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Adults Meeting Fruit and Vegetable Intake Recommendations — United States, 2019

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The 2020–2025 Dietary Guidelines for Americans* advise incorporating more fruits and vegetables into U.S. residents' diets as part of healthy dietary patterns. Adults should consume 1.5–2 cup-equivalents of fruits and 2–3 cup-equivalents of vegetables daily.† A healthy diet supports healthy immune function (*1*) and helps to prevent obesity, type 2 diabetes, cardiovascular diseases, and some cancers (*2*); having some of these conditions can predispose persons to more severe illness and death from COVID-19 (*3*). CDC used the most recent 2019 Behavioral Risk Factor Surveillance system (BRFSS) data to estimate the percentage of states' adult population who met intake recommendations overall and by sociodemographic characteristics for 49 states and the District of Columbia (DC). Overall, 12.3% of adults met fruit recommendations, ranging from 8.4% in West Virginia to 16.1% in Connecticut, and 10.0% met vegetable recommendations, ranging from 5.6% in Kentucky to 16.0% in Vermont. The prevalence of meeting fruit intake recommendations was highest among Hispanic adults (16.4%) and lowest among males (10.1%); meeting vegetable intake recommendations was highest among adults aged ≥51 years (12.5%) and lowest among those living below or close to the poverty level (income to poverty ratio [IPR] <1.25) (6.8%). Additional policies§ and programs that will increase access to fruits and vegetables in places where U.S. residents live, learn, work, and play, might increase consumption and improve health.

BRFSS is an annual, state-based, random-digit–dialed telephone survey of health-related behaviors representative of noninstitutionalized adults aged ≥18 years in the United States and participating territories.¶ Since 1989, BRFSS has collected information on respondents' frequency of fruit and vegetable consumption. The current module assesses the number of times per day, week, or month a respondent consumed whole fruit, 100% fruit juice, salads, fried potatoes, other potatoes, and other vegetables during the past 30 days. In 2019, New Jersey data did not meet the minimum requirements for inclusion** and were excluded. Among 418,268 respondents

* https://www.dietaryguidelines.gov/sites/default/files/2020-12/Dietary_Guidelines_for_Americans_2020-2025.pdf

† Appropriate for adults who engage in <30 minutes of moderate physical activity; more active adults might be able to consume more while staying within calorie needs. https://www.myplate.gov/eat-healthy/fruits; https://www.myplate.gov/eat-healthy/vegetables

§ https://www.healthypeople.gov/sites/default/files/NWS_ExecutiveSummary_2018-10.03.pdf

¶ https://www.cdc.gov/brfss/

** https://www.cdc.gov/brfss/annual_data/2019/pdf/overview-2019-508.pdf

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to the current BRFSS, 8,458 residents of Guam and Puerto Rico were excluded, because the scoring algorithms were derived from the National Health and Nutrition Examination Survey (NHANES), which excludes territories, as were 59,589 respondents who did not answer one or more questions in the fruit and vegetable module, 1,347 with implausible reported values of fruit or vegetable intake (>16 times and >23 times per day, respectively), 54,306 who did not report income, and two who did not report race. The resulting analytic sample included 294,566 (70%) participants. Among states included in the analysis, the median state response rate was 49.4% and ranged from 37.3% to 73.1%.[††]

Previously developed scoring algorithms were used to estimate the percentage of each state's population who met fruit and vegetable intake recommendations. Development of the methodology (*4*) and application of the prediction algorithm have been previously reported.[§§] Twenty-four–hour dietary recall data from 2013–2016 NHANES were used to fit age- and sex-specific logistic regression models that estimate probabilities of meeting recommendations as functions of reported daily frequency of consumption, race/ethnicity, and IPR, adjusting for day-to-day variation (*4*). Consistent with previous studies (*4*,*5*), analyses accounted for the complex survey design and nonresponse, and balanced repeated replication was used to calculate standard errors and 95% CIs with SAS (version 9.4; SAS Institute). T-tests were used to compare differences by sociodemographic groups with Stata (version 17.0; StataCorp). This activity was reviewed by CDC and was conducted consistent with applicable federal law and CDC policy.[¶¶]

In 2019, the median frequency of reported fruit intake was once per day; this was consistent across all jurisdictions (Table 1). The median frequency of reported vegetable intake was 1.6 times per day, ranging from 1.5 times per day in Louisiana, Mississippi, Nevada, and New Mexico to 1.9 times per day in Maine and Vermont. Among all respondents, 12.3% of adults met fruit intake recommendations, ranging from 8.4% in West Virginia to 16.1% in Connecticut, and 10.0% met vegetable intake recommendations, ranging from 5.6% in Kentucky to 16.0% in Vermont.

Fruit intake (Table 2) and vegetable intake (Table 3) varied by sociodemographic characteristics. Overall, a higher proportion of women met both fruit and vegetable recommendations (14.5% and 12.4%, respectively) than did men (10.1% and 7.6%, respectively); a similar pattern was observed across most states. A significantly higher proportion of adults aged ≥51 years (12.5%) met vegetable recommendations compared with younger adults aged 18–30 years (7.1%) and 31–50 years (8.7%). This pattern was also observed in 37 states. A significantly higher proportion of Hispanic adults (16.4%) met

[††] https://www.cdc.gov/brfss/annual_data/2019/pdf/2019-sdqr-508.pdf

[§§] https://www.cdc.gov/nutrition/data-statistics/data-users-guide.html

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

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TABLE 1. State-specific median frequency of fruit and vegetable intake among adults aged ≥18 years and percentage of respondents meeting federal fruit and vegetable recommendations — Behavioral Risk Factor Surveillance System, 49 states* and District of Columbia, 2019

		Median daily intake frequency		% of respondents (95% CI) meeting recommendations	
Jurisdiction	**Sample size**	**Fruit**	**Vegetable**	**Fruit**	**Vegetable**
Overall	**294,566**	**1.0**	**1.6**	**12.3 (11.2–13.3)**	**10.0 (8.8–11.3)**
Alabama	4,990	1.0	1.6	10.3 (8.7–12.0)	6.7 (5.1–8.3)
Alaska	2,138	1.0	1.7	12.2 (9.5–15.0)	11.4 (8.8–14.0)
Arizona	6,149	1.0	1.6	14.8 (12.6–16.9)	12.8 (10.5–15.0)
Arkansas	3,571	1.0	1.6	11.6 (9.6–13.6)	10.8 (8.7–13.0)
California	8,894	1.0	1.6	13.6 (11.9–15.2)	11.3 (9.6–13.0)
Colorado	6,740	1.0	1.7	12.4 (10.7–14.1)	10.4 (8.7–12.2)
Connecticut	6,228	1.0	1.7	16.1 (14.2–18.0)	14.1 (12.1–16.1)
Delaware	2,684	1.0	1.7	13.4 (10.9–15.8)	9.1 (7.0–11.2)
District of Columbia	1,873	1.0	1.8	14.5 (11.8–17.1)	12.8 (10.3–15.3)
Florida	11,389	1.0	1.7	12.4 (10.6–14.2)	10.5 (8.6–12.5)
Georgia	5,017	1.0	1.7	11.2 (9.3–13.1)	8.9 (6.9–10.8)
Hawaii	6,279	1.0	1.6	11.9 (10.2–13.6)	12.2 (10.3–14.1)
Idaho	3,847	1.0	1.7	10.3 (8.5–12.0)	9.7 (7.6–11.7)
Illinois	4,565	1.0	1.6	12.9 (11.1–14.6)	8.9 (7.2–10.7)
Indiana	5,845	1.0	1.6	13.0 (11.3–14.7)	10.5 (8.7–12.3)
Iowa	7,460	1.0	1.6	10.6 (9.1–12.1)	7.3 (5.8–8.8)
Kansas	8,297	1.0	1.7	10.9 (9.5–12.4)	9.8 (8.1–11.4)
Kentucky	4,743	1.0	1.6	8.8 (7.1–10.4)	5.6 (4.1–7.2)
Louisiana	3,324	1.0	1.5	11.2 (9.2–13.2)	7.3 (5.7–8.9)
Maine	7,902	1.0	1.9	11.9 (10.1–13.7)	10.9 (8.9–12.9)
Maryland	12,464	1.0	1.6	13.5 (11.9–15.2)	9.9 (8.2–11.5)
Massachusetts	5,209	1.0	1.7	13.4 (11.6–15.3)	10.5 (8.6–12.3)
Michigan	8,031	1.0	1.6	11.1 (9.5–12.7)	7.2 (5.7–8.8)
Minnesota	11,732	1.0	1.6	12.7 (11.1–14.2)	8.8 (7.2–10.4)
Mississippi	3,651	1.0	1.5	10.5 (8.6–12.5)	7.7 (6.0–9.4)
Missouri	5,299	1.0	1.6	8.7 (7.2–10.2)	7.4 (5.6–9.2)
Montana	5,073	1.0	1.7	10.0 (8.4–11.5)	9.6 (7.8–11.3)
Nebraska	12,557	1.0	1.6	10.7 (9.2–12.1)	8.0 (6.4–9.6)
Nevada	2,086	1.0	1.5	8.6 (6.9–10.3)	7.4 (5.5–9.3)
New Hampshire	4,043	1.0	1.7	12.9 (11.0–14.8)	12.3 (10.2–14.5)
New Mexico	4,638	1.0	1.5	11.5 (9.7–13.3)	9.2 (7.2–11.1)
New York	9,181	1.0	1.7	15.3 (13.5–17.1)	14.2 (12.3–16.0)
North Carolina	2,971	1.0	1.7	11.0 (9.2–12.8)	9.5 (7.6–11.5)
North Dakota	4,394	1.0	1.6	9.8 (8.0–11.7)	7.3 (5.6–9.1)
Ohio	9,616	1.0	1.6	9.5 (8.0–11.0)	7.4 (5.8–9.0)
Oklahoma	3,958	1.0	1.6	8.7 (7.2–10.2)	6.9 (5.2–8.5)
Oregon	4,303	1.0	1.7	12.9 (11.1–14.7)	12.2 (10.3–14.1)
Pennsylvania	5,150	1.0	1.6	10.6 (9.0–12.3)	8.4 (6.7–10.1)
Rhode Island	4,002	1.0	1.7	14.8 (12.6–17.0)	13.4 (11.1–15.8)
South Carolina	5,050	1.0	1.6	11.9 (10.2–13.7)	10.2 (8.4–12.0)
South Dakota	4,762	1.0	1.6	10.3 (8.1–12.5)	7.4 (5.4–9.5)
Tennessee	4,289	1.0	1.7	11.0 (9.2–12.8)	9.2 (7.3–11.1)
Texas	8,260	1.0	1.6	13.8 (11.7–15.8)	11.9 (9.8–14.0)
Utah	9,011	1.0	1.6	11.5 (10.0–13.1)	8.3 (6.8–9.8)
Vermont	4,530	1.0	1.9	15.3 (13.1–17.6)	16.0 (13.6–18.4)
Virginia	7,268	1.0	1.7	12.2 (10.4–13.9)	9.6 (7.9–11.4)
Washington	9,604	1.0	1.7	12.6 (11.0–14.2)	11.9 (10.1–13.7)
West Virginia	4,117	1.0	1.6	8.4 (6.8–9.9)	6.9 (5.3–8.6)
Wisconsin	3,881	1.0	1.6	11.6 (9.7–13.5)	7.6 (5.9–9.3)
Wyoming	3,501	1.0	1.7	9.4 (7.7–11.2)	8.4 (6.4–10.5)

* New Jersey data did not meet the minimum requirements for inclusion in the 2019 aggregate data set and were excluded.

fruit intake recommendations compared with those who were non-Hispanic White overall (11.1%); this pattern was observed in 14 states (Table 2). Overall, a significantly lower proportion of non-Hispanic Black adults (6.9%) met vegetable intake recommendations than did their non-Hispanic White counterparts (10.1%); however, this pattern was statistically significant in only three states (California, Massachusetts, and Nevada). Overall, a significantly higher proportion of adults living in households with the highest income category met vegetable intake recommendations (12.2%) than did adults living in middle income households (7.7%) and with the lowest income categories (6.8%); patterns were similar in most states.

TABLE 2. State-specific percentage of respondents meeting federal fruit intake recommendations, by sex, age, race/ethnicity, and income-to-poverty ratio — Behavioral Risk Factor Surveillance System, 49 states* and District of Columbia, 2019

	% (95% CI)										
	Sex		Age group, yrs			Race/Ethnicity[†]			IPR		
Jurisdiction	Male	Female (Ref)	18–30	31–50	≥51 (Ref)	Black	Hispanic	White (Ref)	<1.25	1.25–3.49	>3.49 (Ref)
National	**10.1[§] (8.5–11.6)**	**14.5 (13.1–15.8)**	**10.2 (7.7–12.6)**	**13.2 (11.4–14.9)**	**12.6 (11.1–14.1)**	**12.9 (11.1–14.7)**	**16.4[§] (14.4–18.5)**	**11.1 (10.1–12.2)**	**12.8 (11.2–14.4)**	**10.9[§] (9.6–12.3)**	**12.9 (11.5–14.2)**
Alabama	9.2 (6.6–11.7)	11.4 (9.4–13.4)	9.5 (4.9–14.2)	11.9 (9.2–14.6)	9.5 (7.6–11.4)	12.9[§] (9.7–16.0)	17.3 (6.2–28.4)	9.1 (7.5–10.7)	12.0 (8.5–15.4)	8.0[§] (6.0–10.0)	11.3 (9.1–13.5)
Alaska	9.5[§] (6.3–12.7)	15.4 (11.2–19.6)	13.6 (4.6–22.6)	10.9 (7.0–14.8)	12.9 (9.8–15.9)	—[¶]	—[¶]	11.2 (8.8–13.6)	16.2 (6.1–26.4)	8.4[§] (4.7–12.0)	13.4 (10.1–16.7)
Arizona	12.7 (9.7–15.8)	16.8 (13.9–19.7)	13.8 (8.4–19.2)	15.6 (11.8–19.5)	14.5 (11.9–17.1)	19.3 (10.2–28.4)	17.8 (13.3–22.2)	13.1 (11.0–15.3)	19.6 (13.9–25.4)	11.7 (8.8–14.6)	15.1 (12.4–17.7)
Arkansas	10.7 (7.7–13.7)	12.5 (9.9–15.0)	10.3 (5.1–15.5)	12.0 (8.4–15.6)	12.0 (9.7–14.3)	13.1 (7.8–18.4)	18.6 (9.3–27.9)	10.8 (8.9–12.7)	11.1 (7.5–14.7)	10.5 (7.8–13.2)	12.9 (10.0–15.8)
California	11.3[§] (8.9–13.6)	15.8 (13.7–18.0)	9.5[§] (6.3–12.8)	15.1 (12.2–18.0)	14.5 (12.2–16.9)	11.2 (7.5–14.8)	16.3[§] (13.8–18.8)	12.3 (10.5–14.1)	13.9 (11.3–16.5)	13.4 (10.8–15.9)	13.5 (11.4–15.6)
Colorado	10.7[§] (8.2–13.1)	14.1 (11.9–16.3)	9.8 (6.1–13.6)	14.4 (11.3–17.4)	12.0 (9.8–14.1)	12.7 (7.1–18.2)	15.3 (12.0–18.5)	11.6 (9.9–13.4)	10.8 (7.9–13.7)	10.3[§] (8.0–12.5)	13.6 (11.5–15.7)
Connecticut	13.6[§] (10.9–16.3)	18.6 (15.9–21.2)	15.0 (10.0–20.0)	15.8 (12.5–19.1)	16.7 (14.3–19.2)	15.7 (11.0–20.5)	19.8 (15.0–24.7)	15.7 (13.6–17.8)	17.3 (12.8–21.9)	14.4 (11.5–17.2)	16.6 (14.3–18.9)
Delaware	11.3 (7.6–15.0)	15.2 (12.2–18.2)	10.3 (4.2–16.3)	15.3 (10.7–19.9)	13.2 (10.4–16.1)	15.3 (9.7–21.0)	21.8[§] (13.0–30.6)	11.4 (9.1–13.6)	14.0 (9.5–18.5)	13.6 (9.2–17.9)	13.1 (10.3–15.9)
District of Columbia	11.8 (7.7–16.0)	16.9 (13.7–20.0)	7.2[§] (2.3–12.0)	17.9 (13.2–22.5)	16.2 (12.6–19.8)	15.0 (11.3–18.8)	15.3 (8.3–22.3)	13.8 (10.4–17.2)	14.8 (8.7–20.9)	14.8 (9.8–19.8)	14.3 (11.3–17.4)
Florida	10.2[§] (7.7–12.7)	14.5 (12.1–17.0)	10.8 (6.6–15.0)	13.8 (10.4–17.2)	12.1 (9.7–14.4)	14.5 (9.7–19.2)	15.7[§] (11.6–19.8)	10.7 (9.1–12.4)	13.5 (9.8–17.2)	12.3 (9.5–15.1)	12.1 (9.8–14.4)
Georgia	9.6 (6.7–12.6)	12.7 (10.4–14.9)	9.7 (4.8–14.5)	12.8 (9.5–16.0)	10.6 (8.3–12.9)	11.1 (7.9–14.3)	19.6[§] (12.6–26.5)	10.0 (8.1–12.0)	12.4 (8.9–15.9)	9.4 (6.7–12.1)	11.8 (9.3–14.3)
Hawaii	9.3[§] (7.1–11.6)	14.4 (11.9–16.9)	11.3 (7.2–15.4)	13.0 (9.8–16.1)	11.3 (9.0–13.5)	7.6 (1.9–13.4)	16.7 (12.2–21.1)	13.1 (10.7–15.5)	14.7 (10.7–18.6)	11.6 (8.7–14.4)	11.5 (9.5–13.5)
Idaho	8.2[§] (5.7–10.7)	12.3 (9.9–14.8)	8.1 (3.8–12.4)	10.3 (7.4–13.1)	11.4 (8.9–13.9)	—[¶]	11.8 (6.9–16.6)	10.0 (8.2–11.9)	11.6 (7.5–15.7)	8.5 (6.4–10.7)	11.2 (8.7–13.7)
Illinois	10.1[§] (7.6–12.6)	15.5 (13.1–17.8)	10.8 (6.6–15.0)	12.5 (9.7–15.4)	14.1 (11.7–16.6)	13.6 (9.6–17.6)	16.3[§] (12.7–20.0)	11.9 (10.0–13.7)	13.7 (10.1–17.4)	11.2 (8.7–13.7)	13.5 (11.3–15.7)
Indiana	11.1[§] (8.7–13.6)	14.9 (12.7–17.1)	11.3 (7.3–15.4)	14.3 (11.3–17.2)	12.8 (10.7–14.9)	15.9 (11.4–20.5)	18.7[§] (12.9–24.6)	12.3 (10.6–14.0)	13.2 (9.9–16.5)	10.8[§] (8.6–12.9)	14.5 (12.2–16.7)
Iowa	7.7[§] (5.6–9.7)	13.4 (11.4–15.5)	8.2 (4.5–12.0)	10.8 (8.4–13.2)	11.5 (9.5–13.6)	13.5 (7.0–20.1)	16.7[§] (11.8–21.6)	10.1 (8.7–11.6)	9.5 (6.7–12.4)	9.3 (7.3–11.3)	11.4 (9.6–13.2)
Kansas	8.7[§] (6.7–10.7)	13.1 (11.1–15.1)	8.5 (5.2–11.8)	12.1 (9.6–14.6)	11.2 (9.3–13.1)	11.9 (7.7–16.2)	13.2 (9.3–17.2)	10.5 (9.1–12.0)	9.6 (6.6–12.5)	9.1[§] (7.3–11.0)	12.3 (10.4–14.2)
Kentucky	6.7[§] (4.5–9.0)	10.8 (8.5–13.1)	8.1 (3.7–12.5)	8.8 (6.1–11.4)	9.1 (6.8–11.3)	14.2 (6.4–22.0)	17.7[§] (8.3–27.1)	8.0 (6.5–9.5)	10.2 (6.2–14.2)	6.6 (4.4–8.9)	9.6 (7.6–11.7)
Louisiana	10.6 (7.5–13.8)	11.8 (9.5–14.0)	10.8 (5.4–16.2)	11.7 (8.5–14.9)	11.0 (8.7–13.4)	13.8[§] (9.9–17.6)	18.2 (8.9–27.5)	9.2 (7.4–11.1)	12.7 (9.0–16.5)	9.7 (6.7–12.8)	11.5 (8.9–14.0)
Maine	9.3[§] (6.7–11.9)	14.5 (12.0–17.0)	10.3 (4.8–15.7)	12.9 (9.8–16.1)	11.9 (9.8–14.0)	—[¶]	27.5 (9.9–45.1)	11.7 (10.0–13.5)	8.0[§] (5.3–10.7)	9.3[§] (6.9–11.6)	14.5 (12.1–17.0)
Maryland	10.8[§] (8.4–13.1)	16.1 (13.9–18.3)	12.4 (8.1–16.7)	13.8 (11.1–16.5)	13.8 (11.7–16.0)	13.9 (11.1–16.7)	18.0[§] (13.3–22.7)	12.8 (11.1–14.6)	14.3 (10.7–17.8)	11.9 (9.5–14.3)	14.1 (12.1–16.1)
Massachusetts	11.9 (9.2–14.7)	14.9 (12.5–17.3)	10.6 (6.2–15.0)	15.6 (12.2–18.9)	13.1 (10.7–15.5)	12.0 (7.0–17.0)	15.6 (11.2–20.0)	13.5 (11.5–15.4)	12.8 (8.8–16.7)	12.2 (9.4–15.0)	14.0 (11.8–16.2)
Michigan	8.0[§] (5.8–10.1)	14.2 (12.0–16.5)	7.8[§] (4.2–11.4)	11.5 (8.8–14.2)	12.2 (10.1–14.4)	13.7 (9.8–17.5)	11.0 (6.8–15.1)	10.8 (9.2–12.4)	11.1 (8.0–14.2)	9.2[§] (7.2–11.2)	12.1 (10.1–14.1)
Minnesota	9.7[§] (7.7–11.8)	15.6 (13.4–17.8)	9.4[§] (5.9–12.8)	12.3 (9.8–14.8)	14.3 (12.1–16.6)	13.1 (8.7–17.6)	15.4 (11.1–19.7)	12.6 (11.0–14.1)	14.2 (10.7–17.6)	9.8[§] (7.9–11.6)	13.6 (11.8–15.5)
Mississippi	9.2 (6.0–12.5)	11.7 (9.5–13.9)	12.0 (5.6–18.4)	11.2 (8.4–14.0)	9.3 (7.2–11.3)	12.3[§] (9.1–15.6)	—[¶]	8.3 (6.5–10.0)	9.4 (6.6–12.3)	9.7 (7.0–12.5)	11.8 (8.9–14.8)
Missouri	6.6[§] (4.5–8.7)	10.7 (8.7–12.8)	6.0 (2.7–9.4)	9.5 (7.0–12.1)	9.3 (7.3–11.3)	11.1 (7.2–14.9)	10.0 (4.1–15.9)	8.2 (6.7–9.6)	8.0 (5.1–10.8)	6.7[§] (4.9–8.5)	10.1 (8.1–12.1)
Montana	8.1[§] (5.9–10.2)	12.0 (9.8–14.2)	6.2[§] (2.8–9.7)	10.9 (8.1–13.7)	11.0 (8.9–13.0)	—[¶]	12.8 (5.5–20.0)	9.7 (8.2–11.3)	8.7 (5.9–11.4)	8.3[§] (6.3–10.4)	11.6 (9.5–13.7)
Nebraska	8.3[§] (6.2–10.4)	13.1 (11.1–15.1)	9.2 (5.6–12.9)	10.6 (8.2–13.1)	11.4 (9.4–13.3)	13.5 (7.5–19.5)	14.9[§] (11.4–18.4)	10.2 (8.8–11.7)	10.3 (7.7–12.8)	9.3 (7.3–11.2)	11.6 (9.7–13.5)
Nevada	7.6 (5.1–10.1)	9.7 (7.4–12.0)	5.5 (2.1–9.0)	9.8 (6.7–12.9)	8.9 (6.4–11.4)	8.4 (4.0–12.9)	11.7 (7.8–15.5)	8.1 (6.2–10.0)	9.9 (5.7–14.1)	8.2 (5.5–10.9)	8.5 (6.4–10.6)
New Hampshire	10.1[§] (7.5–12.7)	15.7 (12.9–18.5)	10.8 (5.4–16.1)	11.7 (8.5–15.0)	14.4 (11.9–16.9)	—[¶]	—[¶]	12.8 (10.9–14.7)	8.5[§] (5.3–11.7)	12.4 (9.5–15.2)	13.8 (11.4–16.2)

See table footnotes on the next page.

TABLE 2. (*Continued*) State-specific percentage of respondents meeting federal fruit intake recommendations, by sex, age, race/ethnicity, and income-to-poverty ratio — Behavioral Risk Factor Surveillance System, 49 states* and District of Columbia, 2019

	% (95% CI)										
	Sex		Age group, yrs			Race/Ethnicity[†]			IPR		
Jurisdiction	Male	Female (Ref)	18–30	31–50	≥51 (Ref)	Black	Hispanic	White (Ref)	<1.25	1.25–3.49	>3.49 (Ref)
North Carolina	9.3 (6.6–12.0)	12.7 (10.3–15.0)	10.2 (5.4–15.0)	12.5 (9.3–15.6)	10.2 (8.0–12.5)	10.1 (7.0–13.1)	13.4 (8.7–18.1)	10.8 (8.8–12.8)	8.1[§] (5.3–10.9)	10.4 (7.3–13.5)	12.1 (9.9–14.4)
North Dakota	7.3[§] (4.9–9.6)	12.8 (10.0–15.5)	8.4 (3.9–12.9)	9.5 (6.5–12.6)	10.9 (8.6–13.2)	—[¶]	16.5 (6.3–26.8)	9.3 (7.6–11.0)	11.5 (6.1–16.8)	7.0[§] (4.9–9.2)	11.0 (8.7–13.3)
Ohio	7.6[§] (5.4–9.7)	11.3 (9.4–13.3)	7.6 (3.6–11.6)	10.1 (7.6–12.6)	9.9 (8.1–11.7)	11.0 (7.2–14.7)	20.4[§] (10.6–30.2)	8.7 (7.3–10.2)	7.6[§] (5.3–10.0)	8.4 (6.4–10.5)	10.8 (8.8–12.8)
Oklahoma	7.0[§] (4.8–9.2)	10.2 (8.2–12.2)	8.8 (4.6–13.0)	8.8 (6.3–11.3)	8.5 (6.6–10.4)	8.5 (4.0–12.9)	12.9 (7.6–18.2)	8.3 (6.8–9.9)	7.9 (5.0–10.8)	7.5 (5.4–9.6)	9.8 (7.7–11.9)
Oregon	10.1[§] (7.8–12.5)	15.6 (13.1–18.2)	10.4 (6.2–14.6)	13.2 (10.3–16.2)	13.7 (11.1–16.3)	—[¶]	13.3 (9.2–17.4)	13.3 (11.4–15.2)	11.6 (7.9–15.2)	11.4 (8.9–13.9)	14.1 (11.8–16.4)
Pennsylvania	8.1[§] (5.9–10.2)	13.1 (10.8–15.5)	8.3 (4.4–12.3)	12.1 (9.0–15.1)	10.5 (8.4–12.6)	13.7 (9.5–17.8)	15.5 (9.6–21.4)	9.8 (8.2–11.5)	10.4 (6.5–14.3)	8.5[§] (6.3–10.6)	11.8 (9.7–13.8)
Rhode Island	12.8 (9.7–16.0)	16.7 (13.8–19.6)	10.9 (5.8–16.1)	16.7 (12.5–20.9)	15.2 (12.6–17.8)	15.5 (8.5–22.6)	16.7 (10.7–22.7)	14.1 (11.9–16.3)	14.6 (10.1–19.0)	12.6 (9.4–15.8)	15.8 (13.0–18.5)
South Carolina	10.3 (7.7–12.9)	13.5 (11.1–15.9)	10.2 (6.0–14.5)	13.5 (10.1–16.9)	11.6 (9.5–13.8)	15.1[§] (11.5–18.7)	16.9 (6.6–27.2)	10.4 (8.7–12.1)	12.7 (9.1–16.3)	11.0 (8.2–13.8)	12.3 (10.0–14.5)
South Dakota	8.3 (5.1–11.4)	12.5 (9.5–15.4)	7.6 (2.2–13.0)	10.6 (6.9–14.2)	11.4 (8.5–14.3)	—[¶]	23.1 (7.5–38.8)	9.7 (7.7–11.8)	12.1 (5.9–18.4)	8.1 (5.2–11.0)	11.3 (8.5–14.1)
Tennessee	9.9 (7.1–12.7)	12.2 (10.0–14.4)	10.1 (5.3–14.9)	10.6 (7.7–13.5)	11.8 (9.5–14.2)	11.6 (7.8–15.4)	15.3 (6.1–24.5)	10.7 (8.8–12.6)	10.5 (7.4–13.5)	9.5 (6.9–12.1)	12.3 (9.7–14.8)
Texas	11.5[§] (8.6–14.4)	16.2 (13.4–18.9)	13 (8.1–17.9)	14.5 (11.2–17.8)	13.6 (10.8–16.5)	12.8 (8.1–17.4)	17.5[§] (13.7–21.4)	11.0 (9.1–12.9)	15.1 (10.8–19.4)	13.2 (9.7–16.7)	13.7 (11.2–16.2)
Utah	8.5[§] (6.4–10.7)	14.6 (12.6–16.7)	8.0[§] (4.6–11.3)	12.5 (10.0–15.0)	12.9 (10.7–15.1)	8.6 (1.6–15.6)	15.4[§] (11.7–19.1)	10.9 (9.4–12.5)	10.2 (7.0–13.4)	10.1 (8.1–12.2)	12.5 (10.6–14.4)
Vermont	11.5[§] (8.6–14.3)	19.1 (15.8–22.3)	10.8 (5.2–16.5)	17.0 (12.8–21.3)	16.0 (13.4–18.7)	—[¶]	13.9 (3.4–24.5)	15.4 (13.2–17.6)	11.1[§] (7.0–15.3)	12.2[§] (9.2–15.1)	18.0 (15.0–21.0)
Virginia	9.1[§] (6.7–11.5)	15.2 (12.8–17.6)	11.2 (6.5–15.8)	13.0 (10.0–15.9)	12.1 (9.9–14.3)	14.0 (10.6–17.3)	16.6[§] (11.6–21.7)	10.9 (9.2–12.6)	11.5 (8.2–14.8)	9.5[§] (7.3–11.8)	13.6 (11.3–15.9)
Washington	10.1[§] (7.9–12.3)	15.1 (12.9–17.3)	9.7 (6.0–13.3)	13.2 (10.5–16.0)	13.4 (11.2–15.6)	14.2 (8.1–20.4)	16.1 (12.3–19.9)	12.4 (10.8–14.1)	12.0 (8.9–15.2)	11.6 (9.4–13.9)	13.0 (11.1–14.9)
West Virginia	6.1[§] (4.2–8.1)	10.6 (8.3–12.9)	8.5 (3.8–13.3)	8.7 (6.0–11.4)	8.0 (6.4–9.7)	13.4 (3.1–23.7)	—[¶]	8.1 (6.6–9.6)	8.3 (5.4–11.2)	6.9 (5.0–8.9)	9.7 (7.5–12.0)
Wisconsin	7.7[§] (5.4–9.9)	15.5 (12.7–18.4)	7.9 (3.3–12.5)	12.2 (8.9–15.5)	12.7 (10.2–15.2)	7.9 (2.3–13.4)	13.5 (6.4–20.6)	11.4 (9.6–13.3)	10.0 (6.0–13.9)	10.8 (7.9–13.6)	12.4 (10.1–14.6)
Wyoming	7.2[§] (4.7–9.6)	11.8 (9.4–14.2)	6.8 (2.4–11.2)	9.3 (6.3–12.4)	10.7 (8.4–13.0)	—[¶]	12.1 (6.4–17.8)	9.0 (7.3–10.7)	8.9 (5.0–12.7)	8.0 (5.7–10.3)	10.4 (8.1–12.7)

Abbreviations: IPR = income-to-poverty ratio; Ref = referent group.

* New Jersey data did not meet the minimum requirements for inclusion in the 2019 aggregate data set and were excluded.

[†] Black and White persons are non-Hispanic; Hispanic persons could be of any race. Other racial/ethnic groups were not reported because of small sample sizes but were included in overall estimates and estimates by other demographic characteristics.

[§] p<0.05 for t-test comparing differences by demographic groups to the Ref.

[¶] Sample sizes <50 were considered unstable and were not reported.

Discussion

In 2019, fruit and vegetable intake among U.S. adults remained low, with only approximately one in 10 adults meeting either recommendation; differences were found by state, age, sex, race/ethnicity, and household income. Consistent with previous analyses of BRFSS data (*4*,*5*), a higher percentage of women than men met recommendations for fruit and vegetable intake, and larger disparities were observed in vegetable intake than fruit intake by age groups and household income. Results were also consistent with earlier findings (*5*) that higher percentages of Hispanic than non-Hispanic White adults met fruit intake recommendations while lower percentages of non-Hispanic Black than non-Hispanic White adults met vegetable intake recommendations. In 2015, intake was also low: 12.2% of respondents met fruit intake recommendations and 9.3% met vegetable intake recommendations (*5*); however, direct comparisons between current findings to those of 2015 cannot be made because of changes in methodology.***

Perceived barriers to fruit and vegetable consumption include cost, as well as limited availability and access (*6*–*8*). For some persons, such barriers might have worsened during the COVID-19 pandemic, related to economic and supply chain disruptions that could further limit ability to access healthier foods (*9*). Tailored intervention efforts to increase fruit and

*** https://www.cdc.gov/nutrition/data-statistics/using-the-new-BRFSS-modules.html

TABLE 3. State-specific percentage of respondents meeting federal vegetable intake recommendations, by sex, age, race/ethnicity, and income-to-poverty ratio — Behavioral Risk Factor Surveillance System, 49 states* and District of Columbia, 2019

	% (95% CI)										
	Sex		Age group, yrs			Race/Ethnicity[†]			IPR		
Jurisdiction	Men	Women (Ref)	18–30	31–50	≥51 (Ref)	Black	Hispanic	White (Ref)	<1.25	1.25–3.49	>3.49 (Ref)
National	**7.6[§] (5.8–9.4)**	**12.4 (10.6–14.3)**	**7.1[§] (5.0–9.3)**	**8.7 (6.5–10.8)**	**12.5 (10.3–14.6)**	**6.9[§] (5.2–8.6)**	**11.0 (9.3–12.6)**	**10.1 (8.4–11.8)**	**6.8[§] (5.0–8.5)**	**7.7[§] (5.9–9.4)**	**12.2 (10.5–14.0)**
Alabama	5.6 (3.5–7.7)	7.7 (5.6–9.8)	5.3 (3.0–7.5)	6.2 (4.0–8.5)	7.6 (5.4–9.9)	5.0 (1.7–8.3)	10.5 (7.2–13.8)	7.1 (3.8–10.4)	4.4[§] (2.0–6.8)	4.3[§] (1.9–6.6)	9.4 (7.0–11.7)
Alaska	9.6 (6.1–13.0)	13.5 (10.0–16.9)	10.3 (6.4–14.2)	8.7 (4.8–12.6)	14.6 (10.7–18.4)	—[¶]	—[¶]	11.5 (6.9–16.1)	9.5 (6.2–12.8)	9.1 (5.8–12.4)	12.9 (9.6–16.2)
Arizona	10.4[§] (7.2–13.5)	15.2 (12.1–18.3)	11.2 (8.0–14.3)	11.6 (8.5–14.8)	14.3 (11.2–17.4)	8.4 (3.9–13.0)	14.5 (9.9–19.0)	12.5 (7.9–17.1)	8.9[§] (5.7–12.2)	10.9 (7.7–14.1)	15.2 (11.9–18.4)
Arkansas	9.0 (6.0–12.1)	12.6 (9.5–15.6)	10.6 (7.8–13.4)	9.5 (6.7–12.3)	12.0 (9.2–14.8)	11.2 (0–23.3)	12.1 (0–24.2)	10.4 (0–22.6)	9.6 (6.6–12.6)	9.5 (6.4–12.5)	12.7 (9.7–15.7)
California	7.9[§] (5.3–10.5)	14.7 (12.1–17.3)	7.9[§] (4.9–10.8)	9.7 (6.7–12.6)	14.7 (11.7–17.6)	6.7[§] (3.9–9.5)	10.1 (7.3–12.9)	12.0 (9.1–14.8)	7.3[§] (5.0–9.7)	9.7[§] (7.3–12.0)	13.6 (11.3–16.0)
Colorado	7.9[§] (5.2–10.6)	13.0 (10.3–15.7)	8.1[§] (5.1–11.1)	8.7 (5.7–11.7)	13.2 (10.2–16.2)	6.7 (3.0–10.4)	9.5 (5.8–13.2)	10.7 (7.0–14.4)	6.0[§] (3.7–8.3)	8.2[§] (5.9–10.5)	12.1 (9.8–14.4)
Connecticut	11.0[§] (8.0–13.9)	17.2 (14.2–20.1)	10.2[§] (7.2–13.2)	11.7 (8.7–14.7)	17.1 (14.2–20.1)	9.7 (5.6–13.7)	13.4 (9.4–17.5)	14.8 (10.7–18.8)	9.7[§] (7.1–12.3)	11.0[§] (8.4–13.6)	16.2 (13.6–18.8)
Delaware	6.6[§] (3.6–9.7)	11.3 (8.3–14.4)	4.2[§] (1.0–7.5)	7.9 (4.6–11.2)	11.8 (8.5–15.1)	5.4 (0–12.3)	7.4 (0.6–14.3)	10.0 (3.1–16.9)	4.7[§] (1.7–7.8)	5.4[§] (2.3–8.5)	11.6 (8.5–14.7)
District of Columbia	10.5 (7.1–14.0)	14.9 (11.5–18.3)	10.6 (6.9–14.2)	12.4 (8.8–16.1)	15.1 (11.4–18.7)	7.9 (1.3–14.4)	12.2 (5.7–18.8)	15.9 (9.4–22.4)	4.7[§] (1.4–8.0)	7.8[§] (4.5–11.0)	15.8 (12.5–19.1)
Florida	8.1[§] (5.3–10.9)	12.9 (10.1–15.7)	8.5 (5.5–11.6)	8.5 (5.4–11.6)	12.5 (9.5–15.6)	8.5 (4.6–12.4)	11.2 (7.3–15.1)	10.7 (6.8–14.6)	7.0[§] (3.9–10.1)	7.9[§] (4.8–11.0)	13.5 (10.4–16.6)
Georgia	6.4[§] (3.7–9.1)	11.2 (8.5–13.9)	7.1 (4.1–10.1)	7.3 (4.4–10.3)	11.0 (8.0–14.0)	7.1 (2.3–11.9)	6.6 (1.7–11.4)	10.0 (5.1–14.8)	6.7 (3.8–9.6)	6.9 (4.0–9.8)	10.7 (7.8–13.7)
Hawaii	9.7[§] (6.9–12.6)	14.6 (11.8–17.5)	8.7[§] (5.8–11.6)	11.4 (8.5–14.3)	14.0 (11.1–16.9)	9.2 (7.2–11.2)	17.5[§] (15.5–19.5)	13.4 (11.4–15.4)	11.2 (8.7–13.7)	9.4[§] (6.9–12.0)	13.6 (11.1–16.2)
Idaho	7.4[§] (4.5–10.4)	11.9 (9.0–14.9)	6.9[§] (3.6–10.2)	7.4[§] (4.1–10.7)	12.9 (9.6–16.3)	—[¶]	11.4 (7.6–15.2)	9.7 (5.9–13.5)	6.8[§] (4.0–9.7)	7.4[§] (4.6–10.3)	12.1 (9.2–15.0)
Illinois	6.2[§] (3.8–8.7)	11.5 (9.0–14.0)	5.6[§] (2.8–8.5)	7.7 (4.9–10.6)	11.4 (8.6–14.3)	5.5 (1.9–9.1)	8.6 (5.0–12.2)	9.5 (6.0–13.1)	6.3[§] (3.9–8.7)	5.2[§] (2.8–7.6)	11.4 (8.9–13.8)
Indiana	8.3[§] (5.7–10.9)	12.8 (10.2–15.3)	8.1[§] (5.3–10.9)	9.7 (6.9–12.5)	12.4 (9.6–15.1)	6.6 (0.7–12.5)	10.8 (4.9–16.7)	10.8 (4.9–16.7)	8.6[§] (5.9–11.2)	7.7[§] (5.1–10.4)	13.0 (10.3–15.6)
Iowa	5.0[§] (2.7–7.4)	9.6 (7.2–11.9)	5.0[§] (2.4–7.5)	5.5[§] (3.0–8.1)	9.7 (7.2–12.3)	7.2 (3.7–10.7)	8.5 (4.9–12.0)	7.3 (3.8–10.8)	4.8[§] (2.8–6.9)	5.4[§] (3.4–7.5)	8.7 (6.7–10.8)
Kansas	7.1[§] (4.5–9.6)	12.4 (9.9–15.0)	6.6[§] (3.9–9.3)	8.5 (5.8–11.2)	12.3 (9.6–15.0)	5.8 (2.5–9.2)	9.2 (5.9–12.6)	10.0 (6.6–13.3)	6.1[§] (3.7–8.4)	8.0[§] (5.6–10.3)	11.7 (9.3–14.0)
Kentucky	4.0[§] (1.6–6.3)	7.3 (5.0–9.6)	4.0 (1.4–6.6)	4.5 (1.9–7.1)	7.3 (4.7–9.9)	2.2 (0–5.9)	8.1 (4.4–11.8)	5.9 (2.2–9.6)	3.0[§] (0.8–5.2)	3.6[§] (1.4–5.9)	7.8 (5.5–10.0)
Louisiana	5.9 (3.7–8.1)	8.7 (6.5–10.9)	4.4[§] (1.8–7.0)	6.1[§] (3.5–8.7)	9.8 (7.2–12.4)	5.0 (0.8–9.3)	11.0 (6.8–15.3)	7.8 (3.6–12.1)	5.0[§] (2.5–7.4)	5.3[§] (2.9–7.8)	9.6 (7.2–12.1)
Maine	7.8[§] (5.1–10.5)	14.0 (11.2–16.7)	8.3[§] (5.6–11.1)	9.0[§] (6.2–11.7)	13.0 (10.3–15.8)	—[¶]	18.6[§] (14.6–22.6)	10.9 (6.8–14.9)	6.6[§] (3.6–9.6)	7.3[§] (4.3–10.3)	14.2 (11.2–17.2)
Maryland	6.6[§] (4.1–9.2)	12.9 (10.3–15.4)	6.5[§] (3.8–9.3)	7.3[§] (4.5–10.0)	13.2 (10.5–15.9)	7.5 (3.9–11.1)	12.7 (9.0–16.3)	10.1 (6.5–13.8)	6.2[§] (4.0–8.4)	6.8[§] (4.6–9.0)	11.8 (9.6–14.0)
Massachusetts	8.1[§] (5.3–10.8)	12.7 (10.0–15.4)	6.2[§] (3.1–9.2)	8.6[§] (5.6–11.6)	13.7 (10.7–16.7)	6.0[§] (3.1–8.9)	8.9 (5.9–11.8)	11.1 (8.2–14.0)	5.6[§] (3.2–8.0)	6.9[§] (4.5–9.3)	12.5 (10.1–14.9)
Michigan	4.9[§] (2.5–7.2)	9.6 (7.3–12.0)	4.8[§] (2.3–7.3)	5.4[§] (2.9–7.9)	9.5 (7.0–12.0)	4.8 (2.1–7.6)	12.7[§] (9.9–15.4)	7.2 (4.5–10.0)	4.5[§] (2.4–6.7)	5.0[§] (2.9–7.2)	9.1 (7.0–11.3)
Minnesota	6.1[§] (3.7–8.6)	11.5 (9.1–13.9)	5.7[§] (3.0–8.4)	6.8[§] (4.1–9.5)	11.7 (9.0–14.4)	5.5 (2.1–9.0)	8.6 (5.1–12.1)	8.8 (5.3–12.3)	6.7[§] (4.7–8.8)	5.9[§] (3.8–7.9)	10.3 (8.2–12.4)
Mississippi	6.3 (4.0–8.6)	8.9 (6.6–11.2)	4.9[§] (2.2–7.5)	7.2 (4.5–9.8)	9.5 (6.8–12.1)	5.8 (1.4–10.2)	—[¶]	8.9 (4.4–13.3)	3.5[§] (0.7–6.2)	6.6[§] (3.9–9.4)	10.7 (8.0–13.5)
Missouri	5.5[§] (3.0–8.0)	9.3 (6.8–11.8)	4.9[§] (2.2–7.6)	6.4 (3.7–9.1)	9.4 (6.6–12.1)	4.5 (0–9.5)	9.2 (4.3–14.2)	7.6 (2.7–12.6)	4.2[§] (1.7–6.8)	5.7[§] (3.1–8.2)	9.3 (6.8–11.8)
Montana	8.5 (6.0–11.1)	10.6 (8.1–13.2)	7.7 (5.1–10.3)	8.9 (6.3–11.5)	10.7 (8.1–13.4)	—[¶]	16.6[§] (13.4–19.9)	9.5 (6.2–12.7)	7.2[§] (4.7–9.8)	7.2[§] (4.6–9.7)	12.0 (9.4–14.5)
Nebraska	5.8[§] (3.4–8.1)	10.2 (7.9–12.6)	5.9[§] (3.4–8.5)	6.2[§] (3.6–8.8)	10.3 (7.7–12.9)	5.8 (2.1–9.5)	7.1 (3.4–10.8)	8.1 (4.4–11.8)	5.1[§] (2.8–7.4)	5.3[§] (3.0–7.6)	10.3 (8.0–12.7)
Nevada	5.6[§] (2.8–8.3)	9.5 (6.7–12.2)	5.8 (2.9–8.8)	5.9 (3.0–8.9)	9.4 (6.4–12.3)	5.4[§] (3.2–7.5)	6.4 (4.3–8.6)	9.0 (6.8–11.1)	4.2[§] (1.5–6.8)	5.5[§] (2.9–8.1)	9.5 (6.8–12.1)
New Hampshire	9.6[§] (6.4–12.9)	15.1 (11.8–18.3)	10.3[§] (7.1–13.5)	9.2[§] (6.1–12.4)	15.0 (11.8–18.2)	—[¶]	—[¶]	12.0 (7.1–17.0)	6.5[§] (3.5–9.4)	8.4[§] (5.4–11.3)	14.9 (12.0–17.8)

See table footnotes on the next page.

TABLE 3. (*Continued*) State-specific percentage of respondents meeting federal vegetable intake recommendations, by sex, age, race/ethnicity, and income-to-poverty ratio — Behavioral Risk Factor Surveillance System, 49 states* and District of Columbia, 2019

	% (95% CI)										
	Sex		Age group, yrs			Race/Ethnicity[†]			IPR		
Jurisdiction	Men	Women (Ref)	18–30	31–50	≥51 (Ref)	Black	Hispanic	White (Ref)	<1.25	1.25–3.49	>3.49 (Ref)
North Carolina	7.6 (4.7–10.5)	11.4 (8.6–14.3)	7.4[§] (4.3–10.6)	7.6[§] (4.5–10.8)	12.1 (9.0–15.2)	8.0 (4.5–11.6)	7.1 (3.5–10.6)	10.3 (6.7–13.9)	4.8[§] (2.0–7.5)	7.0[§] (4.2–9.8)	12.2 (9.5–15.0)
North Dakota	5.4[§] (2.6–8.2)	9.5 (6.7–12.4)	6.0 (3.3–8.7)	5.5[§] (2.8–8.1)	9.6 (6.9–12.3)	—[¶]	8.6 (3.6–13.7)	6.9 (1.9–12.0)	5.5[§] (3.1–7.9)	4.2[§] (1.8–6.6)	9.2 (6.8–11.6)
Ohio	5.7[§] (3.5–8.0)	9.1 (6.8–11.3)	4.8[§] (2.4–7.2)	6.6 (4.2–9.0)	9.2 (6.8–11.6)	5.6 (2.2–9.0)	13.0[§] (9.6–16.4)	7.3 (3.9–10.7)	4.5[§] (2.1–6.8)	5.4[§] (3.1–7.7)	9.7 (7.3–12.0)
Oklahoma	5.7 (3.5–8.0)	7.9 (5.6–10.1)	4.6[§] (2.0–7.2)	6.1 (3.5–8.7)	8.5 (5.9–11.1)	5.4 (2.5–8.3)	7.4 (4.5–10.3)	7.0 (4.1–9.9)	3.4[§] (0.8–6.0)	4.7[§] (2.2–7.3)	9.6 (7.0–12.1)
Oregon	9.4[§] (6.5–12.3)	14.9 (12.0–17.9)	9.1[§] (6.0–12.2)	10.4[§] (7.3–13.5)	14.8 (11.8–17.9)	—[¶]	8.9 (3.8–13.9)	12.3 (7.2–17.3)	7.7[§] (5.1–10.4)	10.0[§] (7.4–12.7)	14.4 (11.8–17.1)
Pennsylvania	5.8[§] (3.2–8.4)	10.9 (8.3–13.6)	5.4[§] (2.7–8.1)	7.1 (4.4–9.7)	10.5 (7.8–13.1)	5.7 (2.3–9.2)	10.6 (7.1–14.0)	8.5 (5.0–11.9)	6.5[§] (4.2–8.8)	4.7[§] (2.4–7.0)	10.7 (8.4–13.0)
Rhode Island	9.3[§] (5.7–13.0)	17.4 (13.7–21.0)	9.9[§] (6.9–13.0)	12.0 (8.9–15.1)	15.8 (12.7–18.9)	8.6 (1.4–15.8)	8.7 (1.4–15.9)	13.9 (6.7–21.2)	8.2[§] (5.3–11.0)	12.6 (9.7–15.5)	14.9 (12.0–17.8)
South Carolina	8.2[§] (5.6–10.8)	12.0 (9.4–14.7)	8.5 (5.8–11.2)	8.3[§] (5.5–11.0)	12.3 (9.6–15.0)	7.6 (2.3–13.0)	13.6 (8.2–18.9)	10.6 (5.2–15.9)	6.2[§] (3.6–8.8)	7.6[§] (5.0–10.3)	12.9 (10.2–15.5)
South Dakota	5.9 (2.9–8.8)	9.1 (6.2–12.1)	4.6[§] (1.4–7.9)	6.5 (3.2–9.8)	9.6 (6.3–12.8)	—[¶]	14.5 (8.9–20.1)	7.0 (1.4–12.6)	7.2 (4.4–9.9)	4.5[§] (1.7–7.2)	9.3 (6.5–12.0)
Tennessee	7.6 (4.9–10.2)	10.8 (8.2–13.5)	6.9[§] (4.0–9.8)	7.6 (4.7–10.5)	11.4 (8.5–14.3)	5.8 (0.1–11.5)	11.5 (5.8–17.2)	9.6 (3.9–15.3)	6.7[§] (3.9–9.5)	6.8[§] (4.0–9.5)	11.7 (8.9–14.5)
Texas	10.2 (7.5–12.9)	13.6 (11.0–16.3)	8.8[§] (5.2–12.5)	11.3 (7.7–14.9)	14.4 (10.8–18.0)	7.6 (2.8–12.4)	12.7 (7.9–17.5)	12.7 (7.9–17.5)	7.8[§] (4.9–10.7)	10.6 (7.7–13.5)	14.1 (11.2–17.0)
Utah	6.3[§] (4.0–8.5)	10.4 (8.1–12.7)	5.1[§] (2.2–8.1)	7.3[§] (4.4–10.2)	11.8 (8.9–14.8)	5.2 (2.1–8.4)	9.0 (5.9–12.2)	8.2 (5.1–11.4)	5.4[§] (3.4–7.4)	5.9[§] (3.9–8.0)	10.0 (8.0–12.1)
Vermont	10.8[§] (7.1–14.5)	21.0 (17.3–24.7)	13.3[§] (10.1–16.6)	13.7[§] (10.4–17.0)	18.5 (15.2–21.7)	—[¶]	7.9 (0.6–15.2)	16.2 (8.9–23.5)	11.6[§] (8.3–14.8)	12.9[§] (9.6–16.2)	18.6 (15.3–21.9)
Virginia	7.1[§] (4.4–9.7)	12.1 (9.5–14.8)	5.9[§] (2.9–8.9)	8.0[§] (5.0–11.0)	12.7 (9.7–15.7)	6.9 (3.8–10.0)	10.5 (7.4–13.6)	10.4 (7.3–13.5)	4.3[§] (1.9–6.8)	6.6[§] (4.1–9.0)	12.2 (9.8–14.7)
Washington	9.2[§] (6.5–11.9)	14.6 (11.9–17.3)	6.7[§] (3.8–9.7)	11.1 (8.1–14.0)	14.9 (11.9–17.9)	10.3 (7.3–13.2)	13.5 (10.5–16.4)	11.9 (8.9–14.8)	8.9[§] (6.6–11.2)	9.4[§] (7.1–11.7)	13.3 (11.0–15.6)
West Virginia	4.9[§] (2.5–7.2)	9.0 (6.7–11.4)	3.5[§] (1.3–5.7)	4.7[§] (2.4–6.9)	7.5 (5.3–9.7)	4.9 (2.0–7.9)	—[¶]	7.0 (4.0–10.0)	4.8[§] (2.2–7.4)	5.1[§] (2.5–7.6)	9.7 (7.2–12.3)
Wisconsin	5.0[§] (2.5–7.6)	10.1 (7.6–12.7)	5.7[§] (3.1–8.2)	7.2 (4.7–9.8)	9.1 (6.6–11.7)	5.5 (1.1–9.9)	8.4 (4.0–12.8)	7.6 (3.2–12.0)	6.0 (3.6–8.5)	5.0[§] (2.6–7.5)	9.3 (6.8–11.7)
Wyoming	5.3[§] (2.1–8.5)	11.8 (8.6–14.9)	7.8[§] (4.9–10.7)	7.6[§] (4.7–10.5)	11.0 (8.1–13.9)	—[¶]	9.0 (3.9–14.1)	8.4 (3.3–13.5)	4.1[§] (1.3–7.0)	6.1[§] (3.2–8.9)	10.6 (7.7–13.4)

Abbreviations: IPR = income-to-poverty ratio; Ref = referent group.

* New Jersey data did not meet the minimum requirements for inclusion in the 2019 aggregate data set and were excluded.

† Black and White persons are non-Hispanic; Hispanic persons could be of any race. Other racial/ethnic group not reported because of small sample sizes but were included in overall estimates and estimates by other demographic characteristics.

§ $p<0.05$ for t-test comparing differences by demographic groups to the Ref.

¶ Sample sizes <50 were considered unstable and were not reported.

vegetable intake are needed to reduce age, sex, racial/ethnic, and income disparities in meeting fruit and vegetable intake recommendations among U.S. adults. States and communities can take actions by supporting food policy councils (community-based coalitions often supporting a specific community such as households with incomes below the federal poverty level or persons from racial and ethnic minority groups) to build a more sustainable food system,[†††] supporting community retail programs to attract grocery stores and supermarkets to underserved communities to improve community food quality[§§§] and increase healthy food access, promoting participation in federal nutrition assistance programs,[¶¶¶] and implementing nutrition incentive and produce prescription programs[****] that provide resources for persons to purchase fruits and vegetables. Additional efforts might include the use of nutrition standards, organizational food service guidelines,[††††] and farm-to-institution approaches to ensure that culturally preferred fruit and vegetable offerings are available in work sites, hospitals, park and recreation centers, food banks and pantries, restaurants, and other locations (*10*). Education and social marketing can also help to ensure awareness of the recommended amounts of

††† https://www.foodpolicynetworks.org/

§§§ https://www.cdc.gov/nccdphp/dnpao/state-local-programs/healthier-food-retail.html

¶¶¶ https://www.nal.usda.gov/legacy/fnic/usda-nutrition-assistance-programs

**** https://www.nutritionincentivehub.org/

†††† https://www.cdc.gov/nutrition/healthy-food-environments/food-serv-guide.html

Summary

What is already known about this topic?

The percentage of U.S. adults meeting fruit and vegetable intake recommendations is low.

What is added by this report?

In 2019, 12.3% and 10.0% of surveyed adults met fruit and vegetable intake recommendations, respectively. Meeting fruit intake recommendations was highest among Hispanic adults (16.4%) and lowest among males (10.1%). Meeting vegetable intake recommendations was highest among adults aged ≥51 years (12.5%) and lowest among adults with low income (6.8%).

What are the implications for public health practice?

States can use this information to tailor efforts to populations at high risk (e.g., men, young adults, and adults with lower income) and to implement enhanced interventions, policies, and programs that help persons increase fruit and vegetable consumption to support immune function and prevent chronic diseases.

fruits and vegetables to consume and how to incorporate fruits and vegetables into meals and snacks.[§§§§] Finally, conditions in which persons are born, live, learn, work, play, worship, and age, known as social determinants of health, affect health and influence the opportunities available to practice healthy behaviors. Ensuring that all persons, at all times, have physical, social, and economic access to enough foods, including fruits and vegetables that are safe, high quality, and meet their dietary needs and food preferences, requires multisectoral and multilevel collaboration.[¶¶¶¶]

The findings of this report are subject to at least five limitations. First, self-reported dietary behaviors are subject to recall and social desirability biases whereby different demographic groups might overestimate and others underestimate dietary intake.[*****] Second, BRFSS includes only noninstitutionalized adults; therefore, findings cannot be generalized to the entire U.S. adult population. In addition, U.S. territories were excluded because of the NHANES scoring algorithm. Third, using the algorithms to estimate intake might have resulted in measurement error. However, previous analyses showed that applying prediction equations to BRFSS frequency data yielded estimates comparable with national estimates that used more accurate 24-hour recalls (*4*). Fourth, 14% (59,589) of participants had missing fruit and vegetable data, and these respondents tended to be older and have a lower income. However, the percentage of missing data on fruit and vegetable and respondent characteristics are similar to that in previous studies (*4*,*5*). Finally, 16% (54,306) of participants had missing income data, but the estimated percentage of persons meeting recommendations was similar when missing income was imputed based on age, sex, and race/ethnicity.

§§§§ https://www.myplate.gov/eat-healthy/what-is-myplate

¶¶¶¶ https://www.cdc.gov/chronicdisease/programs-impact/sdoh.htm

***** https://dietassessmentprimer.cancer.gov/concepts/

Too few U.S. residents consume the recommended amounts of fruits and vegetables. Following a dietary pattern that includes sufficient fruits and vegetables can help protect against some chronic conditions that are among the leading causes of mortality in the United States (*2*); some of these conditions are also associated with more severe illness from COVID-19 (*3*). For most states, the BRFSS module is the only source of uniform, state-level dietary data for adults, and this information often provides critical metrics for state chronic disease plans. States can use the findings to guide their programs, communications and social marketing, and policies to support improving fruit and vegetable access and intake. Continued efforts to increase fruit and vegetable consumption by improving access and affordability in diverse community and institutional settings will help mitigate health disparities among U.S. residents.

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References

1. Childs CE, Calder PC, Miles EA. Diet and immune function. Nutrients 2019;11:1933. PMID:31426423 https://doi.org/10.3390/nu11081933
2. Mokdad AH, Ballestros K, Echko M, et al.; US Burden of Disease Collaborators. The state of US health, 1990–2016: burden of diseases, injuries, and risk factors among US states. JAMA 2018;319:1444–72. PMID:29634829 https://doi.org/10.1001/jama.2018.0158
3. CDC. COVID-19: people with certain medical conditions. Atlanta, GA: US Department of Health and Human Services, CDC; 2021. Accessed March 1, 2021. https://www.cdc.gov/coronavirus/2019-ncov/need-extra-precautions/people-with-medical-conditions.html
4. Moore LV, Dodd KW, Thompson FE, Grimm KA, Kim SA, Scanlon KS. Using Behavioral Risk Factor Surveillance System data to estimate the percentage of the population meeting US Department of Agriculture food patterns fruit and vegetable intake recommendations. Am J Epidemiol 2015;181:979–88. PMID:25935424 https://doi.org/10.1093/aje/kwu461
5. Lee-Kwan SH, Moore LV, Blanck HM, Harris DM, Galuska D. Disparities in state-specific adult fruit and vegetable consumption—United States, 2015. MMWR Morb Mortal Wkly Rep 2017;66:1241–7. PMID:29145355 https://doi.org/10.15585/mmwr.mm6645a1
6. Yeh MC, Ickes SB, Lowenstein LM, et al. Understanding barriers and facilitators of fruit and vegetable consumption among a diverse multi-ethnic population in the USA. Health Promot Int 2008;23:42–51. PMID:18182418 https://doi.org/10.1093/heapro/dam044
7. Mook K, Laraia BA, Oddo VM, Jones-Smith JC. Food security status and barriers to fruit and vegetable consumption in two economically deprived communities of Oakland, California, 2013–2014. Prev Chronic Dis 2016;13:E21. PMID:26866947 https://doi.org/10.5888/pcd13.150402

8. Chapman K, Goldsbury D, Watson W, et al. Exploring perceptions and beliefs about the cost of fruit and vegetables and whether they are barriers to higher consumption. Appetite 2017;113:310–9. PMID:28263775 https://doi.org/10.1016/j.appet.2017.02.043
9. Davis KF, Downs S, Gephart JA. Towards food supply chain resilience to environmental shocks. Nat Food 2021;2:54–65. https://doi.org/10.1038/s43016-020-00196-3
10. Harris D, Lott M, Lakins V, Bowden B, Kimmons J. Farm to institution: creating access to healthy local and regional foods. Adv Nutr 2012;3:343–9. PMID:22585910 https://doi.org/10.3945/an.111.001677

Alcohol Consumption and Binge Drinking During Pregnancy Among Adults Aged 18–49 Years — United States, 2018–2020

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There is no known safe amount of alcohol consumption during pregnancy; drinking alcohol during pregnancy can cause fetal alcohol spectrum disorders and might increase the risk for miscarriage and stillbirth (*1*). The prevalence of drinking among pregnant women increased slightly during 2011–2018; however, more recent estimates are not yet reported (*2*). CDC estimated the prevalence of self-reported current drinking (at least one alcoholic drink in the past 30 days) and binge drinking (consuming four or more drinks on at least one occasion in the past 30 days) among pregnant adults aged 18–49 years, overall and by selected characteristics, using 2018–2020 Behavioral Risk Factor Surveillance System (BRFSS) data. During 2018–2020, 13.5% of pregnant adults reported current drinking and 5.2% reported binge drinking: both measures were 2 percentage points higher than during 2015–2017. Pregnant adults with frequent mental distress were 2.3 and 3.4 times as likely to report current and binge drinking, respectively, compared with those without frequent mental distress. In addition, pregnant adults without a usual health care provider were 1.7 times as likely to report current drinking as were those with a current provider. Alcohol consumption during pregnancy continues to be a serious problem. Integration of mental health services into clinical care and improving access to care might help address alcohol consumption and mental distress during pregnancy to prevent associated adverse outcomes (*3*).

BRFSS is an annual, state-based, random-digit-dialed telephone survey of health-related behaviors representative of noninstitutionalized adults aged ≥18 years in the United States and participating territories. CDC analyzed 2018–2020 BRFSS self-reported data from 6,327 pregnant adults aged 18–49 years from all 50 U.S. states* and the District of Columbia. The analysis included all pregnant respondents irrespective of gender identity. In 2018, 2019, and 2020, median BRFSS response rates were 49.9% (range = 38.8%–67.2%), 49.4% (37.3%–73.1%), and 47.6% (34.5%–67.2%), respectively.†

Persons who reported their sex at birth as female were asked if they were currently pregnant. Current drinking§ and binge drinking¶ were defined based on 2020–2025 Dietary Guidelines for Americans.** Sociodemographic and health characteristics examined in this analysis included age, race/ethnicity, education, employment status, marital status, having a usual health care provider,†† and experiencing frequent mental distress.§§

Among pregnant adults, CDC estimated the prevalence and 95% CIs for current and binge drinking, overall and by sociodemographic and health characteristics and U.S. Department of Health and Human Services (HHS) region.¶¶ Multivariable regression was used to estimate adjusted prevalence ratios (aPRs) and 95% CIs to identify factors associated with current and binge drinking. To understand potential differences associated with the COVID-19 pandemic, the overall prevalence estimates were examined by year. Differences by year and HHS region were examined using Rao-Scott chi-square tests. Data were weighted to represent state-level population estimates and aggregated to represent regional and national estimates. P-values <0.05 and 95% CIs of aPRs that excluded 1.0 were considered statistically significant. SAS statistical software (version 9.4; SAS Institute) SURVEY procedures were used to account for complex sampling. This activity was reviewed by CDC and was conducted consistent with applicable federal law and CDC policy.***

Among pregnant adults, 13.5% reported current drinking and 5.2% reported binge drinking (38.5% of current drinkers) (Table). The prevalence of current drinking did not differ significantly by year: 11.8% (95% CI = 9.6–14.1) in 2018, 14.6% (11.2%–17.9%) in 2019, and 14.3% (10.5%–18.1%) in 2020 (p = 0.40). The prevalence of binge drinking also did

* New Jersey did not collect sufficient data to meet the minimum requirements for inclusion in 2019 BRFSS public use data set.

† Response rates were calculated using standards set by the American Association for Public Opinion Research. https://www.aapor.org/Standards-Ethics/Standard-Definitions-(1).aspx

§ Current drinking was defined as a response of "one or more" to the question, "During the past 30 days, how many days per week or per month did you have at least one drink of any alcoholic beverage such as beer, wine, a malt beverage or liquor?" https://www.cdc.gov/brfss/questionnaires/pdf-ques/2020-BRFSS-Questionnaire-508.pdf

¶ Binge drinking was defined as a response of "one or more" to the question, "Considering all types of alcoholic beverages, how many times during the past 30 days did you have four or more drinks on an occasion?"

** https://www.dietaryguidelines.gov/sites/default/files/2020-12/Dietary_Guidelines_for_Americans_2020-2025.pdf

†† Having a usual health care provider was ascertained by response to the question, "Do you have one person you think of as your personal doctor or health care provider?" Participants who answered "no" were asked, "Is there more than one, or is there no person who you think of as your personal doctor or health care provider?" Responses were dichotomized into one or more (yes) or none (no).

§§ Frequent mental distress was defined as a response of ≥14 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?" https://www.cdc.gov/hrqol/pdfs/mhd.pdf

¶¶ Sample sizes permitted examination of current drinking only by HHS region. https://www.hhs.gov/about/agencies/iea/regional-offices/index.html

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

TABLE. Estimated prevalence* and adjusted prevalence ratios of current drinking† and binge drinking§ reported by pregnant adults aged 18–49 years (N = 6,327), by selected characteristics — Behavioral Risk Factor Surveillance System, United States, 2018–2020

Characteristic	Current drinking		Binge drinking	
	% (95% CI)	aPR¶ (95% CI)	% (95% CI)	aPR¶ (95% CI)
Overall	**13.5 (11.7–15.4)**	—	**5.2 (3.6–6.7)**	—
Age group, yrs				
18–24	16.8 (12.3–21.4)	1.0 (0.7–1.3)	8.5 (4.6–12.4)**	1.4 (0.8–2.6)
25–29	10.3 (7.5–13.1)	0.6 (0.5–0.8)	NA††	0.6 (0.3–1.2)
30–34	11.1 (7.5–14.6)	0.6 (0.4–0.9)	NA††	1.1 (0.5–2.3)
35–49	17.0 (13.8–20.2)	Ref	4.4 (2.8–6.1)	Ref
Race/Ethnicity				
White, non-Hispanic	12.7 (10.9–14.5)	1.1 (0.7–1.6)	4.1 (2.9–5.3)	1.0 (0.5–2.2)
Black, non-Hispanic	15.0 (8.1–21.8)**	1.1 (0.6–2.0)	NA††	1.5 (0.5–4.5)
Hispanic	12.5 (8.0–17.1)	Ref	NA††	Ref
Other, non-Hispanic	17.2 (11.5–23.0)	1.4 (0.9–2.3)	NA††	1.6 (0.6–4.1)
Education				
High school diploma or less	10.2 (7.3–13.0)	Ref	4.9 (2.5–7.3)**	Ref
Some college	15.9 (11.6–20.2)	1.8 (1.2–2.5)	7.5 (3.5–11.5)**	1.8 (1.0–3.5)
College degree	15.7 (13.2–18.1)	2.2 (1.5–3.1)	3.5 (2.4–4.5)	1.2 (0.6–2.3)
Employment status				
Employed	15.6 (13.1–18.2)	1.5 (1.1–2.1)	6.1 (3.9–8.4)	2.1 (1.1–4.0)
Not employed	10.7 (8.0–13.3)	Ref	3.9 (1.9–5.8)**	Ref
Marital status				
Married	10.2 (8.0–12.5)	Ref	NA††	Ref
Not married	17.3 (14.3–20.3)	1.8 (1.2–2.5)	8.3 (5.6–10.9)	2.5 (1.1–6.0)
Has a usual health care provider				
Yes	11.9 (10.1–13.7)	Ref	4.4 (3.0–5.9)	Ref
No	17.8 (13.2–22.4)	1.7 (1.2–2.3)	7.2 (3.2–11.3)**	1.7 (0.8–3.3)
Frequent mental distress§§				
Yes	27.4 (19.7–35.0)	2.3 (1.7–3.1)	15.3 (7.8–22.8)**	3.4 (1.9–5.8)
No	11.6 (9.8–13.3)	Ref	3.8 (2.4–5.1)	Ref

Abbreviations: aPR= adjusted prevalence ratio; NA = not available; Ref = referent group.
* Percentages weighted to represent national estimates of the U.S. population.
† Defined as consuming at least one alcoholic drink in the past 30 days.
§ Defined as consuming four or more alcoholic drinks on one occasion at least once in the past 30 days.
¶ Model includes age, race/ethnicity, education, employment status, marital status, usual health care provider, and frequent mental distress.
** Estimate might be unstable because the relative SE is 0.2–0.3.
†† Estimate suppressed because the relative SE is >0.3.
§§ Defined as reporting ≥14 days of poor mental health in the past 30 days.

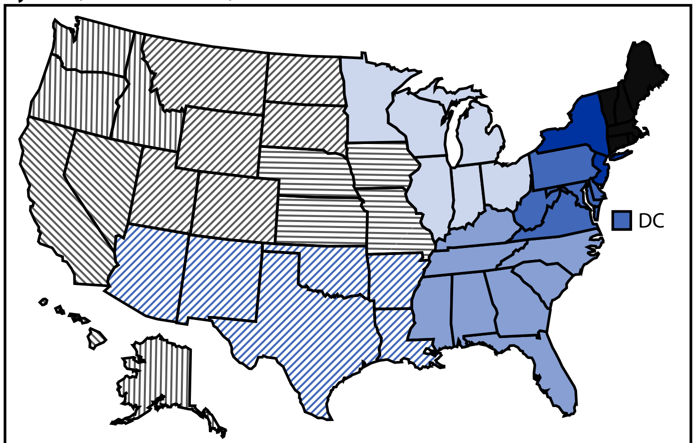
not differ significantly by year: 3.8% (2.4%–5.2%) in 2018, 5.8% (3.2%–8.4%) in 2019, and 6.1% (2.4%–9.7%) in 2020 (p = 0.38). Current drinking differed by age, education, employment, and marital status, and binge drinking differed by employment and marital status. Pregnant adults reporting frequent mental distress had approximately twice the prevalence of current drinking (aPR = 2.3 [1.7–3.1]) and approximately three times the prevalence of binge drinking (aPR = 3.4 [1.9–5.8]) as did those not reporting frequent mental distress. Pregnant adults without a usual health care provider more frequently reported current drinking (17.8%; aPR = 1.7 [1.2–2.3]) than did those with a usual provider (11.9%). Current drinking varied somewhat by HHS Regions (Figure), although differences were not statistically significant (p = 0.25).[†††]

Discussion

During 2018–2020, approximately one in seven pregnant adults reported drinking alcohol in the past 30 days and, among those, approximately 40% reported binge drinking. Current and binge drinking increased by approximately 2 percentage points in 2018–2020 estimates compared with estimates from the previous 3-year period, consistent with an upward trend observed since 2011 (*2*,*4*). There was no evidence of increased alcohol consumption by pregnant adults in 2020 relative to 2019, despite possible increased alcohol sales and consumption among the general population during the first months of the COVID-19 pandemic (*5*).[§§§]

††† *Region 1*: Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, and Vermont; *Region 2*: New Jersey and New York; *Region 3*: Delaware, District of Columbia, Maryland, Pennsylvania, Virginia, and West Virginia; *Region 4*: Alabama, Florida, Georgia, Kentucky, Mississippi, North Carolina, South Carolina, and Tennessee; *Region 5*: Illinois, Indiana, Michigan, Minnesota, Ohio, and Wisconsin; *Region 6*: Arkansas, Louisiana, New Mexico, Oklahoma, and Texas; *Region 7*: Iowa, Kansas, Missouri, and Nebraska; *Region 8*: Colorado, Montana, North Dakota, South Dakota, Utah, and Wyoming; *Region 9*: Arizona, California, Hawaii, and Nevada; *Region 10*: Alaska, Idaho, Oregon, and Washington.
§§§ https://pubs.niaaa.nih.gov/publications/surveillance-covid-19/COVSALES.htm

FIGURE. Estimated prevalence* of current drinking† among pregnant adults aged 18–49 years (N = 6,327), by U.S. Department of Health and Human Services regions§ — Behavioral Risk Factor Surveillance System, United States, 2018–2020



Abbreviation: DC = District of Columbia.

* Percentages weighted to represent national estimates of the U.S. population. Estimates for Region 9 and Region 6 might be unstable because the relative SEs are 0.2–0.3.

† Defined as having consumed at least one alcoholic drink in the past 30 days.

§ *Region 1*: Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, and Vermont; *Region 2*: New Jersey and New York; *Region 3*: Delaware, District of Columbia, Maryland, Pennsylvania, Virginia, and West Virginia; *Region 4*: Alabama, Florida, Georgia, Kentucky, Mississippi, North Carolina, South Carolina, and Tennessee; *Region 5*: Illinois, Indiana, Michigan, Minnesota, Ohio, and Wisconsin; *Region 6*: Arkansas, Louisiana, New Mexico, Oklahoma, and Texas; *Region 7*: Iowa, Kansas, Missouri, and Nebraska; *Region 8*: Colorado, Montana, North Dakota, South Dakota, Utah, and Wyoming; *Region 9*: Arizona, California, Hawaii, and Nevada; *Region 10*: Alaska, Idaho, Oregon, and Washington.

Summary

What is already known about this topic?

Alcohol consumption during pregnancy can cause fetal alcohol spectrum disorders and might increase the risk for poor pregnancy and birth outcomes. There is no known safe amount of alcohol consumption during pregnancy.

What is added by this report?

During 2018–2020, 13.5% of pregnant adults in the United States reported current drinking, and 5.2% reported binge drinking in the past 30 days. Those with no usual health care provider and those reporting frequent mental distress were more likely to consume alcohol.

What are the implications for public health practice?

High prevalence of alcohol consumption among pregnant adults requires integrated, evidence-based interventions to prevent alcohol-related harms and address factors associated with alcohol consumption.

This report found several factors correlated with drinking during pregnancy including age, education, and marital status, which are generally consistent with other nationally representative studies (*4*,*6*). Having a usual health care provider was associated with lower alcohol consumption. Having a usual health care provider might increase receipt of prevention services including alcohol screening and brief intervention, an effective tool universally recommended in primary care settings (*7*,*8*). CDC is working to increase alcohol screening and brief intervention and community-level interventions.¶¶¶ Addressing barriers to having a usual health care provider might also help address alcohol consumption during pregnancy.

Frequent mental distress was correlated with current and binge drinking, although the direction of the relationship is unclear (*9*). Universal screening for anxiety and depression along with perinatal depression prevention interventions are recommended for women and pregnant adults.**** Integration of mental health services has been proposed in primary care setting and might be considered when addressing alcohol consumption during pregnancy (*3*).

The findings in this report are subject to at least five limitations. First, cross-sectional data limit inferences about temporal relationships. Second, low response rates could introduce selection bias. Third, data are self-reported and subject to misclassification related to recall and social desirability biases. Fourth, pregnancy might be misclassified because early pregnancies might be unrecognized. Finally, drinking was reported over a 30-day period which might not reflect drinking patterns earlier in pregnancy when consumption tends to be higher (*10*). These last three limitations might contribute to underestimates of drinking during pregnancy.

Alcohol consumption during pregnancy continues to be a serious problem. Addressing it requires clinical and community-wide interventions, such as alcohol screening and brief intervention and limiting alcohol sales. Improved access to care, including mental health services, might reduce prenatal alcohol use and prevent poor pregnancy and birth outcomes.

¶¶¶ https://www.cdc.gov/ncbddd/fasd/alcohol-screening.html; https://www.thecommunityguide.org/topic/excessive-alcohol-consumption

**** The Well-Woman Chart outlines preventive services recommended by the Women's Preventive Service Initiative, U.S. Preventive Services Task Force, and Bright Futures. https://www.womenspreventivehealth.org/wp-content/uploads/WPSI_WWC_11x17_2021Update.pdf

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References

1. Bailey BA, Sokol RJ. Prenatal alcohol exposure and miscarriage, stillbirth, preterm delivery, and sudden infant death syndrome. Alcohol Res Health 2011;34:86–91. PMID:23580045
2. Denny CH, Acero CS, Terplan M, Kim SY. Trends in alcohol use among pregnant women in the U.S., 2011–2018. Am J Prev Med 2020;59:768–9. PMID:33011009 https://doi.org/10.1016/j.amepre.2020.05.017
3. National Council for Mental Wellbeing. Substance use disorders and the person-centered healthcare home. Washington, DC; 2010. https://www.thenationalcouncil.org/wp-content/uploads/2020/01/National_Council_SU_Report.pdf?daf=375ateTbd56
4. Denny CH, Acero CS, Naimi TS, Kim SY. Consumption of alcohol beverages and binge drinking among pregnant women aged 18–44 years—United States, 2015–2017. MMWR Morb Mortal Wkly Rep 2019;68:365–8. PMID:31022164 https://doi.org/10.15585/mmwr.mm6816a1
5. Barbosa C, Cowell AJ, Dowd WN. Alcohol consumption in response to the COVID-19 pandemic in the United States. J Addict Med 2021;15:341–4. PMID:33105169 https://doi.org/10.1097/ADM.0000000000000767
6. Grant BF, Chou SP, Saha TD, et al. Prevalence of 12-month alcohol use, high-risk drinking, and DSM-IV alcohol use disorder in the United States, 2001–2002 to 2012–2013: Results from the National Epidemiologic Survey on Alcohol and Related Conditions. JAMA Psychiatry 2017;74:911–23. PMID:28793133 https://doi.org/10.1001/jamapsychiatry.2017.2161
7. Curry SJ, Krist AH, Owens DK, et al.; US Preventive Services Task Force. Screening and behavioral counseling interventions to reduce unhealthy alcohol use in adolescents and adults: US Preventive Services Task Force recommendation statement. JAMA 2018;320:1899–909. PMID:30422199 https://doi.org/10.1001/jama.2018.16789
8. American College of Obstetricians and Gynecologists. American College of Obstetricians and Gynecologists committee opinion no. 762: Prepregnancy counseling. Obstet Gynecol 2019;133:e78–89. PMID: 30575679 https://doi.org/10.1097/AOG.0000000000003013
9. McHugh RK, Weiss RD. Alcohol use disorder and depressive disorders. Alcohol Res 2019;40:arcr.v40.1.01. PMID:31649834 https://doi.org/10.35946/arcr.v40.1.01
10. Ethen MK, Ramadhani TA, Scheuerle AE, et al.; National Birth Defects Prevention Study. Alcohol consumption by women before and during pregnancy. Matern Child Health J 2009;13:274–85. PMID:18317893 https://doi.org/10.1007/s10995-008-0328-2

Firearm Homicides and Suicides in Major Metropolitan Areas — United States, 2015–2016 and 2018–2019

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Firearm homicides and suicides represent an ongoing public health concern in the United States. During 2018–2019, a total of 28,372 firearm homicides (including 3,612 [13%] among youths and young adults aged 10–19 years [youths]) and 48,372 firearm suicides (including 2,463 [5%] among youths) occurred among U.S. residents (*1*). This report is the fourth in a series* that provides statistics on firearm homicides and suicides in major metropolitan areas. As with earlier reports, this report provides a special focus on youth violence, including suicide, recognizing the magnitude of the problem and the importance of early prevention efforts. Firearm homicide and suicide rates were calculated for the 50 most populous U.S. metropolitan statistical areas (MSAs)† for the periods 2015–2016 and 2018–2019, separated by a transition year (2017), using mortality data from the National Vital Statistics System (NVSS) and population data from the U.S. Census Bureau. Following a period of decreased firearm homicide rates among persons of all ages after 2006–2007 in large metropolitan areas collectively and nationally, by 2015–2016 rates had returned to levels comparable to those observed a decade earlier and remained nearly unchanged as of 2018–2019. Firearm suicide rates among persons aged ≥10 years have continued to increase in large MSAs collectively as well as nationally. Although the youth firearm suicide rate remained much lower than the overall rate, the youth rate nationally also continued to increase, most notably outside of large MSAs. The findings in this report underscore a continued and urgent need for a comprehensive approach to prevention. This includes efforts to prevent firearm homicide and suicide in the first place and support individual persons and communities at increased risk, as well as lessening harms after firearm homicide and suicide have occurred.

NVSS mortality data for 2015–2016 and 2018–2019 were used to identify firearm homicides (*International Classification of Diseases, Tenth Revision* underlying cause codes X93–X95 and U01.4) and firearm suicides (codes X72–X74) among U.S. residents. Firearm homicide and suicide counts were tabulated for the 50 largest MSAs (by population rank midyear 2019).§ Tabulated counts were integrated with U.S. Census Bureau population estimates for these MSAs to calculate annual firearm homicide rates for persons of all ages and annual firearm suicide rates for persons aged ≥10 years (data for persons aged <10 years were excluded because suicide intent is often not attributed to young children). Rates were similarly calculated for youths and young adults aged 10–19 years. Overall rates were age-adjusted to the year 2000 U.S. standard population profile. MSA-specific data involving firearm homicide or suicide counts less than 20 are not presented because of concerns related to statistical stability and data privacy. However, such data were included in calculations for the large MSAs combined. This activity was reviewed by CDC and was conducted consistent with applicable federal law and CDC policy.¶

Firearm homicide rates among persons of all ages during 2018–2019 varied widely across large MSAs, ranging from 1.1 (the Providence, Warwick [Rhode Island, Massachusetts] MSA and the San Jose, Sunnyvale, Santa Clara [California] MSA) to 18.9 (the Memphis [Tennessee, Mississippi, Arkansas] MSA) per 100,000 residents per year (Table). The rate for all large MSAs combined was 4.8 and the national rate was 4.5, comparable to rates of 4.9 and 4.4 observed for 2015–2016, respectively. The youth firearm homicide rate for the large MSAs combined was 4.9 during 2018–2019 and the national rate was 4.3, both representing increases from 2015–2016 when these rates were 4.7 and 3.9, respectively. Males accounted for approximately 85% of firearm homicide victims during both reporting periods for the 50 largest MSAs combined as well as nationally (National Vital Statistics System, unpublished data, 2020). During both periods, non-Hispanic Black (Black) persons represented a disproportionately large percentage of firearm homicide victims for the large MSAs combined (approximately 65%) relative to population representation (approximately 15%), with a comparable pattern seen nationally (58% and 13%, respectively) (National Vital Statistics System, unpublished data, 2020).

* https://www.cdc.gov/mmwr/preview/mmwrhtml/mm6018a1.htm; https://www.cdc.gov/mmwr/preview/mmwrhtml/mm6230a1.htm; https://www.cdc.gov/mmwr/volumes/67/wr/mm6744a3.htm

† An MSA is defined by the U.S. Office of Management and Budget (OMB) as consisting of "at least one urbanized area of 50,000 or more population, plus adjacent territory that has a high degree of social and economic integration with the core as measured by commuting ties." MSAs are geographically delineated by groupings of neighboring counties and can cross state boundaries; names are assigned by the OMB based on the names of one to three principal cities or places within each MSA. This report refers to MSAs as delineated by the OMB in March 2020.

§ The same MSAs were the 50 most populous during both reporting periods; rankings by total population changed slightly. This group includes most MSAs with a resident population of at least 1 million and represented approximately 55% of the U.S. resident population during 2018–2019.

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

TABLE. Numbers and annual rates of firearm homicides and suicides (per 100,000 persons) for the 50 most populous metropolitan statistical areas — United States, 2015–2016 and 2018–2019*

MSA	Yrs	No.† (rate)§			
		Firearm homicides		Firearm suicides	
		All ages	Ages 10–19 yrs	Ages ≥10 yrs	Ages 10–19 yrs
Total	**2015–2016**	**27,392 (4.4)**	**3,224 (3.9)**	**44,950 (7.7)**	**2,118 (2.5)**
	2018–2019	**28,370 (4.5)**	**3,612 (4.3)**	**48,371 (8.1)**	**2,463 (2.9)**
50 most populous MSAs combined	**2015–2016**	**17,097 (4.9)**	**2,147 (4.7)**	**18,433 (5.8)**	**850 (1.9)**
	2018–2019	**17,027 (4.8)**	**2,259 (4.9)**	**20,122 (6.2)**	**931 (2.0)**
Atlanta, Sandy Springs, Alpharetta (Georgia)	2015–2016	717 (6.3)	106 (6.5)	764 (7.6)	48 (2.9)
	2018–2019	763 (6.5)	108 (6.4)	963 (9.2)	51 (3.0)
Austin, Round Rock, Georgetown (Texas)	2015–2016	99 (2.3)	—¶	283 (8.2)	—
	2018–2019	84 (1.9)	—	311 (8.1)	—
Baltimore, Columbia, Towson (Maryland)	2015–2016	656 (12.2)	63 (9.1)	239 (4.7)	—
	2018–2019	676 (12.5)	67 (9.7)	248 (4.7)	—
Birmingham, Hoover (Alabama)	2015–2016	266 (12.8)	23 (8.3)	222 (11.4)	—
	2018–2019	312 (15.1)	32 (11.5)	216 (11.3)	—
Boston, Cambridge, Newton (Massachusetts, New Hampshire)	2015–2016	113 (1.2)	—	179 (2.0)	—
	2018–2019	130 (1.3)	—	189 (2.0)	—
Buffalo, Cheektowaga (New York)	2015–2016	81 (3.6)	—	76 (3.3)	—
	2018–2019	91 (4.2)	—	73 (3.4)	—
Charlotte, Concord, Gastonia (North Carolina, South Carolina)	2015–2016	238 (4.9)	24 (3.6)	352 (8.1)	23 (3.4)
	2018–2019	253 (5.0)	31 (4.4)	367 (7.8)	—
Chicago, Naperville, Elgin (Illinois, Indiana, Wisconsin)	2015–2016	1,527 (8.1)	272 (10.7)	620 (3.6)	29 (1.1)
	2018–2019	1,413 (7.6)	242 (9.8)	666 (3.9)	27 (1.1)
Cincinnati (Ohio, Kentucky, Indiana)	2015–2016	175 (4.1)	31 (5.2)	313 (8.2)	22 (3.7)
	2018–2019	192 (4.5)	34 (5.7)	357 (9.1)	—
Cleveland, Elyria (Ohio)	2015–2016	298 (7.8)	33 (6.4)	277 (7.2)	—
	2018–2019	284 (7.5)	42 (8.4)	315 (8.2)	—
Columbus (Ohio)	2015–2016	206 (5.0)	33 (6.2)	256 (7.0)	—
	2018–2019	205 (4.8)	23 (4.2)	276 (7.3)	—
Dallas, Fort Worth, Arlington (Texas)	2015–2016	537 (3.8)	62 (3.0)	932 (7.8)	54 (2.6)
	2018–2019	613 (4.0)	95 (4.4)	1,074 (8.4)	66 (3.0)
Denver, Aurora, Lakewood (Colorado)	2015–2016	173 (3.0)	—	469 (9.6)	24 (3.3)
	2018–2019	198 (3.4)	37 (5.0)	537 (10.2)	28 (3.8)
Detroit, Warren, Dearborn (Michigan)	2015–2016	652 (8.1)	50 (4.5)	554 (7.0)	28 (2.5)
	2018–2019	639 (7.9)	44 (4.1)	580 (7.3)	30 (2.8)
Hartford, East Hartford, Middletown (Connecticut)	2015–2016	55 (2.5)	—	59 (2.5)	—
	2018–2019	46 (2.0)	—	91 (3.9)	—
Houston, The Woodlands, Sugar Land (Texas)	2015–2016	828 (6.1)	109 (5.6)	921 (8.2)	45 (2.3)
	2018–2019	817 (5.8)	143 (7.0)	936 (7.8)	50 (2.5)
Indianapolis, Carmel, Anderson (Indiana)	2015–2016	298 (7.7)	45 (8.3)	308 (8.9)	—
	2018–2019	325 (8.3)	57 (10.2)	361 (10.0)	23 (4.1)
Jacksonville (Florida)	2015–2016	208 (7.4)	32 (8.8)	299 (11.1)	—
	2018–2019	241 (8.4)	44 (11.7)	323 (11.4)	—
Kansas City (Missouri, Kansas)	2015–2016	327 (8.2)	38 (6.8)	375 (10.4)	22 (4.0)
	2018–2019	410(10.1)	51 (9.0)	471 (12.4)	31 (5.5)
Las Vegas, Henderson, Paradise (Nevada)	2015–2016	234 (5.6)	26 (4.8)	391 (10.4)	—
	2018–2019	224 (5.2)	36 (6.3)	468 (11.5)	—
Los Angeles, Long Beach, Anaheim (California)	2015–2016	1,003 (3.7)	123 (3.6)	781 (3.2)	25 (0.7)
	2018–2019	871 (3.3)	105 (3.2)	773 (3.2)	24 (0.7)
Louisville/Jefferson County (Kentucky, Indiana)	2015–2016	200 (8.4)	25 (7.9)	255 (11.1)	—
	2018–2019	189 (8.0)	27 (8.6)	252 (11.0)	—
Memphis (Tennessee, Mississippi, Arkansas)	2015–2016	396 (15.0)	52 (14.0)	183 (8.0)	—
	2018–2019	494 (18.9)	75 (20.5)	222 (9.5)	—
Miami, Fort Lauderdale, Pompano Beach (Florida)	2015–2016	669 (5.9)	98 (7.1)	613 (5.3)	—
	2018–2019	694 (6.0)	64 (4.6)	712 (5.9)	—
Milwaukee, Waukesha (Wisconsin)	2015–2016	267 (8.9)	30 (7.2)	182 (6.5)	—
	2018–2019	207 (7.1)	24 (5.8)	182 (6.4)	—
Minneapolis, St. Paul, Bloomington (Minnesota, Wisconsin)	2015–2016	136 (2.0)	26 (2.8)	315 (5.2)	20 (2.2)
	2018–2019	123 (1.8)	23 (2.4)	368 (5.7)	23 (2.4)
Nashville–Davidson, Murfreesboro, Franklin (Tennessee)	2015–2016	177 (4.8)	29 (6.1)	331 (10.3)	23 (4.9)
	2018–2019	230 (6.1)	45 (9.1)	348 (10.4)	20 (4.0)
New Orleans, Metairie (Louisiana)	2015–2016	404 (16.7)	54 (17.7)	186 (8.1)	—
	2018–2019	370 (15.6)	45 (14.6)	202 (8.7)	—

See table footnotes on the next page.

TABLE (*Continued*). Numbers and annual rates of firearm homicides and suicides (per 100,000 persons) for the 50 most populous metropolitan statistical areas — United States, 2015–2016 and 2018–2019*

		No.† (rate)§			
		Firearm homicides		Firearm suicides	
MSA	Yrs	All ages	Ages 10–19 yrs	Ages ≥10 yrs	Ages 10–19 yrs
New York, Newark, Jersey City (New York, New Jersey, Pennsylvania)	2015–2016	917 (2.4)	91 (2.0)	513 (1.4)	—
	2018–2019	679 (1.8)	76 (1.7)	517 (1.4)	—
Oklahoma City (Oklahoma)	2015–2016	163 (6.0)	21 (5.7)	317 (13.5)	20 (5.5)
	2018–2019	151 (5.5)	—	319 (12.9)	—
Orlando, Kissimmee, Sanford (Florida)	2015–2016	251 (5.1)	23 (3.7)	275 (6.2)	—
	2018–2019	239 (4.5)	26 (4.0)	331 (7.0)	—
Philadelphia, Camden, Wilmington (Pennsylvania, New Jersey, Delaware, Maryland)	2015–2016	800 (6.8)	94 (6.1)	513 (4.5)	—
	2018–2019	849 (7.3)	96 (6.3)	526 (4.6)	—
Phoenix, Mesa, Chandler (Arizona)	2015–2016	397 (4.4)	42 (3.3)	865 (10.6)	34 (2.7)
	2018–2019	407 (4.3)	53 (4.0)	906 (10.2)	35 (2.6)
Pittsburgh (Pennsylvania)	2015–2016	233 (5.4)	38 (7.2)	381 (8.7)	—
	2018–2019	197 (4.5)	24 (4.7)	408 (9.1)	—
Portland, Vancouver, Hillsboro (Oregon, Washington)	2015–2016	80 (1.7)	—	356 (8.2)	—
	2018–2019	78 (1.6)	—	399 (8.7)	21 (3.6)
Providence, Warwick (Rhode Island, Massachusetts)	2015–2016	38 (1.1)	—	103 (3.3)	—
	2018–2019	32 (1.1)	—	96 (3.2)	—
Raleigh, Cary (North Carolina)	2015–2016	64 (2.5)	—	121 (5.4)	—
	2018–2019	55 (2.0)	—	152 (6.3)	—
Richmond (Virginia)	2015–2016	178 (7.3)	—	211 (9.0)	—
	2018–2019	189 (7.7)	25 (7.9)	205 (8.8)	—
Riverside, San Bernardino, Ontario (California)	2015–2016	303 (3.3)	41 (3.0)	408 (5.4)	20 (1.5)
	2018–2019	366 (4.0)	43 (3.2)	455 (5.7)	—
Sacramento, Roseville, Folsom (California)	2015–2016	162 (3.6)	21 (3.5)	259 (6.2)	—
	2018–2019	135 (2.9)	—	237 (5.4)	—
St. Louis (Missouri, Illinois)	2015–2016	596 (11.4)	61 (8.6)	442 (8.7)	—
	2018–2019	676 (13.0)	82 (11.8)	486 (9.4)	23 (3.3)
Salt Lake City (Utah)	2015–2016	46 (1.9)	—	237 (12.4)	20 (5.7)
	2018–2019	44 (1.8)	—	246 (12.0)	—
San Antonio, New Braunfels (Texas)	2015–2016	266 (5.5)	27 (3.9)	305 (7.3)	20 (2.9)
	2018–2019	246 (4.9)	42 (5.8)	380 (8.7)	36 (5.0)
San Diego, Chula Vista, Carlsbad (California)	2015–2016	103 (1.6)	—	282 (4.8)	—
	2018–2019	107 (1.5)	—	335 (5.5)	—
San Francisco, Oakland, Berkeley (California)	2015–2016	414 (4.5)	60 (5.8)	263 (3.0)	—
	2018–2019	285 (3.1)	33 (3.2)	264 (3.0)	—
San Jose, Sunnyvale, Santa Clara (California)	2015–2016	58 (1.5)	—	97 (2.7)	—
	2018–2019	43 (1.1)	—	99 (2.7)	—
Seattle, Tacoma, Bellevue (Washington)	2015–2016	165 (2.2)	32 (3.6)	452 (6.7)	29 (3.3)
	2018–2019	186 (2.4)	37 (4.1)	523 (7.4)	32 (3.5)
Tampa, St. Petersburg, Clearwater (Florida)	2015–2016	204 (3.7)	21 (3.1)	568 (9.4)	—
	2018–2019	213 (3.7)	23 (3.2)	591 (9.4)	—
Virginia Beach, Norfolk, Newport News (Virginia, North Carolina)	2015–2016	248 (6.8)	38 (8.7)	271 (8.3)	20 (4.6)
	2018–2019	247 (7.0)	35 (8.0)	295 (9.3)	—
Washington, Arlington, Alexandria (DC, Virginia, Maryland, West Virginia)	2015–2016	471 (3.8)	42 (2.7)	459 (4.3)	28 (1.8)
	2018–2019	509 (4.1)	72 (4.6)	471 (4.2)	29 (1.8)

Abbreviations: DC = District of Columbia; MSA = metropolitan statistical area.

* Numbers and rates reflect decedent place of residence, not place of occurrence. This table includes only the 50 most populous MSAs among the 384 MSAs currently delineated and therefore cannot be used to establish comprehensive national rankings.

† These national and MSA–specific numbers exclude a small fraction of records with undocumented decedent age (four firearm homicides and four firearm suicides) and might therefore differ slightly from numbers in the text.

§ Per 100,000 residents per year. Rates are age–adjusted to the year 2000 U.S. standard population profile.

¶ Dashes indicate entry suppressed because of statistical instability or data confidentiality concerns (both associated with small numbers).

Overall firearm suicide rates during 2018–2019 also varied widely across large MSAs, ranging from 1.4 (the New York, Newark, Jersey City [New York, New Jersey, Pennsylvania] MSA) to 12.9 (the Oklahoma City [Oklahoma] MSA) per 100,000 residents per year (Table). The rates for large MSAs combined and nationally were 6.2 and 8.1, respectively, both representing increases from 2015–2016, when the respective rates were 5.8 and 7.7. From 2015–2016 to 2018–2019, firearm suicides rates increased for 30 (60%) of the 50 largest MSAs. During both periods, youth firearm suicide rates were much lower than overall rates. For the largest MSAs collectively, the youth firearm suicide rate during 2018–2019 was

Summary

What is already known about this topic?

In the United States, firearm homicides are disproportionately concentrated in large metropolitan areas, and firearm suicides are disproportionately concentrated outside such areas.

What is added by this report?

Firearm homicide rates among persons of all ages remained nearly unchanged from 2015–2016 to 2018–2019 in large metropolitan areas collectively and nationally; rates among youths increased somewhat within and outside large metropolitan areas. Firearm suicide rates increased in large metropolitan areas collectively and nationally; the rate among youths increased outside large metropolitan areas.

What are the implications for public health practice?

There is an urgent need for comprehensive firearm homicide and suicide prevention efforts to reduce overall rates as well as ethnic and racial disparities; increases in rates among youths within and outside of metropolitan areas represent a notable concern.

2.0, comparable to the rate of 1.9 observed for 2015–2016; the national rate for 2018–2019 was 2.9, representing a more notable increase from the rate of 2.5 for the earlier period. Similar to firearm homicides, males accounted for approximately 85% of firearm suicides in both reporting periods for the 50 largest MSAs combined and nationally (National Vital Statistics System, unpublished data, 2020). During both periods, non-Hispanic White (White) persons represented a disproportionately large percentage of firearm suicide victims (approximately 80%) for the largest MSAs combined relative to population representation (approximately 55%), with a comparable national pattern (85% and 63%, respectively) (National Vital Statistics System, unpublished data, 2020).

Discussion

During 2018–2019, homicide was the sixteenth leading cause of death overall in the United States and the third leading cause among youths (*2*); firearm injuries were the underlying cause of death in 75% of all homicides and in 91% of youth homicides (*1*). From 2015–2016 to 2018–2019, firearm homicide rates among persons of all ages were nearly unchanged nationally and for the 50 largest MSAs combined. The youth firearm homicide rate for the largest MSAs combined increased somewhat across the two periods, with the national rate among youths increasing more notably; these increases coincided with those in youth firearm homicide rates for less populous metropolitan and nonmetropolitan areas which markedly exceeded the increase for the largest MSAs (*3*). For the largest MSAs collectively, firearm homicide rates among persons of all ages and among youths have both remained higher than corresponding national rates.

For the same period, suicide was the tenth leading cause of death nationwide among persons aged ≥10 years and the second leading cause among youths (*2*); firearm injuries were listed as the underlying cause of death in 50% of all suicides and in 43% of all youth suicides (*1*). Previously observed increases in overall firearm suicide rates continued in recent years, in the largest MSAs collectively and nationally. Youth firearm suicide rates also increased nationally but remained nearly level in the largest MSAs combined; this coincided with increases in youth rates for less populous metropolitan and nonmetropolitan areas, with the rate for nonmetropolitan areas increasing most notably (*3*). In contrast to firearm homicide rates, overall firearm suicide rates and youth firearm suicide rates in the largest MSAs collectively have remained lower than the corresponding national rates.

Firearm homicide remains a persistent problem in metropolitan areas in the Unites States, especially among young Black males, and increasingly, in less populous and nonmetropolitan areas as well. Previous research has found that wealth inequality, lack of trust in institutions, and economic deprivation are associated with firearm homicide rates at the county level (*4*). Persistently high rates among racial and ethnic minority youths might be rooted in stressors associated with living in under-resourced communities and ultimately caused by systemic racism or multigenerational poverty resulting from limited educational and economic opportunities (*5*). Although not specifically evaluated for effects on firearm homicide, prevention efforts that strengthen household financial security (e.g., tax credits, child care subsidies, temporary assistance to families, and livable wages) and that improve access to high-quality early childhood education have demonstrated positive effects on important risk factors for firearm homicide, including poverty, school performance, school dropout rates, substance use, behavioral problems, and arrests for violent and nonviolent offenses (*6*,*7*).

Firearm suicide similarly remains a persistent public health problem, particularly among White males. Multiple factors influence suicide risk, including family and relationship problems, job and financial concerns, mental illness, substance use, and stigma around help-seeking (*8*,*9*). The effects of the evolving drug overdose epidemic might also be contributing to the risk among youths, either directly through their own substance use or indirectly through adult use that increases the prevalence of adverse childhood experiences (*6*).

Another factor likely affecting both firearm homicide and suicide is access to firearms by persons at risk for harming themselves or others (*10*). However, the specific nature of and avenues to firearm access among inner-city youths should be more fully explored. Reducing access to lethal means before or during an acute suicidal crisis by safely storing firearms or temporarily removing them from the home can help reduce suicide risk, particularly among youths (*9*).

A focus on upstream prevention can potentially reduce both firearm homicide and suicide rates. This includes approaches that prevent the risk of firearm homicide and suicide in the first place, such as strengthening economic supports, strengthening access to and delivery of care, teaching coping and problem-solving skills, building positive and nurturing relationships, connecting youths to caring adults and activities, and implementing place-based interventions (e.g., remediating abandoned buildings and blighted areas, creating and maintaining green spaces, and investing in basic services and commercial activities) (*6*,*7*,*9*). Together, such measures are associated with reductions in youth violence and crime, suicide, and risk factors such as weapon carrying, substance use, school dropout, involvement in high-risk social networks such as gangs, depression, stress and anxiety, and suicidal thoughts and behavior (*7*,*9*). As part of a comprehensive prevention approach, individual persons and communities at increased risk should be supported through identification of and response to warning signs, through evidence-based programs and treatment (*6*,*9*), and by lessening harms after violence and suicide have occurred (*6*,*7*,*9*).

The findings in this report are subject to at least two limitations. First, although the findings incorporate the most recent comprehensive mortality data available at the time of analysis, they do not fully characterize changing patterns in firearm-related violence; summary statistics for 2020 indicate a further increase in the rate of firearm-related death overall, largely because of an increase in the homicide rate (*3*). Second, and notwithstanding the intended focus on youth firearm homicide and suicide, a broader analysis might have addressed these outcomes for other age groups not separately considered.

Firearm injuries contribute substantially to premature death and disability. Ongoing monitoring of such injuries in both metropolitan and nonmetropolitan areas can help assess and guide prevention efforts.

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References

1. CDC. WISQARS: fatal injury reports, national, regional, and state, 1981–2019. Atlanta, GA: US Department of Health and Human Services, CDC; 2020. https://wisqars.cdc.gov/fatal-reports
2. CDC. WISQARS: leading causes of death reports, 1981–2019. Atlanta, GA: US Department of Health and Human Services, CDC; 2020. https://wisqars.cdc.gov/fatal-leading
3. CDC. CDC WONDER: underlying cause of death, 1999–2020. Atlanta, GA: US Department of Health and Human Services, CDC; 2021. https://wonder.cdc.gov/Deaths-by-Underlying-Cause.html
4. Rowhani-Rahbar A, Quistberg DA, Morgan ER, Hajat A, Rivara FP. Income inequality and firearm homicide in the US: a county-level cohort study. Inj Prev 2019;25(Suppl 1):i25–30. PMID:30782593 https://doi.org/10.1136/injuryprev-2018-043080
5. Nation M, Chapman DA, Edmonds T, et al. Social and structural determinants of health and youth violence: shifting the paradigm of youth violence prevention. Am J Public Health 2021;111(S1):S28–31. PMID:34038155 https://doi.org/10.2105/AJPH.2021.306234
6. CDC. Preventing adverse childhood experiences (ACEs): leveraging the best available evidence. Atlanta, GA: US Department of Health and Human Services, CDC; 2019. https://www.cdc.gov/violenceprevention/pdf/preventingACES.pdf
7. David-Ferdon C, Vivolo-Kantor AM, Dahlberg LL, Marshall KJ, Rainford N, Hall JE. A comprehensive technical package for the prevention of youth violence and associated risk behaviors. Atlanta, GA: US Department of Health and Human Services, CDC; 2016. https://www.cdc.gov/violenceprevention/pdf/yv-technicalpackage.pdf
8. Stone DM, Simon TR, Fowler KA, et al. Vital signs: trends in state suicide rates—United States, 1999–2016 and circumstances contributing to suicide—27 states, 2015. MMWR Morb Mortal Wkly Rep 2018;67:617–24. PMID:29879094 https://doi.org/10.15585/mmwr.mm6722a1
9. Stone DM, Holland KM, Bartholow BN, Crosby AE, Davis SP, Wilkins N. Preventing suicide: a technical package of policy, programs, and practices. Atlanta, GA: US Department of Health and Human Services, CDC; 2017. https://www.cdc.gov/violenceprevention/pdf/suicideTechnicalPackage.pdf
10. Anglemyer A, Horvath T, Rutherford G. The accessibility of firearms and risk for suicide and homicide victimization among household members: a systematic review and meta-analysis. Ann Intern Med 2014;160:101–10. PMID:24592495 https://doi.org/10.7326/M13-1301

Risk Factors for Severe COVID-19 Outcomes Among Persons Aged ≥18 Years Who Completed a Primary COVID-19 Vaccination Series — 465 Health Care Facilities, United States, December 2020–October 2021

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Vaccination against SARS-CoV-2, the virus that causes COVID-19, is highly effective at preventing COVID-19–associated hospitalization and death; however, some vaccinated persons might develop COVID-19 with severe outcomes[†] (*1,2*). Using data from 465 facilities in a large U.S. health care database, this study assessed the frequency of and risk factors for developing a severe COVID-19 outcome after completing a primary COVID-19 vaccination series (primary vaccination), defined as receipt of 2 doses of an mRNA vaccine (BNT162b2 [Pfizer-BioNTech] or mRNA-1273 [Moderna]) or a single dose of JNJ-78436735 [Janssen (Johnson & Johnson)] ≥14 days before illness onset. Severe COVID-19 outcomes were defined as hospitalization with a diagnosis of acute respiratory failure, need for noninvasive ventilation (NIV), admission to an intensive care unit (ICU) including all persons requiring invasive mechanical ventilation, or death (including discharge to hospice). Among 1,228,664 persons who completed primary vaccination during December 2020–October 2021, a total of 2,246 (18.0 per 10,000 vaccinated persons) developed COVID-19 and 189 (1.5 per 10,000) had a severe outcome, including 36 who died (0.3 deaths per 10,000). Risk for severe outcomes was higher among persons who were aged ≥65 years, were immunosuppressed, or had at least one of six other underlying conditions. All persons with severe outcomes had at least one of these risk factors, and 77.8% of those who died had four or more risk factors. Severe COVID-19 outcomes after primary vaccination are rare; however, vaccinated persons who are aged ≥65 years, are immunosuppressed, or have other underlying conditions might be at increased risk. These persons should receive targeted interventions including chronic disease management, precautions to reduce exposure, additional primary and booster vaccine doses, and effective pharmaceutical therapy as indicated to reduce risk for severe COVID-19 outcomes. Increasing COVID-19 vaccination coverage is a public health priority.

Data from 465 facilities in the Premier Healthcare Database Special COVID-19 Release (PHD-SR) were analyzed.[§] Persons who completed primary vaccination (including those who might have received additional doses as part of their primary vaccination series, and booster vaccine doses) were included in the analysis.[¶] Persons with partial vaccination recorded in PHD-SR were excluded. COVID-19 was identified by querying all encounters in PHD-SR during March 2020–October 2021.[**] Severe outcomes were defined as any one of the following: diagnosis of acute respiratory failure, need for NIV, ICU admission, or death. [††] The risk for COVID-19

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† https://www.medrxiv.org/content/10.1101/2021.07.08.21259776v1

§ PHD-SR, formerly known as the PHD COVID-19 Database, is a large U.S. health care all-payor administrative database that includes inpatient and hospital-based outpatient (e.g., emergency department or clinic) health care encounters from >900 geographically diverse, nonprofit, nongovernmental, community, and teaching hospitals and health systems from rural and urban areas. PHD-SR represents approximately 20% of U.S. inpatient admissions. Of all reporting centers, 465 reported vaccination data during December 2020–October 2021 and were included in the study. Updated PHD-SR data are released every 2 weeks; data for this report were obtained from PHD-SR release date November 8, 2021. https://offers.premierinc.com/rs/381-NBB-525/images/PHD_COVID-19_White_Paper.pdf

¶ Completion of a primary vaccination series was defined as receipt of the second of 2 doses of an mRNA vaccination series (Pfizer-BioNTech or Moderna]) or a single dose of Janssen ≥14 days before onset of illness. Only vaccines with Food and Drug Administration (FDA) full or emergency use authorization were considered in this definition. The definition of persons who completed primary vaccination included persons who might have received either or both of additional doses as part of their primary vaccination series or booster vaccine doses after primary vaccination (1.2% received additional vaccine doses). Vaccination was collected using current procedural terminology (CPT) codes (0001A and 002A for first and second Pfizer-BioNTech doses, respectively, 0011A and 0012A for first and second Moderna doses, respectively, 0031A for Janssen vaccine) and standard charge codes (510771000010000 and 510771000020000 for first and second Pfizer-BioNTech doses, respectively, 510771000110000 and 510771000120000 for first and second Moderna doses, respectively, and 510771000310000 for Janssen vaccine).

** Inpatient and outpatient encounters for COVID-19 were identified based on primary or secondary diagnosis coding for COVID-19 (legacy coding with *International Classification of Diseases, Tenth Revision, Clinical Modification* (ICD-10-CM) code B97.29 [other coronavirus as the cause of diseases classified elsewhere] for March 2020, ICD-10-CM codes U07.1 [COVID-19] or J12.82 [pneumonia due to coronavirus disease 2019] during March 2020–October 2021), or SARS-CoV-2 reverse transcription–polymerase chain reaction (RT-PCR) positivity. Encounters were excluded if there had been a previous COVID-19 encounter within the 90 days preceding vaccination to minimize collection of readmissions of infections occurring before vaccination and/or persistent positive RT-PCR test results.

†† Acute respiratory failure was identified by ICD-10-CM codes (J80, J96.00, J96.90, R06.00, R06.03, R06.09, R06.3, R06.89, and R09.2) or procedure codes (5A1935Z, 5A1945Z, and 5A1955Z); NIV was identified using CPT code 94660 with exclusion of persons with concurrent ICD-10-CM coding for obstructive sleep apnea (G47.33) or obesity hypoventilation syndrome (E66.2) to avoid confounding because of chronic use; ICU admission was identified from hospital chargemaster records (a comprehensive list of items billable from an encounter); deaths were identified from discharge status. Deaths included persons discharged to hospice. Where a person had several COVID-19 encounters meeting criteria, outcomes were defined based on the encounter with the most severe outcome.

severe outcomes and deaths per 10,000 persons were calculated among persons who completed primary vaccination. Among persons with COVID-19 after primary vaccination, a logistic regression model was specified to estimate the odds for severe versus nonsevere outcomes. Covariates included age group, sex, race/ethnicity, six selected underlying conditions (Supplementary Table, https://stacks.cdc.gov/view/cdc/113043),[§§] vaccine type, time since primary vaccination, prevalence of the SARS-CoV-2 B.1.617.2 (Delta) variant,[¶¶] and previous COVID-19 (defined as COVID-19 occurring >90 days before primary vaccination). Receipt of anti–SARS-CoV-2 monoclonal antibodies[***] was not entered in the model, because no severe outcomes were identified in this subgroup. Statistically significant risk factors for severe outcomes were identified from the model, and the number of risk factors per person was calculated. All analyses were performed using SAS statistical software (version 9.4; SAS Institute); p-values <0.05 were considered statistically significant. This activity was reviewed by CDC and conducted consistent with applicable federal law and CDC policy.[†††]

During December 2020–October 2021, a total of 1,228,664 persons aged ≥18 years completed primary vaccination (Pfizer-BioNTech, 72.8%; Moderna, 20.0%, Janssen, 6.5%; unspecified mRNA vaccine, 0.8%) across 465 facilities in PHD-SR. Among these, 2,246 (18 per 10,000) acquired COVID-19, including 327 who were hospitalized, 189 (1.5 per 10,000) who had a severe COVID-19 outcome, and 36 (0.3 per 10,000) who had a COVID-19–related death (including nine persons discharged to hospice). Among those who acquired COVID-19 after primary vaccination, 1.6% (36) died, 1.1% (24) survived and were admitted to an ICU, and 5.7% (129) survived and received a diagnosis of acute respiratory failure or required NIV but were not admitted to an ICU (Table).

Adjusted odds ratios (aOR) of severe COVID-19 outcomes after primary vaccination were higher among persons aged ≥65 years (aOR = 3.22; 95% CI = 1.81–5.74), and those with immunosuppression (aOR = 1.91; 95% CI = 1.37–2.66), pulmonary disease (aOR = 1.69; 95% CI = 1.31–2.18), liver disease (aOR = 1.68; 95% CI = 1.12–2.52), chronic kidney disease (aOR = 1.61; 95% CI = 1.19–2.19), neurologic disease (aOR = 1.54; 95% CI = 1.06–2.25), diabetes (aOR = 1.47; 95% CI = 1.14–1.89), or cardiac disease (aOR = 1.44; 95% CI = 1.01–2.06) (Figure 1). Compared with persons who received the Janssen vaccine, Pfizer-BioNTech recipients had similar odds of severe outcomes (aOR = 0.70; 95% CI = 0.39–1.26), whereas recipients of the Moderna vaccine had lower odds (aOR = 0.56; 95% CI = 0.32–0.98). Odds of severe outcomes did not differ significantly by sex, race/ethnicity, time since primary vaccination, or whether infection occurred during the period of Delta variant predominance. Previous COVID-19 illness was associated with reduced odds of severe outcomes (aOR = 0.27; 95% CI = 0.09–0.84).

Among 446 persons with COVID-19 after primary vaccination who received anti–SARS-CoV-2 monoclonal therapy (casirivimab and imdevimab [93.3%] or bamlanivimab and etesivimab [6.7%]), none experienced severe outcomes. Among 3,395 persons who received booster or additional vaccine doses, 27 (0.8%) acquired COVID-19, three of whom experienced severe outcomes (but no ICU admissions or deaths).

All persons with severe COVID-19 outcomes after primary vaccination had at least one of the eight risk factors identified as significant in the model. The frequency of having four or more risk factors increased with disease severity, ranging from 18.8% (386) among persons who had nonsevere outcomes, 56.9% (87) among survivors who had respiratory failure or were admitted to an ICU, to 77.8% (28) among persons who died. Among 36 persons who died, 15 (41.7%) had do-not-resuscitate orders at the time of hospital admission (Figure 2).

[§§] Underlying medical conditions were identified based on ICD-10-CM coding present on any (one or more) inpatient or outpatient encounter in PHD-SR during January 2019–October 2021. Conditions were selected to encompass the majority of medical conditions identified by CDC as being associated with higher risk for severe COVID-19. https://www.cdc.gov/coronavirus/2019-ncov/science/science-briefs/underlying-evidence-table.html

[¶¶] SARS-CoV-2 B.1.617.2 (Delta) variant predominance was defined as the period when the Delta variant accounted for ≥50% of sequenced isolates in the United States. Delta variant prevalence represented <50% of sequenced isolates before June 19, 2021 and ≥50% of sequenced isolates from June 20, 2021 onwards, per CDC genomic surveillance data (https://covid.cdc.gov/covid-data-tracker/#variant-proportions) (Accessed December 12, 2021). PHD-SR provides monthly temporal resolution (rather than weekly or daily) for encounter data; therefore, the end of June 2021 was used as the cutoff for pre-Delta and Delta variant predominant phases (pre-Delta = March 2020–June 2021; Delta = July 2021–October 2021).

[***] Receipt of anti-SARS-CoV-2 monoclonal antibodies with FDA approval under emergency use authorization for treatment of COVID-19 (bamlanivimab and etesevimab; casirivimab and imdevimab; and sotrovimab) were collected using standard charge codes entered during COVID-19 encounters (250250132240000, 250250132310000, 250250132770000, 250250132780000, 250250132790000, 250250132800000, 250250133110000, 250250133130000, 250250133600000, 250250133730000, 250888027880000, 250888028180000, 250888028190000, 510771002390000, 510771002400000, 510771002410000, 510771002430000, 510771002440000, 510771002450000, 510771002460000, 510771002470000, and 510771002480000). Two of these monoclonal preparations are currently approved for use in combination only (bamlanivimab/ etesevimab and casirivimab/ imdevimab); for these combinations, administration of the two components had to be documented within 24 hours of each other. Use of monoclonal antibodies for post- or preexposure prophylaxis was not evaluated in this study.

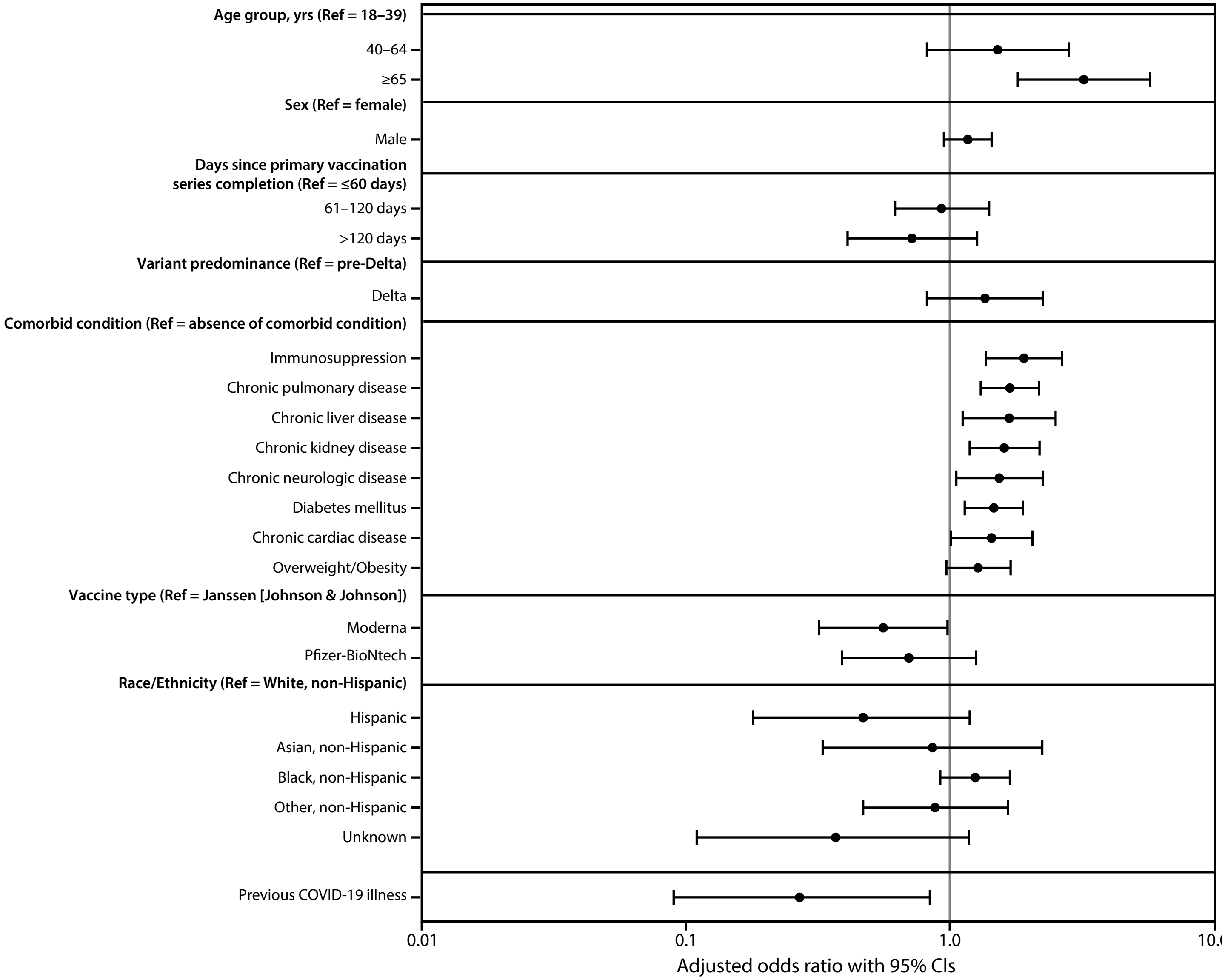
[†††] 45 C.F.R. part 46, 21 C.F.R. part 56; 42 U.S.C. Sect. 241(d); 5 U.S.C. Sect. 552a; 44 U.S.C. Sect. Sect. 3501 et seq.

TABLE. Characteristics of persons with COVID-19 after completing a primary COVID-19 vaccination series, overall and by disease outcome, and adjusted odds ratios for severe COVID-19 outcomes — 465 health care facilities, United States, December 2020–October 2021

	No. (%) with COVID-19 after primary vaccination			
Characteristic	**Total (N = 2,246)**	**Nonsevere outcome (n = 2,057)**	**Severe outcome (n = 189)**	**aOR of severe versus nonsevere COVID-19 outcome (95% CI)**
Disposition				
Outpatient	**1,360 (60.6)**	NA	NA	NA
ED/Observation	**559 (24.9)**	NA	NA	NA
Hospitalization	**327 (14.6)**	NA	NA	NA
Severe outcome				
Any severe outcome	**189 (8.4)**	NA	NA	NA
Death	**36 (1.6)**	NA	NA	NA
Survivors admitted to ICU*	**24 (1.1)**	NA	NA	NA
Survivors with respiratory failure,[†] without ICU admission or death	**129 (5.7)**	NA	NA	NA
Sex				
Female	**1,294 (57.6)**	1,204 (58.6)	90 (47.6)	1.0
Male	**951 (42.3)**	852 (41.4)	99 (52.4)	1.17 (0.95–1.44)
Unknown	**1 (0.0)**	1 (0.0)	0 (—)	NA
Age group, yrs				
18–39	**251 (11.2)**	248 (12.1)	3 (1.6)	1.0
40–64	**807 (35.9)**	772 (37.5)	35 (18.5)	1.52 (0.82–2.83)
≥65	**1,188 (52.9)**	1,037 (50.4)	151 (79.9)	3.22 (1.81–5.74)
Race/Ethnicity				
Hispanic	**77 (3.4)**	75 (3.6)	2 (1.1)	0.47 (0.18–1.19)
Asian, non-Hispanic	**52 (2.3)**	49 (2.4)	3 (1.6)	0.86 (0.33–2.24)
Black, non-Hispanic	**323 (14.4)**	288 (14.0)	35 (18.5)	1.25 (0.92–1.69)
White, non-Hispanic	**1,643 (73.2)**	1,502 (73.1)	141 (74.6)	1.0
Other, non-Hispanic	**87 (3.9)**	80 (3.9)	7 (3.7)	0.88 (0.47–1.66)
Unknown	**64 (2.8)**	63 (3.1)	1 (0.5)	0.37 (0.11–1.18)
Vaccine type				
Janssen (Johnson & Johnson)	**196 (8.8)**	173 (8.4)	23 (12.2)	1.0
Moderna	**422 (18.9)**	397 (19.3)	25 (13.2)	0.56 (0.32–0.98)
Pfizer-BioNTech	**1,618 (72.4)**	1,479 (71.9)	139 (73.5)	0.70 (0.39–1.26)
Unspecified mRNA vaccine	**10 (0.4)**	8 (0.4)	2 (1.1)	1.19 (0.15–9.74)
Days since primary vaccination series completion				
≤60	**325 (13.3)**	290 (14.1)	35 (18.5)	1.0
61–120	**409 (18.2)**	377 (18.3)	32 (16.9)	0.93 (0.62–1.41)
>120	**1,512 (67.3)**	1,390 (67.6)	122 (64.6)	0.72 (0.41–1.27)
Infected during Delta variant[†,§] predominance	**1,819 (81.0)**	1,676 (81.5)	143 (75.7)	1.36 (0.82–2.25)
Underlying medical conditions				
Overweight/Obesity	**609 (27.1)**	532 (25.9)	77 (40.7)	1.28 (0.97–1.7)
Diabetes mellitus	**633 (28.2)**	535 (26.0)	98 (51.9)	1.47 (1.14–1.89)
Immunosuppression	**446 (19.9)**	360 (17.5)	86 (45.5)	1.91 (1.37–2.66)
Chronic kidney disease	**353 (15.7)**	271 (13.2)	82 (43.4)	1.61 (1.19–2.19)
Chronic neurologic disease	**301 (13.4)**	242 (11.8)	59 (31.2)	1.54 (1.06–2.25)
Chronic cardiac disease	**753 (33.5)**	624 (30.4)	129 (68.3)	1.44 (1.01–2.06)
Chronic pulmonary disease	**889 (39.6)**	752 (36.6)	137 (72.5)	1.69 (1.31–2.18)
Chronic liver disease	**124 (5.5)**	103 (5.0)	21 (11.1)	1.68 (1.12–2.52)
Previous COVID-19 illness	**68 (3.0)**	67 (3.3)	1 (0.5)	0.27 (0.09–0.84)
Receipt of monoclonal antibody therapy	**446 (19.9)**	446 (21.7)	0 (—)	NA
Receipt of booster/additional vaccine doses	**27 (1.2)**	24 (1.2)	3 (1.6)	NA
At least one risk factor[¶]	**1,728 (76.9)**	1,539 (74.8)	189 (100)	NA

Abbreviations: aOR = adjusted odds ratio; ED = emergency department; ICU = intensive care unit.; NA = not applicable.
* Survivors admitted to ICU include all survivors requiring invasive mechanical ventilation.
† Respiratory failure defined as diagnostic coding for acute respiratory failure or need for noninvasive ventilation.
§ SARS-CoV-2 B.1.617.2 (Delta) variant.
¶ Risk factors for severe COVID-19 outcomes after completion of a primary vaccination series, as identified in the multivariable model (age ≥65 years, diabetes mellitus, immunosuppression, chronic kidney disease, chronic liver disease, chronic neurologic disease, chronic cardiac disease, or chronic pulmonary disease).

FIGURE 1. Risk factors for severe COVID-19 outcomes among persons who completed a primary COVID-19 vaccination series — 465 health care facilities, United States, December 2020–October 2021



Abbreviations: Delta = SARS-CoV-2 B.1.617.2 (Delta) variant; Ref = referent group.

Discussion

In this analysis of data from 465 U.S. health care facilities, severe COVID-19 outcomes (i.e., respiratory failure, ICU admission, or death) were rare among adults aged ≥18 years after primary vaccination. These findings are consistent with studies that have shown that COVID-19 vaccination lowers the likelihood of COVID-19–associated hospitalization and death (*1,2*). Risk for a severe COVID-19 outcome after primary vaccination was higher among persons aged ≥65 years, were immunosuppressed, or had one of six other underlying conditions; all persons with severe COVID-19 outcomes after primary vaccination had at least one risk factor. This study provides insight into the frequency of and risk factors for severe outcomes among persons who acquired COVID-19 after primary vaccination during periods of pre-Delta and Delta variant predominance; findings might not be applicable to the risk from SARS-CoV-2 B.1.1.529 (Omicron) variant or future variants.

In this study, age ≥65 years, immunosuppression, diabetes, and chronic kidney, cardiac, pulmonary, neurologic, and liver disease were associated with higher odds for severe COVID-19 outcomes;[§§§] all persons with severe COVID-19 outcomes after primary vaccination had at least one of these risk factors.

[§§§] CDC's National Center for Chronic Disease Prevention and Health Promotion collects data on chronic disease in the U.S. population using a set of 124 indicators. https://www.cdc.gov/mmwr/pdf/rr/rr6401.pdf (Accessed December 12, 2021).

Summary

What is already known about this topic?

COVID-19 vaccines are highly effective against COVID-19–associated hospitalization and death.

What is added by this report?

Among 1,228,664 persons who completed primary vaccination during December 2020–October 2021, severe COVID-19–associated outcomes (0.015%) or death (0.0033%) were rare. Risk factors for severe outcomes included age ≥65 years, immunosuppressed, and six other underlying conditions. All persons with severe outcomes had at least one risk factor; 78% of persons who died had at least four.

What are the implications for public health practice?

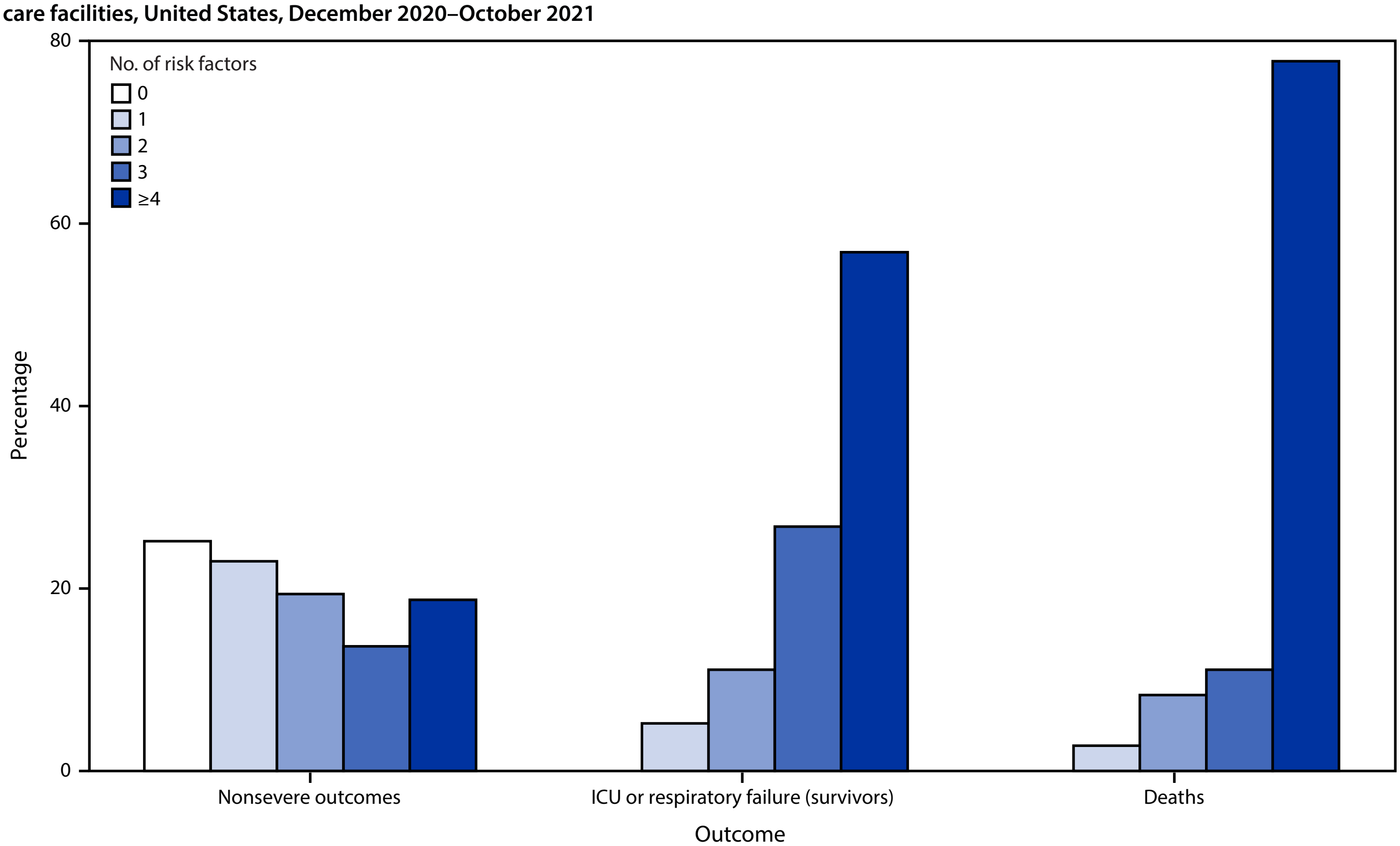
Vaccinated persons who are older, immunosuppressed, or have other underlying conditions should receive targeted interventions including chronic disease management, precautions to reduce exposure, additional primary and booster vaccine doses, and effective pharmaceutical therapy to mitigate risk for severe outcomes. Increasing vaccination coverage is a critical public health priority.

These findings are consistent with those of previous studies of a largely prevaccination U.S. population (*3*) and a U.K. population predominantly vaccinated with ChAdOx1-SARS-COV-2 (AstraZeneca) vaccine (*4*). Approximately one half of U.S. adults have a major chronic disease that increases their risk for severe COVID-19 (*5*). Even after primary vaccination, a significant proportion of the population might remain at risk and require additional strategies to prevent severe COVID-19 outcomes.

Population-wide data have demonstrated that COVID-19 hospitalization and death are more frequent among Hispanic, non-Hispanic Black, and non-Hispanic American Indian or Alaska Native persons than among non-Hispanic White persons.[¶¶¶] This might be explained by higher levels of SARS-CoV-2 exposure, reduced access to care, and higher rates of uncontrolled underlying conditions experienced by these populations (*6*); however, this study did not find an association

¶¶¶ CDC collects data on risk for SARS-CoV-2 infection, hospitalization, and death by race/ethnicity from COVID-NET, a population-based surveillance system collecting data through a network of 250 acute-care hospitals across 14 states. https://www.cdc.gov/coronavirus/2019-ncov/covid-data/investigations-discovery/hospitalization-death-by-race-ethnicity.html (Accessed December 12, 2021).

FIGURE 2. Frequency of risk factors in persons with COVID-19 after completion of a primary vaccination series, by outcome*,† — 465 health care facilities, United States, December 2020–October 2021



Abbreviation: ICU = intensive care unit.
* Outcome totals: nonsevere = 2,057; ICU/respiratory failure = 153; deaths = 36.
† All persons in the ICU or respiratory failure (survivors) and deceased groups had at least one risk factor.

between race/ethnicity and severe COVID-19 outcomes after primary vaccination, suggesting that COVID-19 vaccines are important for helping to mitigate racial and ethnic disparities exacerbated by the COVID-19 pandemic.

Several factors could contribute to severe outcomes in populations who are at risk, including suboptimal response to vaccination, waning immunity, and predisposition to severe disease. Persons who might not have mounted a protective immune response after initial vaccination might benefit from an additional primary dose (*2*). Booster vaccination after primary vaccination has been demonstrated to further reduce the risk for infection, particularly severe COVID-19 (*7*), and is recommended by CDC for all persons aged ≥18 years.[****] Pharmaceutical therapies are also available for preventing and treating COVID-19 in at-risk populations.[††††] In addition, findings from this study complement data from clinical trials (*8,9*) suggesting that anti–SARS-CoV-2 monoclonal antibodies when appropriate might protect vaccinated persons with COVID-19 from experiencing severe outcomes.

The findings in this report are subject to at least five limitations. First, the reliance on procedure, diagnosis, and billing codes to define vaccination status, underlying conditions, and outcomes might have led to misclassification because of inaccurate or incomplete records. In addition, presence of underlying conditions might not be fully collected by administrative coding. Second, outcomes that occurred during COVID-19 encounters might have been related to other factors (e.g., diminished access to routine services for control of chronic diseases might have exacerbated severe outcomes in persons with comorbidities). Third, the components of the composite outcome are not necessarily of equal severity and results should be interpreted accordingly; the number of deaths alone was too small to allow analysis of risk factors in this subgroup. Fourth, persons with underlying conditions might be more likely to access health care, thereby disproportionately increasing COVID-19 risk estimates in this group compared with persons without underlying conditions. Finally, PHD-SR represents a convenience sample of health care facilities, limiting generalizability to the U.S. population.

Approximately 70% of eligible adults in the United States have completed a primary COVID-19 vaccination series.[§§§§] With the emergence of novel variants of concern and development of additional therapeutic strategies, studies in vaccinated populations are vital to guide targeted guidelines and interventions for persons at risk for severe outcomes. COVID-19–associated outcomes occurred in a small proportion of persons (0.015%) who had completed primary vaccination, all of whom were aged ≥65 years, immunosuppressed, or had other underlying conditions. Even when vaccinated, persons with identifiable risk factors should receive interventions including chronic disease management, precautions to reduce exposure, additional primary and booster vaccine doses, and effective pharmaceutical therapy as indicated to reduce risk for severe COVID-19–associated outcomes. Increasing COVID-19 vaccination coverage is a public health priority.

**** CDC recommends booster vaccination with any one of the three FDA-approved COVID-19 vaccines for all persons aged ≥18 years, 2 months or more after receiving the Janssen vaccine or 6 months or more after completing a primary mRNA vaccine series. In addition, persons aged 16–17 years can receive a Pfizer-BioNTech COVID-19 vaccine booster 6 months after completing their primary vaccination series. https://www.cdc.gov/coronavirus/2019-ncov/vaccines/booster-shot.html

†††† https://emergency.cdc.gov/han/2021/han00461.asp

§§§§ CDC collects data on vaccine delivery and administration in the United States and reports it through the CDC COVID Data Tracker. https://covid.cdc.gov/covid-data-tracker/#vaccinations_vacc-total-admin-rate-total (Accessed December 12, 2021).

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References

1. Scobie HM, Johnson AG, Suthar AB, et al. Monitoring incidence of COVID-19 cases, hospitalizations, and deaths, by vaccination status—13 U.S. jurisdictions, April 4–July 17, 2021. MMWR Morb Mortal Wkly Rep 2021;70:1284–90. PMID:34529637 https://doi.org/10.15585/mmwr.mm7037e1
2. Embi PJ, Levy ME, Naleway AL, et al. Effectiveness of 2-dose vaccination with mRNA COVID-19 vaccines against COVID-19–associated hospitalizations among immunocompromised adults—nine states, January–September 2021. MMWR Morb Mortal Wkly Rep 2021;70:1553–9. PMID:34735426 https://doi.org/10.15585/mmwr.mm7044e3
3. Kompaniyets L, Pennington AF, Goodman AB, et al. Underlying medical conditions and severe illness among 540,667 adults hospitalized with COVID-19, March 2020–March 2021. Prev Chronic Dis 2021;18:E66. PMID:34197283 https://doi.org/10.5888/pcd18.210123
4. Hippisley-Cox J, Coupland CA, Mehta N, et al. Risk prediction of COVID-19 related death and hospital admission in adults after covid-19 vaccination: national prospective cohort study. BMJ 2021;374:n2244. PMID:34535466 https://doi.org/10.1136/bmj.n2244
5. Razzaghi H, Wang Y, Lu H, et al. Estimated county-level prevalence of selected underlying medical conditions associated with increased risk for severe COVID-19 illness—United States, 2018. MMWR Morb Mortal Wkly Rep 2020;69:945–50. PMID:32701937 https://doi.org/10.15585/mmwr.mm6929a1

6. Webb Hooper M, Nápoles AM, Pérez-Stable EJ. COVID-19 and racial/ethnic disparities. JAMA 2020;323:2466–7. PMID:32391864 https://doi.org/10.1001/jama.2020.8598
7. Bar-On YM, Goldberg Y, Mandel M, et al. Protection of BNT162b2 vaccine booster against COVID-19 in Israel. N Engl J Med 2021;385:1393–400. PMID:34525275 https://doi.org/10.1056/NEJMoa2114255
8. Weinreich DM, Sivapalasingam S, Norton T, et al.; Trial Investigators. REGEN-COV antibody combination and outcomes in outpatients with COVID-19. N Engl J Med 2021;385:e81. PMID:34587383 https://doi.org/10.1056/NEJMoa2108163
9. Dougan M, Nirula A, Azizad M, et al.; BLAZE-1 Investigators. Bamlanivimab plus etesevimab in mild or moderate COVID-19. N Engl J Med 2021;385:1382–92. PMID:34260849 https://doi.org/10.1056/NEJMoa2102685

Receipt of COVID-19 Vaccine During Pregnancy and Preterm or Small-for-Gestational-Age at Birth — Eight Integrated Health Care Organizations, United States, December 15, 2020–July 22, 2021

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COVID-19 vaccines are recommended during pregnancy to prevent severe maternal morbidity and adverse birth outcomes; however, vaccination coverage among pregnant women has been low (*1*). Concerns among pregnant women regarding vaccine safety are a persistent barrier to vaccine acceptance during pregnancy. Previous studies of maternal COVID-19 vaccination and birth outcomes have been limited by small sample size (*2*) or lack of an unvaccinated comparison group (*3*). In this retrospective cohort study of live births from eight Vaccine Safety Datalink (VSD) health care organizations, risks for preterm birth (<37 weeks' gestation) and small-for-gestational-age (SGA) at birth (birthweight <10th percentile for gestational age) after COVID-19 vaccination (receipt of ≥1 COVID-19 vaccine doses) during pregnancy were evaluated. Risks for preterm and SGA at birth among vaccinated and unvaccinated pregnant women were compared, accounting for time-dependent vaccine exposures and propensity to be vaccinated. Single-gestation pregnancies with estimated start or last menstrual period during May 17–October 24, 2020, were eligible for inclusion. Among 46,079 pregnant women with live births and gestational age available, 10,064 (21.8%) received ≥1 COVID-19 vaccine doses during pregnancy and during December 15, 2020–July 22, 2021; nearly all (9,892; 98.3%) were vaccinated during the second or third trimester. COVID-19 vaccination during pregnancy was not associated with preterm birth (adjusted hazard ratio [aHR] = 0.91; 95% CI = 0.82–1.01). Among 40,627 live births with birthweight available, COVID-19 vaccination in pregnancy was not associated with SGA at birth (aHR = 0.95; 95% CI = 0.87–1.03). Results consistently showed no increased risk when stratified by mRNA COVID-19 vaccine dose, or by second or third trimester vaccination, compared with risk among unvaccinated pregnant women. Because of the small number of first-trimester exposures, aHRs for first-trimester vaccination could not be calculated. These data add to the evidence supporting the safety of COVID-19 vaccination during pregnancy. To reduce the risk for severe COVID-19–associated illness, CDC recommends COVID-19 vaccination for women who are pregnant, recently pregnant (including those who are lactating), who are trying to become pregnant now, or who might become pregnant in the future (*4*).

VSD is a collaboration between CDC and nine health care organizations representing approximately 3% of the U.S. population. This observational retrospective study included singleton live births from eight VSD sites in California, Colorado, Minnesota, Oregon, Washington, and Wisconsin (Kaiser Permanente: Colorado, Northern California, Northwest, Southern California, and Washington; Denver Health; HealthPartners; and Marshfield Clinic). Females aged 16–49 years with estimated pregnancy start during May 17–October 24, 2020, and expected delivery dates, based on a 40-week gestation, during February 21–July 31, 2021, were included. This cohort was likely to be pregnant when COVID-19 vaccines were first authorized in the United States. Pregnancies ending in live birth were identified from standardized VSD files using a validated pregnancy algorithm. The algorithm uses *International Classification of Diseases, Tenth Revision, Clinical Modification* (ICD-10-CM) diagnosis codes, Current Procedural Terminology codes, birth records, and electronic health record data (last menstrual period and expected delivery date) to identify the date and gestational age for live births (*5*). The algorithm then estimates the pregnancy start date, equivalent to the last menstrual period. Receipt of COVID-19 vaccines was identified from standardized VSD files, incorporating electronic health record, claims, and state and regional immunization information system data. All COVID-19 vaccine doses administered from the last menstrual period through 3 days before delivery were included. Vaccines administered within 3 days of delivery were excluded to reduce potential misclassification of vaccines administered postpartum as having been administered during pregnancy.

Primary outcomes were preterm birth, defined as birth <37 weeks' gestation, and SGA at birth, defined as birthweight <10th percentile for gestational age compared with a U.S. reference population (*6*). Gestational age was determined from the VSD pregnancy algorithm. Birthweight was ascertained from birth records or maternal-infant linked electronic health record data. Covariates were obtained from ICD-10-CM codes and administrative and electronic health record data. State-level percentages of positive COVID-19 test results during the second trimester were calculated using publicly available data.* Propensity to be vaccinated during pregnancy was estimated using a generalized additive model with binomial distribution and logit link, including calendar week of pregnancy start, maternal age, race/ethnicity, prenatal care adequacy, maternal comorbidities, neighborhood poverty, state-level percentage of positive COVID-19 test results during the second trimester, and VSD site. Time-dependent COVID-19 vaccine and COVID-19 diagnosis Cox models with standardized inverse probability weighting were used to estimate the aHR of any COVID-19 vaccination during pregnancy and preterm and SGA at birth outcomes. This approach accounts for immortal time bias because shorter-duration pregnancies or those ending in preterm birth provide less opportunity to be vaccinated during pregnancy (*7*). In addition, aHRs were calculated for receipt of a first or second dose of an mRNA vaccine and for vaccination in the second or third trimester. Analysis was performed using SAS software (version 9.4; SAS Institute). Associations are reported based on aHRs and 95% CIs. Statistical significance was defined as a p-value <0.05 with a two-sided test. This surveillance was approved by the institutional review boards of participating sites with a waiver of informed consent. This activity was reviewed by CDC and was conducted consistent with applicable federal law and CDC policy.†

A total of 55,671 potentially eligible pregnancies resulting in a live birth were identified in VSD. After excluding 67 females ineligible because of age (i.e., <16 or >49 years), 926 with multiple (e.g., twin or triplet) gestations, 2,489 with no documented care in the health system, 295 with implausible gestational age, and 5,815 with pregnancy start date outside the prespecified periods, 46,079 (82.8%) single-gestation pregnancies ending in live birth with data on gestational age remained. Among these, 10,064 pregnant women (21.8%) received ≥1 COVID-19 vaccine doses during pregnancy and during December 15, 2020–July 22, 2021. COVID-19 vaccination during pregnancy varied by maternal age, race/ethnicity, and selected maternal comorbidities (Table 1). First (or only) vaccine doses were received in the first trimester by 172 (1.7%) women, in the second trimester by 3,668 (36.5%), and in the third trimester by 6,224 (61.8%). Most women received mRNA vaccines, including 5,478 (54.4%) who received Pfizer-BioNTech and 4,162 (41.4%) who received Moderna vaccines; 424 (4.2%) received Janssen (Johnson & Johnson) vaccine. Among 9,640 women who received mRNA vaccines during pregnancy, 1,759 (18.2%) received 1 dose, and 7,881 (81.8%) received 2 doses (Table 2).

* https://protect-public.hhs.gov
† 45 C.F.R. part 46.102(l)(2), 21 C.F.R. part 56; 42 U.S.C. Sect. 241(d); 5 U.S.C. Sect. 552a; 44 U.S.C. Sect. 3501 et seq.

Summary

What is already known about this topic?

Pregnant women with COVID-19 are at increased risk for severe illness and adverse birth outcomes, yet many remain reluctant to be vaccinated.

What is added by this report?

In a retrospective cohort of >40,000 pregnant women, COVID-19 vaccination during pregnancy was not associated with preterm birth or small-for-gestational-age at birth overall, stratified by trimester of vaccination, or number of vaccine doses received during pregnancy, compared with unvaccinated pregnant women.

What are the implications for public health practice?

These data support the safety of COVID-19 vaccination during pregnancy. CDC recommends COVID-19 vaccination for women who are pregnant, recently pregnant, who are trying to become pregnant now, or who might become pregnant in the future.

The overall prevalence of preterm birth and SGA at birth were 6.6 and 8.2 per 100 live births, respectively (Table 3). COVID-19 vaccination during pregnancy was not significantly associated with increased risk for preterm birth overall (aHR = 0.91; 95% CI = 0.82–1.01; p = 0.06) or SGA at birth (aHR = 0.95; 95% CI = 0.87–1.03; p = 0.24), or when stratified by mRNA vaccine dose number during pregnancy, compared with the risk in unvaccinated pregnant women. There also was no association with increased risk for preterm or SGA at birth when evaluating vaccination by trimester for the first (or only) vaccine dose.

Discussion

In this large, multisite, retrospective cohort study, receipt of COVID-19 vaccine during pregnancy was not associated with increased risk for preterm birth or SGA at birth. The absolute risk for severe morbidity associated with COVID-19 in pregnancy is low; however, women with symptomatic COVID-19 during pregnancy have a more than twofold increased risk for intensive care unit admission, invasive ventilation, and extracorporeal membrane oxygenation, and a 70% increased risk for death, compared with nonpregnant women with symptomatic infections (*8*). Evidence of the benefits of COVID-19 vaccination during pregnancy continues to accrue, including the detection of antibodies in cord blood (*9*). Together, these findings reinforce the importance of communicating the risks for COVID-19 during pregnancy, the benefits of vaccination, and information on the safety and effectiveness of COVID-19 vaccination during pregnancy.

To date, only a few reports have described outcomes among live births after COVID-19 vaccination in pregnancy. Data

TABLE 1. Characteristics of women who received and did not receive COVID-19 vaccine during pregnancy,* by vaccination status — eight U.S. health care organizations,† December 15, 2020–July 22, 2021

Characteristic	Vaccination status, no. (%)	
	Unvaccinated	Vaccinated
All pregnancies with gestational age data	**36,015 (78.2)**	**10,064 (21.8)**
Pregnancy start date range (based on 2020 epidemiologic weeks)§		
May 17–Jun 13	7,598 (21.1)	366 (3.6)
Jun 14–Jul 11	7,131 (19.8)	1,124 (11.2)
Jul 12–Aug 8	6,400 (17.8)	2,043 (20.3)
Aug 9–Sep 5	6,095 (16.9)	2,360 (23.5)
Sep 6–Oct 3	5,742 (15.9)	2,608 (25.9)
Oct 4–Oct 24	3,049 (8.5)	1,563 (15.5)
Race/Ethnicity¶		
Hispanic	13,840 (38.4)	2,462 (24.5)
White, non-Hispanic	11,588 (32.2)	4,325 (43.0)
Asian, non-Hispanic	5,642 (15.7)	2,571 (25.6)
Black, non-Hispanic	3,293 (9.1)	271 (2.7)
Other/Unknown**	1,652 (4.6)	435 (4.3)
Prenatal care index††		
Adequate/Plus	25,308 (70.3)	7,263 (72.2)
Intermediate	7,404 (20.5)	2,202 (21.9)
Inadequate	3,303 (9.2)	599 (5.9)
Comorbidities§§		
Asthma	2,733 (7.6)	802 (8.0)
Cancer	120 (0.3)	28 (0.3)
Cardiovascular disease	104 (0.3)	43 (0.4)
COVID-19 disease¶¶	1,269 (3.5)	281 (2.8)
Diabetes (type I or II)	611 (1.7)	167 (1.7)
Hypertension	1,732 (4.8)	552 (5.5)
Liver disease	417 (1.2)	97 (1.0)
Obesity***	10,426 (29.0)	2,407 (23.9)
Smoking (ever)	7,242 (20.1)	1,786 (17.8)
Systemic lupus	103 (0.3)	20 (0.2)
Age, mean (SD), yrs,	**29.8 (5.3)**	**32.3 (4.5)**
Percentage living in poverty, mean (SD)†††	**10.0 (8.0)**	**8.0 (7.0)**
State-level COVID-19 positivity, mean (SD)§§§	**9.0 (2.0)**	**9.0 (2.0)**

* Vaccines administered during December 15, 2020–July 22, 2021; vaccinated refers to all COVID-19 vaccine doses (including first or second doses) administered from last menstrual period to 3 days before delivery.
† Kaiser Permanente: Colorado, Northern California, Northwest, Southern California, and Washington; Denver Health (Colorado); HealthPartners (Minnesota); and Marshfield Clinic (Wisconsin).
§ The Vaccine Safety Datalink pregnancy algorithm was used to estimate the pregnancy start date (equivalent to the last menstrual period).
¶ Race/ethnicity came from electronic health data, based on self-report.
** Unknown refers to missing ethnicity and unknown race.
†† Adequacy of prenatal care defined based on the Kotelchuck prenatal care index.
§§ Presence of comorbidities defined as having one or more inpatient or two or more outpatient diagnoses for the period 3 years before pregnancy through 20 weeks' gestation.
¶¶ COVID-19 disease during pregnancy based on having a COVID-19 diagnosis within 30 days before last menstrual period or during pregnancy.
*** Obesity was defined as having obesity diagnosis or body mass index ≥30 kg/m^2 before pregnancy or during the first trimester.
††† Percentage living in poverty by neighborhood (i.e., U.S. Census tract) from the American Community Survey 5-year summary for 2019.
§§§ Average state-level COVID-19 test positivity during second trimester was calculated using publicly available data (https://protect-public.hhs.gov/).

TABLE 2. Vaccination during pregnancy, by vaccine type, timing of first dose, and total doses received during pregnancy — eight U.S. health care organizations,* December 15, 2020–July 22, 2021

Characteristic	Vaccinated, no. (%)
All	**10,064 (100)**
Vaccine type	
Pfizer-BioNTech	5,478 (54.4)
Moderna	4,162 (41.4)
Janssen (Johnson & Johnson)	424 (4.2)
Timing of first dose in pregnancy	
First trimester	172 (1.7)
Second trimester	3,668 (36.5)
Third trimester	6,224 (61.8)
Doses during pregnancy (mRNA vaccines)	
At least 1	9,640 (100)
1 dose	1,759 (18.2)
2 doses	7,881 (81.8)

* Kaiser Permanente: Colorado, Northern California, Northwest, Southern California, and Washington; Denver Health (Colorado); HealthPartners (Minnesota); and Marshfield Clinic (Wisconsin).

from CDC's v-safe COVID-19 Vaccine Pregnancy Registry found that among live births, 9.4% were preterm, and 3.2% were SGA, consistent with background rates (*3*). The proportion identified as SGA at birth in the current study is higher than that in the v-safe registry likely because of variation in data sources (e.g., electronic health record data versus voluntary self-report) and calculation of SGA using different reference populations (U.S. versus international). An observational study from Israel also reported no association between COVID-19 vaccination in pregnancy and adverse maternal or birth outcomes (*2*). In addition, in a cohort study from the United Kingdom, among 1,328 pregnant women, 140 (10.5%) received a COVID-19 vaccine during pregnancy, and birth outcomes did not differ between vaccinated and unvaccinated women (*10*). The current study further demonstrates the safety of COVID-19 vaccination among pregnant women related to preterm birth and SGA at birth outcomes.

The findings in this report are subject to at least four limitations. First, although VSD sites access multiple data sources to identify receipt of COVID-19 vaccines during pregnancy, some vaccinations might have been missed, potentially biasing results toward the null. Second, data on selected confounders, such as previous history of preterm or SGA at birth, were not available, and data on previous infections with SARS-CoV-2 (the virus that causes COVID-19) that might have affected propensity to be vaccinated were not fully identified through previous COVID-19 diagnoses. In addition, reduced risks for preterm birth after third-trimester vaccination or receipt of a single mRNA vaccine dose during pregnancy were likely due to residual immortal time bias. Third, because of the timing of

TABLE 3. Preterm births, small-for-gestational-age births, and adjusted hazard ratios* among women receiving COVID-19 vaccine during pregnancy compared with unvaccinated pregnant women — eight U.S. health care organizations,† December 15, 2020–July 22, 2021

Event	No. of subjects	Prevalence (events per 100 live births)	aHR§ (95% CI)
Preterm birth¶			
Full population	**46,079**	**6.6**	**NA**
No COVID-19 vaccines during pregnancy	36,015	7.0	Ref
Any COVID-19 vaccine during pregnancy	10,064	4.9	0.91 (0.82–1.01)
mRNA vaccine, 1 dose	1,759	7.7	0.78 (0.66–0.93)
mRNA vaccine, 2 doses	7,881	4.3	0.97 (0.86–1.10)
Second trimester**	3,668	6.4	1.05 (0.90–1.23)
Third trimester**	6,224	4.0	0.82 (0.72–0.94)
Small-for-gestational-age at birth††			
Full population	**40,627**	**8.2**	**NA**
No COVID-19 vaccines during pregnancy	31,699	8.2	Ref
Any COVID-19 vaccine during pregnancy	8,928	8.2	0.95 (0.87–1.03)
mRNA vaccine, 1 dose	1,576	8.2	0.92 (0.80–1.07)
mRNA vaccine, 2 doses	6,982	8.3	0.98 (0.89–1.08)
Second trimester**	3,226	8.6	1.00 (0.86–1.17)
Third trimester**	5,561	8.0	0.93 (0.85–1.02)

Abbreviations: aHR = adjusted hazard ratio; NA = not applicable; Ref = referent group.

* Associations were estimated using a time-dependent covariate Cox model with inverse probability weighting and COVID-19 disease status as a time-dependent covariate.

† Kaiser Permanente: Colorado, Northern California, Northwest, Southern California, and Washington; Denver Health (Colorado); HealthPartners (Minnesota); and Marshfield Clinic (Wisconsin).

§ Inverse probability weighting was computed using a generalized additive model for receiving 1 or 2 doses of COVID-19 vaccines during pregnancy with calendar week of pregnancy start date, maternal age, race/ethnicity, prenatal care adequacy, maternal comorbidities, state level COVID-19 average test positivity during the second trimester, neighborhood poverty, and Vaccine Safety Datalink site as covariates.

¶ <37 weeks' gestational age.

** Based on timing for first or only vaccine dose; first trimester vaccinations are not included in analyses stratified by trimester because few exposures occurred (172).

†† Birthweight for gestational age <10th percentile.

COVID-19 vaccine availability and the timing of the births in this cohort, few first-trimester vaccinations were observed. Nevertheless, the second and third trimester are critical periods for fetal growth and development. Risks associated with vaccination during the first trimester should be evaluated in future studies that include vaccines administered throughout pregnancy. Finally, this retrospective cohort does not include more recent pregnancies in women who might have been eligible for additional or booster vaccine doses during pregnancy.

Despite these limitations, the findings from this retrospective, multisite cohort of a large and diverse population with comprehensive data on vaccination, comorbidities, and birth outcomes add to the evidence supporting the safety of COVID-19 vaccination during pregnancy. CDC recommends COVID-19 vaccination for women who are pregnant, recently pregnant (including those who are lactating), who are trying to become pregnant now, or who might become pregnant in the future (*4*) to reduce the risk for severe COVID-19–associated outcomes.

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References

1. Razzaghi H, Meghani M, Pingali C, et al. COVID-19 vaccination coverage among pregnant women during pregnancy—eight integrated health care organizations, United States, December 14, 2020–May 8, 2021. MMWR Morb Mortal Wkly Rep 2021;70:895–9. PMID:34138834 https://doi.org/10.15585/mmwr.mm7024e2
2. Wainstock T, Yoles I, Sergienko R, Sheiner E. Prenatal maternal COVID-19 vaccination and pregnancy outcomes. Vaccine 2021;39:6037–40. PMID:34531079 https://doi.org/10.1016/j.vaccine.2021.09.012
3. Shimabukuro TT, Kim SY, Myers TR, et al.; CDC v-safe COVID-19 Pregnancy Registry Team. Preliminary findings of mRNA Covid-19 vaccine safety in pregnant persons. N Engl J Med 2021;384:2273–82. PMID:33882218 https://doi.org/10.1056/NEJMoa2104983
4. CDC. COVID-19 vaccines while pregnant or breastfeeding. Atlanta, GA: US Department of Health and Human Services, CDC; 2021. https://www.cdc.gov/coronavirus/2019-ncov/vaccines/recommendations/pregnancy.html
5. Naleway AL, Crane B, Irving SA, et al. Vaccine Safety Datalink infrastructure enhancements for evaluating the safety of maternal vaccination. Ther Adv Drug Saf 2021;12:20420986211021233. PMID:34178302 https://doi.org/10.1177/20420986211021233
6. Talge NM, Mudd LM, Sikorskii A, Basso O. United States birth weight reference corrected for implausible gestational age estimates. Pediatrics 2014;133:844–53. PMID:24777216 https://doi.org/10.1542/peds.2013-3285
7. Fell DB, Dimitris MC, Hutcheon JA, et al. Guidance for design and analysis of observational studies of fetal and newborn outcomes following COVID-19 vaccination during pregnancy. Vaccine 2021;39:1882–6. PMID:33715900 https://doi.org/10.1016/j.vaccine.2021.02.070
8. Zambrano LD, Ellington S, Strid P, et al.; CDC COVID-19 Response Pregnancy and Infant Linked Outcomes Team. Update: characteristics of symptomatic women of reproductive age with laboratory-confirmed SARS-CoV-2 infection by pregnancy status—United States, January 22–October 3, 2020. MMWR Morb Mortal Wkly Rep 2020;69:1641–7. PMID:33151921 https://doi.org/10.15585/mmwr.mm6944e3
9. Kashani-Ligumsky L, Lopian M, Cohen R, et al. Titers of SARS CoV-2 antibodies in cord blood of neonates whose mothers contracted SARS CoV-2 (COVID-19) during pregnancy and in those whose mothers were vaccinated with mRNA to SARS CoV-2 during pregnancy. J Perinatol 2021;41:1–4. https://doi.org/10.1038/s41372-021-01216-1
10. Blakeway H, Prasad S, Kalafat E, et al. COVID-19 vaccination during pregnancy: coverage and safety. Am J Obstet Gynecol 2021;S0002:S0002-9378(21)00873-5. PMID:34389291 https://doi.org/10.1016/j.ajog.2021.08.007

Notes from the Field

Three Human Rabies Deaths Attributed to Bat Exposures — United States, August 2021

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During September 28–November 10, 2021, CDC confirmed three human rabies deaths in the United States, all in persons who did not seek postexposure prophylaxis (PEP) after bat exposures that occurred during August 2021. This increase in bat-associated human rabies deaths in the United States followed only three deaths during the previous 48 months. The cases during fall 2021 occurred in two adults and one child, all male, from Idaho, Illinois, and Texas. Initial symptoms included pain and paresthesia near the site of exposure progressing to dysphagia, altered mental status, paralysis, seizure-like activity, and autonomic instability. All three patients had recognized direct contact (e.g., bite or collision) with a bat approximately 3–7 weeks before symptom onset and died approximately 2–3 weeks after symptom onset. The deaths were associated with three bat species: *Lasionycteris noctivagans* (silver-haired bat), *Tadarida brasiliensis* (Mexican free-tailed bat), and *Eptesicus fuscus* (big brown bat) (Figure). All three species are common in the United States and have been implicated in previous rabies cases. One patient submitted the bat responsible for exposure for testing but refused PEP, despite the bat testing positive for rabies virus, due to a long-standing fear of vaccines. The other two patients did not realize the risk for rabies from their exposures, either because they did not notice a bite or scratch or did not recognize bats as a potential source of rabies. Case and contact investigations were led by the appropriate state and local health departments, and all human laboratory testing occurred at CDC. This activity was reviewed by CDC and conducted consistent with applicable federal law and CDC policy.*

Rabies is a zoonotic disease transmitted primarily through virus-laden saliva from the bite of an infected mammal. The typical incubation period from exposure to symptom onset is 3–12 weeks. Rabies is nearly always fatal once symptoms develop but nearly always preventable when PEP is administered in accordance with the recommendations of the Advisory Committee on Immunization Practices.† During 1960–2018, approximately 70% of 89 human rabies cases acquired in the United States were caused by exposures to bats (*1*). Although human rabies deaths in the United States are rare, rabid animals and rabies exposures are relatively common (*2*). Since 2014, all states except Hawaii have reported rabid bats. In 2020, public health programs tested approximately 24,000 bats for

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

† https://www.cdc.gov/mmwr/preview/mmwrhtml/rr5902a1.htm

FIGURE. Three bat species A) *Eptesicus fuscus* (big brown bat), B) *Lasionycteris noctivagans* (silver-haired bat), and C) *Tadarida brasiliensis* (Mexican free-tailed bat) implicated in three human exposures — United States, August 2021

Photo A/unidentified patient; Photo B/Mark Mayfield; Photo C/Stephen Gergeni.

rabies, 1,401 (5.8%) of which were confirmed positive. CDC estimates that 60,000 persons each year receive rabies PEP following animal exposures (*3*), approximately two-thirds of these may be attributed to bats, depending on the local rabies epidemiology (*4*).

Preventing transmission of rabies from bats to humans can be accomplished by 1) avoiding contact with bats, 2) safely capturing and testing bats implicated in human exposures, and 3) seeking rapid evaluation for PEP when direct bat contact occurs and rabies cannot be ruled out. Two of the bat-associated cases in fall 2021 were considered avoidable exposures: one was attributed to a bat roost in the patient's home, the other to the patient picking up the bat with his bare hands. Safely excluding bats from homes and instructing persons not to touch bats can prevent rabies exposures.[§] Two patients released the bat after contact had occurred rather than capturing it for testing. When a person has known or potential (e.g., while sleeping) contact with a bat, it should be safely captured,[¶] if possible, and tested at a qualified laboratory. Timely bat rabies testing can save lives by ensuring persons at highest risk for rabies receive PEP, as well as reduce the cost, time, and resources associated with unnecessary PEP. PEP should be considered for any person who has direct contact with a bat unless the bat tests negative for rabies or public health officials can be reasonably certain there is no exposure risk.

Bats are ecologically critical species with seasonal activity patterns. Although bat activity is reduced in winter months, increased human-bat contacts often occur again in late spring to early fall (*5*). Avoiding contact with bats is the best way to protect both bat and human health. When human-bat contact is unavoidable, bat rabies testing and PEP are highly effective strategies to save human lives.

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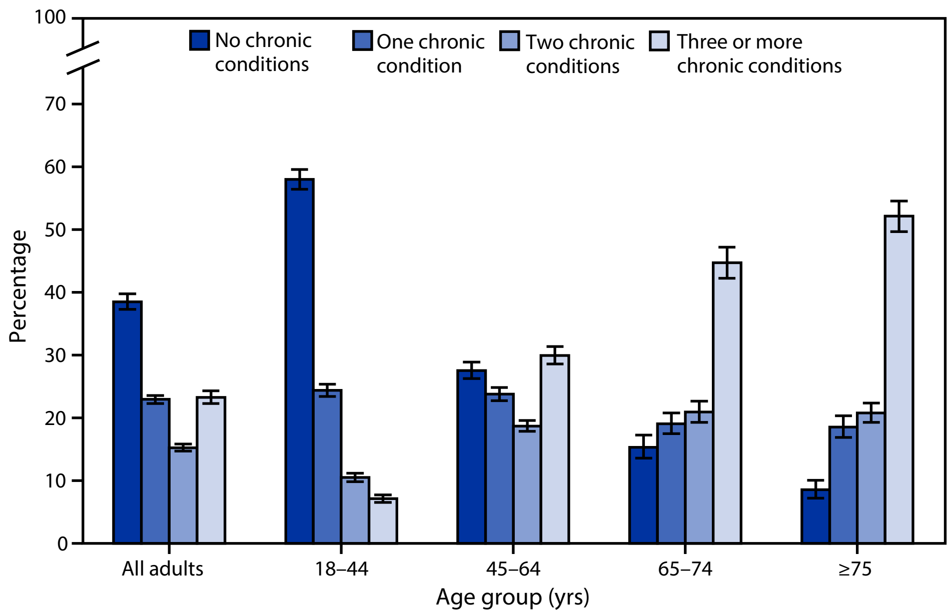
References

1. Pieracci EG, Pearson CM, Wallace RM, et al. Vital Signs: trends in human rabies deaths and exposures—United States, 1938–2018. MMWR Morb Mortal Wkly Rep 2019;68:524–8. PMID:31194721 https://doi.org/10.15585/mmwr.mm6823e1
2. Ma X, Monroe BP, Wallace RM, et al. Rabies surveillance in the United States during 2019. J Am Vet Med Assoc 2021;258:1205–20. PMID:33978439 https://doi.org/10.2460/javma.258.11.1205
3. Whitehouse ER, Person MK, Brown CM, Slavinski S, Rao AK, Blanton JD. Evaluating surveillance for and estimating administration of rabies postexposure prophylaxis in the United States, 2012–2018. PLoS Negl Trop Dis 2021;15:e0009878. PMID:34695115 https://doi.org/10.1371/journal.pntd.0009878
4. Steinberg HD, Bemis K, Frias MM, Christiansen D. Inappropriate administration of rabies postexposure prophylaxis, Cook County, Illinois, USA. Emerg Infect Dis 2020;26:2515–7. PMID:32946729 https://doi.org/10.3201/eid2610.200232
5. Patyk K, Turmelle A, Blanton JD, Rupprecht CE. Trends in national surveillance data for bat rabies in the United States: 2001-2009. Vector Borne Zoonotic Dis 2012;12:666–73. PMID:22607069 https://doi.org/10.1089/vbz.2011.0839

[§] https://www.cdc.gov/rabies/bats/contact/home.html
[¶] https://www.cdc.gov/rabies/bats/contact/capture.html

QuickStats

Distribution* of Emergency Department Visits† Made by Adults, by Age and Number of Chronic Conditions§ — United States, 2017–2019



* With 95% CIs indicated with error bars.

† Based on a sample of visits to emergency departments in noninstitutional general and short-stay hospitals, excluding federal, military, and Veterans Administration hospitals, located in the 50 U.S. states and the District of Columbia.

§ Defined as emergency department visits made by patients with documentation in their medical record of a diagnosis of one of the following chronic conditions, regardless of the diagnosis for the current visit: alcohol misuse, abuse, or dependence; arthritis; asthma; cancer; chronic kidney disease; chronic obstructive pulmonary disease; congestive heart failure; coronary artery disease; ischemic heart disease or history of myocardial infarction; depression; diabetes; end-stage renal disease; HIV/AIDS; hyperlipidemia; hypertension; obesity; obstructive sleep apnea; osteoporosis; history of pulmonary embolism; and substance use or dependence.

During 2017–2019, 38.5% of adult emergency department visits were made by patients with no chronic conditions, 22.9% made by those with one, 15.3% made by those with two, and 23.3% made by those with three or more chronic conditions. The percentage of adult emergency department visits made by patients with no chronic conditions or one chronic condition decreased with age, from 58.0% among patients aged 18–44 years to 8.5% among patients aged ≥75 years with no chronic conditions and from 24.4% among patients aged 18–44 years to 18.5% among patients aged ≥75 years with one chronic condition. In contrast, the percentage of visits by patients with two or three or more chronic conditions increased with age, from 10.5% among patients aged 18–44 years to 20.8% among patients aged ≥75 years with two conditions and from 7.1% among patients aged 18–44 years to 52.1% among patients aged ≥75 years with three or more chronic conditions.

Source: The National Center for Health Statistics, National Hospital Ambulatory Medical Care Survey, 2017–2019. https://www.cdc.gov/nchs/ahcd/ahcd_questionnaires.htm

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