Centers for Disease Control and Prevention
MMWR
Morbidity and Mortality Weekly Report
Weekly / Vol. 71 / No. 30
July 29, 2022

Gun Carrying Among Youths, by Demographic Characteristics, Associated Violence Experiences, and Risk Behaviors — United States, 2017–2019

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Suicide and homicide are the second and third leading causes of death, respectively, among youths aged 14–17 years (*1*); nearly one half (46%) of youth suicides and most (93%) youth homicides result from firearm injuries (*1*). Understanding youth gun carrying and associated outcomes can guide prevention initiatives (*2*). This study used the updated measure of gun carrying in the 2017 and 2019 administrations of CDC's Youth Risk Behavior Survey* (YRBS) to describe the national prevalence of gun carrying for reasons other than hunting or sport among high school students aged <18 years and to examine the associations between gun carrying and experiencing violence, suicidal ideation or attempts, or substance use. Gun carrying during the previous 12 months was reported by one in 15 males and one in 50 females. Gun carrying was significantly more likely among youths with violence-related experiences (adjusted prevalence ratio [aPR] range = 1.5–10.1), suicidal ideation or attempts (aPR range = 1.8–3.5), or substance use (aPR range = 4.2–5.6). These results underscore the importance of comprehensive approaches to preventing youth violence and suicide, including strategies that focus on preventing youth substance use and gun carrying (*3*).

CDC's YRBS uses an independent three-stage cluster sample design to achieve a nationally representative sample of students in grades 9–12 who attend public or private schools in the 50 states and the District of Columbia (*4*). The overall response rates for 2017 and 2019 were 60% (14,765) and 60.3% (13,677), respectively. After the removal of responses missing age (153; 0.5%), those indicating legal age to purchase a firearm (i.e., age ≥18 years) (3,412; 12%), and those missing sex (138; 0.5%) or gun carrying information (2,927; 10.3%), the final analytic sample included 21,812 students. Information on YRBS weighting, sampling, and psychometric properties has previously been reported (*4,5*). YRBS was reviewed and approved by CDC and ICF institutional review boards.†

The YRBS gun carrying question was modified in 2017 to exclude carrying for recreational use and to expand the time frame from 30 days to 12 months to permit inclusion of infrequent carrying. Gun carrying was assessed by the question, "During the past 12 months, on how many days did you carry a gun? (Do not count the days when you carried a gun only for hunting or for a sport, such as target shooting)." The question reflects overall gun carrying and is not specific to a particular context such as a school or neighborhood. Gun carrying on school property is not assessed in the national YRBS. Both years of data (2017 and 2019) with the same new wording were used to maximize the sample size for analyses with relatively rare experiences and risk behaviors. The prevalence of gun carrying was comparable across years. Responses were coded as zero days versus ≥1 days (1 to ≥6 days), and prevalence differences were examined by sex, race and ethnicity, age, and

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

* https://www.cdc.gov/healthyyouth/data/yrbs/results.htm
† 45 C.F.R. part 46; 21 C.F.R. part 56.

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sexual identity (i.e., heterosexual, gay/lesbian/bisexual, or not sure). Chi-square and t-tests were used to assess demographic differences, with p-values <0.05 considered statistically significant. Associations between gun carrying and 17 independent variables reflecting experiences with violence, suicidal ideation or attempts, or substance use (Supplementary Table 1, https://stacks.cdc.gov/view/cdc/119459) were assessed in separate sex-stratified adjusted logistic regression models, which generated aPRs and corresponding 95% CIs for each independent variable. All regression models included age, race and ethnicity, and sexual identity. SUDAAN statistical software (version 11.0.1; RTI International) accounted for the complex sample design and weighting of the survey. Frequency of gun carrying was examined among 766 male and 209 female students who carried a gun on ≥1 day in the 12 months preceding the survey. Similar models were used to test differences between those who carried a gun on ≥6 days compared with those who carried a gun on 1–5 days.

Gun carrying was significantly more prevalent among males (6.8%) than among females (1.9%) (Table 1). Among males, gun carrying was most common among non-Hispanic Black (Black) students (10.6%), followed by Hispanic (7.2%) and non-Hispanic White (White) (6.1%) students. Among females, gun carrying was more common among Hispanic (3.5%) than among Black (2.0%) and White students (1.1%).

Gun carrying was significantly more prevalent among those students who had experienced violence, suicidal ideation or attempts, or substance use than it was among those who had not (Table 2). For example, gun carrying among males and females was more prevalent among those who had been threatened or injured with a weapon on school property (25.9% and 11.2%, respectively) than it was among those who had not (5.2% and 1.3%, respectively). The aPRs for all 10 violence-related experiences, including fighting, bullying, dating violence, missing school because of safety concerns, and sexual violence, were significant (aPR ranges = 1.6–6.3 and 1.5–10.1 among males and females, respectively). Gun carrying was significantly more prevalent among students who reported seriously considering attempting suicide (aPR for males = 1.9; aPR for females = 1.8) or attempting suicide (aPR for males = 3.1; aPR for females = 3.5) than it was among those who had not. Each substance use measure was associated with higher prevalence of gun carrying (aPR ranges = 4.2–5.2 and 4.3–5.6 among males and females, respectively). Students who had been offered or sold drugs on school property were also more likely to carry a gun (aPR for males = 2.8; aPR for females = 4.0).

Most students who carried a gun reported carrying on 1–3 days (males = 46.8%; females = 69.8%) or ≥6 days (males = 42.0%; females = 21.6%) during the past 12 months (Figure). Overall, those who carried a gun on ≥6 days were more likely to report three of the violence-related experiences, suicidal ideation or attempts, and all four substance use measures than

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

Suggested citation: [Author names; first three, then et al., if more than six.] [Report title]. MMWR Morb Mortal Wkly Rep 2022;71:[inclusive page numbers].

TABLE 1. Prevalence of gun carrying among high school students aged <18 years (N = 21,812), by demographic characteristics — National Youth Risk Behavior Survey, United States, 2017 and 2019

Characteristic	Males (n = 10,521) % (95% CI) 0 days	Males (n = 10,521) % (95% CI) ≥1 day	Males Chi-square p-value	Females (n = 11,291) % (95% CI) 0 days	Females (n = 11,291) % (95% CI) ≥1 day	Females Chi-square p-value
Total	**93.2 (92.4–93.9)**	**6.8 (6.1–7.6)**	—	**98.1 (97.6–98.5)**	**1.9 (1.5–2.4)**	—
Race and ethnicity*						
Black†	89.4 (86.7–91.6)	10.6 (8.4–13.3)§	0.001	98.0 (96.8–98.8)	2.0 (1.2–3.2)	0.003
White†	93.9 (92.7–94.9)	6.1 (5.1–7.3)		98.9 (98.4–99.2)	1.1 (0.8–1.6)	
Hispanic	92.8 (91.5–93.9)	7.2 (6.1–8.5)¶		96.5 (94.9–97.6)	3.5 (2.4–5.1)¶,**	
Age group, yrs						
≤15	93.7 (92.7–94.5)	6.3 (5.5–7.3)	0.170	97.6 (96.8–98.3)	2.4 (1.7–3.2)	0.028
16–17	92.8 (91.8–93.8)	7.2 (6.2–8.2)		98.5 (97.9–98.8)	1.5 (1.2–2.1)††	
Sexual identity						
Heterosexual	93.6 (92.7–94.3)	6.4 (5.7–7.3)	0.290	98.4 (97.9–98.8)	1.6 (1.2–2.1)	0.098
Gay, lesbian, or bisexual	94.1 (90.7–96.3)	5.9 (3.7–9.3)		97.6 (96.4–98.4)	2.4 (1.6–3.6)	
Not sure	89.7 (83.8–93.6)	10.3 (6.4–16.2)		95.6 (91.2–97.8)	4.4 (2.2–8.8)	

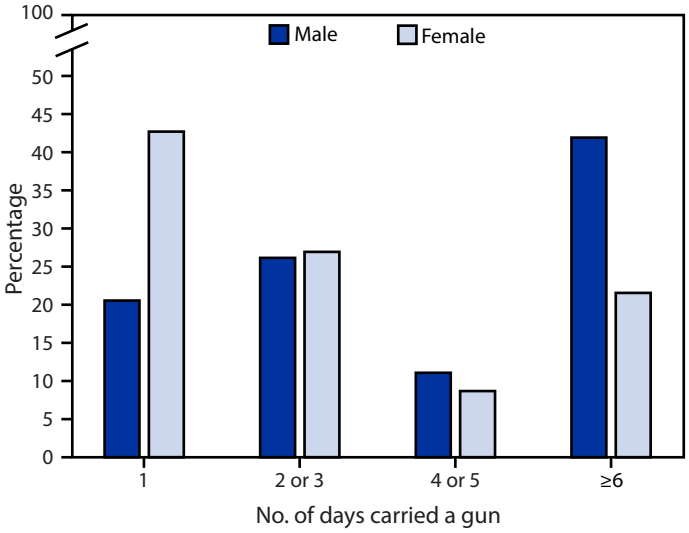
* Other races and ethnicities are not presented because of limited interpretability of these heterogenous groups.
† Non-Hispanic.
§ Significant difference between White and Black students based on t-test analysis (p<0.05).
¶ Significant difference between Black and Hispanic students based on t-test analysis (p<0.05).
** Significant difference between White and Hispanic students based on t-test analysis (p<0.05).
†† Significant difference between students aged ≤15 years and those aged 16–17 years, based on t-test analysis (p<0.05).

TABLE 2. Prevalence of gun carrying, by violence, suicide, and substance use–related behaviors and experiences among high school students aged <18 years, by sex — National Youth Risk Behavior Survey, United States, 2017 and 2019

Risk behaviors and experiences	Males: Carried a gun, % (95% CI) Did not experience the risk behavior	Males: Carried a gun, % (95% CI) Experienced the risk behavior	Males aPR* (95% CI)	Females: Carried a gun, % (95% CI) Did not experience the risk behavior	Females: Carried a gun, % (95% CI) Experienced the risk behavior	Females aPR* (95% CI)
In a physical fight†	2.9 (2.3–3.6)	15.4 (13.3–17.8)	5.6 (4.3–7.2)	0.7 (0.5–1.0)	7.0 (5.4–8.9)	10.1 (6.2–16.3)
In a physical fight on school property†	4.8 (4.1–5.6)	21.0 (18.2–24.0)	4.3 (3.5–5.4)	1.3 (1.0–1.7)	11.7 (8.6–15.7)	8.0 (5.4–11.8)
Threatened or injured with a weapon on school property†	5.2 (4.6–6.0)	25.9 (21.7–30.6)	5.0 (4.0–6.1)	1.3 (1.0–1.8)	11.2 (7.5–16.4)	6.9 (4.3–11.1)
Was electronically bullied†	6.2 (5.4–7.1)	11.3 (9.5–13.4)	2.0 (1.6–2.6)	1.5 (1.1–2.0)	3.3 (2.5–4.4)	2.3 (1.6–3.2)
Was bullied on school property†	6.3 (5.5–7.2)	9.1 (7.8–10.7)	1.6 (1.3–2.0)	1.6 (1.3–2.1)	2.6 (1.9–3.5)	1.5 (1.1–2.1)
Missed school because felt unsafe§	5.8 (5.0–6.7)	20.8 (16.7–25.7)	3.6 (2.7–4.8)	1.4 (1.1–1.8)	7.4 (5.1–10.7)	4.8 (3.0–7.6)
Carried a weapon¶ on school property§	5.3 (4.6–6.2)	34.3 (28.5–40.5)	6.3 (5.0–8.1)	1.5 (1.2–2.0)	21.1 (13.2–32.2)	10.1 (6.0–17.0)
Experienced sexual violence by anyone†	5.7 (4.9–6.6)	24.0 (19.1–29.8)	4.1 (3.2–5.4)	1.1 (0.9–1.5)	5.7 (4.3–7.4)	5.0 (3.6–6.9)
Experienced sexual dating violence†,**	7.3 (6.4–8.5)	33.0 (24.9–42.3)	4.7 (3.5–6.3)	1.8 (1.3–2.4)	5.9 (4.2–8.3)	2.9 (2.0–4.4)
Experienced physical dating violence†,††	7.5 (6.5–8.6)	22.9 (18.2–28.5)	3.3 (2.5–4.3)	1.8 (1.4–2.4)	7.5 (5.3–10.6)	3.0 (2.0–4.5)
Seriously considered attempting suicide†	6.1 (5.3–7.0)	11.7 (9.6–14.1)	1.9 (1.5–2.5)	1.5 (1.1–2.0)	3.3 (2.5–4.3)	1.8 (1.3–2.6)
Attempted suicide†	5.8 (5.0–6.7)	19.4 (14.4–25.6)	3.1 (2.2–4.5)	1.3 (1.0–1.8)	5.7 (4.0–8.0)	3.5 (2.3–5.3)
Current binge drinking§§	4.0 (3.5–4.6)	18.7 (15.6–22.2)	5.2 (4.1–6.7)	1.0 (0.7–1.5)	5.3 (3.9–7.2)	5.6 (3.4–9.0)
Current marijuana use¶¶	4.0 (3.4–4.8)	16.9 (14.7–19.5)	4.2 (3.4–5.2)	1.0 (0.8–1.3)	4.8 (3.4–6.7)	4.8 (3.2–7.1)
Lifetime prescription drug misuse***	4.5 (3.9–5.1)	22.6 (19.4–26.1)	5.2 (4.3–6.3)	1.2 (0.9–1.6)	5.8 (4.6–7.2)	4.3 (3.1–6.1)
Lifetime illicit drug use†††	4.6 (3.9–5.5)	19.9 (17.1–23.0)	4.4 (3.5–5.5)	1.1 (0.8–1.4)	6.5 (4.9–8.6)	5.6 (3.9–8.0)
Offered or sold drugs on school property†	4.6 (4.0–5.3)	13.6 (11.6–15.9)	2.8 (2.3–3.4)	1.0 (0.7–1.5)	5.0 (3.9–6.3)	4.0 (2.7–6.1)

Abbreviation: aPR = adjusted prevalence ratio.
* Models adjusted for age, race and ethnicity, and sexual identity.
† During the 12 months before the survey.
§ On ≥1 day during the 30 days before the survey.
¶ Such as a gun, knife, or club.
** Among students who dated or went out with someone during the 12 months before the survey and answered the sexual dating violence question (6,573 males; 7,094 females).
†† Among students who dated or went out with someone during the 12 months before the survey and answered the physical dating violence question (7,385 males; 8,194 females).
§§ Had four or more drinks of alcohol in a row (if they were female) or five or more drinks of alcohol in a row (if they were male) within a couple of hours on ≥1 day during the 30 days before the survey.
¶¶ One or more times during the 30 days before the survey.
*** One or more times during the respondent's lifetime.
††† Lifetime use of at least one of the following: heroin, cocaine, methamphetamines, synthetic marijuana, ecstasy, hallucinogenic drugs, or inhalants.

FIGURE. Frequency of gun carrying among high school students aged <18 years (males, n = 766; females, n = 209) who carried a gun ≥1 day during the past 12 months, by sex — National Youth Risk Behavior Survey, United States, 2017 and 2019



were those who carried a gun less often (Supplementary Table 2, https://stacks.cdc.gov/view/cdc/119473).

Discussion

The revised YRBS question helps distinguish potentially risky forms of gun carrying from recreational use, and the expanded time frame allows infrequent gun carrying by youths to be included. Whereas one in 15 males and one in 50 females carried a gun at least once in the 12 months before the survey, the prevalence of gun carrying was much higher among some subgroups of youths, particularly those who missed school because of safety concerns and those who had experienced violence. For example, among those who were threatened or injured with a weapon on school property, more than one in four males and one in nine females carried a gun. Youths who carried a gun more frequently were more likely to have engaged in substance use and to have experienced violence. Youths who carry guns often report self-protection as the reason; however, youth gun carrying is associated with risk for serious injury or death (*2,6*). The higher prevalence of gun carrying among those who have experienced suicidal ideation or attempts or other forms of violence highlights the potential for lethal consequences if firearms are used against oneself or others. The association between youth gun carrying and substance use further suggests an increased risk for impaired, impulsive, situational, or escalating actions (*7*).

When variations in gun carrying across racial and ethnic groups and in relation to youth behaviors and experiences are reviewed, consideration of the larger context is important. Social and structural conditions (e.g., concentrated poverty, high crime rates, and economic or residential instability) are associated with youth violence and contribute to inequities in violence among racial and ethnic minority populations (*3*). Further, youths who have experienced violence, discrimination, or racism might feel an increased need for protection, might be unwilling or unable to rely on law enforcement, and might carry a gun for self-protection (*2,6*).

The findings in this report are subject to at least four limitations. First, YRBS data are cross-sectional and cannot be used to determine the temporal order of associations. Second, all examined behaviors, including gun carrying, were self-reported and therefore might be misreported. Third, the category of students unsure of their sexual identity might include students who are not yet certain of their sexual identity and students who did not understand the question (*4*). Finally, YRBS does not collect contextual factors that might elucidate the gun carrying behaviors of youth (e.g., how acquired, where carried, substance use while carrying, and carrying a gun for someone else).

These findings suggest that a substantial proportion of high school students, particularly those who have experienced violence, suicidal ideation or attempts, or who engage in substance use, carry guns outside the context of hunting or sport. Some studies have found that counseling and education with provision of safety devices can promote safer firearm storage behaviors in the home and that child access prevention laws are associated with reductions in risk for firearm suicide, unintentional firearm injuries, and gun carrying among children and youths *(8–10)*. However, additional research is necessary to identify strategies to prevent youth gun carrying and support effective implementation of such strategies, especially among

Summary

What is already known about this topic?

Among youths aged 14–17 years, suicide and homicide are the second and third leading causes of death, respectively. Most youth homicides result from firearm injuries; firearms are the most common method of youth suicide.

What is added by this report?

Using a new measure that excludes recreational gun carrying, one in 15 male and one in 50 female high school students reported carrying a gun for nonrecreational purposes at least once during the preceding 12 months. Gun carrying was more prevalent among those who experienced violence, suicidal ideation or attempts, or substance use.

What are the implications for public health practice?

Comprehensive strategies using the best available evidence including addressing youth substance use and gun carrying can prevent youth violence and suicide.

those youths at highest risk for experiencing violence. Taken together, the results underscore the importance of comprehensive approaches to preventing multiple forms of violence affecting youths and associated behaviors such as substance use and gun carrying. To help states and communities take advantage of the best available evidence to prevent violence, CDC has released a series of technical packages that describe the evidence for programs, policies, and practices to reduce multiple forms of violence, including youth violence, sexual or dating violence, and suicide, through strategies such as connecting youths to caring adults and activities, strengthening economic supports, improving access and delivery of care, creating protective environments, and teaching coping and problem-solving skills (*3*).

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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.

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Progress Toward the Elimination of Mother-to-Child Transmission of Hepatitis B Virus — Worldwide, 2016–2021

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Mother-to-child transmission (MTCT) of hepatitis B virus (HBV) often results in chronic HBV infection, the leading cause of cirrhosis and liver cancer (*1*). If not vaccinated, nine in 10 children infected at birth will become chronically infected. Globally, an estimated 6.4 million (range = 4.4–10.8 million) children aged ≤5 years are living with chronic HBV infection (*2*). In 2016, the World Health Assembly endorsed the goal to eliminate viral hepatitis as a public health threat by 2030, including the elimination of MTCT of HBV (*3*). Elimination of MTCT of HBV can be validated by demonstrating ≤0.1% prevalence of HBV surface antigen (HBsAg) among children aged ≤5 years, as well as ≥90% coverage with hepatitis B birth dose (HepB-BD) and 3 doses of hepatitis B vaccine (HepB3) (*4*,*5*). This report describes global progress toward elimination of MTCT of HBV during 2016–2021. By December 2020, 190 (98%) of 194 World Health Organization (WHO) member states* had introduced universal infant vaccination with hepatitis B vaccine (HepB), and 110 (57%) countries provided HepB-BD to all newborns. During 2016–2020, global HepB3 coverage remained between 82% and 85%, whereas HepB-BD coverage increased from 37% to 43%. In 2020, among the 99 countries reporting both HepB3 and HepB-BD coverage, 41 (41%) achieved ≥90% coverage with both. By December 2021, serosurveys documented ≤0.1% HBsAg prevalence among children in 11 countries. Accelerating HepB-BD introduction, increasing HepB3 coverage, and monitoring programmatic and impact indicators are essential for elimination of MTCT of HBV.

Immunization Activities

Because immunization is a key intervention to prevent MTCT of HBV, WHO recommends that all newborns receive a timely HepB-BD† dose followed by 2–3 additional HepB doses, according to national schedules (*1*). Countries report immunization data to WHO annually through the WHO and UNICEF Joint Reporting Form. WHO and UNICEF review reported coverage data and surveys to generate country-specific coverage estimates.§ This activity was reviewed by CDC and was conducted consistent with applicable federal law and CDC policy.¶

By 2020, 190 (98%) of 194 countries had introduced universal infant hepatitis B vaccination compared with 186 (96%) in 2016. In 2020, 110 (57%) countries provided HepB-BD** to all newborns, a 10% increase from 100 (52%) in 2016. During 2016–2020, 33 to 34 (17%–18%) countries, mostly in the European Region, administered HepB-BD selectively to newborns of HBsAg-positive mothers (i.e., selective or targeted birth dose vaccination) each year.†† The number of countries that had not introduced routine HepB-BD vaccination declined by 15%, from 60 (31%) in 2016 to 51 (26%) in 2020§§ (Table 1). Most of these countries are in the African Region where 34 (72%) of 47 countries do not provide a HepB-BD.

During 2016–2020, global coverage with HepB3 remained between 82% and 85%, whereas timely coverage with HepB-BD increased from 37% to 43%. During this period, regional HepB3 and HepB-BD coverages were highest in the Western Pacific Region and lowest in the African Region (Table 1). During 2016–2019, HepB3 coverage was ≥90% in 61%–63% of reporting countries; this proportion declined to 52% in 2020. HepB-BD coverage was ≥90% in 51%–58% of reporting countries, with the highest proportion (58%) observed in 2016 and lowest (51%) in 2017. During 2016–2019, among countries that reported coverage with HepB3 and HepB-BD, 47%–54% reported ≥90% coverage for both; this proportion declined to 41% in 2020 (Table 1).

Other Interventions to Prevent Mother-to-Child Transmission

To prevent MTCT of HBV, countries with selective HepB-BD vaccination policies rely on antenatal screening combined with antiviral treatment for eligible HBsAg-positive pregnant women and postexposure prophylaxis for HBV-exposed

* https://www.who.int/countries

† Timely HepB-BD is defined as a hepatitis B vaccine dose administered within 24 hours of birth.

§ Most recent available WHO/UNICEF estimates of national immunization coverage were for 2020. https://immunizationdata.who.int/pages/coverage/hepb.html?CODE=Global&GROUP=WHO%20Regions+Countries&ANTIGEN=&YEAR=

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

** Referred to as universal HepB-BD vaccination.

†† Thirty (91%) of 33 countries implementing selective HepB-BD in 2020 were in the European Region, two (6%) were in the Western Pacific Region, and one (3%) was in the Region of the Americas.

§§ In 2020, 34 (67%) of 51 countries that had not yet introduced HepB-BD were in the African Region, nine (18%) in the Region of the Americas, five (10%) in the Eastern Mediterranean Region, and three (6%) in the South-East Asia Region.

TABLE 1. Hepatitis B vaccination policies and coverage with ≥3 doses of hepatitis B vaccine and with hepatitis B vaccine birth dose — worldwide, 2016–2020*

Variable	Countries, No. (%)				
	2016	2017	2018	2019	2020
HepB vaccination policy†,§					
Universal, infant	186 (96)	188 (97)	189 (97)	190 (98)	190 (98)
Universal, children aged ≥1 yr	3 (2)	3 (2)	2 (1)	1 (1)	1 (1)
Selective	5 (3)	3 (2)	3 (2)	3 (2)	3 (2)
HepB-BD vaccination policy†					
Universal	100 (52)	104 (54)	106 (55)	109 (56)	110 (57)
Selective	34 (17)	34 (18)	34 (17)	33 (17)	33 (17)
HepB-BD not introduced	60 (31)	56 (29)	54 (28)	52 (27)	51 (26)
Immunization coverage					
HepB3 coverage reported¶	185 (99)	185 (98)	186 (98)	189 (99)	189 (99)
HepB3 coverage ≥90%**	116 (63)	113 (61)	116 (62)	119 (63)	98 (52)
Timely HepB-BD coverage†† reported§§	80 (80)	90 (87)	92 (87)	96 (88)	99 (90)
Timely HepB-BD coverage ≥90%¶¶	46 (58)	46 (51)	50 (54)	53 (55)	53 (54)
Both HepB3 and HepB-BD coverage reported†	80 (41)	90 (46)	92 (47)	96 (49)	99 (51)
Both HepB3 and HepB-BD coverage ≥90%***	43 (54)	42 (47)	46 (50)	51 (53)	41 (41)
HepB3 coverage, global and regional, %†††					
Global	84	84	84	85	82
Regions†					
African	73	74	74	75	73
Americas	88	84	83	79	81
Eastern Mediterranean	81	83	84	85	81
European	82	84	85	92	91
South-East Asia	89	90	90	91	86
Western Pacific	93	92	90	94	94
Timely HepB-BD coverage, global and regional, %†††					
Global	37	42	42	44	43
Regions†					
African	10	10	12	15	16
Americas	50	54	56	55	60
Eastern Mediterranean	20	33	33	33	33
European§§§	41	41	42	44	43
South-East Asia	34	45	48	53	51
Western Pacific	83	84	83	84	81

Abbreviations: HepB = hepatitis B vaccine; HepB3 = third dose of HepB; HepB-BD = birth dose of HepB; WHO = World Health Organization.

* https://immunizationdata.who.int/pages/coverage/hepb.html?CODE=Global&GROUP=WHO%20Regions+Countries&ANTIGEN=&YEAR=

† Among all 194 WHO member states. https://www.who.int/countries

§ HepB vaccination policy: universal = all persons in the applicable age group (i.e., all infants, children aged 1–12 years, or adolescents aged 13–15 years for routine HepB vaccination, and all newborns for HepB-BD) receive HepB; selective = only infants born to mothers with positive HBsAg test results receive HepB vaccination, starting with HepB-BD.

¶ Among countries with universal infant HepB vaccination policy.

** Among countries that reported HepB3 coverage.

†† Timely HepB-BD is defined as a dose of HepB given within 24 hours of birth.

§§ Among countries with universal HepB-BD policy.

¶¶ Among countries that reported HepB-BD coverage.

*** Among countries that reported both HepB3 and HepB-BD coverage.

††† Global or regional coverage = a weighted sum of WHO/UNICEF estimates of national coverage (WUENIC) by target population from the United Nations Population Division's World Population Prospects.

§§§ For all countries in the European region, including 30 countries with selective HepB-BD policies that do not report HepB-BD coverage to WHO. This results in lower regional estimate than the actual coverage in countries with universal HepB-BD policies that report this information to WHO.

infants¶¶ (*1*). Information on the performance of these interventions is usually not reportable and is collected through special studies.

In 2020, among 33 countries with selective HepB-BD vaccination policies, 32 (97%) implemented nationwide antenatal hepatitis B screening, with ≥90% coverage in 17 (89%) of 19 countries with available information. HepB-BD coverage among infants born to HBV-infected mothers was ≥90% in all nine countries with available information (*6–8*).

¶¶ WHO recommends using the same treatment criteria for pregnant and nonpregnant persons: antiviral treatment against HBV for infected persons with HBV viral load >200,000 IU/mL (or, in the absence of DNA testing, for HBeAg-positive persons). Postexposure prophylaxis for HBV-exposed newborns (i.e., those born to HBsAg-positive women) includes administration of timely HepB-BD and 2 or 3 subsequent HepB doses, and where feasible, administration of hepatitis B immune globulin at birth. In addition, these infants may be offered postvaccination serology testing at age 9–12 months to determine their HBV infection status. https://apps.who.int/iris/bitstream/handle/10665/333391/9789240002708-eng.pdf?sequence=1&isAllowed=y

HBsAg Seroprevalence in Children and Mother-to-Child Transmission Rate

For countries with a universal HepB-BD vaccination policy, the impact target to achieve elimination of MTCT of HBV is ≤0.1% HBsAg prevalence among children aged ≤5 years; for countries with a selective HepB-BD policy, the impact target also includes an MTCT rate ≤2% (Table 2) (*4*,*5*). In 2019, WHO estimated global HBsAg prevalence among children aged ≤5 years to be 0.9%, with prevalence ranging from 0.1% in the Region of the Americas to 2.5% in the African region (Table 3) (*2*). According to a modeling study, HBsAg prevalence among children aged 5 years in 2016 was ≤0.1% in 52 of 119 countries assessed (*9*); by December 2021, 11 countries[***] had demonstrated HBsAg prevalence ≤0.1% in representative serosurveys. Studies in two countries[†††] with selective HepB-BD demonstrated an MTCT rate ≤2% (Table 3).

Validation

The Global Validation Advisory Committee for elimination of MTCT of HIV and syphilis was established in 2015. In 2021, the Committee's role was expanded to include validation

[***] Brunei, Cook Islands, Fiji, Niue, Palau, and Samoa in the Western Pacific Region; Georgia and Spain in the European Region; Colombia in the Region of the Americas; and Bangladesh and Thailand in the South-East Asia Region.
[†††] Japan and the United Kingdom.

TABLE 2. Impact and programmatic targets for validation of elimination of mother-to-child transmission of hepatitis B — World Health Organization, 2021*

Target	Description
Countries with universal HepB-BD vaccination policy†	
Impact target	
≤0.1% HBsAg prevalence in children aged ≤5 yrs	Childhood HBsAg prevalence is a proxy for HBV incidence. Reflects cumulative incidence from perinatal and early horizontal transmission. Preferably measured in representative serosurveys among children aged ≤5 yrs. For regions and countries with a long history of high hepatitis B vaccination coverage, serosurveys conducted in children aged >5 yrs (e.g., school-based surveys), can be acceptable. If implementing a serosurvey is not feasible, a mathematical modeling of the impact indicator based on available representative empirical data may be considered. Triangulation of methods is recommended.
Programmatic targets§	
≥90% HepB3 national infant immunization coverage	National coverage with ≥3 doses of hepatitis B vaccine.
≥90% timely HepB-BD national immunization coverage	National coverage with timely HepB-BD; timely HepB-BD is defined as a dose of HepB given within 24 hrs of birth.
Additional programmatic target	
≥80% HepB3 and HepB-BD coverage in all provinces or subnational areas	To provide supportive evidence for equity consideration; not required for validation. Demonstrates lack of heterogeneity in coverage throughout the country.
Countries with selective HepB-BD vaccination policy¶	
Impact target	
≤0.1% HBsAg prevalence in children aged ≤5 yrs	Same as for countries with universal HepB-BD.
Additional impact target	
≤2% MTCT rate	MTCT rate measures the proportion of HBsAg-positive infants among HBV-exposed infants (i.e., those born to HBsAg-positive mothers). Infant's HBV infection status is determined based on the results of post-vaccination serology testing of exposed infants aged 9–12 mos.
Programmatic targets§	
≥90% HepB3 national infant immunization coverage	Same as for countries with universal HepB-BD.
≥90% timely HepB-BD immunization coverage among HBV-exposed infants**	
≥90% coverage with hepatitis B antenatal screening	Percentage of pregnant women in antenatal care tested for hepatitis B.
≥90% coverage of eligible HBsAg-positive pregnant women with antiviral treatment against HBV	Eligibility is determined in accordance with national policies or WHO guidance on use of antiviral prophylaxis for prevention of MTCT of HBV.

Abbreviations: HBsAg = hepatitis B virus surface antigen; HBV = hepatitis B virus; HepB3 = third dose of hepatitis B vaccine; HepB-BD = birth dose of hepatitis B vaccine; MTCT = mother-to-child transmission; WHO = World Health Organization.
* https://www.who.int/publications/i/item/9789240028395 and https://www.who.int/publications/i/item/9789240039360
† Countries with universal HepB-BD vaccination policy administer HepB-BD to all newborns.
§ All programmatic targets must be achieved and maintained for at least 2 years.
¶ Countries with selective HepB-BD vaccination policy administer HepB-BD to hepatitis B-exposed newborns only.
** HBV-exposed is defined as born to an HBsAg-positive mother.

of elimination of MTCT of HBV. WHO revised the global guidance on the validation of elimination of MTCT to include "triple" elimination of HIV, syphilis, and hepatitis B (*5*). The programmatic and impact indicators for validation of elimination of MTCT of HBV vary according to countries' HepB vaccination programs (Table 2).

Piloting of validation instruments in seven countries[§§§] demonstrated feasibility of their use. Representative serosurvey data to support direct impact measurement were available in five countries.[¶¶¶] In England (the pilot did not include the rest of the United Kingdom), HBsAg prevalence and the MTCT rate were extrapolated from routinely collected antenatal screening data. National HepB immunization coverage data were available in all seven pilot countries; subnational data were available in five.[****]

Discussion

Substantial progress has been made toward elimination of MTCT of HBV in most WHO regions. Globally, 41 countries reported ≥90% coverage with both HepB-BD and HepB3, a critical component of elimination of viral hepatitis as a public health problem by 2030. Successful implementation of HepB vaccination and other interventions to prevent MTCT globally resulted in a substantial decrease in HBV prevalence among children in all regions except for the African region (*2*).

Currently, nearly all countries include HepB in their routine infant immunization schedules; however, during 2016–2020, little change in global coverage for HepB3 and HepB-BD was observed. The introduction of HepB-BD into routine immunization programs in 10 additional countries during 2016–2020 is encouraging. However, the slow increase in the number of countries that include HepB-BD in their routine immunization programs suggests that this process has stalled, especially in the African Region. Further, service disruptions caused by the COVID-19 pandemic contributed to the decline of the immunization coverage with HepB in 2020, particularly for HepB3 (*10*). To meet programmatic targets for elimination of MTCT of HBV, interventions to mitigate the pandemic's impact on immunization systems need to be implemented (*10*).

Accelerating the introduction of HepB-BD into the routine immunization programs of remaining countries is essential for achieving global elimination of MTCT of HBV. The African region, which has a high prevalence of chronic HBV infection (*2*) and where HepB-BD introduction is lagging, requires special attention. Increasing demand among pregnant women and awareness among policymakers and health care workers, improving links between maternal and child health and immunization programs, and ensuring sustainable support would help with successful implementation of HepB-BD vaccination.

Data on impact measures to support validation of elimination of MTCT of HBV are currently available for only a few countries. Countries that have met immunization coverage targets are encouraged to conduct serosurveys to document HBsAg prevalence. Implementing nationwide hepatitis B serosurveys is challenging, given a large sample size and

TABLE 3. Estimated and directly measured hepatitis B virus surface antigen seroprevalence and mother-to-child transmission rate, by World Health Organization region — select countries, worldwide, 2008–2021

Variable	Prevalence (range), %
WHO modeling estimates*	
HBsAg seroprevalence among children aged <5 yrs for 2019	
Globally	0.9 (0.7–1.6)
Regions†	
African	2.5 (1.7–4.0)
Americas	0.1 (<0.1–0.2)
Eastern Mediterranean	0.8 (0.5–1.1)
European	0.3 (0.1–0.5)
South-East Asia	0.4 (0.3–1.0)
Western Pacific	0.3 (0.2–0.5)
Direct measurements§	
HBsAg seroprevalence among children (yrs)	
Bangladesh (2011–2012)¶	0.05 (0.0–0.1)
Brunei (2011)**	0.1 (NR)
Colombia (2019)††	0 (0.0–0.09)
Cook Islands (2012)**	0.0 (NR)
Fiji (2008)**	0.0 (NR)
Georgia (2021)§§	0.03 (0.0–0.19)
Niue (2015)**	0.0 (NR)
Palau (2008)**	0.0 (NR)
Samoa (2014)**	0.09 (NR)
Spain (2015)¶¶	0.0 (NR)
Thailand (2014)***	0.1 (NR)
HBV MTCT rate,††† % (yrs)	
Japan (2014–2016)§§§	2.0
United Kingdom (2014–2019)¶¶¶	<0.5

Abbreviations: HBsAg = Hepatitis B virus surface antigen; HBV = hepatitis B virus; MTCT = mother-to-child transmission; NR = not reported; WHO = World Health Organization.

* https://doi.org/10.1016/s2468-1253(18)30056-6
† https://www.who.int/countries
§ Methodologies for seroprevalence and MTCT rate data sources: disease modeling (WHO estimates), representative population-based serosurveys (Bangladesh, Brunei, Fiji, Georgia, Palau, Samoa, Spain, and Thailand), census surveys (Cook Islands and Niue), two-phase classification survey (Colombia), national survey of antenatal screening sites (Japan), analysis of routinely collected antenatal screening program data (United Kingdom).
¶ https://www.ajtmh.org/view/journals/tpmd/99/3/article-p764.xml
** https://www.who.int/publications/i/item/9789290616986
†† https://doi.org/10.1111/jvh.13719
§§ https://ncdc.ge/#/pages/file/b08a70c2-44a1-4279-9d3b-6145dd98ea51
¶¶ https://doi.org/10.15585/mmwr.mm7030a1
*** https://doi.org/10.1371/journal.pone.0150499
††† HBV MTCT rate is the percentage of infants with chronic HBV infection among infants born to HBsAg-positive mothers.
§§§ https://doi.org/10.1002/ygh2.441
¶¶¶ National data submitted to the European Regional Hepatitis B Working Group, 2022.

§§§ Brazil, Egypt, England, Georgia, Mongolia, Rwanda, and Thailand.
¶¶¶ Egypt, Georgia, Mongolia, Rwanda, and Thailand.
**** Brazil, England, Georgia, Mongolia, and Thailand.

Summary

What is already known about this topic?

Mother-to-child transmission of hepatitis B virus (HBV), a leading cause of liver cancer, is targeted for global elimination.

What is added by this report?

During 2016–2020, global coverage with the third dose of hepatitis B vaccine remained between 82% and 85%, whereas timely coverage with hepatitis B birth dose increased from 37% to 43%. Coverage in 2020 was ≥90% for both the hepatitis B birth dose and the 3-dose series of hepatitis B vaccine in 41% of countries. In 11 countries, prevalence of HBV surface antigen among children was ≤0.1%.

What are the implications for public health practice?

Accelerating hepatitis B birth dose introduction, increasing coverage with the third dose of hepatitis B vaccine, and monitoring programmatic and impact indicators are essential for elimination of mother-to-child transmission of HBV.

considerable resource requirements. Integration with other serosurveys[††††] or use of multiphase methodology surveys[§§§§] could help reduce implementation costs. Although mathematical modeling is not a substitute for serosurveys, triangulation of various data sources could be considered in assessing the elimination of MTCT of HBV.

To better assess progress toward meeting the elimination targets, countries with selective HepB-BD will need to establish data systems to document performance measures of additional interventions to prevent MTCT of HBV[¶¶¶¶] (*4*,*5*). Most HBsAg-positive mothers in countries with historically low HBV prevalence come from countries where prevalence is high (*6*); therefore, ensuring equal access for foreign-born women to antenatal services and MTCT prevention interventions is important.

The findings in this report are subject to at least two limitations. First, missing immunization data from some countries that did not report to WHO prevent accurate assessment of global and regional coverage. Second, in countries with selective HepB-BD vaccination, limited data availability hampers evaluation of their progress toward elimination of MTCT.

Elimination of MTCT of HBV is achievable with the currently available tools; based on modeled estimates, Elimination of MTCT might have already been attained in several countries (*9*). Countries will be able to apply for validation once the standardized tools are finalized. For countries with a high prevalence of HBV that do not yet have the capability to achieve impact targets, milestones known as the Path to Elimination which assess progress toward achieving programmatic targets (*5*) are available to measure progress toward elimination of MTCT. Integration of activities to prevent MTCT of HBV with interventions to prevent MTCT of HIV and syphilis provides the opportunity to synergize across these programs to help achieve triple elimination. Once achieved globally, elimination of MTCT of HBV will result in removing perinatal transmission as a source of chronic HBV infections and will be an important milestone toward achieving elimination of viral hepatitis as a public health threat.

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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.

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[††††] https://ncdc.ge/#/pages/file/b08a70c2-44a1-4279-9d3b-6145dd98ea51
[§§§§] https://onlinelibrary.wiley.com/doi/10.1111/jvh.13719
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Chronic Conditions Among Adults Aged 18–34 Years — United States, 2019

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Chronic conditions are common, costly, and major causes of death and disability.* Addressing chronic conditions and their determinants in young adulthood can help slow disease progression and improve well-being across the life course (*1*); however, recent prevalence estimates examining chronic conditions in young adults overall and by subgroup have not been reported. CDC analyzed data from the Behavioral Risk Factor Surveillance System (BRFSS) to measure prevalence of 11 chronic conditions among adults aged 18–34 years overall and by selected characteristics, and to measure prevalence of health-related risk behaviors by chronic condition status. In 2019, more than one half (53.8%) of adults aged 18–34 years reported having at least one chronic condition, and nearly one quarter (22.3%) reported having more than one chronic condition. The most prevalent conditions were obesity (25.5%), depression (21.3%), and high blood pressure (10.7%). Differences in the prevalence of having a chronic condition were most noticeable between young adults with a disability (75.8%) and without a disability (48.3%) and those who were unemployed (62.3%) and students (45.8%). Adults aged 18–34 years with a chronic condition were more likely than those without one to report binge drinking, smoking, or physical inactivity. Coordinated efforts by public and private sectors might help raise awareness of chronic conditions among young adults and help improve the availability of evidence-based interventions, policies, and programs that are effective in preventing, treating, and managing chronic conditions among young adults (*1*).

BRFSS is an annual state-based, random-digit–dialed telephone survey of noninstitutionalized U.S. adults aged ≥18 years.† In 2019, BRFSS included data from 67,104 respondents aged 18–34 years; New Jersey did not collect sufficient data to meet the minimum requirement for inclusion in the public-use data set. The median response rate for the remaining 49 states and the District of Columbia was 49.4% (range = 37.3% for New York to 73.1% for South Dakota).§ Having a chronic condition was defined as responding "yes" to having ever been told by a doctor or other health professional that the respondent had any of the following: a depressive disorder (depression); arthritis; a heart attack, angina, coronary heart disease, or stroke (heart disease/stroke); chronic obstructive pulmonary disease; skin or other types of cancer (cancer); kidney disease; diabetes; high cholesterol; high blood pressure; or current asthma. The five conditions with the lowest prevalence were combined into a single variable called "other." Obesity (body mass index ≥30.0 kg/m^2) was based on self-reported height and weight. Health-related risk behaviors included self-reported binge drinking, current smoking, and physical inactivity.¶

Prevalence of any condition and of each specific condition was estimated overall and by selected sociodemographic, location, and health-related characteristics, including self-rated health and access to health care. Prevalence of each health-related risk behavior was estimated by chronic condition status. Paired t-tests were conducted to identify subgroup differences among all pairs except those including other race and ethnicity and other employment status. Although all comparisons reported are statistically significant (Bonferroni-corrected p-value <0.05), only sociodemographic and location comparisons where the prevalence ratio is >1.3 will be discussed. Multiple imputation techniques were used to account for missing data.** SAS (version 9.4; SAS Institute) and SUDAAN (version 11.0; RTI International) were used to account for survey weights and the complex sampling design. This activity was reviewed by CDC and was conducted consistent with applicable federal law and CDC policy.††

Overall, 53.8% (39.8 million) of adults aged 18–34 years had at least one of the 11 conditions, and 22.3% had more than one condition (Figure 1). The most frequently reported conditions were obesity (25.5%), depression (21.3%), and high blood pressure (10.7%), and more than one half (ranging from 53.9% among adults with obesity to among 86.0% of adults with diabetes) of those with a specific condition had

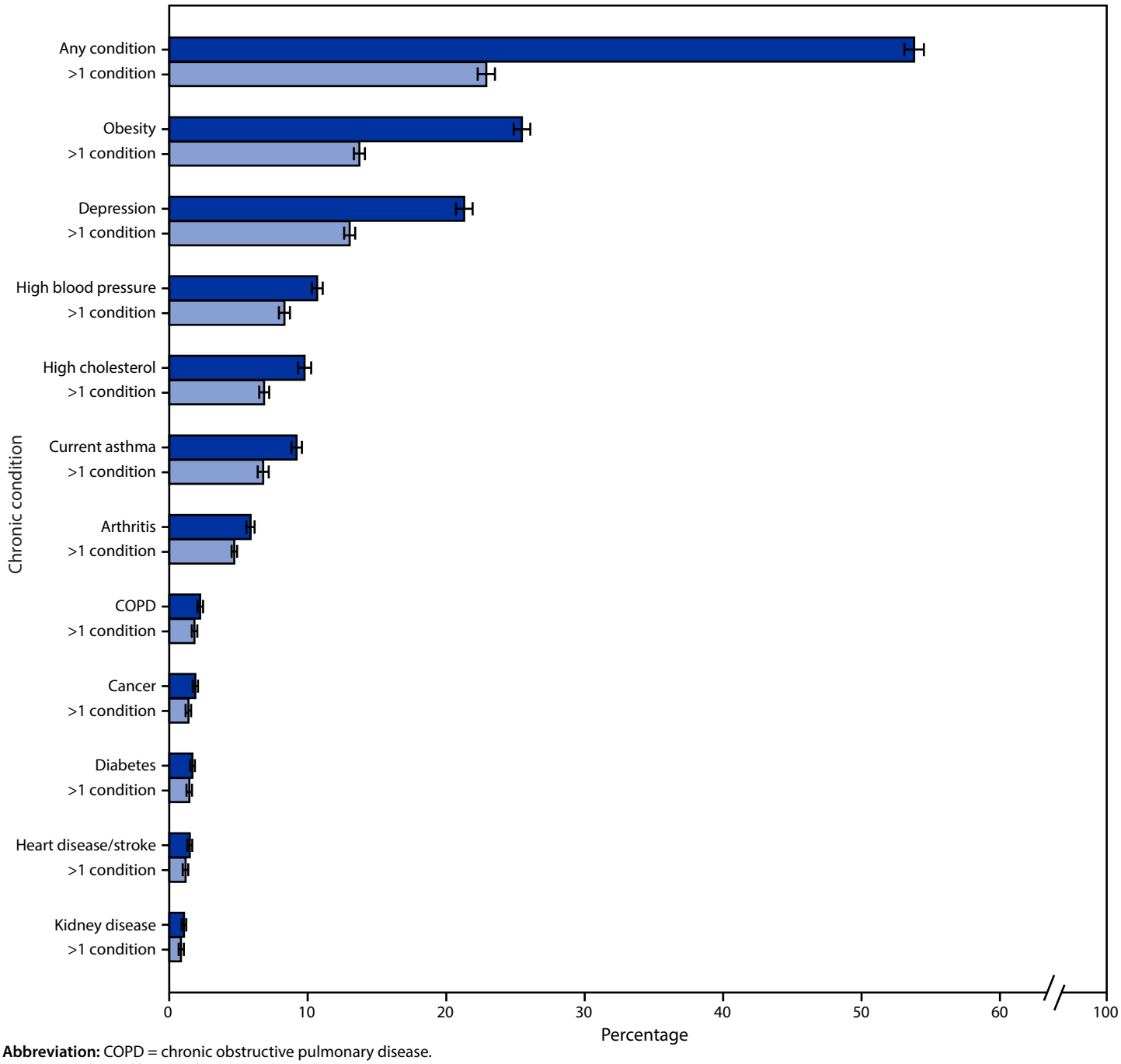
* https://www.cdc.gov/chronicdisease/index.htm
† https://www.cdc.gov/brfss/about/index.htm
§ https://www.cdc.gov/brfss/annual_data/2019/pdf/2019-sdqr-508.pdf

¶ Binge drinking was defined as males having five or more drinks on one occasion and females having four or more drinks on one occasion. Smoking was defined by self-report of smoking >100 cigarettes in one's lifetime and still smoking some days or every day at the time of the survey. Physical inactivity was defined as responding "no" to the question, "During the past month, other than your regular job, did you participate in any physical activities or exercises such as running, calisthenics, golf, gardening, or walking for exercise?"

** Overall, 3% of the data were missing; variables with the most frequent missing data were poverty level (20%), high cholesterol (19%), and obesity (10%). The SAS multiple imputation procedure using the fully conditional specification method generated multiple (five) data sets (https://support.sas.com/resources/papers/proceedings15/2081-2015.pdf). As part of the SUDAAN procedure, the estimates reported were obtained by combining the results from all the imputed data sets.

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

FIGURE 1. Percentage* of chronic conditions† among adults aged 18–34 years — Behavioral Risk Factor Surveillance System, United States, 2019



Abbreviation: COPD = chronic obstructive pulmonary disease.

* 95% CIs indicated by error bars.

† Behavioral Risk Factor Surveillance System respondents were classified as having a chronic condition if they had a body mass index >30.0 kg/m^2 or if they had ever been told by a doctor, nurse, or other health professional they had any of the following conditions: depression, arthritis, heart disease/stroke, COPD, cancer, kidney disease, diabetes, high cholesterol, high blood pressure, or currently have asthma. https://www.cdc.gov/brfss/annual_data/2019/pdf/codebook19_llcp-v2-508.HTML

at least one other condition. For example, although 25.5% of young adults had obesity, 13.7% of young adults had obesity and at least one other condition. Having any chronic condition was significantly associated with all selected characteristics. Differences in the prevalence of having any condition by sociodemographic and location characteristics were most noticeable between young adults with a disability (75.8%) and those without a disability (48.3%) and those who were unemployed (62.3%) and a student (45.8%) (Table).

TABLE. Prevalence of chronic conditions* reported by adults aged 18–34 years, by selected characteristics — Behavioral Risk Factor Surveillance System, United States, 2019

Characteristic	No.	% (95% CI)							
			Chronic condition§						
		Any chronic condition*†	Obesity	Depression	HBP	High cholesterol¶	Asthma	Arthritis	Other
Overall	67,104	53.8 (53.1–54.5)	25.5 (24.9–26.1)	21.3 (20.8–21.8)	10.7 (10.3–11.1)	9.8 (9.3–10.2)	9.2 (8.9–9.6)	5.9 (5.6–6.2)	7.4 (7.1–7.8)
Sociodemographic characteristics									
Sex									
Men	35,131	50.0 (49.0–50.9)	23.2 (22.4–24.0)	15.8 (15.2–16.4)	13.4 (12.8–14.0)	10.0 (9.4–10.6)	7.1 (6.6–7.5)	4.9 (4.5–5.3)	6.5 (6.0–7.0)
Women	31,973	57.7 (56.7–58.7)	27.9 (27.0–28.8)	27.0 (26.2–27.9)	7.8 (7.4–8.3)	9.6 (8.9–10.3)	11.5 (11.0–12.1)	6.9 (6.5–7.4)	8.4 (7.9–9.0)
Age group, yrs									
18–24	24,411	48.7 (47.6–49.8)	19.4 (18.5–20.3)	22.0 (21.2–22.9)	7.9 (7.3–8.4)	7.2 (6.6–7.9)	10.3 (9.7–10.9)	3.5 (3.2–3.9)	5.5 (5.0–6.1)
25–34	42,693	57.3 (56.5–58.2)	29.8 (29.0–30.5)	20.8 (20.2–21.4)	12.7 (12.2–13.2)	11.6 (11.0–12.2)	8.5 (8.1–9.0)	7.5 (7.1–7.9)	8.7 (8.2–9.2)
Race and Ethnicity									
White, NH	42,674	56.4 (55.7–57.2)	23.9 (23.3–24.6)	27.0 (26.3–27.7)	11.5 (11.0–12.0)	9.4 (8.9–9.9)	9.9 (9.4–10.3)	7.4 (7.0–7.8)	7.1 (6.7–7.5)
Black, NH	5,990	56.8 (54.6–58.9)	33.7 (31.5–36.0)	16.0 (14.6–17.6)	12.5 (11.3–13.8)	10.0 (8.7–11.6)	11.6 (10.5–12.8)	4.9 (4.2–5.8)	8.7 (7.6–10.0)
Hispanic	10,853	52.4 (50.7–54.2)	29.2 (27.6–30.7)	14.6 (13.6–15.8)	9.4 (8.5–10.3)	10.5 (9.4–11.6)	7.8 (7.0–8.8)	3.8 (3.2–4.6)	8.2 (7.2–9.3)
Other/Multiple race, NH	7,587	40.6 (38.5–42.7)	15.9 (14.6–17.4)	13.8 (12.6–15.1)	7.7 (6.8–8.7)	10.0 (8.8–11.4)	6.7 (5.8–7.7)	4.1 (3.4–5.0)	6.0 (5.1–7.2)
Poverty level**									
<100% FPL	12,090	57.2 (55.3–59.1)	29.1 (27.6–30.6)	23.7 (22.3–25.2)	11.8 (10.8–12.8)	10.3 (8.9–11.9)	10.9 (9.9–12.0)	6.4 (5.8–7.2)	9.7 (8.8–10.7)
≥100% to <200% FPL	16,144	56.3 (54.7–57.9)	27.5 (26.2–28.8)	23.0 (21.9–24.1)	11.0 (10.3–11.8)	9.7 (8.7–10.7)	9.7 (8.8–10.7)	6.6 (6.0–7.3)	8.6 (7.8–9.4)
≥200% FPL	38,870	51.5 (50.5–52.4)	23.3 (22.5–24.1)	19.7 (19.0–20.4)	10.1 (9.7–10.7)	9.6 (9.1–10.2)	8.4 (8.0–8.9)	5.3 (4.9–5.7)	6.1 (5.6–6.6)
Employment status††									
Employed	46,781	53.7 (52.9–54.5)	26.1 (25.5–26.8)	19.4 (18.8–20.0)	11.0 (10.5–11.4)	9.7 (9.2–10.2)	8.3 (7.9–8.7)	5.6 (5.3–6.0)	7.0 (6.6–7.5)
Unemployed	4,449	62.3 (59.6–64.8)	29.2 (26.8–31.7)	30.9 (28.8–33.1)	13.5 (12.0–15.1)	11.4 (9.6–13.5)	12.5 (10.9–14.3)	7.9 (6.7–9.4)	10.1 (8.5–12.1)
Student	9,406	45.8 (44.1–47.5)	15.9 (14.6–17.3)	21.1 (19.8–22.5)	7.1 (6.3–8.0)	7.8 (6.9–8.8)	10.0 (9.1–11.0)	2.7 (2.2–3.2)	4.5 (3.8–5.2)
Other	5,857	62.6 (60.2–64.9)	35.1 (32.5–37.9)	28.4 (26.5–30.3)	12.8 (11.5–14.1)	12.7 (11.2–14.3)	12.7 (11.3–14.4)	11.9 (10.6–13.3)	13.6 (12.2–15.2)
Education level††									
High school or less	24,690	55.6 (54.5–56.7)	28.5 (27.5–29.5)	20.9 (20.1–21.7)	11.9 (11.3–12.6)	9.4 (8.6–10.2)	9.4 (8.8–10.0)	6.0 (5.5–6.4)	9.0 (8.3–9.7)
Some college or more	42,196	52.4 (51.6–53.2)	23.2 (22.5–23.9)	21.7 (21.1–22.4)	9.8 (9.3–10.2)	10.0 (9.5–10.6)	9.1 (8.7–9.6)	5.8 (5.4–6.2)	6.2 (5.8–6.6)
Disability§§									
Without disability	54,198	48.3 (47.6–49.1)	23.8 (23.2–24.4)	14.5 (14.0–15.0)	9.0 (8.7–9.4)	8.9 (8.4–9.5)	7.6 (7.2–8.0)	3.8 (3.6–4.1)	5.5 (5.1–5.8)
With disability	12,906	75.8 (74.3–77.1)	32.3 (30.9–33.7)	48.9 (47.4–50.4)	17.3 (16.3–18.4)	13.3 (12.3–14.3)	16.0 (15.0–17.0)	14.1 (13.2–15.1)	15.3 (14.3–16.4)
Location characteristics									
Region¶¶									
Northeast	9,534	53.7 (52.2–55.3)	22.5 (21.3–23.8)	21.8 (20.6–23.1)	9.6 (8.7–10.6)	10.4 (9.5–11.5)	11.3 (10.4–12.3)	5.5 (4.8–6.2)	6.7 (5.9–7.5)
Midwest	19,093	55.7 (54.5–56.9)	27.3 (26.3–28.4)	23.8 (22.8–24.7)	10.6 (10.0–11.4)	8.8 (8.1–9.5)	10.2 (9.5–10.9)	6.9 (6.3–7.5)	6.9 (6.3–7.5)
South	20,422	55.6 (54.4–56.8)	28.0 (26.9–29.1)	21.2 (20.3–22.1)	11.5 (10.9–12.2)	10.4 (9.6–11.2)	7.9 (7.4–8.6)	6.3 (5.8–6.9)	8.7 (8.0–9.5)
West	18,055	49.3 (48.0–50.7)	21.8 (20.7–22.9)	19.2 (18.3–20.1)	10.0 (9.3–10.8)	9.3 (8.5–10.1)	9.3 (8.6–10.0)	4.6 (4.1–5.1)	6.3 (5.7–7.0)

See table footnotes on the next page.

TABLE (*Continued*). Prevalence of chronic conditions* reported by adults aged 18–34 years, by selected characteristics — Behavioral Risk Factor Surveillance System, United States, 2019

Characteristic	No.	% (95% CI)							
			Chronic condition§						
		Any chronic condition*†	Obesity	Depression	HBP	High cholesterol¶	Asthma	Arthritis	Other
Urbanicity* **									
Urban	59,720	53.4 (52.7–54.1)	25.1 (24.5–25.7)	21.2 (20.7–21.8)	10.5 (10.1–10.9)	9.8 (9.3–10.3)	9.2 (8.8–9.6)	5.7 (5.4–6.0)	7.4 (7.0–7.8)
Rural	7,384	59.8 (57.6–62.1)	32.9 (30.7–35.2)	22.7 (21.1–24.5)	13.7 (12.3–15.2)	9.7 (8.1–11.5)	10.0 (8.8–11.3)	8.3 (7.3–9.5)	7.9 (6.9–9.1)
Self-rated health status									
Fair or poor general health††									
No	59,899	50.4 (49.7–51.2)	23.3 (22.7–23.9)	18.8 (18.3–19.3)	9.0 (8.7–9.4)	8.8 (8.3–9.3)	8.3 (7.9–8.7)	4.5 (4.2–4.8)	5.6 (5.3–6.0)
Yes	7,205	79.8 (77.9–81.5)	42.0 (40.1–44.0)	41.0 (39.1–42.9)	23.4 (21.9–25.1)	17.5 (16.0–19.2)	16.7 (15.4–18.1)	16.6 (15.3–18.1)	21.3 (19.7–23.1)
Frequent physical distress§§									
No	62,463	52.1 (51.4–52.8)	24.8 (24.2–25.4)	19.6 (19.1–20.1)	9.8 (9.5–10.2)	9.3 (8.8–9.7)	8.7 (8.3–9.0)	4.6 (4.4–4.9)	6.4 (6.1–6.8)
Yes	4,641	76.8 (74.6–78.9)	35.0 (32.6–37.5)	44.2 (41.8–46.7)	22.3 (20.3–24.3)	16.7 (14.7–18.8)	17.0 (15.4–18.8)	22.4 (20.4–24.6)	21.0 (18.9–23.3)
Frequent mental distress¶¶									
No	54,922	48.8 (48.0–49.6)	24.4 (23.7–25.0)	14.1 (13.6–14.6)	9.4 (9.1–9.8)	9.2 (8.7–9.8)	8.0 (7.7–8.4)	4.7 (4.4–5.0)	6.2 (5.9–6.6)
Yes	12,182	76.1 (74.7–77.5)	30.5 (29.1–31.9)	53.7 (52.2–55.3)	16.3 (15.2–17.4)	12.4 (11.3–13.5)	14.8 (13.8–15.8)	11.1 (10.3–12.1)	12.7 (11.6–13.8)
Health care coverage									
Access to health care†									
No	11,479	52.5 (50.9–54.1)	27.4 (26.0–28.9)	18.4 (17.3–19.6)	11.3 (10.3–12.2)	9.5 (8.5–10.6)	6.8 (6.1–7.6)	5.2 (4.7–5.9)	8.4 (7.5–9.4)
Yes	54,859	54.1 (53.4–54.9)	25.1 (24.4–25.7)	21.9 (21.3–22.5)	10.6 (10.2–11.0)	9.9 (9.4–10.4)	9.9 (9.5–10.3)	6.0 (5.7–6.3)	7.2 (6.8–7.6)

Abbreviations: FPL = federal poverty level; HBP = high blood pressure; NH = non-Hispanic.

* Behavioral Risk Factor Surveillance System respondents were classified as having an underlying chronic condition if they answered "yes" to having any of the following conditions (question number): depression (C06.09); HBP (C04.01); high cholesterol (C05.01); asthma (C06.04 and C06.05); arthritis (C07.01); other (C06.01, C06.02, C06.03, C06.06, C06.07, C06.08, C06.10, and C06.11). The questionnaire can be found at https://www.cdc.gov/brfss/questionnaires/pdf-ques/2019-BRFSS-Questionnaire-508.pdf. Obesity was defined as having a body mass index ≥30.0 kg/m^2 based on self-reported height and weight.

† Having any chronic condition was significantly ($p<0.05$) associated with all characteristics, except health care coverage.

§ Having obesity, depression, HBP, current asthma, arthritis, or other chronic conditions was significantly ($p<0.05$) associated with sex, age, race and ethnicity, poverty level, employment status, disability status, region, and all self-rated health characteristics; obesity, HBP, and arthritis were significantly ($p<0.05$) associated with urban-rural status; and obesity, HBP, and other conditions were significantly associated with education level. Obesity, depression, current asthma, arthritis, and other chronic conditions were significantly associated with health care coverage.

¶ Having high cholesterol was significantly ($p<0.05$) associated with age, employment status, disability status, region, and self-rated general, physical, and mental health.

** Poverty level is the ratio of total family income to FPL per family size (% FPL).

†† Sample size <67,104 because of missing data; multiple imputation has been used for all other characteristics and conditions.

§§ Adults were considered to have a disability if they reported having one or more of the following six disability types: hearing, vision, cognition, mobility, self-care, or independent living.

¶¶ https://www2.census.gov/geo/pdfs/maps-data/maps/reference/us_regdiv.pdf

*** Urban-rural status was categorized using the National Center for Health Statistics 2013 Urban-Rural Classification Scheme for Counties. https://www.cdc.gov/nchs/data/series/sr_02/sr02_166.pdf

††† Fair or poor general health was defined based on responses to the question, "Would you say in general that your health is—excellent, very good, good, fair, or poor?"

§§§ Frequent physical distress was defined as responding ≥14 days to the question, "Now thinking about your physical health, which includes physical illness and injury, for how many days during the past 30 days was your physical health not good?"

¶¶¶ Frequent mental distress was defined as responding ≥14 days to the question, "Now thinking about your mental health, which includes stress, depression, and problems with emotions, for how many days during the past 30 days was your mental health not good?"

Consistent with having any condition, the prevalence of having obesity, depression, or high blood pressure was significantly associated with nearly all selected characteristics. Differences in the prevalence for having obesity were most noticeable between young adults aged 25–34 years (29.8%) and 18–24 years (19.4%), non-Hispanic Black persons (33.7%) and non-Hispanic White persons (23.9%), those who were unemployed (29.2%) or employed (26.1%) and a student (15.9%), those with (32.3%) and without (23.8%) a disability, and those living in rural (32.9%) and urban (25.1%) areas. Differences in the prevalence of having depression were most noticeable between females (27.0%) and males (15.8%),

Summary

What is already known about this topic?

Chronic conditions are common, costly, and major causes of death and disability. Addressing conditions in young adulthood can help slow disease progression and improve well-being across the life span; however, recent estimates among young adults have not been reported.

What is added by this report?

In 2019, 53.8% of adults aged 18–34 years had at least one chronic condition, and 22.3% had more than one condition. Prevalence of any as well as specific chronic conditions varied by population subgroup.

What are the implications for public health practice?

Coordinated efforts might help improve the availability of evidence-based interventions, policies, and programs that are effective in preventing, treating, and managing chronic conditions in young adults.

non-Hispanic White persons (27.0%) and non-Hispanic Black persons (16.0%) or Hispanic persons (14.6%), adults who were unemployed (30.9%) and employed (19.4%), and those with (48.9%) and without (14.5%) a disability. Differences in the prevalence of high blood pressure were most noticeable between males (13.4%) and females (7.8%), young adults aged 25–34 years (12.7%) and 18–24 years (7.9%), non-Hispanic Black persons (12.5%) and Hispanic persons (9.4%), those who were unemployed (13.5%) or employed (11.0%) and a student (7.1%), those with (17.3%) and without (9.0%) a disability, and those living in rural (13.7%) and urban (10.5%) areas. Prevalence of health-related risk behaviors was higher among those with any condition than among those without one (Figure 2).

Discussion

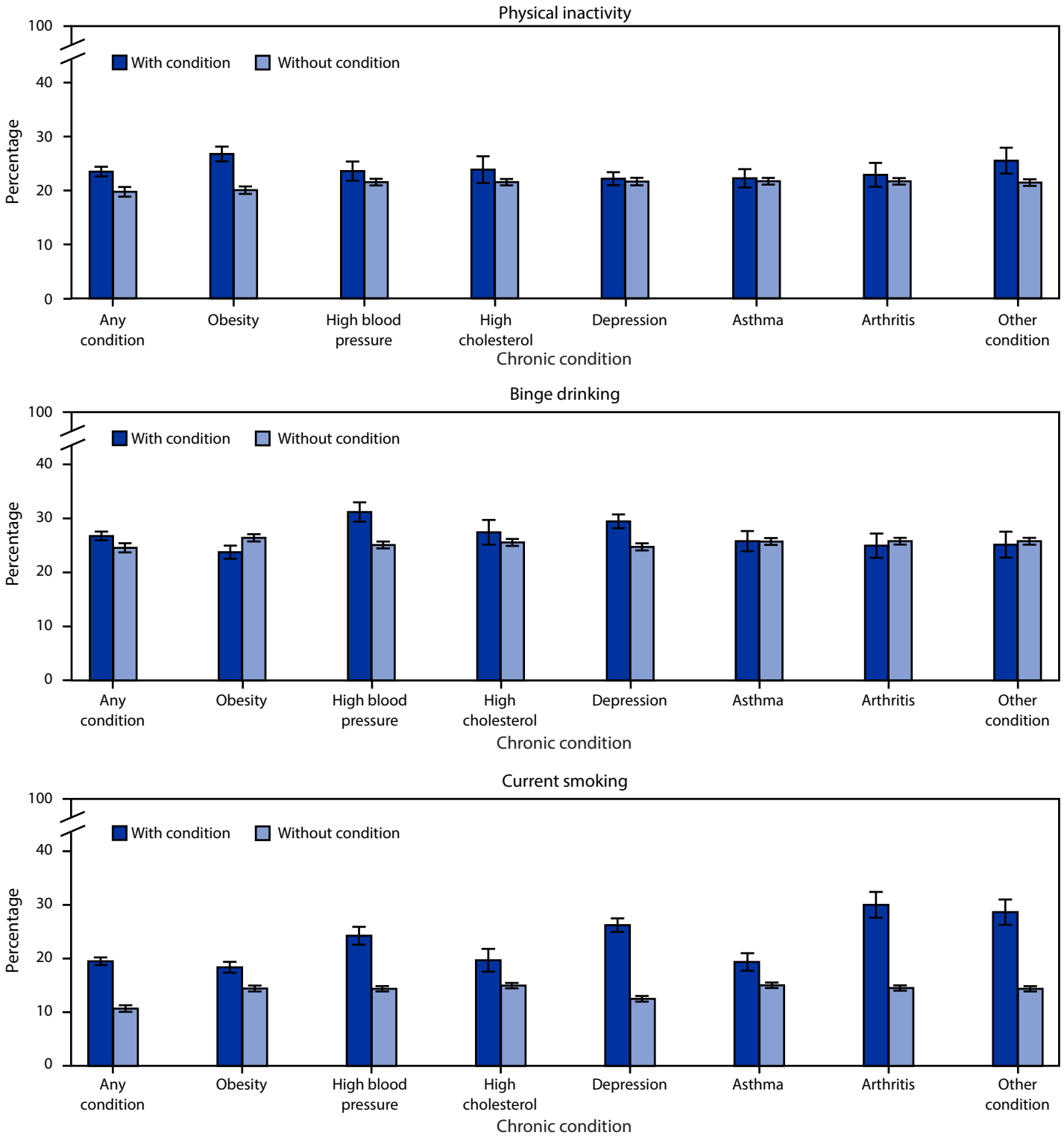
Approximately one half of young adults reported at least one chronic condition, with the most common being obesity (25.5%), depression (21.3%), and high blood pressure (10.7%). Young adults with any chronic condition were more likely than those without a chronic condition to report binge drinking, smoking, and physical inactivity. Because chronic conditions become more prevalent with age, a focus on prevention and risk factors is essential for health across the life span. These findings highlight the importance of increasing the availability of evidence-based strategies tailored to young adults to improve the prevention, treatment, and management of chronic conditions.

Research among the adult population has found differences in the prevalence of specific chronic conditions by sociodemographic characteristics. For example, the prevalence of obesity was higher among adults aged 25–44 years than among those aged 20–24 years (*2*). Obesity prevalence was also highest among adults with a physical activity limitation disability (*2*). The prevalence estimates for obesity and hypertension were also elevated among non-Hispanic Black persons, those unemployed but previously working, and adults not living in a metropolitan statistical area (*3*). Long-standing inequities[§§] across many chronic conditions might be reduced by addressing social determinants of health and removing systemic and long-standing barriers to practicing healthy behaviors (e.g., poor living and working conditions and racial discrimination) (*1*,*4*). Moreover, consistent with what is known regarding risk factors for chronic conditions (*5*), young adults who reported binge drinking, smoking, and physical inactivity were more likely to have at least one chronic condition than those who did not report these behaviors, and some of the common chronic conditions in this age group (obesity, high blood pressure, and high cholesterol) are metabolic risk factors for other chronic conditions (e.g., diabetes or heart disease).[¶¶] Addressing health behaviors and intermediate conditions among young adults can help improve long-term health and well-being over the life course (*1*).

Including a developmental perspective and incorporating mechanisms and channels that specifically resonate with young adults might help improve the effectiveness of strategies to reduce the prevalence of chronic conditions among this group. However, health interventions and programs to help guide individual-, clinical-, and community-level strategies to improve chronic conditions in this population are limited (*1*). The National Academies report on Investing in the Health and Well-Being of Young Adults provides a set of recommendations across domains to develop evidence-based practices for young adults for medical and behavioral health, including prevention (*1*). For example, within the health care domain, the report recommends building on evidence-based practices shown to be effective in adults of all ages and adolescents to 1) identify and determine the efficacy of practices that might be promising in young adults, 2) identify practices that once modified are likely to be effective, and 3) support research to develop practices in young adults in areas identified as unlikely to be addressed with current practices (*1*). Within the public health infrastructure domain, the report recommends research 1) in the effectiveness of multilevel strategies in improving health outcomes and reaching hard-to-reach young adults, 2) on how social media influences health outcomes, and 3) to improve understanding of how social determinants of health and other factors contribute to health disparities among young adults (*1*). These recommendations provide a broad framework that can guide the development of effective strategies to improve the health of young adults.

[§§] https://www.cdc.gov/socialdeterminants/index.htm
[¶¶] https://www.who.int/news-room/fact-sheets/detail/noncommunicable-diseases

FIGURE 2. Percentage* of engaging in health-related risk behaviors,† by adults aged 18–34 years with and without reported chronic conditions§ — Behavioral Risk Factor Surveillance System, United States, 2019



* 95% CIs indicated by error bars; prevalence of physical inactivity is significantly different ($p<0.05$) between those with and without the following conditions: any condition, obesity, high blood pressure, and other; prevalence of binge drinking is significantly different ($p<0.05$) between those with and without the following conditions: any condition, obesity, high blood pressure, and depression; prevalence of current smoking is significantly different ($p<0.05$) between those with and without each condition.

† Health-related risk behaviors were defined as follows: physical inactivity (other than regular job, not engaging in any physical activities or exercises such as running, calisthenics, golf, gardening, or walking for exercise during the past month); binge drinking (males having five or more drinks on one occasion, females having four or more drinks on one occasion); current smoking (smoking ≥100 cigarettes in one's lifetime and still smoking on at least some days).

§ Other includes the following conditions: chronic obstructive pulmonary disease, cancer, diabetes, heart disease/stroke, and kidney disease.

The findings in this report are subject to at least two limitations. First, BRFSS data are self-reported and subject to recall and social-desirability biases. For example, prevalence of self-reported, physician-diagnosed chronic conditions might be underestimated; however, state-level prevalence of some conditions is consistent with estimates derived from electronic health records (*6*). Second, the median response rate of 49.4% might reduce generalizability; however, BRFSS uses a sophisticated weighting method (iterative proportional fitting) that does not require demographic information for small geographic areas, thereby reducing the potential for certain biases (*7*).

Approximately one half of young adults reported at least one chronic condition. Continued efforts are needed to help identify, develop, and modify, where necessary, effective strategies to prevent, treat, and manage chronic conditions in young adults. Public health professionals might consider tailoring individual- and community-level strategies to young adults.

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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.

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Safety Monitoring of COVID-19 mRNA Vaccine Second Booster Doses Among Adults Aged ≥50 Years — United States, March 29, 2022–July 10, 2022

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The Advisory Committee on Immunization Practices (ACIP) recommends that all persons aged ≥5 years receive 1 booster dose of a COVID-19 vaccine after completion of their primary series.* On March 29, 2022, the Food and Drug Administration (FDA) authorized a second mRNA booster dose ≥4 months after receipt of a first booster dose for adults aged ≥50 years and persons aged ≥12 years with moderate to severe immunocompromise (*1*,*2*). To characterize the safety of a second mRNA booster dose among persons aged ≥50 years, CDC reviewed adverse events and health impact assessments reported to v-safe and the Vaccine Adverse Event Reporting System (VAERS) after receipt of a second mRNA booster dose during March 29–July 10, 2022. V-safe is a voluntary smartphone-based U.S. active surveillance system that monitors adverse events occurring after COVID-19 vaccination. VAERS is a U.S. passive surveillance system for monitoring adverse events after vaccination, managed by CDC and FDA (*3*). During March 29–July 10, 2022, approximately 16.8 million persons in the United States aged ≥50 years received a fourth dose.† Among 286,380 v-safe registrants aged ≥50 years who reported receiving a second booster of an mRNA vaccine, 86.9% received vaccines from the same manufacturer for all 4 doses (i.e., homologous vaccination). Among registrants who reported homologous vaccination, injection site and systemic reactions were less frequent after the second booster dose than after the first booster dose. VAERS received 8,515 reports of adverse events after second mRNA booster doses among adults aged ≥50 years, including 8,073 (94.8%) nonserious and 442 (5.1%) serious events. CDC recommends that health care providers and patients be advised that local and systemic reactions are expected after a second booster dose, and that serious adverse events are uncommon.

The v-safe platform allows existing registrants to report receipt of a COVID-19 booster dose and new registrants to enter information about all doses received (https://vsafe.cdc.gov/en/). Health surveys sent daily during the first week after administration of each dose include questions about local injection site and systemic reactions and health impacts.§ CDC's v-safe call center contacts registrants who indicate that medical care was sought after vaccination and encourages completion of a VAERS report, if indicated.

VAERS accepts reports of postvaccination adverse events from health care providers, vaccine manufacturers, and members of the public.¶ VAERS reports of hospitalization, prolongation of hospitalization, life-threatening illness, permanent disability, congenital anomaly or birth defect, or death are classified as serious.** VAERS staff members assign Medical Dictionary for Regulatory Activities preferred terms (MedDRA PTs) to the signs, symptoms, and diagnostic findings included in VAERS reports.†† Reports of serious events to VAERS were reviewed by CDC and FDA physicians to form a consensus clinical impression based on available data. For this analysis, death certificates and autopsy reports were requested for any report of death. CDC physicians reviewed all available information for each decedent to form an impression about the cause of death. For reports of myocarditis and pericarditis, rare adverse events that have been associated with mRNA COVID-19 vaccines, CDC sought information about the clinical course of each case and determined whether the CDC myocarditis case definition was met.§§

* ACIP recommends that all persons aged ≥5 years receive 1 booster dose of a COVID-19 vaccine after completion of their primary series (≥5 months after BNT162b2 [Pfizer-BioNTech] or mRNA-1273 [Moderna] primary series and ≥2 months after Ad26.COV2 (Johnson & Johnson [Janssen] primary series); mRNA vaccine is preferred over Janssen for the first booster dose. https://www.cdc.gov/vaccines/covid-19/clinical-considerations/covid-19-vaccines-us.html (Accessed July 12, 2022).

† https://covid.cdc.gov/covid-data-tracker/#cases_casesper100klast7days (Accessed July 12, 2022).

§ Health surveys were sent for the most recent dose entered via text messages that link to web-based surveys on days 0–7 after receipt of a vaccine dose; then weekly through 6 weeks after vaccination; and then at 3, 6, and 12 months after vaccination. Local injection site reactions included itching, pain, redness, and swelling. Systemic reactions included abdominal pain, myalgia, chills, diarrhea, fatigue, fever, headache, joint pain, nausea, rash, and vomiting. Health impacts included inability to perform normal daily activities, inability to work or attend school, and receipt of medical care.

¶ Health care providers are encouraged by CDC and FDA to report adverse events to VAERS and are required by COVID-19 vaccine Emergency Use Authorizations to report certain adverse events after vaccination to VAERS, including death (https://vaers.hhs.gov/faq.html). A VAERS form includes patient information, vaccine information, vaccine administration information, and information regarding the adverse event (https://vaers.hhs.gov/docs/VAERS%202.0_Checklist.pdf).

** VAERS reports are classified as serious based on the Code of Federal Regulations Title 21. https://www.accessdata.fda.gov/scripts/cdrh/cfdocs/cfcfr/cfrsearch.cfm?fr

†† Each VAERS report might be assigned at least one MedDRA PT. A MedDRA coded event does not indicate a medically confirmed diagnosis. https://www.meddra.org/how-to-use/basics/hierarchy

§§ Reports of myocarditis and pericarditis were identified in VAERS by searching for selected MedDRA PTs. In VAERS, acute myocarditis was defined as presence of signs and symptoms including new onset or worsening of at least one of the following signs or symptoms: chest pain, pressure, discomfort, dyspnea, shortness of breath, pain with breathing, palpitations, or syncope; or at least two of the following signs or symptoms in children aged ≤11 years: irritability, vomiting, poor feeding, tachypnea, or lethargy; and at least one new finding of elevated troponin, electrocardiogram findings consistent with myocarditis, abnormal cardiac function or wall motion on echocardiogram, cardiac magnetic resonance imaging findings consistent with myocarditis, or histopathologic findings consistent with myocarditis; and no other identifiable cause for these findings.

Local and systemic reactions and health impacts reported during the week after second booster dose vaccination were described for v-safe registrants aged ≥50 years who reported receiving a second booster during March 29–July 10, 2022, ≥4 months after their first booster dose; this analysis was further limited to registrants who received mRNA vaccines for all doses (both homologous and heterologous) and completed at least one daily health survey after receiving their second booster dose and at least one survey after a previous vaccine dose. Among registrants who received homologous mRNA vaccination, the odds of reporting an adverse reaction or health impact after receiving the second booster dose versus previous doses were compared using a multivariable generalized estimating equations model that accounted for demographic variables and repeated measures. Comparisons of adverse reactions and health impacts by vaccine dose were restricted to persons who received homologous mRNA vaccination because previous studies observed different patterns of reporting among recipients of heterologous mRNA and among recipients of homologous Ad26.COV2 (Johnson & Johnson [Janssen]) booster vaccination (*4*). VAERS adverse event reports after a second booster dose were described by serious and nonserious classification, demographic characteristics, and MedDRA PTs. All analyses were conducted using SAS software (version 9.4; SAS Institute); p-values <0.05 were considered statistically significant. These surveillance activities were reviewed by CDC and conducted consistent with applicable federal law and CDC policy.¶¶

Review of v-safe Data

During March 29–July 10, 2022, a total of 286,380 v-safe registrants aged ≥50 years reported receiving a second mRNA vaccine booster dose (homologous or heterologous). The median registrant age was 67 years; 173,525 (60.6%) were female. In the week after receipt of the second booster dose, local injection site reactions were reported by 67,521 (49.1%) BNT162b2 (Pfizer-BioNTech) and 92,472 (62.1%) mRNA-1273 (Moderna) vaccine recipients; systemic reactions were reported by 60,705 (44.2%) Pfizer-BioNTech and 76,756 (51.5%) Moderna vaccine recipients (Table 1). Both local and systemic reactions were mostly mild to moderate in severity and were most frequently reported the day after vaccination. In the week after receipt of the second booster dose, 14,682 (10.7%) Pfizer-BioNTech and 22,385 (15.0%) Moderna vaccine recipients reported inability to complete normal daily activities; 4,300 (3.1%) Pfizer-BioNTech and 5,927 (4.0%) Moderna vaccine recipients reported inability to work or attend school. Receipt of medical care during the week after the second booster vaccination was reported by 0.8% and 0.7% of Pfizer-BioNTech and Moderna vaccine recipients, respectively; most received care via telehealth (0.2% and 0.3%, respectively) or clinic (0.3% and 0.2%, respectively) appointment. Hospitalization was reported by 81 (0.03%) registrants; 39 (48.1%) indicated that the hospitalization was unrelated to vaccination, 28 (34.6%) were unreachable or unwilling to provide additional information, and 14 (17.3%) completed a VAERS report.

Among 248,887 (86.9%) v-safe registrants aged ≥50 years who received homologous vaccination and a second mRNA booster dose, local injection site reactions were less frequently reported after the second booster dose than after any previous doses (p<0.001); systemic reactions were less frequently reported after the second booster than after either dose 2 or the first booster dose (p<0.001) (Figure). Inability to complete normal daily activities, to work, or to attend school was less frequently reported after the homologous second booster dose

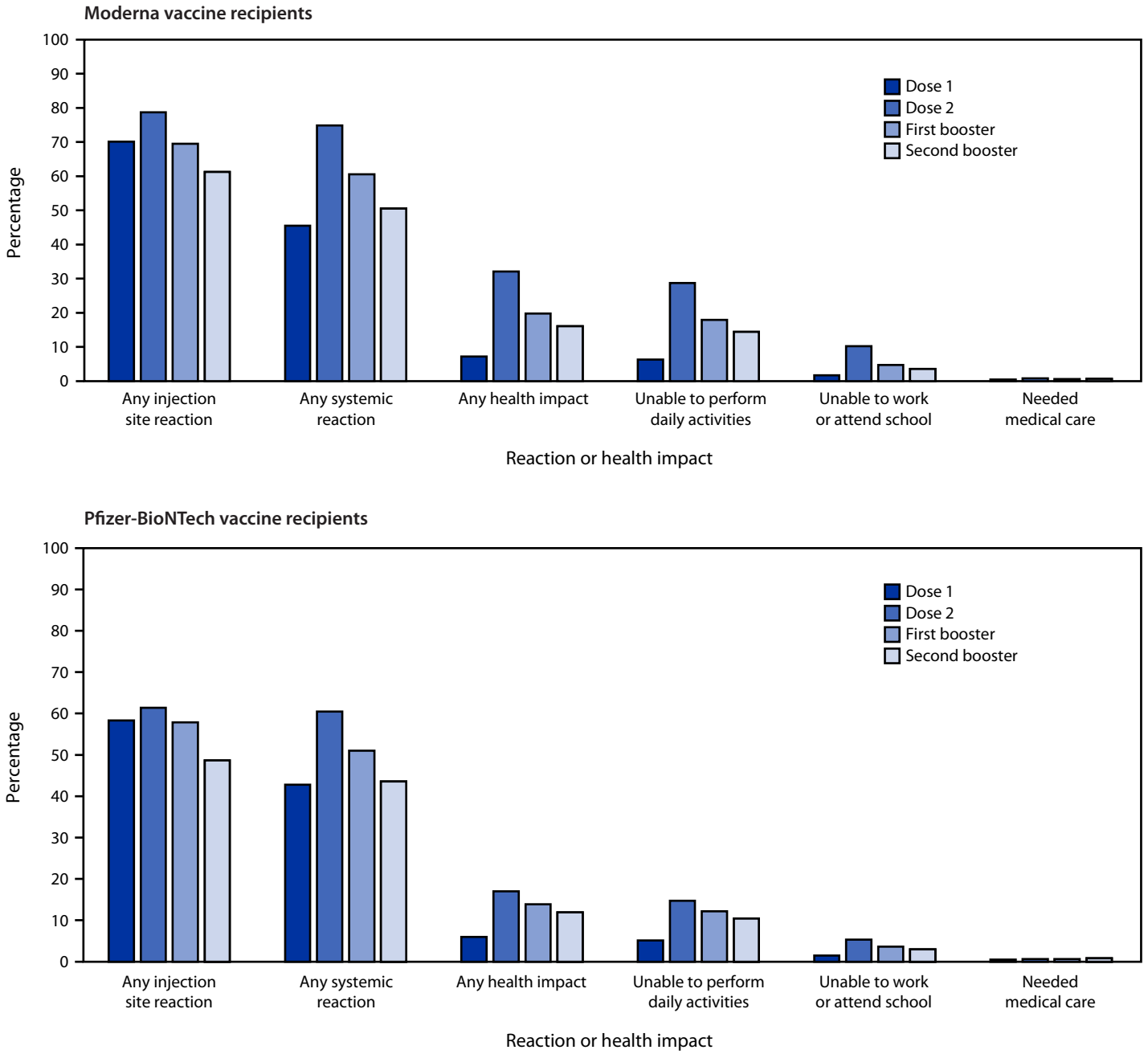
TABLE 1. Adverse reactions and health impacts reported to v-safe by registrants aged ≥50 years (N = 286,380) who received a COVID-19 mRNA second booster dose,* by vaccine product received — United States, March 29–July 10, 2022

Event	% Reporting reaction or health impact after receipt of second booster dose†	
	Pfizer-BioNTech (n = 148,921)	Moderna (n = 137,459)
Any local injection site reaction	**49.1**	**62.1**
Itching	5.4	10.2
Pain	45.8	57.2
Redness	5.7	12.4
Swelling	8.9	16.8
Any systemic reaction	**44.2**	**51.5**
Abdominal pain	2.4	2.7
Myalgia	20.9	27.2
Chills	9.5	13.8
Diarrhea	4.1	4.3
Fatigue	31.0	37.8
Fever	10.6	15.2
Headache	21.3	26.4
Joint pain	11.8	15.5
Nausea	5.2	6.6
Rash	0.8	1.1
Vomiting	0.5	0.5
Any health impact	**12.2**	**16.8**
Unable to perform normal daily activities	10.7	15.0
Unable to work or attend school	3.1	4.0
Needed medical care	0.8	0.7
Telehealth	0.2	0.3
Clinic	0.3	0.2
Emergency visit	0.1	0.1
Hospitalization	0.03	0.03

* Includes only persons who received mRNA COVID-19 vaccine for primary series and first booster dose (homologous and heterologous).
† Percentage of registrants who reported a reaction or health impact at least once during days 0–7 after vaccination.

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

FIGURE. Adverse reactions and health impacts* reported by adults aged ≥50 years who received COVID-19 vaccine booster,† by dose — v-safe data, United States, March 29–July 10, 2022§



* Local injection site reactions included itching, pain, redness, and swelling. Systemic reactions included abdominal pain, myalgia, chills, diarrhea, fatigue, fever, headache, joint pain, nausea, rash, and vomiting. Health impacts included inability to perform normal daily activities, inability to work or attend school, and receipt of medical care.

† Adults received either homologous Moderna (125,807) or Pfizer-BioNTech (123,080) COVID-19 vaccine booster doses and completed at least one v-safe health check-in survey on days 0–7 after each vaccine dose.

§ The odds of reporting any local injection site or systemic reaction or health impact after second booster dose and previous doses were compared using a multivariable generalized estimating equations model that accounted for the correlation between registrants and adjusted for demographic variables (p-values <0.05 were considered statistically significant); all second booster and first booster dose comparisons were statistically significant.

TABLE 2. Reports of nonserious and serious events to VAERS among persons aged ≥50 years who received any COVID-19 mRNA second booster dose (N = 8,515) — United States, March 29–July 10, 2022

Reported event	No. (%) reporting
Nonserious events, VAERS reports	**8,073 (94.8)**
Symptom, sign, diagnostic result, or condition* (% of total)	
COVID-19	2,111 (26.1)
Expired product administered	1,589 (19.7)
SARS-CoV-2 positive test result	1,443 (17.9)
Fatigue	1,236 (15.3)
Headache	1,047 (13.0)
Fever	975 (12.1)
Cough	911 (11.3)
Pain	810 (10.0)
Product storage error	704 (8.7)
Oropharyngeal pain	655 (8.1)
SARS-CoV-2 test	637 (7.9)
No adverse event†	599 (7.4)
Chills	544 (6.7)
Malaise	475 (5.9)
Rhinorrhea	463 (5.7)
Serious VAERS reports (% of total)§,¶,**	**442 (5.2)††**

TABLE 2 (*Continued*). Reports of nonserious and serious events to VAERS among persons aged ≥50 years who received any COVID-19 mRNA second booster dose (N = 8,515) — United States, March 29–July 10, 2022

Reported event	No. (%) reporting
Clinical impression (% of serious events)	
COVID-19	84 (19.0)
Death§§	52 (11.8)
Cerebrovascular accident	24 (5.4)
Pulmonary embolism	19 (4.3)
Atrial fibrillation	18 (4.1)
Hearing issue¶¶	16 (3.6)
Respiratory infection	9 (2.0)
Hypertension	9 (2.0)
Syncope	9 (2.0)
Fall	8 (1.8)
Transient ischemic attack	8 (1.8)
Arrythmia	7 (1.6)
Myocardial infarction	7 (1.6)
Cognitive concern	6 (1.4)
Thrombosis	4 (0.9)
Coronary artery disease	3 (0.7)
Diabetic ketoacidosis	3 (0.7)
Chronic heart failure	2 (0.5)
Chronic obstructive pulmonary disease	2 (0.5)
Peripheral neuropathy	2 (0.5)
Seizure	2 (0.5)
Shortness of breath	2 (0.5)

Abbreviations: MedDRA PT = Medical Dictionary for Regulatory Activities preferred term; VAERS = Vaccine Adverse Event Reporting System.

* Signs and symptoms in VAERS reports are assigned MedDRA PTs by VAERS staff members. Each VAERS report might be assigned at least one MedDRA PT, which can include normal diagnostic findings. A MedDRA PT does not represent a medical diagnosis made or confirmed by a provider or clinical reviewer.

† Reports of no adverse event were accompanied by reports of vaccine error (e.g., expired product administered, product storage error, or extra dose administered).

§ VAERS reports are classified as serious if any of the following are reported: hospitalization, prolongation of hospitalization, life-threatening illness, permanent disability, congenital anomaly or birth defect, or death.

¶ Serious reports to VAERS were reviewed by CDC physicians to form a clinical impression. The clinical impression of the event does not establish a causal role with vaccination. Reports of myocarditis were identified using a combination of MedDRA PTs; in some cases, reports of myocarditis (identified by fulfilling criteria of the CDC working case definition of myocarditis) did not have the MedDRA PT "myocarditis" assigned to them. https://www.meddra.org/how-to-use/basics/hierarchy

** Cells with fewer than two reports were suppressed.

†† Five reports that were duplications were removed from this list.

§§ For the six reports of death with sufficient information, cause of death as stated on the death certificate included congestive heart failure, aortic dissection, grand mal seizure, end-stage dementia, and cardiac arrest secondary to coronary artery disease.

¶¶ Clinical impressions for "hearing issues" included tinnitus and loss of hearing.

Summary

What is already known about this topic?

During March 29–July 10, 2022, approximately 16.8 million persons in the United States aged ≥50 years received a fourth dose of a COVID-19 vaccine.

What is added by this report?

Among persons aged ≥50 years who reported homologous mRNA COVID-19 vaccination, injection site and systemic reactions were less frequent after a second booster dose than after the first booster dose. Ninety-five percent of 8,515 events reported to the Vaccine Adverse Event Reporting System were nonserious.

What are the implications for public health practice?

Health care providers and patients should be aware that local and systemic reactions are expected after a second mRNA COVID-19 booster dose. Serious adverse events are uncommon.

than after either dose 2 or the first booster dose (p<0.001). Receipt of medical care was more frequently reported after the homologous Moderna second booster dose (0.7%) than the first booster dose (0.6%) (p<0.001) and more frequently reported after the second homologous Pfizer-BioNTech dose (0.8%) than the first booster dose (0.6%) (p<0.01).

Review of VAERS Data

During March 29–July 10, 2022, VAERS received and processed 8,515 reports of one or more adverse events after receipt of a second mRNA booster dose among adults aged ≥50 years (Table 2). The median age of these recipients was 68 years; 5,357 (62.9%) reports were for events among women. Most reports were for nonserious events (8,073; 94.8%), including 2,894 (35.8%) vaccination errors (e.g., expired product administered and product storage error); COVID-19 (2,111; 26.1%); and local and systemic reactions known to be associated with the vaccines and COVID-19, including fatigue (1,236; 15.3%), headache (1,047; 13.0%), and fever (975; 12.1%). Among the 2,894 reports indicating a vaccination error, only 388 (13.4%) also listed an adverse health event, including COVID-19 (74; 19.0%), injection site pain (69; 17.7%), and fever (63; 16.2%) (J. Baggs, PhD, CDC, personal communication, July 2022).

Among the 8,515 VAERS reports of adverse events after receipt of a second mRNA booster dose among adults aged

≥50 years, 12 were preliminary reports of myocarditis (six nonserious and six serious); one case was verified by medical record review and met the CDC case definition for myocarditis; the patient was continuing to recover at time of this report.

Among the 442 (5.2%) reports of serious events after second mRNA booster vaccination among adults aged ≥50 years 52 were reports of death; the median age of decedents was 84 years. For the six reports of death with sufficient information, cause of death as stated on the death certificate included congestive heart failure, aortic dissection, grand mal seizure, end-stage dementia, and cardiac arrest secondary to coronary artery disease. Among the serious events reported, 84 were of COVID-19 (19.0%).

Discussion

Limited data are available regarding the safety of second COVID-19 booster doses. The findings in this report are consistent with those from a small open-label clinical study of second boosters (154 participants received Pfizer-BioNTech and 120 Moderna vaccines) that did not detect any unexpected safety concerns (*5*). Among 248,887 v-safe registrants aged ≥50 years with homologous vaccination and a second booster dose, injection site and systemic reactions were less frequently reported after the second booster dose than the first booster dose. Similarly, adverse reactions after a first booster dose were less common than were those after dose 2 of the primary series among v-safe registrants aged ≥18 years (*4*) and clinical trial subjects (*6*,*7*). In general, reactions were less frequently reported by v-safe registrants aged ≥50 years after a second booster dose than by adults aged ≥18 years after a first booster dose (*4*); this difference is not unexpected because v-safe participants aged ≥65 years are less likely to report reactions after COVID-19 vaccination than are younger adults (*8*). Overall, 94.8% of VAERS reports were nonserious and vaccine administration errors represented approximately one third of nonserious reports; 13.4% of these also listed an adverse health event. Among both nonserious and serious reports to VAERS, COVID-19 was the most commonly reported event; this is not unexpected given the current epidemiology of the pandemic.

Health care providers are required to report any death that occurs after COVID-19 vaccination to VAERS regardless of whether death has any association with vaccination. Among 40 reports of death after second booster doses, the median decedent age exceeded the median age for all VAERS reports. Reporting rates for death after primary COVID-19 vaccination were higher among adults aged ≥50, consistent with general age-specific mortality rates in the adult population (*9*). After review of available information (six of 40 reports), no vaccine-associated deaths were identified in these reports.

The findings in this report are subject to at least five limitations. First, v-safe is a voluntary reporting program and only 286,380 of the 16.8 million persons aged ≥50 years who received a fourth dose during this period reported receipt to v-safe; therefore, data might not be representative of the entire vaccinated U.S. population. Second, vaccine recipients who experience an adverse event could be more likely to respond to v-safe surveys. Third, VAERS is a passive system and is subject to reporting biases and underreporting, especially of nonserious events (*3*). Fourth, medical review of reported deaths after vaccination is dependent on availability of medical records, death certificates, and autopsy reports, which might be unavailable or not available in a timely manner. Finally, a report to v-safe or VAERS alone cannot be used to assess causality.

ACIP recommends that all persons aged ≥5 years receive one booster dose of a COVID-19 vaccine after completion of their primary series; adults aged ≥50 years and persons aged ≥12 years with moderate to severe immunocompromise might receive a second booster ≥4 months after their first booster dose. Among adults aged ≥50 years, vaccine effectiveness against COVID-19-associated hospitalization ≥120 days after dose 3 was 55% and ≥7 days after dose 4 was 80%, reinforcing recommendations that persons in this age group should receive a second booster when they become eligible (*10*). Preliminary safety findings after receipt of second booster doses among adults aged ≥50 years are similar to those after receipt of first booster doses. Reports of reactions after the second booster dose are less common than are those after the first. Health care providers and patients should be advised that local and systemic reactions are expected after second booster doses and that serious adverse events are infrequently reported. CDC and FDA will continue to monitor vaccine safety and will provide updates as needed to guide COVID-19 vaccination recommendations.

Acknowledgments

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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. Phillip G. Blanc reports previous membership on the alumni council (2017–2020) of the Harvard T.H. Chan School of Public Health and ownership of Community Health Systems, Inc. stock. No other potential conflicts of interest were disclosed.

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Notes from the Field

Cluster of Parechovirus Central Nervous System Infections in Young Infants — Tennessee, 2022

Lili Tao, MD, PhD[1]; Mary-Margaret A. Fill, MD[2]; Ritu Banerjee, MD, PhD[3]; Romney M. Humphries, PhD[1]

During April 12–May 24, 2022, 23 previously healthy infants aged 5 days–3 months were admitted to a Tennessee children's hospital for human parechovirus (PeV) meningoencephalitis.* PeV is a nonenveloped RNA virus of the Picornaviridae family. PeV infections range from mild, self-limiting gastroenteritis to severe sepsis-like disease and central nervous system (CNS) infection, (*1*) and infants aged <3 months are disproportionately affected. PeV genotype 3 is responsible for the most severe cases, with a pattern of biannual cycle circulation that peaks during summer months (*2*,*3*). Although PeV infection is not a reportable disease, the Tennessee Department of Health was notified. An assessment of cases was conducted to better understand this unusually large cluster of infections.

At this children's hospital, a lumbar puncture is performed as part of sepsis evaluation for all infants aged <1 month and for older infants when clinically indicated. Cerebrospinal fluid (CSF) testing includes a multiplex molecular panel (BioFire FilmArray Meningitis/Encephalitis Panel, bioMerieux) for all infants aged ≤3 months and for patients aged >3 months if the CSF white blood cell (WBC) count is >5 cells per high power field. For this investigation, a comprehensive review of electronic health records was conducted to assess demographic characteristics, social history, signs and symptoms at admission, laboratory test results, and treatment course of all patients in whom PeV was detected by the multiplex molecular panel during the cluster period. This study was reviewed and approved by the Vanderbilt University Medical Center Institutional Review Board and was conducted consistent with applicable federal law and CDC policy.†

Median age of the patients was 24 days; 13 (57%) were female and 10 (43%) were male (Table). Five patients were preterm (28–36 weeks' gestation). Signs and symptoms included fever, fussiness, and poor feeding. Most patients became symptomatic in the community (22, 96%); one preterm infant became symptomatic while in the neonatal intensive care unit (NICU). One (4%) patient attended a child care facility, and 16 (70%) had siblings at home or were exposed to other children.

TABLE. Characteristics of infants with parechovirus central nervous system infection (N = 23) — Nashville, Tennessee, April 12–May 24, 2022

Characteristic	No. (%)
Sex	
Female	13 (57)
Male	10 (43)
Median age (range), days	**24 (5–99)**
Gestational age at delivery	
Preterm (28–36 wks)	5 (22)
Term (37–40 wks)	18 (78)
Acquisition of infection	
Community	22 (96)
NICU	1 (4)
Exposure to other children	**16 (70)**
Signs and symptoms	
Fever	20 (87)
Fussiness	13 (57)
Poor feeding	8 (35)
Sleepiness	4 (17)
Respiratory distress	4 (17)
Rhinorrhea, congestion	3 (13)
Seizure	1 (4)
Rash	1 (4)
Elevated CSF WBC count*	7† (32)

Abbreviations: CSF = cerebrospinal fluid; NICU = neonatal intensive care unit; WBC = white blood cell.
* CSF cell count performed for 22 of 23 patients.
† Contamination during collection was presumed for three specimens.

Leukopenia was detected in only four (17%) patients. CSF cell count was performed for 22 patients; seven (32%) specimens demonstrated an elevated WBC count, including three with probable blood contamination during collection. All but one of the infants were admitted to the hospital; four (17%) infants developed severe disease that required treatment in the NICU. Brain magnetic resonance imaging was performed in four severely ill NICU patients, which detected diffusion within the white matter consistent with typical PeV meningoencephalitis in all of these patients. Antibiotics were initially prescribed for the 23 patients but were discontinued for 13 (57%) within 24 hours of detection of PeV. The mean hospital stay was 4.5 days (range = 1–26 days). Twenty-one (91.3%) patients recovered without complications. One patient was scheduled for a 6-month follow-up for possible late onset hearing loss and hypercoagulation evaluation. One patient experienced persistent seizures and was anticipated to experience severe developmental delay.

The multiple molecular panel had been introduced at the children's hospital in May 2018 to aid in the diagnosis of potential pathogens among patients with suspected meningitis or encephalitis. Nineteen cases were detected over 5 months in 2018, likely representing a baseline incidence of PeV CNS

* Infants were hospitalized at the Monroe Carell Jr. Children's Hospital, Vanderbilt University Medical Center, Nashville, Tennessee.
† 45 C.F.R. part 46, 21 C.F.R. part 56; 42 U.S.C. Sect. 241(d); 5 U.S.C. Sect. 552a; 44 U.S.C. Sect. 3501 et seq.

infections. Seven cases of PeV were detected during 2019–2021. The absence of a biennial peak in 2020 is presumably because of social isolation during the COVID-19 pandemic, suggesting that PeV transmission is closely associated with social activity. However, 29 cases were detected in 2022 at the children's hospital, including the 23 cases described in this report that were detected within a 6-week period. This peak in infections might reflect relaxation of COVID-19 isolation measures, consistent with increased prevalence of other respiratory viruses (e.g., respiratory syncytial virus)[§] (*4*,*5*). When PeV is circulating, clinicians should consider testing for PeV in young infants, including those with normal CSF parameters.[¶] The rapid detection of PeV in CSF by multiplex molecular panels can limit antibiotic administration and improve patient management. Parents with young infants, especially those with infants aged <3 months, should be aware of the symptoms and visit a pediatrician if symptoms persist.

[§] https://www.cdc.gov/rsv/index.html
[¶] https://emergency.cdc.gov/han/2022/han00469.asp

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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. Ritu Banjeree reports grant support from the National Institute for Allergy and Infectious Diseases, National Institutes of Health for an unrelated rapid diagnostics trial. Romney M. Humphries reports grant support from bioMerieux, Momentum BioSciences, Ltd, and Specific Diagnostics; contract and grant support from Qiagen; consulting fees from bioMerieux, Merck, Pattern Bioscience, Inc., Qiagen, QPex Biopharma, Inc., Specific Diagnostics, and Torus; vice chairmanship of the Infectious Diseases Society of America Diagnostics Committee, and membership on the American Society for Microbiology Professional Practices Committee, College of American Pathologists Microbiology Committee, and Clinical and Laboratory Standards Institute Antimicrobial Susceptibility Testing subcommittee; and stock options in Accelerate Diagnostics and Specific Diagnostics. Mary-Margaret A. Fill reports sponsored travel from the Council of State and Territorial Epidemiologists to attend the 2022 conference. No other potential conflicts of interest were disclosed.

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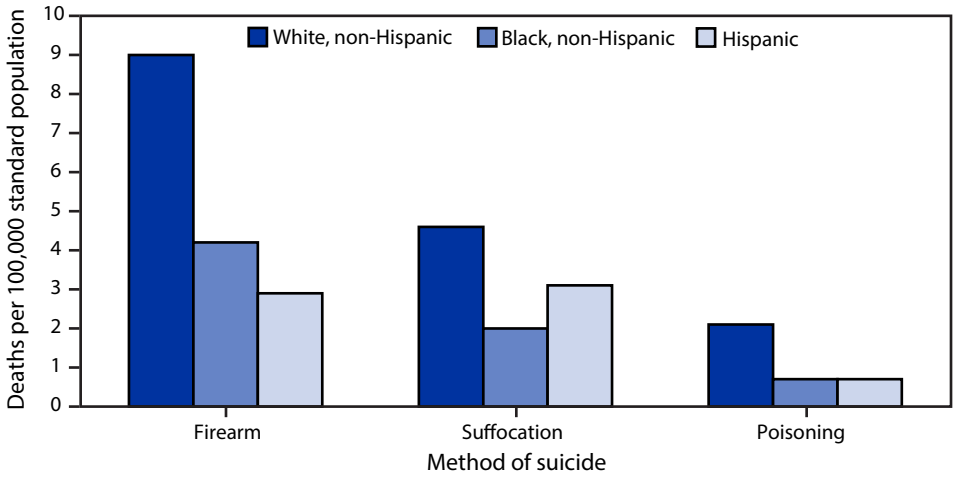
QuickStats

FROM THE NATIONAL CENTER FOR HEALTH STATISTICS

Age-Adjusted Suicide Rates* for the Three Leading Methods of Suicide, by Race and Ethnicity† — National Vital Statistics System, United States, 2020



* Age-adjusted suicide rates are per 100,000 standard population. The three most common methods of suicide are identified using *International Classification of Diseases, Tenth Revision* underlying cause-of-death codes X72–X74 (firearm), X70 (suffocation), and X60–X69 (poisoning), as reported on the death certificate.

† Race and ethnicity categories are based on the 1997 Office of Management and Budget standards. Data are shown for the three largest race and ethnicity groups, comprising 94% of all suicides.

Age-adjusted rates for all three leading methods of suicide (firearm, suffocation, and poisoning) were highest for non-Hispanic White (White) persons compared with non-Hispanic Black (Black) and Hispanic or Latino (Hispanic) persons. The age-adjusted rate of suicide by firearm was 9.0 per 100,000 standard population for White persons followed by 4.2 for Black persons and 2.9 for Hispanic persons. The rate of suicide by suffocation (includes hanging) was 4.6 for White persons followed by 3.1 for Hispanic persons and 2.0 for Black persons. The rate of suicide by poisoning was 2.1 for White persons and 0.7 for both Black and Hispanic persons. Suicide by firearm was the leading method for both White and Black persons, whereas suffocation was the leading method for Hispanic persons followed closely by firearm.

Source: National Vital Statistics System, Mortality Data. http://www.cdc.gov/nchs/nvss/deaths.htm

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For more information on this topic, CDC recommends the following link: https://www.cdc.gov/suicide

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ISSN: 0149-2195 (Print)