiple public health and social challenges and to improving the lives of children, families, and communities. To understand the potential impact of preventing adverse childhood experiences in reducing negative health and well-being outcomes, state survey data were used to estimate population attributable fractions representing potential percentage reductions in the number of observed cases of health conditions, health risk behaviors, and socioeconomic impacts.

Methods

The Behavioral Risk Factor Surveillance System (BRFSS)* is a state-based telephone survey of noninstitutionalized adults administered annually within each state, the District of Columbia, and U.S. territories. Participants report on a range of health conditions and risk behaviors. During the 2015–2017 data collection years, 27 states included state-added adverse childhood experience questions, in addition to the standardized set of BRFSS questions. These 11 state-added questions assess exposure to eight types of adverse childhood experiences: three types of abuse (physical, emotional, and sexual) and five types of household challenges (household member substance misuse, incarceration, mental illness, parental divorce, or witnessing intimate partner violence) before age 18 years. The adverse childhood experience items administered on the California and New Hampshire BRFSS surveys were inconsistent with those administered by the other states and were excluded, leaving 25 states† in these analyses. Data were collected from 144,017 respondents who answered all adverse childhood experience questions and provided responses for age, race/ethnicity, and sex. Each respondent was classified into one of the following adverse childhood experience exposure categories based on the number of adverse childhood experience types reported: zero, one, two or three, and four or more types of adverse childhood experience exposure. The content and scoring of BRFSS adverse childhood experience items have been previously described (*17*).

Associations between outcomes and adverse childhood experience exposure were assessed. Coronary heart disease, stroke, asthma, chronic obstruction pulmonary disease (COPD), cancer (excluding skin cancer), kidney disease, diabetes, and depression were measured by asking respondents whether they had ever been told by a health care professional that they had the condition. Body mass index (BMI), calculated from self-reported height and weight, was used to determine each participant's overweight or obesity status (overweight defined as BMI of ≥25 kg/m^2; obesity defined as BMI of ≥30 kg/m^2). Current smoking was defined as lifetime smoking of at least 100 cigarettes and currently smoking on at least some days. Heavy drinking was defined as adult men consuming at least 15 alcoholic beverages per week or adult women consuming at least eight alcoholic beverages per week in the past 30 days. Socioeconomic challenges included current lack of health insurance, current unemployment status, and attainment of less than a high school diploma or equivalent education.

* https://www.cdc.gov/brfss.

† In 2015, data were analyzed from Alaska, Kansas, Kentucky, Maryland, Ohio, South Carolina, and Texas; in 2016, from Arizona, Arkansas, Georgia, Louisiana, Michigan, New York, Oklahoma, Pennsylvania, and Utah; and in 2017, from Connecticut, Illinois, Iowa, Nevada, Oregon, South Dakota, Tennessee, Virginia, and Wisconsin.

As a preliminary step, the frequency distributions, including weighted percentages and corresponding 95% confidence intervals (CIs) of adverse childhood experience exposure by sociodemographic characteristics, were estimated. The overall bivariate associations between adverse childhood experience score and each sociodemographic variable were subsequently tested using chi-squared tests of independence. Logistic regression models were used to quantify the associations between adverse childhood experience exposure and each of the health outcomes, health risk behaviors, and socioeconomic challenges. All models were adjusted for race/ethnicity (non-Hispanic white [white], non-Hispanic black [black], non-Hispanic American Indian/Alaska Native [AI/AN], non-Hispanic Asian [Asian], Hispanic, and non-Hispanic other [Other][§]); sex (male or female); and age group (18–24, 25–34, 35–44, 45–54, 55–64, and ≥65 years). Population attributable fractions, adjusted for age, race/ethnicity, and sex, were estimated using the predicted probabilities from the models to ascertain the percentage reduction in the number of observed cases of each outcome that would be expected if adverse childhood experience exposure were incrementally reduced or eliminated in the study population (*18*). R (version 3.6.0; R Core Team) was used for all analyses and accounted for the complex survey design. Response rates for the states analyzed ranged from 30.6% to 59.0%.

Results

Overall, 60.9% of adults in the study population experienced at least one type of adverse childhood experience, and 15.6% experienced four or more types (Table 1). Sex, race/ethnicity, and age group were independently associated with adverse childhood experience exposure. Women, AI/AN, blacks, and the Other racial/ethnic group were more likely to experience four or more types of adverse childhood experiences than were men and whites. Younger adults reported exposure to more adverse childhood experience types than did older adults, particularly those aged ≥65 years.

Logistic regression analysis of the association between adverse childhood experience exposure and the health outcomes examined found that adults with the highest level of adverse childhood experience exposure had higher odds of having chronic health conditions, with adjusted odds ratios (AORs) ranging from 1.2 (95% CI = 1.1–1.3) for overweight or obesity to 2.8 (95% CI = 2.5–3.1) for COPD, compared with those reporting no adverse childhood experience exposure (Table 2). After adjusting for age, sex, and race/ethnicity, odds of depression (AOR = 5.3, 95% CI = 4.9–5.7), being a current smoker (AOR = 3.1, 95% CI = 2.8–3.3) or heavy drinker (AOR = 1.8, 95% CI = 1.6–2.0), and socioeconomic challenges including current unemployment (AOR = 1.7, 95% CI = 1.5–2.0) were also higher among adults with the highest levels of adverse childhood experience exposure, compared with those reporting no adverse childhood experience exposure.

The largest reductions in observed outcomes were estimated to be among the group with the most exposures (four or more types of adverse childhood experiences) across all outcomes (Table 3). The estimated overall percentage reductions in chronic health conditions associated with preventing all adverse childhood experiences ranged from 1.7% for overweight or obesity to 27.0% for COPD. Substantial reductions were also estimated for depression (44.1%), current smoking (32.9%), and heavy drinking (23.9%). The reductions in socioeconomic challenges ranged from 3.8% (lack of health insurance) to 14.9% (unemployment).

Discussion

Approximately three fifths of the adults among the 25-state study population experienced at least one type of adverse childhood experience, and approximately one in six reported experiencing four or more types of adverse childhood experiences. This study found that adverse childhood experiences are associated with leading causes of morbidity and mortality and with poor socioeconomic outcomes in adulthood. Persons reporting more types of adverse childhood experiences were at highest risk. These findings are consistent with those from similar analyses conducted in England, Europe, and North America (*1*,*2*) and suggest that preventing adverse childhood experiences might reduce occurrences of the outcomes examined, with potential reductions ranging from 1.7% (overweight or obesity) to 44.1% (depression). Given these findings, preventing adverse childhood experiences could have broad positive health, social, and economic impacts. For example, preventing adverse childhood experiences could potentially reduce the number of persons with coronary heart disease, the leading cause of death in the United States (*13*), by up to 12.6%, representing a potential reduction of approximately 1.1 million cases of coronary heart disease for the 25 states analyzed. Applied to national estimates in 2017, this translates to up to 1.9 million cases of coronary heart disease, 2.5 million cases of overweight or obesity, 1.5 million incidences of high school noncompletion, and 21 million cases of depression that would have been potentially avoided by preventing adverse childhood experiences (*19*).

Those who experienced four or more types of adverse childhood experiences accounted for a disproportionate share of the preventable fraction of every health and socioeconomic outcome measured. Although the prevalence of any type of adverse

[§] The Other race/ethnicity category consisted of participants self-reporting as non-Hispanic Native Hawaiian or Other Pacific Islander, non-Hispanic multiracial, or non-Hispanic other.

TABLE 1. Sociodemographic characteristics of adults in the study population, by adverse childhood experience score* — Behavioral Risk Factor Surveillance System (BRFSS), 25 states,† 2015–2017

	Adverse childhood experience score							
	0		1		2–3		≥4	
Characteristic	No.	%§ (95% CI)	No.	%§ (95% CI)	No.	%§ (95% CI)	No.	%§ (95% CI)
Sex¶								
Men	26,852	39.3 (38.5–40.0)	14,590	24.7 (24.0–25.3)	12,340	22.2 (21.5–22.8)	6,781	13.9 (13.4–14.5)
Women	36,513	38.8 (38.2–39.5)	18,570	22.3 (21.7–22.9)	16,802	21.7 (21.1–22.3)	11,569	17.1 (16.6–17.7)
Age group (yrs)¶								
18–24	2,178	29.5 (27.7–31.3)	1,763	24.3 (22.6–25.9)	1,768	25.0 (23.4–26.7)	1,456	21.2 (19.6–22.7)
25–34	3,961	30.5 (29.2–31.9)	2,878	22.9 (21.6–24.2)	3,030	24.8 (23.5–26.1)	2,654	21.8 (20.5–23.1)
35–44	5,617	35.0 (33.7–36.4)	3,711	23.1 (21.9–24.3)	3,663	23.1 (22.0–24.3)	2,998	18.7 (17.7–19.8)
45–54	8,797	37.5 (36.3–38.7)	5,332	23.5 (22.5–24.5)	5,206	22.9 (21.9–24.0)	3,685	16.1 (15.2–17.0)
55–64	13,984	41.4 (40.4–42.5)	7,451	23.3 (22.3–24.2)	6,883	21.6 (20.7–22.4)	4,099	13.7 (13.0–14.5)
≥65	28,828	52.1 (51.3–53.0)	12,025	23.7 (23.0–24.5)	8,592	16.9 (16.2–17.5)	3,458	7.3 (6.8–7.7)
Race/Ethnicity¶,**								
White	52,614	40.2 (39.7–40.7)	26,451	23.1 (22.7–23.6)	22,855	21.7 (21.2–22.2)	13,934	15.0 (14.6–15.4)
Black	4,591	32.0 (30.5–33.5)	3,209	26.4 (24.9–27.8)	2,782	24.0 (22.6–25.4)	1,498	17.7 (16.3–19.0)
American Indian/Alaska Native	838	28.8 (24.6–32.9)	588	21.2 (17.2–25.3)	677	21.6 (17.3–25.9)	726	28.3 (24.1–32.6)
Asian	1,038	56.3 (52.5–60.1)	350	19.8 (16.8–22.8)	283	15.3 (12.7–17.9)	116	8.6 (5.9–11.2)
Hispanic	3,434	38.2 (36.3–40.1)	1,953	23.2 (21.6–24.9)	1,891	22.7 (21.1–24.3)	1,349	15.8 (14.5–17.2)
Other	850	25.5 (22.1–28.9)	609	24.2 (20.7–27.7)	654	22.3 (19.4–25.1)	727	28.0 (24.7–31.4)
Total	**63,365**	**39.0 (38.6–39.5)**	**33,160**	**23.4 (23.0–23.9)**	**29,142**	**21.9 (21.5–22.4)**	**18,350**	**15.6 (15.2–16.0)**

Abbreviation: CI = confidence interval.

* Based on the number of adverse childhood experience types reported.

† States with state-added adverse childhood experience questions: Alaska, Kansas, Kentucky, Maryland, Ohio, South Carolina, and Texas (2015); Arizona, Arkansas, Georgia, Louisiana, Michigan, New York, Oklahoma, Pennsylvania, and Utah (2016); Connecticut, Illinois, Iowa, Nevada, Oregon, South Dakota, Tennessee, Virginia, and Wisconsin (2017).

§ Percentages are weighted estimates; analyzed data are from 25 states with state-added adverse childhood experience questions on BRFSS.

¶ p<0.001 from chi-squared test of independence.

** Participants self-reporting as white, black, American Indian/Alaska Native, Asian, and Other (Native Hawaiian or Other Pacific Islander, multiracial, or other) were non-Hispanic; Hispanic participants could be of any race.

childhood experience was similar among men and women, the prevalence of four or more types of adverse childhood experiences was higher among women. The prevalence of adverse childhood experiences was also higher among persons aged 18–24 and 25–34 years, particularly the prevalence of four or more types of adverse childhood experiences, compared with other age groups. The higher risk among the younger groups could be due to differences across cohorts in risk, willingness to disclose, or ability to recall adverse childhood experiences. Increased mortality among those with higher adverse childhood experiences could also contribute to this pattern. Strategies to prevent adverse childhood experiences in the first place and to intervene with those who have been exposed to adverse childhood experiences might help to reduce prevalence of engaging in health risk behaviors in young adulthood and subsequent negative health outcomes. These strategies might also help to break the multigenerational cycle of adverse childhood experiences as these age groups are most likely to start families or raise children. Significant racial/ethnic inequities were also observed: AI/AN, blacks, and the Other racial/ethnic groups had substantially higher prevalences of four or more types of adverse childhood experiences, compared with whites. Communities could focus on reducing stressors these groups might face from living in underresourced neighborhoods and from historical and ongoing trauma caused by systemic racism or multigenerational poverty resulting from limited educational and economic opportunities (*14*).

Depression, heavy drinking, smoking, lower educational attainment, lack of health insurance, and unemployment were significantly associated with adverse childhood experiences. Previous research has also documented the connection between adverse childhood experiences and substance use and suicide (*6*), underscoring the importance of preventing adverse childhood experiences as a strategy for addressing the opioid overdose crisis, reducing the prevalence of suicide, and preventing leading causes of death in the United States. Prevention of adverse childhood experiences is possible with state and community efforts to build resilient families and communities, provide parental support to develop positive parenting and coping skills, and increase access to, and use of, comprehensive health services (*14*,*15*).

The findings of this report are subject to at least six limitations. First, recall and social desirability biases might reduce accuracy of self-reported adverse childhood experiences, thereby underestimating the actual prevalence of adverse childhood experiences. Second, causality cannot be inferred from these cross-sectional data. Third, data were from 25 states and might not be generalizable to other states. Fourth, the data do not assess severity, frequency, or duration of adverse childhood experiences, nor do

TABLE 2. Association between adverse childhood experience score*,† and health conditions, health risk behaviors, and socioeconomic challenges — Behavioral Risk Factor Surveillance System, 25 states,§ 2015–2017

	Adverse childhood experience score		
	1	2–3	≥4
Outcome	Adjusted odds ratio (95% CI)		
Chronic condition			
Coronary heart disease	1.1 (1.0–1.3)	1.2 (1.1–1.4)	1.8 (1.6–2.1)
Stroke	1.1 (1.0–1.3)	1.3 (1.2–1.5)	2.1 (1.7–2.5)
Asthma	1.3 (1.2–1.4)	1.6 (1.4–1.7)	2.2 (2.0–2.4)
Chronic obstructive pulmonary disease	1.3 (1.1–1.4)	1.7 (1.5–1.9)	2.8 (2.5–3.1)
Cancer (excluding skin)	1.1 (1.0–1.1)	1.2 (1.1–1.3)	1.4 (1.2–1.6)
Kidney disease	1.2 (1.0–1.4)	1.3 (1.2–1.6)	1.7 (1.4–2.0)
Diabetes	1.0 (0.9–1.1)	1.1 (1.1–1.2)	1.4 (1.2–1.5)
Overweight or obesity¶	1.0 (0.9–1.1)	1.1 (1.0–1.2)	1.2 (1.1–1.3)
Mental health			
Depression	1.6 (1.5–1.7)	2.6 (2.4–2.8)	5.3 (4.9–5.7)
Health risk behavior			
Current smoker	1.4 (1.3–1.6)	1.9 (1.8–2.1)	3.1 (2.8–3.3)
Heavy drinker	1.3 (1.2–1.5)	1.6 (1.4–1.8)	1.8 (1.6–2.0)
Socioeconomic challenge			
Less than high school education	1.0 (0.9–1.1)	1.1 (1.0–1.2)	1.4 (1.3–1.6)
Unemployment	1.1 (0.9–1.3)	1.3 (1.2–1.5)	1.7 (1.5–2.0)
No health insurance	1.0 (0.9–1.1)	1.1 (1.0–1.2)	1.3 (1.2–1.5)

Abbreviation: CI = confidence interval.
* Based on the number of adverse childhood experience types reported.
† Referent group had zero adverse childhood experiences; all models were adjusted for sex, age group, and race/ethnicity.
§ States with state-added adverse childhood experience questions: Alaska, Kansas, Kentucky, Maryland, Ohio, South Carolina, and Texas (2015), Arizona, Arkansas, Georgia, Louisiana, Michigan, New York, Oklahoma, Pennsylvania, and Utah (2016); Connecticut, Illinois, Iowa, Nevada, Oregon, South Dakota, Tennessee, Virginia, and Wisconsin (2017).
¶ Overweight: body mass index ≥25 kg/m^2; obesity: body mass index ≥30 kg/m^2.

TABLE 3. Population attributable fractions (PAFs) for health conditions, health risk behaviors, and socioeconomic challenges, by adverse childhood experience score*,† — Behavioral Risk Factor Surveillance System, 25 States,§ 2015–2017

	Adverse childhood experience score			
	1	2–3	≥4	
Outcome	PAF %			Overall PAF %
Chronic condition				
Coronary heart disease	2.6	3.4	6.6	**12.6**
Stroke	—*	5.0	9.6	**14.6**
Asthma	4.2	8.1	11.7	**24.0**
Chronic obstructive pulmonary disease	4.1	9.1	13.8	**27.0**
Cancer (excluding skin)	—	2.4	3.5	**5.9**
Kidney disease	3.7	5.5	6.5	**15.7**
Diabetes	—	2.2	3.5	**5.7**
Overweight or obesity¶	—	0.7	1.0	**1.7**
Mental health				
Depression	6.4	14.7	23.0	**44.1**
Health risk behavior				
Current smoker	5.9	11.1	15.9	**32.9**
Heavy drinker	5.6	9.0	9.3	**23.9**
Socioeconomic challenge				
Less than high school education	—	—	4.6	**4.6**
Unemployment	—	5.7	9.2	**14.9**
No health insurance	—	—	3.8	**3.8**

* Adverse childhood experience categories that were not statistically different from the unexposed (zero adverse childhood experiences) group were not included in the PAF calculation and are indicated by a dash. All models were adjusted for sex, age group, and race/ethnicity.
† Based on the number of adverse childhood experience types reported.
§ States with state-added adverse childhood experience questions: Alaska, Kansas, Kentucky, Maryland, Ohio, South Carolina, and Texas (2015), Arizona, Arkansas, Georgia, Louisiana, Michigan, New York, Oklahoma, Pennsylvania, and Utah (2016); Connecticut, Illinois, Iowa, Nevada, Oregon, South Dakota, Tennessee, Virginia, and Wisconsin (2017).
¶ Overweight: body mass index ≥25 kg/m^2; obesity: body mass index ≥30 kg/m^2.

they contrast the effects of specific types of adverse childhood experiences. Fifth, it was not possible to control for factors that could affect both adverse childhood experiences and selected outcomes (e.g., family socioeconomic position during childhood). Finally, the BRFSS adverse childhood experience module is a brief public health surveillance instrument. As such, it identifies a limited set of adverse childhood experiences and not the full range of childhood adversities. Despite these limitations, the findings from this study can help multiple sectors, including clinicians, researchers, policymakers, and the public, appreciate the connections between cumulative exposure to adversity and mental, physical, and socioeconomic outcomes.

Fundamental to adverse childhood experience prevention is the creation of safe, stable, nurturing relationships and environments for all children and families. CDC's comprehensive approach to preventing adverse childhood experiences uses multiple strategies derived from the best available evidence (*14*). These strategies emphasize early prevention and include 1) strengthening economic supports for families (e.g., earned income tax credits, family-friendly work policies); 2) promoting social norms that protect against violence and adversity (e.g., public education campaigns to support parents and positive parenting, bystander approaches to support healthy relationship behaviors); 3) ensuring a strong start for children (e.g., early childhood home visitation, high quality child care, preschool enrichment programs); 4) enhancing skills to help parents and youths handle stress, manage emotions, and tackle everyday challenges (e.g., social emotional learning programs, safe dating and healthy relationship skill programs, parenting skill and family relationship approaches); 5) connecting youths to caring adults and activities (e.g., mentoring and after school programs). The sixth strategy is intervening to lessen immediate and long-term harms through enhanced primary care to identify and address adverse childhood experience exposures with screening, referral, and support; victim-centered services; and advancement of trauma-informed care for children, youths, and adults with a history of adverse childhood experience exposures. This is important for reducing the consequences of adverse childhood experiences and for helping to protect the next generation of children from exposure to violence and other adverse experiences, such as witnessing substance misuse in their household. Multiple studies have documented that substantial reductions in adverse childhood experiences are possible and can have broad and sustained benefits (*14–16*). For example, adverse childhood experience prevention strategies are associated with higher academic achievement and reductions in depression, suicidal behavior, arrest and incarceration rates, and substance use in adolescence and adulthood (*14*).

Adverse childhood experiences can contribute to a large public health burden across multiple outcomes. Effective, comprehensive approaches to preventing adverse childhood experiences are available. States and communities can use data and resources such as CDC's Preventing Adverse Childhood Experiences (ACEs): Leveraging the Best Available Evidence (*14*) to better understand adverse childhood experiences in their locales, prioritize adverse childhood experience prevention, and improve the mental, physical, and social well-being of their populations over the lifespan (*14*).

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Notes from the Field

Unexplained Dermatologic, Respiratory, and Ophthalmic Symptoms Among Health Care Personnel at a Hospital — West Virginia, November 2017–January 2018

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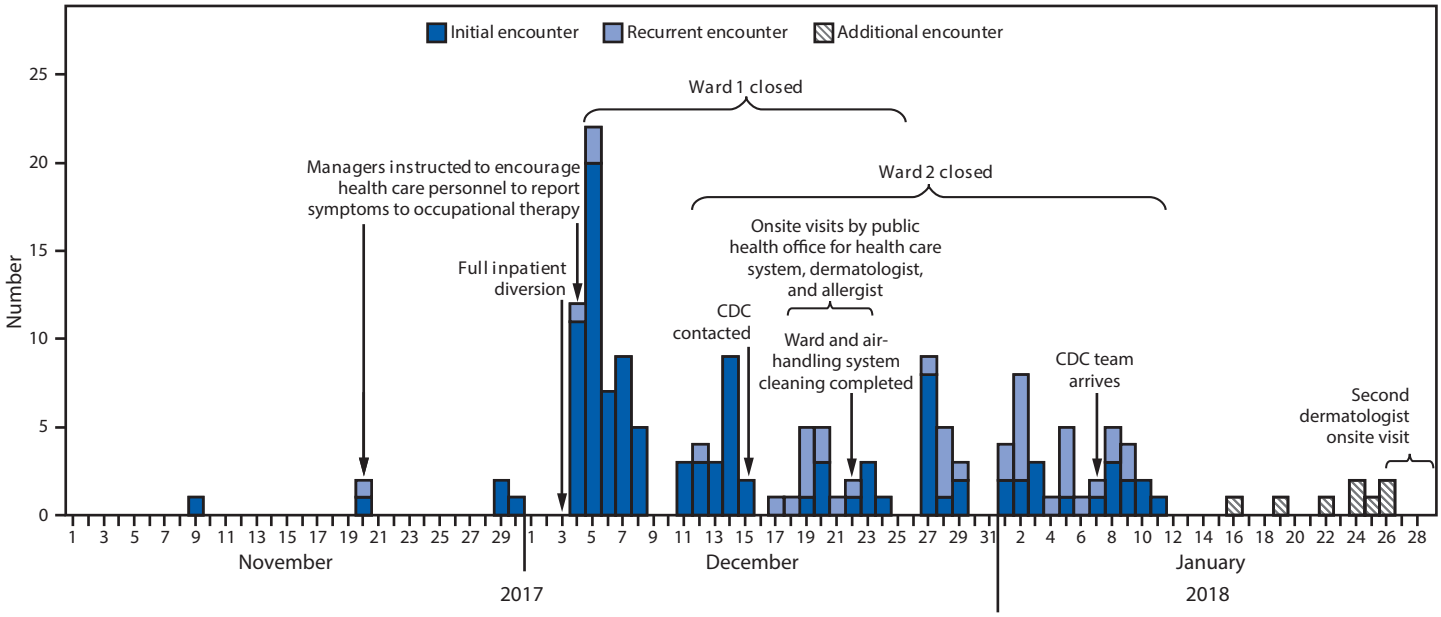
During November 8–December 25, 2017, health care personnel at an 80-bed acute care facility in West Virginia reported dermatologic, respiratory, and ophthalmic symptoms to management or the occupational health clinic, prompting concern about a common exposure, possibly related to construction activities. Symptoms of affected staff members, who performed a range of clinical and nonclinical duties, often improved hours to days after leaving the hospital, suggesting potential exposure to an environmental irritant. Initially, hospital leadership encouraged symptomatic persons to seek evaluation at the occupational health clinic, although systematic evaluations were not implemented. No etiology was identified by environmental sampling for fibers, volatile organic compounds, or mold. In the absence of a clear etiology, hospital leadership stopped inpatient admissions, transferred inpatients from the two wards where most symptomatic staff members worked, and completed cleaning to include associated air-handling systems. Dermatology and allergy consultants evaluated symptomatic staff members, but because of varying clinical manifestations, results were inconclusive. On December 26, one of the closed wards reopened; during the ensuing week, six additional workers reported symptoms, and onsite CDC assistance was requested to identify an etiology. A CDC team arrived on January 8, 2018, and met with hospital and union leadership, reviewed occupational health records, observed occupational health encounters, performed unstructured individual interviews with both affected and unaffected health care personnel, assessed the physical environment, and reviewed environmental testing results. Despite these efforts, investigators were unable to identify an etiology, and the outbreak resolved without intervention.

CDC investigators found that during November 1, 2017–January 12, 2018, a total of 114 workers at the West Virginia hospital had 154 occupational health encounters, including 28 (25%) workers who had multiple encounters (Figure). The most frequently reported symptoms were rash (86%), upper respiratory or ophthalmic symptoms (e.g., nasal congestion and itchy eyes) (43%), and lower respiratory symptoms (e.g., cough and wheezing) (24%). Temperature, documented in 148 (96%) records, never exceeded 100.2°F (37.9°C). Records

FIGURE. Number of occupational health encounters (N = 154) for dermatologic, respiratory, or ophthalmic symptoms among 114 hospital workers — West Virginia, November 1, 2017–January 26, 2018*



* Systematic collection of data was not available during January 13–26, 2018. The "additional encounters" shown were not included in the data analyses.

did not uniformly include symptom severity or duration, exposures, physical findings, or absenteeism. Interviews with a convenience sample of eight persons who had visited the hospital's occupational health clinic with complaints described wide-ranging symptomatology often characterized as mild, and for which they otherwise would not have sought evaluation outside the investigation.

Health care personnel reported that vigorous investigation and response and related effects (e.g., physical barriers and empty wards) heightened their concerns about workplace exposures. Multiple persons reported hearing rumors that occupational health evaluation would be required for subsequent compensation eligibility for potential occupational toxic exposure. Investigators identified no etiology. All units reopened January 16, 2018, and another dermatology consultant visit, including skin biopsy of a symptomatic staff member, occurred during January 26–29, 2018. The biopsy was nonspecific, and no other personnel reported symptoms after January 26, 2018. Despite no identified etiology or recognized interventions, the outbreak resolved.

Arrival of the CDC team 1 month after the peak in health encounters might have limited the ability to identify an etiology. However, inconsistent symptomatology, reports of persons seeking evaluation for subjectively mild symptoms, and rumors that future compensation might require seeking care suggest that response efforts might have inadvertently contributed to reports of illness. Outbreaks of unknown etiology perpetuated by response efforts have been described previously (*1*,*2*).

This investigation demonstrates challenges inherent in investigating outbreaks of unknown etiology and supports the hypothesis that response actions can heighten concern, potentially increasing reporting. Robust investigations might reinforce suspicions of concealed findings even in the absence of true pathology (*3*). Although clear communication and directed interventions are vital, such efforts could unintentionally potentiate events. Finally, this investigation highlights the need for a standardized clinical assessment tool, reflecting input from clinical and public health experts, to facilitate systematic, detailed, data collection.

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Notes from the Field

Botulism Type E After Consumption of Salt-Cured Fish — New Jersey, 2018

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On October 25, 2018, at 2:15 a.m., a woman aged 30 years and her mother, aged 55 years, both of Egyptian descent, arrived at an emergency department in New Jersey in hypotensive shock after 16 hours of abdominal pain, vomiting, and diarrhea. The daughter also reported blurry vision and double vision (diplopia), shortness of breath, chest pain, and difficulty speaking. She appeared lethargic and had ophthalmoplegia and bilateral ptosis. Both women were admitted to the hospital. The mother improved after fluid resuscitation, but the daughter required vasopressor support in the intensive care unit. Although the mother did not have evidence of cranial nerve involvement on admission, during the next 24 hours, she developed dysphagia and autonomic dysfunction with syncope and orthostasis and was transferred to the intensive care unit as her symptoms progressively worsened similar to those of her daughter.

Two days before admission, both women had eaten fesikh, a traditional Egyptian fish dish of uneviscerated gray mullet that is fermented and salt-cured. Fesikh has been linked to foodborne botulism, including a large type E outbreak in Egypt in 1993 (*1*). The Egyptian Ministry of Health has since issued public health warnings regarding fesikh before Sham el-Nessim, the Egyptian holiday commemorating the beginning of spring, during which fesikh is commonly prepared and eaten.* Foodborne botulism outbreaks associated with fesikh and similar uneviscerated salt-cured fish have also occurred in North America (*2*); two outbreaks occurred among persons of Egyptian descent in New Jersey in 1992 (*3*) and 2005 (*4*).

Botulism, a paralytic illness caused by botulinum neurotoxin (BoNT), was suspected because of the reported exposure to fesikh along with symptoms of ophthalmoplegia, bilateral ptosis, dysarthria, and autonomic dysfunction. Per New Jersey Reporting Regulations (NJAC 8:57),† these suspected illnesses were immediately reported to the New Jersey Department of Health. After consultation with CDC, heptavalent botulism antitoxin was released by CDC and administered to both patients within approximately 24 hours of arrival at the hospital. The daughter's symptoms improved, and she was weaned off vasopressors. Both patients survived following intensive care for 2 days and total hospitalization of 7 days each.

CDC tested serum obtained before antitoxin administration. Serum from the daughter tested positive for BoNT type E by the BoNT Endopep-MS assay (*5*); the mother's serum tested negative. A leftover sample of the consumed fesikh also tested positive for BoNT type E and *Clostridium botulinum* type E.

Interviews conducted by the Communicable Disease Service at the New Jersey Department of Health revealed that two fresh mullets purchased by the patients' neighbor at a local Asian market were used to prepare the fesikh. The mother salt-cured and fermented the mullet, leaving the fish uneviscerated and wrapped in plastic in the kitchen for 20 days at ambient temperature. The mother confirmed that she previously used the same method of preparation in Egypt with no deviation in techniques or steps.

These cases illustrate the importance of early recognition and treatment of botulism. Botulism can be fatal, typically from respiratory failure, and treatment delays can result in increased mortality and worsened overall outcomes (*6*). These cases also highlight the role of uneviscerated, salt-cured fish dishes as potential vehicles for foodborne botulism. *C. botulinum* spores are ubiquitous in marine environments, and traditional methods of home preparation for these dishes might support conditions that are favorable for toxin production (i.e. anaerobic conditions) (*2*). Neither of these patients had previously heard of botulism. Risk communication via public awareness campaigns, as has been conducted by the Egyptian Ministry of Health to discourage fesikh consumption, might be indicated in the United States; engagement with Egyptian communities in the United States might provide insights into additional prevention strategies to decrease the risk for foodborne botulism from fesikh and other uneviscerated, salt-cured fish products.

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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.

* https://www.nytimes.com/2013/05/07/world/middleeast/a-taste-of-spring-that-reeks-of-tradition.html.

† https://www.state.nj.us/health/cd/reporting/acode/index.shtml.

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Erratum

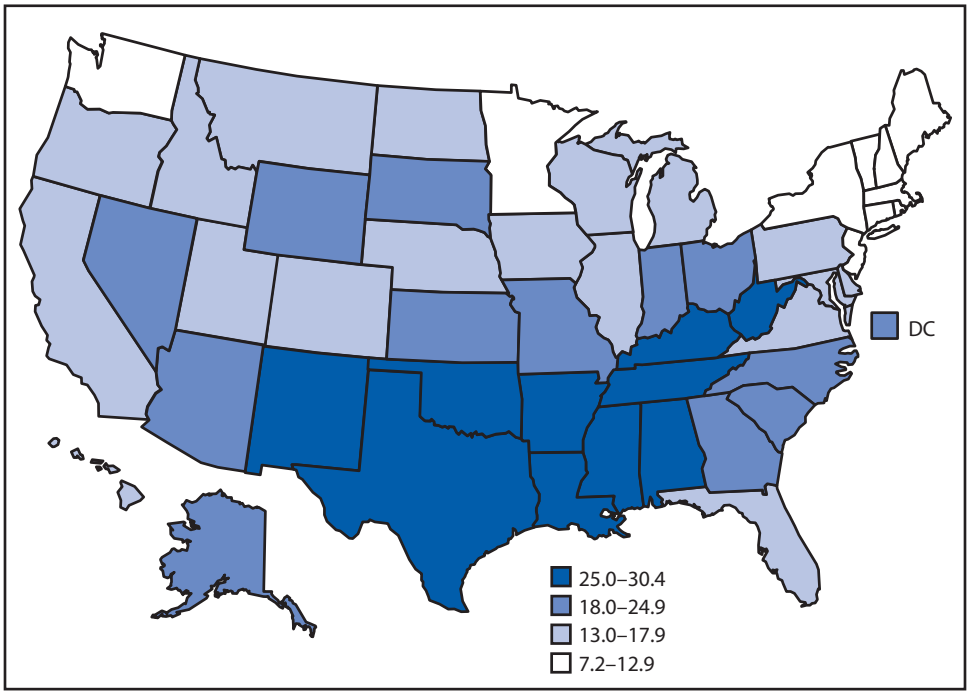
Vol. 68, No. 42

In the report "Global Routine Vaccination Coverage, 2018," on page 937, in the list of authors, the fifth author should have been listed as Samir **V.** Sodha, MD.

QuickStats

FROM THE NATIONAL CENTER FOR HEALTH STATISTICS

Birth Rates* for Teens Aged 15–19 Years, by State — National Vital Statistics System, United States, 2018



Abbreviation: DC = District of Columbia.
* Births per 1,000 females aged 15–19 years. The 2018 U.S. rate was 17.4 births per 1,000 females aged 15–19 years.

In 2018, the U.S. birth rate for teens aged 15–19 years was 17.4 births per 1,000 females, with rates generally lower in the Northeast and higher across the southern states. Teen birth rates ranged from 7.2 in Massachusetts, 8.0 in New Hampshire, 8.3 in Connecticut, and 8.8 in Vermont to rates of 30.4 in Arkansas, 27.8 in Mississippi, 27.5 in Louisiana, 27.3 in Kentucky, and 27.2 in Oklahoma.

Source: National Vital Statistics System. Birth data, 2018. https://www.cdc.gov/nchs/nvss/births.htm.

Reported by: Brady E. Hamilton, PhD, bhamilton@cdc.gov, 301-458-4653.

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