

Tobacco Product Use Among Adults – United States, 2021

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Commercial cigarette smoking among U.S. adults has declined during the preceding 5 decades (1,2); however, tobacco product use remains the leading cause of preventable disease and death in the United States, and some populations continue to be disproportionately affected by tobacco use (1,2). To assess recent national estimates of commercial tobacco use among U.S. persons aged ≥ 18 years, CDC, the Food and Drug Administration (FDA), and the National Cancer Institute analyzed 2021 National Health Interview Survey (NHIS) data. In 2021, an estimated 46 million U.S. adults (18.7%) reported currently using any tobacco product, including cigarettes (11.5%), e-cigarettes (4.5%), cigars (3.5%), smokeless tobacco (2.1%), and pipes (including hookah)* (0.9%).[†] Among those who used tobacco products, 77.5% reported using combustible products (cigarettes, cigars, or pipes), and 18.1% reported using two or more tobacco products.[§] The prevalence of current use of any tobacco product use was higher among the following groups: men; persons aged < 65 years; persons of non-Hispanic other races; non-Hispanic White (White) persons[¶]; residents of rural (nonmetropolitan) areas;

financially disadvantaged (income-to-poverty ratio = 0–1.99); lesbian, gay, or bisexual (LGB) persons; those uninsured or enrolled in Medicaid; adults whose highest level of education was a general educational development (GED) certificate; who had a disability; and who had serious psychological distress. Continued surveillance of tobacco product use, implementation of evidence-based tobacco control strategies (e.g., hard-hitting media campaigns, smoke-free policies, and tobacco price increases), conducting linguistically and culturally appropriate educational campaigns, and FDA regulation of tobacco products will aid in reducing tobacco-related disease, death, and disparities among U.S. adults (3,4).

NHIS is an annual, nationally representative, household survey of the noninstitutionalized U.S. civilian population.** In

** https://ftp.cdc.gov/pub/Health_Statistics/NCHS/Dataset_Documentation/NHIS/2021/srvydesc-508.pdf

*The use of regular pipe, water pipe, or hookah was assessed together using a single question. Interviewers could read the following sentences if necessary: “A hookah is a type of water pipe. It is sometimes called a ‘narghile’ (NAR-ge-lee) pipe. Do not include electronic hookahs or e-hookahs”; “Do not include electronic pipes or e-pipes”; “Do not include pipes filled with substances other than tobacco.”

[†] Categories are not mutually exclusive.

[§] Current use of two or more tobacco products was defined as use either “every day” or “some days” of at least two or more of the following tobacco products: cigarettes (100 or more cigarettes during a person’s lifetime); cigars, cigarillos, or filtered little cigars; pipes, water pipes, or hookahs; electronic cigarettes; or smokeless tobacco products.

[¶] Hispanic persons could be of any race. All other groups were non-Hispanic. The following four non-Hispanic single-race categories were available for sampled adults in the 2021 NHIS public use files: 1) American Indian or Alaska Native (AI/AN); 2) Asian; 3) Black or African American; and 4), White. The “non-Hispanic, other” category includes those adults who were categorized as “non-Hispanic AI/AN and any other group” or “other single and multiple races.”

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2021, a total of 29,482 adults were surveyed^{††} (response rate = 50.9%) (5). Data were weighted to provide nationally representative estimates, adjusting for differences in selection probability and nonresponse. Use of five tobacco products was assessed: cigarettes, cigars (cigars, cigarillos, or filtered little cigars), pipes (regular pipes, water pipes, or hookahs), e-cigarettes, and smokeless tobacco (chewing tobacco, snuff, dip, snus, or dissolvable tobacco). In this report, tobacco use refers to commercial tobacco products and not to tobacco used for medicinal and spiritual purposes by some American Indian communities. Current cigarette smoking was defined as having ever smoked 100 or more cigarettes within one's lifetime and smoking every day or some days at the time of survey. Current use of all other tobacco products was defined as use

of the product every day or some days at the time of survey. Prevalence estimates for current use of any tobacco product, any combustible tobacco product, two or more tobacco products, and quit ratios^{§§} were calculated; for 2021, estimates were calculated overall and by sex, age group, race and ethnicity, U.S. Census Bureau region,^{¶¶} rural/urban designation,^{***} educational attainment (among adults aged ≥25 years), marital status, income-to-poverty ratio,^{†††} sexual orientation,^{§§§}

§§ Quit ratio is the percentage of persons who have ever smoked (100 or more cigarettes during their lifetime) and have quit smoking.

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

*** Rural/urban designation (urbanization level), termed metropolitan statistical area in a previous report, is based on the 2013 National Center for Health Statistics (NCHS) Urban-Rural Classification Scheme for Counties (https://www.cdc.gov/nchs/data/series/sr_02/sr02_166.pdf). The original variable for urbanization level in the NHIS public use data files is four levels; for this report, the four-level variable is reduced to a dichotomous variable.

††† Ratio of family income to poverty threshold for family size variable based on the imputed family income to poverty threshold variable (29,482).

§§§ Sexual orientation was determined using the question, "Which of the following best represents how you think of yourself?" Response options included "gay," "straight, that is, not gay," "bisexual," "something else," and "I don't know the answer" among male respondents, and "lesbian or gay," "straight, that is, not lesbian or gay," "bisexual," "something else," and "I don't know the answer" among female respondents. Respondents were considered to be LGB if they responded "gay," "lesbian or gay," or "bisexual."

†† Because of the COVID-19 pandemic, typical data collection procedures were disrupted. During January–April 2021, contact with household members was attempted first via telephone, with subsequent personal visits allowed (a continuation of procedures from the latter part of 2020). Beginning in May 2021, interviewers returned to regular procedures, whereby first contact with household members was attempted in person, with follow-up allowed by telephone. Allowed personal visits varied by regional office, based on local COVID-19 rates. Interviewers were required to wear masks, practice social distancing, and be fully vaccinated if in-home interviews were conducted. During 2021, 62.8% of interviews were conducted at least partially by telephone compared with 34.3% of interviews in 2019.

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health insurance coverage,^{§§§} disability,^{****} and presence of serious psychological distress.^{††††}

The top five combinations of tobacco products reported among adults who reported use of two or more tobacco products were determined. Previous year changes in tobacco product use prevalences were calculated. Changes in cigarette smoking during 2019–2021 by diagnosed depression^{§§§§} overall and among racial and ethnic groups were also calculated. SAS-Callable SUDAAN software (version 11.0.3; Research Triangle Institute) was used to conduct all analyses. Chi-square tests were used to test for statistical significance. P-values <0.05 were considered statistically significant. This activity was reviewed by CDC and was conducted consistent with applicable federal law and CDC policy.^{¶¶¶¶}

Among U.S. adults in 2021, 18.7% (an estimated 46.0 million) currently used any tobacco product, 14.5% (35.6 million) used any combustible tobacco product, and

3.4% (8.3 million) used two or more tobacco products. Nearly two thirds (66.5%) of adults who ever smoked cigarettes reported having quit (Table). Cigarettes were the most used tobacco product (11.5%; 28.3 million). Prevalence of use and estimated number of users of other tobacco products were as follows: e-cigarettes (4.5%; 11.1 million), cigars (3.5%; 8.6 million), smokeless tobacco (2.1%; 5.2 million), and pipes (0.9%; 2.3 million). Among persons who reported current tobacco product use, 77.5% used combustible tobacco products, and 18.1% used two or more tobacco products. During 2020–2021, a decrease in cigarette smoking prevalence from 12.5% to 11.5% was observed ($p < 0.01$); however, the prevalence of e-cigarette use increased from 3.7% to 4.5% ($p < 0.01$). No statistically significant changes in use prevalences were observed for other tobacco products.

Among adults reporting the use of two or more tobacco products, the most frequently reported combination was cigarettes and e-cigarettes (31.4%), followed by cigarettes and cigars (21.0%), cigarettes and smokeless tobacco (7.9%), e-cigarettes and cigars (7.0%), and cigarettes and pipes (3.7%); in addition, 29.0% of adults who currently used two or more tobacco products reported use of some other combination, including 14.0% who reported use of three or more products (Figure 1).

During 2019–2021, the prevalence of cigarette smoking among adults who were ever told by a health care provider that they had depression (22.9%, 20.5%, and 19.4% in 2019, 2020, and 2021, respectively) was higher than that among those who had never been told that they had depression (12.3%, 10.9%, and 9.9% in 2019, 2020, and 2021, respectively) (Figure 2). Regardless of diagnosed depression status, statistically significant declines in the prevalence of cigarette smoking during 2019–2021 were noted overall, among non-Hispanic Black or African American (Black); White; and Hispanic adults. During 2019–2021, among adults who ever had diagnosed depression, the prevalence of cigarette smoking was highest among non-Hispanic adults of other races in 2019 and 2020, and highest among Black adults in 2021. Among adults who never had diagnosed depression, cigarette smoking prevalence was similar among Black and White adults and was highest among non-Hispanic American Indian or Alaska Native (AI/AN) adults (in 2020), and non-Hispanic adults of other races (2019 and 2021).

In 2021, the prevalence of any current tobacco product use was higher among men (24.1%) than among women (13.6%) (Table). It was also higher among persons aged 25–44 years (22.1%), 45–64 years (21.1%), and 18–24 years (17.0%) than among those aged ≥65 years (11.0%), and higher among non-Hispanic adults of other races (25.6%) or White (21.2%) adults than among Black (18.1%), Hispanic (12.4%), or non-Hispanic Asian (8.6%) adults. Prevalence was higher

§§§ Private coverage: adults who had any comprehensive private insurance plan (including health maintenance organizations and preferred provider organizations). Medicaid: adults aged <65 years; includes those who did not have private coverage, but had Medicaid or other state-sponsored health plans, including the Children's Health Insurance Program (CHIP). For adults aged ≥65 years, those who did not have any private coverage but had Medicare and Medicaid or other state-sponsored health plans were categorized as having Medicaid. Medicare only: adults aged ≥65 years who only had Medicare coverage. Other coverage: adults who did not have private insurance, Medicaid, or other public coverages, but who had any type of military coverage, coverage from other government programs, or Medicare (adults aged <65 years). Uninsured: adults who did not indicate at the time of interview that they were covered under private health insurance, Medicare, Medicaid, CHIP, a state-sponsored health plan, other government programs, or military coverage. Insurance coverage is "as of time of survey."

**** Disability was defined based on self-reported presence of selected limitations including vision, hearing, mobility, remembering or concentrating, self-care, and communication. Respondents who indicated "A lot of difficulty" or "Cannot do at all/unable to do" to at least one of the following six questions: "Do you have difficulty seeing, even when wearing glasses?," "Do you have difficulty hearing, even when using a hearing aid?," "Do you have any difficulty walking or climbing steps?," "Using your usual language, do you have difficulty communicating, for example, understanding or being understood?," "Do you have difficulty remembering or concentrating?," or "Do you have difficulty with self-care, such as washing all over or dressing?" were coded as living with a disability; those who responded "no difficulty" or "some difficulty" to all six questions were coded as no disability. These six questions are based on the short set of questions recommended by the Washington Group on Disability Statistics. https://www.cdc.gov/nchs/washington_group/index.htm

†††† Serious psychological distress was assessed using a set of questions from the six-item Kessler (K6) scale (<https://pubmed.ncbi.nlm.nih.gov/22351472/>) that asks sampled adults to assess the frequency of six characteristics (sadness, nervousness, restlessness, hopelessness, feeling that everything was an effort, and worthlessness) experienced within the previous 30 days. https://ftp.cdc.gov/pub/Health_Statistics/NCHS/Dataset_Documentation/NHIS/2021/srvydesc-508.pdf

§§§§ Depression was defined using the question, "Have you ever been told by a doctor or other health professional that you had... any type of depression?" Those responding "Yes" were classified as having ever had depression in their lifetime and those responding "No" as never having had depression in their lifetime.

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

TABLE. Characteristics of adults aged ≥18 years who reported tobacco product use “every day” or “some days,” by tobacco product and quit ratios — National Health Interview Survey, United States, 2021

Characteristic	Tobacco product use,* % (95% CI) [†]								
	Any tobacco product [§]	Combustible tobacco product [¶]	Cigarettes ^{**}	Cigars ^{††}	Pipes ^{§§}	E-cigarettes ^{¶¶}	Smokeless tobacco products ^{***}	Two or more tobacco products ^{†††}	Quit ratio ^{§§§}
Overall	18.7 (18.1–19.4)	14.5 (14.0–15.1)	11.5 (11.1–12.0)	3.5 (3.2–3.8)	0.9 (0.8–1.1)	4.5 (4.2–4.9)	2.1 (1.9–2.4)	3.4 (3.1–3.7)	66.5 (65.4–67.7)
Sex									
Men	24.1 (23.2–25.1)	18.2 (17.4–19.0)	13.1 (12.4–13.9)	6.2 (5.7–6.7)	1.2 (1.0–1.5)	5.1 (4.7–5.6)	4.2 (3.7–4.6)	4.8 (4.4–5.3)	67.4 (65.9–69.0)
Women	13.6 (13.0–14.3)	11.1 (10.4–11.7)	10.1 (9.5–10.7)	1.0 (0.8–1.2)	0.7 (0.5–0.9)	4.0 (3.6–4.4)	0.2 (0.2–0.3)	2.1 (1.8–2.4)	65.4 (63.8–66.9)
Age group, yrs									
18–24	17.0 (15.1–19.1)	8.5 (7.1–10.0)	5.3 (4.3–6.6)	3.1 (2.2–4.2)	1.5 (1.0–2.3)	11.0 (9.4–12.7)	1.4 (0.8–2.2)	4.3 (3.3–5.5)	50.3 (42.0–58.6)
25–44	22.1 (21.0–23.2)	16.8 (15.9–17.9)	12.6 (11.8–13.5)	4.9 (4.4–5.5)	1.6 (1.3–1.9)	6.5 (5.9–7.1)	2.5 (2.1–2.9)	5.1 (4.5–5.7)	59.0 (56.7–61.2)
45–64	21.1 (20.0–22.2)	17.5 (16.5–18.5)	14.9 (14.0–15.9)	3.5 (3.0–3.9)	0.4 (0.3–0.6)	2.7 (2.3–3.1)	2.8 (2.4–3.3)	2.9 (2.5–3.3)	62.1 (60.4–63.9)
≥65	11.0 (10.3–11.8)	9.8 (9.0–10.6)	8.3 (7.6–9.0)	1.7 (1.4–2.0)	0.4 (0.3–0.5)	0.9 (0.7–1.1)	0.9 (0.7–1.2)	1.1 (0.8–1.4)	81.9 (80.5–83.3)
Race and ethnicity^{¶¶¶}									
AI/AN, non-Hispanic	—****	—****	—****	—****	—****	—****	—****	—****	—****
Asian, non-Hispanic	8.6 (7.0–10.5)	7.0 (5.5–8.8)	5.4 (4.1–6.9)	1.2 (0.7–1.9)	0.9 (0.5–1.6)	2.9 (2.0–4.0)	0.3 (0.1–0.7)	1.8 (1.1–2.8)	70.1 (63.6–76.2)
Black or African American, non-Hispanic	18.1 (16.4–20.0)	16.4 (14.7–18.2)	11.7 (10.3–13.2)	5.1 (4.0–6.3)	2.0 (1.4–2.8)	2.4 (1.8–3.2)	0.9 (0.5–1.4)	3.4 (2.6–4.3)	53.7 (49.5–57.9)
White, non-Hispanic	21.2 (20.4–22.0)	15.9 (15.2–16.6)	12.9 (12.3–13.6)	3.7 (3.4–4.0)	0.8 (0.6–0.9)	5.2 (4.8–5.7)	2.9 (2.6–3.2)	3.8 (3.4–4.1)	67.9 (66.6–69.2)
Hispanic	12.4 (11.2–13.6)	9.9 (8.8–11.0)	7.7 (6.8–8.7)	2.5 (1.9–3.1)	0.9 (0.6–1.2)	3.3 (2.8–4.0)	0.8 (0.5–1.2)	2.2 (1.7–2.7)	67.7 (64.4–70.8)
Other, non-Hispanic	25.6 (21.2–30.4)	18.0 (14.2–22.3)	14.9 (11.4–19.0)	5.2 (2.8–8.6)	1.1 (0.3–2.5)	8.9 (6.2–12.4)	1.2 (0.5–2.4)	5.1 (2.7–8.6)	61.5 (53.5–69.2)
U.S. Census Bureau region^{††††}									
Northeast	16.2 (14.6–17.8)	13.5 (12.1–15.0)	10.4 (9.2–11.7)	3.5 (2.8–4.4)	0.8 (0.5–1.1)	3.2 (2.6–3.9)	1.2 (0.8–1.6)	2.5 (1.8–3.3)	69.1 (66.0–72.1)
Midwest	22.1 (20.7–23.7)	17.2 (16.0–18.5)	14.0 (12.9–15.2)	4.0 (3.4–4.6)	0.8 (0.5–1.1)	4.6 (3.9–5.4)	3.2 (2.7–3.9)	3.8 (3.2–4.4)	64.0 (61.8–66.1)
South	19.7 (18.6–20.8)	15.4 (14.4–16.3)	12.4 (11.6–13.2)	3.7 (3.3–4.2)	1.1 (0.8–1.4)	4.7 (4.2–5.3)	2.3 (1.9–2.7)	3.8 (3.4–4.3)	64.6 (62.7–66.4)
West	16.0 (14.9–17.1)	11.5 (10.6–12.5)	8.9 (8.0–9.8)	2.8 (2.4–3.3)	1.0 (0.8–1.4)	5.2 (4.5–5.9)	1.6 (1.3–2.0)	3.0 (2.6–3.5)	70.9 (68.5–73.2)
Urbanization level^{§§§§}									
Urban	17.5 (16.9–18.2)	13.6 (13.1–14.2)	10.5 (10.0–11.1)	3.5 (3.2–3.8)	0.9 (0.8–1.1)	4.4 (4.1–4.8)	1.8 (1.6–2.0)	3.1 (2.8–3.4)	68.1 (66.8–69.4)
Rural	26.2 (24.4–28.1)	20.1 (18.5–21.7)	18.0 (16.5–19.6)	3.5 (2.7–4.4)	0.9 (0.6–1.4)	5.3 (4.4–6.3)	4.5 (3.8–5.3)	5.1 (4.3–6.0)	58.9 (56.5–61.3)

See table footnotes on page 480.

among adults living in the Midwest (22.1%) or the South (19.7%) U.S. Census Bureau regions than among those living in the Northeast (16.2%) or West (16.0%), as well as higher among those living in rural areas (26.2%) compared with those in urban areas (17.5%). A larger percentage of adults with a GED certificate (39.0%) reported current tobacco product use than did persons with other levels of education (range = 8.6%–24.4%). In addition, use prevalence was higher among persons who were divorced, separated, or widowed (21.3%) or single, never married, or not living with a partner (20.1%) than among those who were married or living with a

partner (17.5%). Other sociodemographic groups with higher prevalences of current tobacco use included persons with low income (24.7%) compared with persons with middle (18.9%) or high income (14.8%), and LGB adults (27.4%) compared with heterosexual/straight adults (18.4%). Higher prevalences of tobacco use were reported by persons who were uninsured (28.4%) or insured by Medicaid (28.1%) than by persons who had some other public insurance (21.6%), private insurance (16.2%), or Medicare only (10.7%); by those with a disability (24.2%) compared with those who did not have a disability (18.2%); and by those who reported serious psychological

TABLE. (Continued) Characteristics of adults aged ≥18 years who reported tobacco product use “every day” or “some days,” by tobacco product and quit ratios — National Health Interview Survey, United States, 2021

Characteristic	Tobacco product use,* % (95% CI) [†]								
	Any tobacco product [§]	Combustible tobacco product [¶]	Cigarettes ^{**}	Cigars ^{††}	Pipes ^{§§}	E-cigarettes ^{¶¶}	Smokeless tobacco products ^{***}	Two or more tobacco products ^{†††}	Quit ratio ^{§§§}
Educational attainment, adults aged ≥25 yrs									
0–12 yrs, no diploma	23.6 (21.5–25.8)	21.2 (19.2–23.3)	20.1 (18.2–22.1)	2.8 (2.0–3.7)	0.4 (0.2–0.8)	3.0 (2.2–4.1)	1.7 (1.2–2.3)	3.7 (2.8–4.7)	54.5 (50.9–58.1)
GED	39.0 (34.2–44.1)	33.6 (28.9–38.4)	30.7 (26.2–35.5)	5.2 (3.2–8.0)	0.9 (0.3–2.2)	6.4 (4.4–9.0)	5.4 (3.5–7.9)	8.3 (6.0–11.3)	52.0 (46.2–57.8)
High school diploma	24.4 (23.1–25.8)	19.7 (18.5–21.0)	17.1 (15.9–18.2)	3.4 (2.9–4.1)	1.0 (0.7–1.4)	4.7 (4.0–5.4)	3.1 (2.6–3.7)	4.3 (3.7–5.0)	62.1 (60.0–64.2)
Some college, no degree	23.3 (21.7–25.0)	19.2 (17.6–20.8)	16.1 (14.7–17.6)	4.2 (3.4–5.2)	1.1 (0.7–1.7)	5.0 (4.2–5.9)	2.3 (1.7–2.9)	4.5 (3.7–5.5)	64.2 (61.5–66.7)
Associate degree (academic, technical, or vocational)	21.5 (19.9–23.2)	16.8 (15.3–18.3)	13.7 (12.3–15.1)	4.0 (3.2–4.9)	0.9 (0.6–1.3)	4.8 (3.9–5.8)	3.0 (2.3–3.8)	4.1 (3.3–5.0)	67.4 (64.6–70.2)
Bachelor's degree	12.0 (11.1–12.9)	9.1 (8.3–9.9)	5.3 (4.7–5.9)	3.8 (3.3–4.4)	0.8 (0.6–1.1)	2.6 (2.1–3.1)	1.6 (1.3–2.0)	1.8 (1.4–2.1)	80.3 (78.2–82.4)
Graduate degree (master's, doctoral, or professional)	8.6 (7.6–9.6)	6.5 (5.6–7.4)	3.2 (2.7–3.9)	2.9 (2.4–3.6)	0.8 (0.6–1.2)	2.0 (1.5–2.5)	0.9 (0.6–1.3)	1.2 (0.8–1.6)	86.3 (83.7–88.6)
Marital status									
Married or living with partner	17.5 (16.7–18.2)	13.4 (12.7–14.1)	10.4 (9.8–11.1)	3.4 (3.1–3.8)	0.7 (0.6–0.9)	3.7 (3.3–4.1)	2.3 (2.0–2.6)	2.8 (2.4–3.1)	71.1 (69.7–72.5)
Divorced, separated, or widowed	21.3 (20.1–22.5)	18.7 (17.6–19.8)	16.8 (15.7–17.9)	2.9 (2.4–3.4)	0.6 (0.4–0.9)	3.5 (2.9–4.1)	2.0 (1.7–2.5)	3.7 (3.2–4.3)	64.1 (62.1–66.1)
Single, never married, or not living with partner	20.1 (18.8–21.5)	14.5 (13.4–15.7)	10.9 (9.9–11.8)	4.2 (3.6–4.9)	1.8 (1.4–2.2)	7.5 (6.6–8.4)	1.7 (1.4–2.1)	4.8 (4.2–5.5)	51.6 (48.7–54.5)
Income to poverty ratio (income level)^{¶¶¶¶}									
0–1.99 (low)	24.7 (23.4–26.1)	20.6 (19.4–21.8)	18.3 (17.2–19.5)	3.4 (2.9–4.0)	1.2 (0.9–1.6)	5.9 (5.2–6.6)	1.9 (1.6–2.4)	5.0 (4.5–5.7)	46.1 (42.4–9.8)
2.00–3.99 (middle)	18.9 (17.9–20.0)	14.8 (13.9–15.8)	12.3 (11.5–13.3)	3.1 (2.6–3.6)	0.9 (0.6–1.1)	4.6 (4.0–5.2)	2.1 (1.7–2.5)	3.5 (3.0–4.1)	56.9 (54.4–9.5)
≥4.00 (high)	14.8 (14.0–15.6)	10.5 (9.8–11.1)	6.7 (6.2–7.3)	3.8 (3.4–4.3)	0.8 (0.6–1.0)	3.6 (3.2–4.1)	2.3 (2.0–2.7)	2.3 (2.0–2.6)	72.5 (71.2–73.8)
Sexual orientation									
Heterosexual or straight	18.4 (17.7–19.1)	14.3 (13.8–14.9)	11.4 (10.9–11.9)	3.5 (3.2–3.8)	0.9 (0.7–1.0)	4.1 (3.8–4.5)	2.2 (2.0–2.5)	3.2 (3.0–3.5)	66.9 (65.7–68.1)
Lesbian, gay, or bisexual	27.4 (24.1–30.9)	18.8 (16.1–21.6)	15.3 (12.9–17.9)	4.1 (2.8–5.8)	2.3 (1.3–3.7)	13.2 (10.6–16.1)	1.2 (0.6–2.1)	7.2 (5.4–9.3)	61.3 (55.9–66.5)
Health insurance coverage^{*****}									
Private	16.2 (15.5–17.0)	11.7 (11.1–12.3)	8.6 (8.1–9.1)	3.5 (3.1–3.8)	0.7 (0.6–0.9)	4.1 (3.8–4.5)	2.3 (2.0–2.6)	2.6 (2.3–2.9)	72.4 (71.0–73.8)
Medicaid	28.1 (26.1–30.1)	24.1 (22.2–26.0)	21.5 (19.9–23.3)	3.7 (3.0–4.6)	1.6 (1.1–2.2)	6.7 (5.6–8.0)	1.8 (1.2–2.5)	5.9 (4.9–7.0)	46.7 (43.6–49.8)
Medicare only (age ≥65 yrs)	10.7 (9.4–12.0)	9.8 (8.6–11.0)	8.4 (7.3–9.6)	1.4 (1.0–1.9)	0.4 (0.2–0.8)	0.9 (0.5–1.3)	0.8 (0.5–1.2)	1.2 (0.7–1.8)	81.1 (78.6–83.4)
Other public insurance	21.6 (19.3–24.1)	17.2 (15.1–19.5)	13.9 (12.0–16.0)	4.4 (3.2–6.0)	1.1 (0.6–1.9)	4.1 (3.0–5.5)	2.3 (1.5–3.3)	3.9 (2.8–5.4)	71.1 (67.3–74.7)
None	28.4 (26.1–30.9)	23.5 (21.5–25.6)	20.0 (18.1–22.1)	5.0 (4.0–6.1)	2.0 (1.3–2.9)	7.2 (6.0–8.7)	2.5 (1.9–3.3)	7.1 (5.9–8.5)	43.8 (40.1–47.6)

See table footnotes on page 480.

distress (37.6%) compared with those who did not report serious psychological distress (18.0%).

Discussion

In 2021, approximately one in nine (11.5%) U.S. adults aged ≥18 years currently smoked cigarettes. Although this finding represents the lowest smoking prevalence recorded since 1965 (1), nearly one in five adults continue to use tobacco products. Cigarettes and other combustible tobacco products constitute

the largest proportion of overall tobacco product use and are the foremost cause of tobacco-related morbidity and mortality in the United States (1). Consistent with the declines during recent decades, the prevalence of cigarette smoking decreased during 2020–2021. Comprehensive tobacco control strategies (e.g., smoke-free laws, media campaigns such as Tips from Former Smokers, and price increases) at the national, state, and local levels likely contributed to the lower cigarette smoking prevalence (3,4).

TABLE. (Continued) Characteristics of adults aged ≥18 years who reported tobacco product use “every day” or “some days,” by tobacco product and quit ratios — National Health Interview Survey, United States, 2021

Characteristic	Tobacco product use,* % (95% CI) [†]								
	Any tobacco product [§]	Combustible tobacco product [¶]	Cigarettes ^{**}	Cigars ^{††}	Pipes ^{§§}	E-cigarettes ^{¶¶}	Smokeless tobacco products ^{***}	Two or more tobacco products ^{†††}	Quit ratio ^{§§§}
Disability^{††††}									
Yes	24.2 (22.3–26.2)	20.4 (18.7–22.2)	18.5 (16.8–20.2)	3.4 (2.6–4.3)	1.1 (0.7–1.6)	4.7 (3.7–5.9)	1.7 (1.2–2.4)	4.2 (3.4–5.3)	64.0 (61.2–66.8)
No	18.2 (17.5–18.8)	13.9 (13.4–14.5)	10.9 (10.4–11.4)	3.5 (3.2–3.8)	0.9 (0.8–1.1)	4.5 (4.2–4.9)	2.2 (1.9–2.4)	3.3 (3.0–3.6)	66.9 (65.7–68.1)
Serious psychological distress^{§§§§§}									
Yes	37.6 (34.0–41.3)	32.1 (28.6–35.7)	28.1 (24.8–31.6)	6.5 (4.7–8.6)	2.7 (1.6–4.4)	10.4 (8.2–12.9)	1.7 (1.0–2.9)	9.8 (7.7–12.2)	45.3 (40.2–50.5)
No	18.0 (17.4–18.7)	13.9 (13.3–14.4)	10.9 (10.4–11.4)	3.4 (3.1–3.7)	0.9 (0.7–1.0)	4.3 (4.0–4.7)	2.2 (1.9–2.4)	3.1 (2.9–3.4)	67.7 (66.6–68.9)

Abbreviations: AI/AN = American Indian or Alaska Native; CHIP = Children’s Health Insurance Program; e-cigarettes = electronic cigarettes; GED = general educational development certificate; NCHS = National Center for Health Statistics; NHIS = National Health Interview Survey.

* Smoking and tobacco product use refers to use of commercial tobacco products and not to tobacco used for medicinal and spiritual purposes by some American Indian communities.

[†] 95% Korn-Graubard CIs. NCHS data presentation standards. https://www.cdc.gov/nchs/data/series/sr_02/sr02_175.pdf

[§] Any tobacco use was defined as use either “every day” or “some days” of at least one tobacco product. For cigarettes, users were defined as adults who reported use either “every day” or “some days” and had smoked 100 or more cigarettes during their lifetime.

[¶] Any combustible tobacco use was defined as use either “every day” or “some days” of at least one combustible tobacco product: cigarettes; cigars, cigarillos, filtered little cigars; pipes, water pipes, or hookah. For cigarettes, users were defined as adults who reported use either “every day” or “some days” and had smoked 100 or more cigarettes during their lifetime.

^{**} Current cigarette smoking was defined as smoking 100 or more cigarettes during a person’s lifetime and now smoking cigarettes “every day” or “some days.”

^{††} Current cigar smoking was defined as smoking cigars, cigarillos, or little filtered cigars at least once during a person’s lifetime and now smoking at least one of these products “every day” or “some days.”

^{§§} Current pipe smoking was defined as smoking tobacco in a regular pipe, water pipe, or hookah at least once during a person’s lifetime and now smoking at least one of these products “every day” or “some days.”

^{¶¶} Current e-cigarette use was defined as using e-cigarettes at least once during a person’s lifetime and now using e-cigarettes “every day” or “some days.”

^{***} Current smokeless tobacco product use was defined as using chewing tobacco, snuff, dip, snus, or dissolvable tobacco at least once during a person’s lifetime and now using at least one of these products “every day” or “some days.”

^{†††} Current multiple tobacco product use was defined as use “every day” or “some days” for two or more of the following tobacco products: cigarettes (100 or more cigarettes during a person’s lifetime); cigars, cigarillos, filtered little cigars; pipes, water pipes, or hookah; e-cigarettes; or smokeless tobacco products.

^{§§§} Quit ratio is the percentage of persons who ever smoked (100 or more cigarettes during their lifetime) who have quit smoking.

^{¶¶¶} Hispanic persons could be of any race. All other groups were non-Hispanic. The following four non-Hispanic single-race categories were available for sampled adults in the 2021 NHIS public use files: 1) AI/AN; 2) Asian; 3) Black or African American; and 4), White. The “non-Hispanic, other” category includes those adults who were categorized as “non-Hispanic AI/AN and any other group” or “other single and multiple races.”

^{****} Based on NCHS data presentation standards, estimates were statistically unreliable (https://www.cdc.gov/nchs/data/series/sr_02/sr02_175.pdf). SAS MACRO used to suppress criteria check. <https://www.sas.com/content/dam/SAS/support/en/sas-global-forum-proceedings/2019/3659-2019.pdf>

^{††††} https://www2.census.gov/geo/pdfs/maps-data/maps/reference/us_regdiv.pdf

^{§§§§} Urbanization level (termed metropolitan statistical area in a previous report) is based on the 2013 NCHS Urban-Rural Classification Scheme for Counties. (https://www.cdc.gov/nchs/data/series/sr_02/sr02_166.pdf). Note that the original variable for urbanization level in the NHIS public use data files is four levels; for this report, the four-level variable has been reduced to a dichotomous variable.

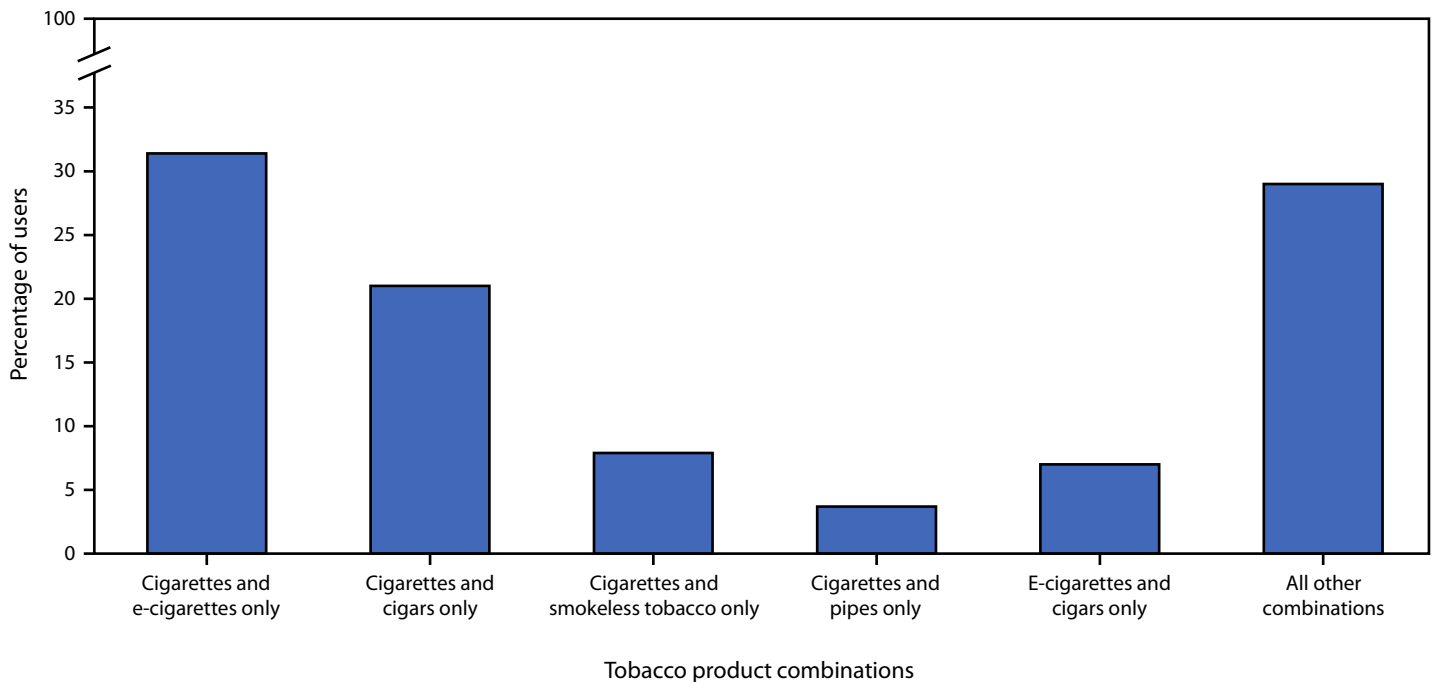
^{¶¶¶¶} Ratio of family income to poverty threshold for family size based on the imputed family income to poverty threshold variable (29,482).

^{*****} *Private coverage:* adults who had any comprehensive private insurance plan (including health maintenance organizations and preferred provider organizations). *Medicaid:* adults aged <65 years; includes those who did not have private coverage but had Medicaid or other state-sponsored health plans, including CHIP. For adults aged ≥65 years, those who did not have any private coverage but had Medicare and Medicaid or other state-sponsored health plans were categorized as having Medicaid. *Medicare only:* adults aged ≥65 years who only had Medicare coverage. *Other coverage:* adults who did not have private insurance, Medicaid, or other public coverages, but who had any type of military coverage, coverage from other government programs, or Medicare (adults aged <65 years). *Uninsured:* adults who did not indicate at the time of interview that they were covered under private health insurance, Medicare, Medicaid, CHIP, a state-sponsored health plan, other government programs, or military coverage. Insurance coverage is “as of time of survey.”

^{†††††} Disability was defined based on self-reported presence of selected limitations including vision, hearing, mobility, remembering or concentrating, self-care, and communication. Respondents who indicated “A lot of difficulty” or “Cannot do at all/unable to do” to at least one of the following six questions: “Do you have difficulty seeing, even when wearing glasses?,” “Do you have difficulty hearing, even when using a hearing aid?,” “Do you have any difficulty walking or climbing steps?,” “Using your usual language, do you have difficulty communicating, for example, understanding or being understood?,” “Do you have difficulty remembering or concentrating?,” or “Do you have difficulty with self-care, such as washing all over or dressing?” were coded as living with a disability; those who responded “no difficulty” or “some difficulty” to all six questions were coded as no disability. These six questions are based on the short set of questions recommended by the Washington Group on Disability Statistics. https://www.cdc.gov/nchs/washington_group/index.htm

^{§§§§§} Serious psychological distress was assessed using a set of questions from the six-item Kessler (K6) scale (<https://pubmed.ncbi.nlm.nih.gov/22351472/>) that asks sampled adults to assess the frequency of six characteristics (sadness, nervousness, restlessness, hopelessness, feeling that everything was an effort, and worthlessness) experienced within the previous 30 days. https://ftp.cdc.gov/pub/Health_Statistics/NCHS/Dataset_Documentation/NHIS/2021/srvydesc-508.pdf

FIGURE 1. Percentage of persons aged ≥ 18 years who reported use of two or more tobacco products, by the top five product combinations — United States, 2021^{*,†,§}



Abbreviation: e-cigarettes = electronic cigarettes.

* Smoking and tobacco product use refers to use of commercial tobacco products and not to tobacco used for medicinal and spiritual purposes by some American Indian communities.

† Current smokeless tobacco product use was defined as using chewing tobacco, snuff, dip, snus, or dissolvable tobacco at least once during a person's lifetime and now using at least one of these products "every day" or "some days."

§ "All other combinations" refers to use of other combinations of two or more products.

Nearly one in five adults who currently used tobacco products used two or more products, with nearly one third of these persons (31.4%) reporting use of both cigarettes and e-cigarettes. Further, the prevalence of e-cigarette use increased during 2020–2021. In addition to continued surveillance of tobacco product use, it is equally important to monitor use of combinations of tobacco products to characterize multiproduct use trends.

Adults identifying as LGB, living in rural areas, or who are uninsured or have Medicaid insurance continue to report high prevalences of tobacco product use (6). Further, smoking prevalence is higher among adults who ever had diagnosed depression than among those who never had diagnosed depression, although, consistent with previous studies, prevalence declined from 2019 to 2021 (1,6,7). Racial and ethnic differences in tobacco product use are more pronounced among adults who ever had diagnosed depression than among those who never had diagnosed depression. Racial and ethnic differences in smoking prevalence might be related to a combination of lived experiences, such as discrimination and frequent tobacco product advertising exposure: disproportionate tobacco product advertising in low-income neighborhoods or areas with high proportions of Black or AI/AN persons has been documented

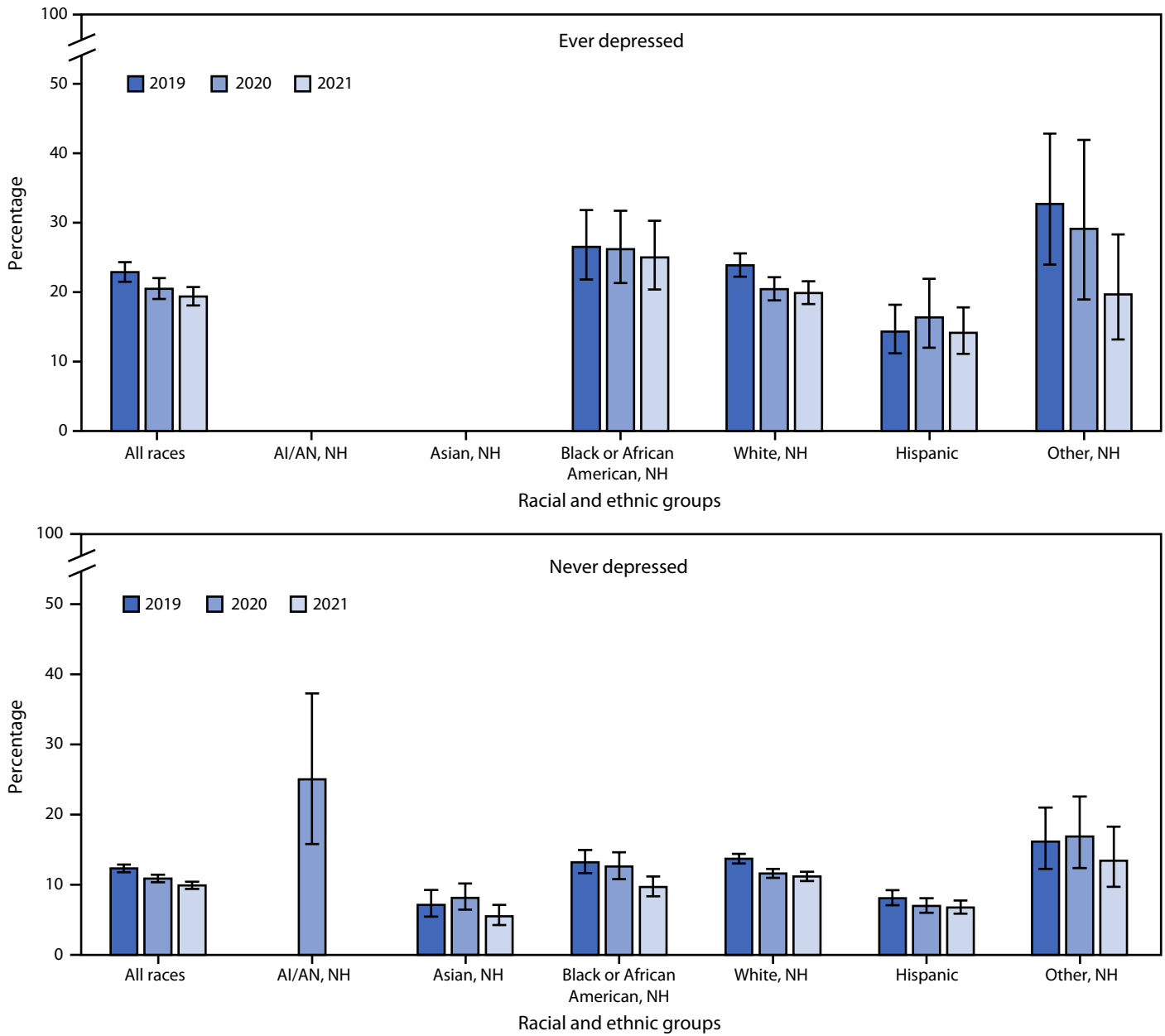
(1,8,9). Racial and ethnic differences in smoking prevalence by diagnosed depression might also be partially attributed to differences in access to mental health care and tobacco cessation services (8,9).

The findings in this report are subject to at least five limitations. First, because NHIS is limited to noninstitutionalized U.S. civilian populations, results are not generalizable to institutionalized populations or persons in the military. Second, responses to questions were self-reported and were not validated by biochemical testing; however, self-reported smoking status has been determined to correlate with serum cotinine levels (10). Third, 2021 tobacco product estimates for AI/AN populations were not statistically reliable^{*****} and therefore are not presented. Fourth, changes in the 2020 and 2021 NHIS survey administration from in-person to primarily telephone-based (because of the COVID-19 pandemic) might affect 2020 and 2021 estimates^{†††††} (5). Finally, these data

^{*****} Based on NCHS data presentation standards, estimates were statistically unreliable (https://www.cdc.gov/nchs/data/series/sr_02/sr02_175.pdf). SAS MACRO used to suppress criteria check. <https://www.sas.com/content/dam/SAS/support/en/sas-global-forum-proceedings/2019/3659-2019.pdf>

^{†††††} https://ftp.cdc.gov/pub/Health_Statistics/NCHS/Dataset_Documentation/NHIS/2020/nonresponse-report-508.pdf

FIGURE 2. Prevalence* of cigarette smoking† among persons aged ≥18 years, by race and ethnicity and depression diagnosis history§ — United States, 2019–2021¶,,††,§§**



Abbreviations: AI/AN = American Indian or Alaska Native; NCHS = National Center for Health Statistics; NH = non-Hispanic.

* With 95% CIs indicated by error bars.

† Smoking and tobacco product use refers to use of commercial tobacco products and not to tobacco used for medicinal and spiritual purposes by some American Indian communities.

§ Depression was defined using the question, “Have you ever been told by a doctor or other health professional that you had ... any type of depression?” Those responding “Yes” were classified as having ever had depression in their lifetime. Those responding “No” were classified as never having had depression in their lifetime.

¶ Among adults who ever had diagnosed depression, statistically significant ($p < 0.05$) trends during 2019–2021 were observed for the following groups: all races; Black or African American, NH; White, NH; and Hispanic adults.

** Among adults who never had diagnosed depression, statistically significant ($p < 0.05$) trends during 2019–2021 were observed for the following groups: all races; Black or African American, NH; White, NH; and Hispanic adults.

†† Among adults who ever had diagnosed depression, estimates were statistically unreliable for AI/AN, NH; and Asian, NH adults during 2019–2021 and are not presented based on NCHS data presentation standards (https://www.cdc.gov/nchs/data/series/sr_02/sr02_175.pdf). SAS MACRO used to suppress criteria check. <https://support.sas.com/resources/papers/proceedings19/3659-2019.pdf>

§§ Among adults who never had diagnosed depression, estimates were statistically unreliable for AI/AN, NH adults in 2019 and 2021 and are not presented based on NCHS data presentation standards (https://www.cdc.gov/nchs/data/series/sr_02/sr02_175.pdf). SAS MACRO used to suppress criteria check. <https://support.sas.com/resources/papers/proceedings19/3659-2019.pdf>

Summary**What is already known about this topic?**

Tobacco product use remains the leading cause of preventable disease and death in the United States.

What is added by this report?

In 2021, approximately 18.7% (46 million) of U.S. adults currently used any tobacco product. Cigarettes were the most frequently reported tobacco product (11.5%), followed by e-cigarettes (4.5%). During 2020–2021, the prevalence of cigarette smoking decreased, and prevalence of e-cigarette use increased.

What are the implications for public health practice?

Continued use of evidence-based comprehensive tobacco control strategies, including linguistically and culturally competent educational campaigns and innovative strategies, combined with Food and Drug Administration regulation of tobacco products will support activities and programs to further reduce tobacco-related disease, death, and disparities.

are cross-sectional, and trends in tobacco product use changes among individual persons cannot be assessed.

In 2021, the 11.5% prevalence of current cigarette smoking was less than the 12% end-of-decade goal set by Healthy People 2020^{§§§§§}. Although cigarette smoking decreased over the past year, e-cigarette use increased, from 3.7% to 4.5%, largely driven by higher prevalence in use among persons aged 18–24 years. Further, declines in cigarette smoking among populations with diagnosed depression represent important successes in tobacco control (7). However, disparities in tobacco use remain. Continued implementation of evidence-based strategies, such as increasing the unit price of tobacco products, enforcing comprehensive smoke-free policies, and conducting linguistically and culturally appropriate educational campaigns, combined with FDA regulation of tobacco products and innovative strategies, will support activities and programs to reduce tobacco use and tobacco-related disparities (3,4).

^{§§§§§} <https://wayback.archive-it.org/5774/20220415165927/https://www.healthypeople.gov/2020/topics-objectives/topic/tobacco-use/objectives>

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References

1. CDC. Smoking & tobacco use. Smoking cessation: a report of the Surgeon General. Atlanta, GA: US Department of Health and Human Services, CDC; 2020. <https://www.cdc.gov/tobacco/sgr/2020-smoking-cessation/index.html>
2. Martell BN, Garrett BE, Caraballo RS. Disparities in adult cigarette smoking—United States, 2002–2005 and 2010–2013. *MMWR Morb Mortal Wkly Rep* 2016;65:753–8. PMID:27491017 <https://doi.org/10.15585/mmwr.mm6530a1>
3. CDC. Best practices for comprehensive tobacco control programs. Atlanta, GA: US Department of Health and Human Services, CDC; 2014. <https://www.cdc.gov/tobacco/stateandcommunity/guides/pdfs/2014/comprehensive.pdf>
4. King BA, Graffunder C. The tobacco control vaccine: a population-based framework for preventing tobacco-related disease and death. *Tob Control* 2018;27:123–4. PMID:29475955 <https://doi.org/10.1136/tobaccocontrol-2018-054276>
5. National Center for Health Statistics. National Health Interview Survey: 2021 survey description. Hyattsville, MD: US Department of Health and Human Services, CDC; National Center for Health Statistics; 2022. https://ftp.cdc.gov/pub/Health_Statistics/NCHS/Dataset_Documentation/NHIS/2021/srvydesc-508.pdf
6. Cornelius ME, Loretan CG, Wang TW, Jamal A, Homa DM. Tobacco product use among adults—United States, 2020. *MMWR Morb Mortal Wkly Rep* 2022;71:397–405. PMID:35298455 <https://doi.org/10.15585/mmwr.mm7111a1>
7. Han B, Volkow ND, Blanco C, Tipperman D, Einstein EB, Compton WM. Trends in prevalence of cigarette smoking among US adults with major depression or substance use disorders, 2006–2019. *JAMA* 2022;327:1566–76. PMID:35471512 <https://doi.org/10.1001/jama.2022.4790>
8. CDC. Best practices user guides: health equity in tobacco prevention and control. Atlanta: US Department of Health and Human Services, CDC; 2015. <https://www.cdc.gov/tobacco/stateandcommunity/best-practices-health-equity/pdfs/bp-health-equity.pdf>
9. Purnell JQ, Peppone LJ, Alcaraz K, et al. Perceived discrimination, psychological distress, and current smoking status: results from the Behavioral Risk Factor Surveillance System Reactions to Race Module, 2004–2008. *Am J Public Health* 2012;102:844–51. PMID:22420821 <https://doi.org/10.2105/AJPH.2012.300694>
10. Binnie V, McHugh S, Macpherson L, Borland B, Moir K, Malik K. The validation of self-reported smoking status by analysing cotinine levels in stimulated and unstimulated saliva, serum and urine. *Oral Dis* 2004;10:287–93. PMID:15315646 <https://doi.org/10.1111/j.1601-0825.2004.01018.x>

Salmonella Outbreaks Associated with Not Ready-to-Eat Breaded, Stuffed Chicken Products — United States, 1998–2022

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Not ready-to-eat (NRTE) breaded, stuffed chicken products (e.g., chicken stuffed with broccoli and cheese) typically have a crispy, browned exterior that can make them appear cooked. These products have been repeatedly linked to U.S. salmonellosis outbreaks, despite changes to packaging initiated in 2006 to identify the products as raw and warn against preparing them in a microwave oven (microwave) (1–4). On April 28, 2023, the U.S. Department of Agriculture proposed to declare *Salmonella* an adulterant* at levels of one colony forming unit per gram or higher in these products (5). *Salmonella* outbreaks associated with NRTE breaded, stuffed chicken products during 1998–2022 were summarized using reports in CDC’s Foodborne Disease Outbreak Surveillance System (FDOSS), outbreak questionnaires, web postings, and data from the Minnesota Department of Health (MDH)[†] and the U.S. Department of Agriculture’s Food Safety and Inspection Service (FSIS). Eleven outbreaks were identified in FDOSS. Among cultured samples from products obtained from patients’ homes and from retail stores during 10 outbreaks, a median of 57% of cultures per outbreak yielded *Salmonella*. The NRTE breaded, stuffed chicken products were produced in at least three establishments.[§] In the seven most recent outbreaks, 0%–75% of ill respondents reported cooking the product in a microwave and reported that they thought the product was sold fully cooked or did not know whether it was sold raw or fully cooked. Outbreaks associated with these products have occurred despite changes to product labels that better inform consumers that the products are raw and provide instructions on safe preparation, indicating that consumer-targeted interventions are not sufficient. Additional *Salmonella* controls at the manufacturer level to reduce contamination in ingredients might reduce illnesses attributable to NRTE breaded, stuffed chicken products.

*The circumstances under which a poultry product is considered adulterated are defined in the Poultry Products Inspection Act, which includes several conditions that result in a product’s being unsafe or harmful to health (21 U.S.C. 453 [g]).

[†]With one exception, MDH first identified and led the investigation for every outbreak described in this report, and also provided CDC with additional outbreak reports for each of the 10 outbreaks.

[§]An establishment at which inspection of the slaughter of poultry, or the processing of poultry products, is maintained under the authority of 21 U.S.C. Chapter 10 Sect. 453p, as determined by the U.S. Department of Agriculture secretary.

State health officials submit reports of foodborne *Salmonella* outbreaks to FDOSS. A foodborne outbreak is defined as the occurrence of a similar illness associated with a common food exposure in two or more persons. *Salmonella* outbreaks with mention of frozen, breaded, or stuffed chicken that occurred during 1998–2022 were identified in FDOSS; data for 2022 are incomplete. Search results were supplemented by information obtained from outbreak investigators, and a review of questionnaires administered to ill persons, web postings, product recall information, product sampling results, and data from MDH and FSIS.

Descriptive analyses were performed using R statistical software (version 4.0.2; R Foundation). The number of outbreaks, illnesses,[¶] and hospitalizations; serotypes; setting where food was prepared; patient sex and age groups; type of chicken used in the products; testing results for food and environmental samples collected from patients’ homes or retail establishments; and product recalls were summarized. Product type and producing establishments were identified through traceback by Minnesota’s Departments of Agriculture and Health or by FSIS.

To examine the cooking practices of ill persons in outbreaks, and whether they believed the product was sold fully cooked, data collected from patient interviews during Minnesota and multistate outbreak investigations were summarized. Responses from outbreaks occurring during 2008–2021, after labeling changes were initiated in 2006, were compared with those from earlier outbreaks. This activity was reviewed by CDC and was conducted consistent with applicable federal law and CDC policy.**

An NRTE breaded, stuffed chicken product was the confirmed^{††} food vehicle in 11 *Salmonella* outbreaks^{§§}

[¶] Illnesses include both laboratory-confirmed and epidemiologically linked to a laboratory-confirmed illness or implicated food. <https://www.cdc.gov/nors/downloads/guidance.pdf>

** 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.

^{††} NRTE breaded, stuffed chicken products were considered the confirmed food vehicle when there was at least one type of evidence (epidemiologic, traceback, or laboratory testing) in point source outbreaks or at least two types of evidence in outbreaks with exposures in multiple venues or in more than one county or state. <https://www.cdc.gov/nors/downloads/guidance.pdf>

^{§§} MDH and FSIS investigated four additional clusters of illness suspected to be associated with NRTE breaded, stuffed chicken products; none met the National Outbreak Reporting System outbreak definition.

that occurred during 1998–2022, comprising 187 cases of illness, 42 hospitalizations, and no deaths (Table 1). The outbreaks were caused by *Salmonella* serotypes Enteritidis (seven outbreaks), Typhimurium (two), Heidelberg (one), and I 4,[5],12:i- (one). In 10 of the 11 outbreaks, the products were prepared in private homes. Outbreak illnesses were identified in 21 U.S. states; five of six single-state outbreaks occurred in Minnesota and illnesses occurred in Minnesota in every multistate outbreak. Among 139 patients for whom data from 10 outbreaks were available, 73 (53%) were male and 64 (42%) of 153 patients were aged 20–49 years.

NRTE breaded, stuffed chicken products were made with comminuted^{¶¶} chicken in the three 2015 and 2021 outbreaks. The type of chicken used during earlier outbreaks was not documented. FSIS issued product recalls in six outbreaks and public health alerts in seven.^{***} Product samples were collected from patients' homes in nine outbreaks and from retail stores in 10.^{†††} A median of 57% (range = 0%–100%) of samples per outbreak from patients' homes and 57% (range = 11%–93%) of samples per outbreak from retail stores yielded *Salmonella* upon culture. An isolate from at least one product matched the patients' serotype or strain in every outbreak in which product was sampled. The producing establishment was unknown for one outbreak; products in the other 10 outbreaks came from at least three producing establishments. Establishments A and B were implicated in five outbreaks each, and establishment C was implicated in three outbreaks. Establishments A and C are still operating; they are two of the six U.S. establishments that make these products.

Among 47 patients in four outbreaks during 1998–2006 (before product labeling changes) who provided data on the appliance used to cook the product, a median of 85% per outbreak (range = 67%–100%) reported cooking the product in a

microwave; among 57 patients who provided these data from seven outbreaks during 2008–2021 (after labeling changes), a median of 20% per outbreak (range = 0%–75%) reported cooking the product in a microwave (Table 2). In four outbreaks that occurred during 1998–2006, among 37 patients who provided information about whether they thought the product was sold fully cooked, a median of 56% per outbreak (range = 33%–100%) reported that they thought the product was sold fully cooked or did not know whether it was sold raw or fully cooked. In six outbreaks during 2008–2021, among 34 patients who provided this information, a median of 27% per outbreak (range = 0%–75%) thought the product was sold fully cooked or did not know whether it was sold raw or fully cooked.

Discussion

Eleven *Salmonella* outbreaks linked to NRTE breaded, stuffed chicken products (involving 187 patients) were reported in the United States during 1998–2022. Most of the products tested contained *Salmonella*. Products were produced by at least three establishments. Outbreaks have continued to occur despite changes made to product labels to better inform consumers and increase the percentages of persons who understand that the product is sold raw. Thus, stronger controls are needed to prevent illnesses associated with these products.

NRTE breaded, stuffed chicken products can be made with various types of chicken, including comminuted, trimmings, or other parts. Certain chicken types are subject to FSIS performance standards, which are used to measure an establishment's process control; the comminuted chicken used to make these products has the highest allowable percentage (13 of 52 [25%]) of *Salmonella* positives (6). On April 28, 2023, the U.S. Department of Agriculture proposed to declare *Salmonella* an adulterant in NRTE breaded, stuffed chicken products, meaning that the product will be subject to regulatory action if *Salmonella* is detected even at very low levels (5).

Canada enacted regulations for certain breaded chicken products after investigators identified 19 *Salmonella* outbreaks caused by NRTE breaded chicken products during 2015–2019 (7). These products were not stuffed; most were chicken nuggets. The government introduced four control options in nonstuffed products to reduce *Salmonella* to below detectable amounts in these products (7). In 2019, the incidence of illness caused by *Salmonella* Enteritidis, the serotype implicated in 89% of those outbreaks, was 33% lower than it was during 2015–2018 and 7% lower than during the baseline years 2010–2014 (8).

Consumer-based interventions alone, such as improved product labels, have not been an effective solution. In recent years, labels have recommended using a conventional oven

^{¶¶} Products that have been ground, mechanically separated, or hand- or mechanically deboned and further chopped, flaked, minced, or otherwise processed to reduce particle size.

^{***} FSIS defines a recall as a firm's action to remove product from commerce to protect the public from consuming adulterated or misbranded product. Although recalling product is a firm's decision, FSIS coordinates with the firm to ensure it has properly identified and removed recalled product from commerce by verifying the effectiveness of the firm's recall activities. FSIS also notifies the public about product recalls. A public health alert is issued when there is reason to believe a meat or poultry product might be associated with human illness, but FSIS cannot identify a specific product that could be recalled (Directive 8080.1, 2013). Some of the outbreaks had both a public health alert and recall, some only a public health alert, and others only a recall.

^{†††} No product samples were collected in the 2013 Washington *Salmonella* Enteritidis outbreak, and no product samples were taken from patients' homes in the 2005 multistate *Salmonella* Heidelberg outbreak. Product sampling during the 2005 multistate *Salmonella* Enteritidis outbreak and the 2006 Minnesota *Salmonella* Typhimurium outbreak occurred together and the proportion of samples yielding *Salmonella* was only counted once in median calculations.

TABLE 1. *Salmonella* outbreaks associated with not ready-to-eat breaded, stuffed raw chicken products — United States, 1998–2022*

Year of first illness	State where exposure occurred (no. of states) [†]	<i>Salmonella</i> serotype	No. of patients	No. of hospitalizations	Site of food preparation	Implicated establishment	Product recall [§]
1998	Minnesota	Typhimurium	33	0	Private home	A	Yes
2005	Multistate (2)	Heidelberg	9	4	Private home	B	No [¶]
2005	Multistate (10)	Enteritidis	41	6	Private home	A, B, and C	Yes [¶]
2006	Minnesota	Typhimurium	3	2	Private home	B	No
2008	Minnesota	Enteritidis	7	3	Private home	A	No [¶]
2008	Multistate (2)	I 4,[5],12:i-	19	8	Private home and workplace cafeteria	A and C**	No [¶]
2013	Washington	Enteritidis	10	0	Camp	Unknown	No
2014	Minnesota	Enteritidis	8	1	Private home	B	Yes
2015	Minnesota	Enteritidis	6	2	Private home	B	Yes [¶]
2015	Multistate (7)	Enteritidis	15	4	Private home	C	Yes [¶]
2021	Multistate (11)	Enteritidis	36	12	Private home	A	Yes [¶]

Abbreviations: FDOSS = Foodborne Disease Outbreak Surveillance System; FSIS = Food Safety and Inspection Service; USDA = U.S. Department of Agriculture.

* Minnesota Department of Health and FSIS investigated four additional clusters of illness that were suspected to be associated with not ready-to-eat breaded, stuffed chicken products; none met the National Outbreak Reporting System definition of an outbreak (<https://www.cdc.gov/nors/downloads/guidance.pdf>). One FDOSS-identified outbreak was a single state outbreak without notification to FSIS. No outbreaks were detected during 2022.

[†] 2005 multistate Heidelberg: Minnesota and Michigan; 2005 multistate Enteritidis: California, Colorado, Illinois, Iowa, Maryland, Minnesota, North Dakota, Oklahoma, Pennsylvania, and Tennessee; 2008 multistate: Minnesota and Wisconsin; 2015 multistate: Connecticut, Illinois, Minnesota, New Hampshire, New York, Oklahoma, and Wisconsin; 2021 multistate: Arizona, Arkansas, Connecticut, Illinois, Indiana, Michigan, Minnesota, Nevada, New York, Ohio, and Oklahoma.

[§] Product recall was considered nationwide for outbreaks during 2005–2018. It is unknown whether the 1998 recall was nationwide. USDA FSIS determines a recall to be nationwide when more than 11 states are involved in the recall.

[¶] Public health alert issued by FSIS. No recall from commerce by the company in the 2005 multistate outbreak, but one grocery store chain voluntarily removed all product from shelves.

** Additional brands of frozen stuffed chicken products were mentioned by patients in one outbreak but not traced back; therefore, the producers were unknown.

rather than a microwave and using a food thermometer (3); however, a consumer research study found that even when consumers read the label, 12% did not realize the product was raw or partially cooked, and among consumers who owned a food thermometer, 52% reported that they typically did not use it while preparing this product (9). Although labeling changes can help protect consumers, the questionnaire data show that some persons who knew the product was raw and followed the cooking instructions still became ill. Moreover, label changes cannot address inequities in access to recommended cooking appliances (3).

The number of patients who became ill from these products is likely much higher than that indicated from outbreak reports. Many persons regularly eat these products: in a U.S. population survey, 7.4% reported eating these products in the previous week.^{§§§} Although implicated products were distributed nationally, MDH officials identified all multistate outbreaks, and almost one half of outbreaks had cases identified only in Minnesota, suggesting that some outbreaks occurred but were not identified in other states.

Illnesses even among persons who reported that they used a conventional oven and knew the product was raw indicate that consumer-based interventions have been insufficient.

^{§§§} <https://www.cdc.gov/Foodnefast/PopSurvey>

Summary

What is already known about this topic?

Not ready-to-eat breaded, stuffed chicken products have repeatedly been a source of *Salmonella* outbreaks. On April 28, 2023, the U.S. Department of Agriculture proposed to declare *Salmonella* an adulterant in these products.

What is added by this report?

During 1998–2022, 11 *Salmonella* outbreaks linked to these products were reported; 57% of samples per outbreak from patient homes and retail stores yielded *Salmonella*. Outbreaks continue to occur, although a smaller percentage of patients reported cooking the product in a microwave after labeling changes.

What are the implications for public health practice?

Outbreaks have continued despite consumer-based interventions. Additional control measures for *Salmonella* contamination by manufacturers could reduce *Salmonella*-involved illnesses associated with these products.

The high rate of contamination of products in outbreaks and the lack of first recognition of multistate outbreaks by a state other than Minnesota suggest that the prevalence of illness due to these products is higher than that indicated by outbreaks. Moreover, only a small proportion of all *Salmonella* illnesses are identified as such. Illness could be reduced by enhanced

TABLE 2. Cooking appliances used by ill persons affected by not ready-to-eat breaded, stuffed raw chicken *Salmonella* outbreaks, by year and serotype — United States, 1998–2022*

Year	State	Serotype	No. of ill persons who responded/No. asked (%)			
			Appliance used to cook product			Thought or didn't know if product was sold fully cooked
			Microwave oven	Conventional oven	Other	
1998	Minnesota	Typhimurium	10/15 (67)	5/15 (33)	0/15 (—)	10/16 (63)
2005	Multistate	Heidelberg	2/2 (100)	0/2 (—)	0/2 (—)	2/2 (100)
2005	Multistate	Enteritidis	19/27 (70)	7/27 (26)	1/27 (4); toaster oven	8/16 (50)
2006	Minnesota	Typhimurium	3/3 (100)	0/3 (—)	0/3 (—)	1/3 (33)
2008	Minnesota	Enteritidis	5/7 (71)	2/7 (29)	0/7 (—)	3/4 (75)
2008	Multistate	14,[5],12:i-	9/12 (75)	3/12 (25)	0/12 (—)	2/6 (33)
2013	Washington	Enteritidis	0/10 (—)	0/10 (—)	10/10 (100); stovetop	Unknown
2014	Minnesota	Enteritidis	1/5 (20)	4/5 (80)	0/5 (—)	0/3 (—)
2015	Minnesota	Enteritidis	1/5 (20)	3/5 (60)	1/5 (20); convection-microwave combination oven	1/5 (20)
2015	Multistate	Enteritidis	0/5 (—)	4/5 (80)	1/5 (20); toaster oven	1/5 (20)
2021	Multistate	Enteritidis	5/13 (38)	6/13 (46)	2/13 (15); air fryer	5/11 (45)

* No outbreaks were detected in 2022.

Salmonella control at the manufacturers that produce these products. The U.S. Department of Agriculture's proposal to declare *Salmonella* an adulterant in NRTE breaded and stuffed chicken products will bring additional focus to this public health problem and encourage producers to better control *Salmonella* in the ingredients used to produce these products.

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References

- Smith KE, Medus C, Meyer SD, et al. Outbreaks of salmonellosis in Minnesota (1998 through 2006) associated with frozen, microwaveable, breaded, stuffed chicken products. *J Food Prot* 2008;71:2153–60. PMID:18939771 <https://doi.org/10.4315/0362-028X-71.10.2153>
- Rounds JM, Taylor AJ, Eikmeier D, et al. Prospective *Salmonella* Enteritidis surveillance and outbreak detection using whole genome sequencing, Minnesota 2015–2017. *Epidemiol Infect* 2020;148:e254. PMID:32539900 <https://doi.org/10.1017/S0950268820001272>
- Marshall KE, Canning M, Ablan M, Crawford TN, Robyn M. Appliances used by consumers to prepare frozen stuffed chicken products—United States, May–July 2022. *MMWR Morb Mortal Wkly Rep* 2022;71:1511–6. PMID:36454679 <https://doi.org/10.15585/mmwr.mm7148a2>
- Post RC. Letter to industry on frozen uncooked poultry. Washington, DC: US Department of Agriculture; 2006. https://www.fsis.usda.gov/sites/default/files/import/Letter_to_Industry_on_Frozen_Uncooked_Poultry.pdf
- Food Safety and Inspection Service, US Department of Agriculture. *Salmonella* in not-ready-to-eat breaded stuffed chicken products. *Fed Regist* 2023 Apr 28;88(82):26249–71. https://www.fsis.usda.gov/sites/default/files/media_file/documents/FSIS-2022-0013.pdf
- Food Safety and Inspection Service. FSIS directive 10,250.2. Washington, DC: US Department of Agriculture, Food Safety and Inspection Service; 2021. https://www.fsis.usda.gov/sites/default/files/media_file/2021-03/10250.2_0.pdf
- Morton VK, Kearney A, Coleman S, et al. Outbreaks of *Salmonella* illness associated with frozen raw breaded chicken products in Canada, 2015–2019. *Epidemiol Infect* 2019;147:e254. PMID:31436145 <https://doi.org/10.1017/S0950268819001432>
- Government of Canada. National Enteric Surveillance Program (NESP): annual summary 2019. Guelph, Canada: Government of Canada, Public Health Agency of Canada; 2020. https://publications.gc.ca/collections/collection_2021/aspc-phac/HP37-15-2019-eng.pdf
- Cates SC, Shumaker E, Brophy J, et al. Food safety consumer research project: meal preparation experiment on raw stuffed chicken breasts. Final report. Research Triangle Park: RTI International; 2020. https://www.fsis.usda.gov/sites/default/files/media_file/2021-04/fscrp-yr3-nrte-final-report.pdf

Provisional Mortality Data — United States, 2022

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The National Center for Health Statistics' (NCHS) National Vital Statistics System (NVSS) collects and reports annual mortality statistics using U.S. death certificate data. Because of the time needed to investigate certain causes of death and to process and review death data, final annual mortality data for a given year are typically released 11 months after the end of the calendar year. Provisional data, which are based on the current flow of death certificate data to NCHS, provide an early estimate of deaths, before the release of final data. NVSS routinely releases provisional mortality data for all causes of death and for deaths associated with COVID-19.* This report is an overview of provisional U.S. mortality data for 2022, including a comparison with 2021 death rates. In 2022, approximately 3,273,705 deaths[†] occurred in the United States. The estimated 2022 age-adjusted death rate decreased by 5.3%, from 879.7 per 100,000 persons in 2021 to 832.8. COVID-19 was reported as the underlying cause or a contributing cause in an estimated 244,986 (7.5%) of those deaths (61.3 deaths per 100,000). The highest overall death rates by age, race and ethnicity, and sex occurred among persons who were aged ≥85 years, non-Hispanic American Indian or Alaska Native (AI/AN), non-Hispanic Black or African American (Black), and male. In 2022, the four leading causes of death were heart disease, cancer, unintentional injuries, and COVID-19. Provisional death estimates provide an early indication of shifts in mortality trends and can guide public health policies and interventions aimed at reducing mortality, including deaths directly or indirectly associated with the COVID-19 pandemic.

NCHS analyzed provisional NVSS death certificate data for deaths occurring among U.S. residents in the United States during January–December 2022. Deaths among residents of U.S. territories and foreign countries were excluded. The number and rates of overall deaths and COVID-19–associated deaths were tabulated by age, sex, and race and ethnicity (categorized as AI/AN, non-Hispanic Asian [Asian], Black, non-Hispanic Native Hawaiian or other Pacific Islander, non-Hispanic White [White], non-Hispanic persons of more than one race [multiracial], unknown, or Hispanic or Latino [Hispanic]). NCHS coded the causes of death according to

the *International Classification of Diseases, Tenth Revision*, which details disease classification and the designation of underlying cause of death (1,2). COVID-19–associated death counts and rates include deaths for which COVID-19 was listed on the death certificate as an underlying or contributing cause of death.[§] COVID-19 was the underlying cause for approximately 76% (186,702) of COVID-19–associated deaths in 2022 (3). Leading causes of death were ranked by counts based on underlying cause of death (4). Age was unknown for 101 (<0.01%) decedents, and race and ethnicity were unknown for 10,086 (0.31%). The trends in deaths during the year were determined by calculating the number of deaths for each week from all causes and from COVID-19. Age-adjusted death rates were calculated for deaths overall and by sex and race and ethnicity. Crude death rates were calculated by age. The population data used to calculate death rates are July 1, 2021 estimates based on the Blended Base produced by the U.S. Census Bureau (5,6). Unless otherwise specified, rate comparisons in the text are statistically significant ($p < 0.05$).

In 2022, approximately 3,273,705 deaths occurred in the United States (Table). The age-adjusted rate, 832.8 deaths per 100,000 standard population, represented a decrease of 5.3% from 879.7 in 2021 (7). The total number of deaths peaked during the weeks ending January 22, 2022 (85,405 deaths) and December 31, 2022 (69,664) (Figure 1). In 2022, total death rates were lowest among persons aged 5–14 years (14.8 per 100,000) and highest among persons aged ≥85 years (15,605.2), similar to patterns in 2021 (Table). Overall death rates decreased for all age groups ≥15 years from 2021 to 2022, while the death rate increased from 25.0 to 26.9 per 100,000 among persons aged 1–4 years during the same period. The changes in overall death rates for age groups <1 year and 5–14 years were not significant. Age-adjusted death rates were higher among males compared with females in 2021 (1,048.0 and 733.3, respectively) and 2022 (984.8 and 700.9, respectively); however, from 2021 to 2022, the death rates decreased 6.0% among males and 4.4% among females.

During 2022, COVID-19 was listed as the underlying or contributing cause of 244,986 deaths (61.3 per 100,000), a 47% decrease from 462,193 deaths (115.6 per 100,000) in 2021. The COVID-19–associated death rate decreased from 2021 to 2022 among age groups ≥15 years, and the rate increased for all

* NVSS provisional mortality data are available at CDC's Provisional WONDER platform (<https://wonder.cdc.gov>). NVSS COVID-19 surveillance data are available online. <https://www.cdc.gov/nchs/nvss/deaths.htm>

[†] Based on death records received and processed as of April 2, 2023, for deaths occurring in the United States among U.S. residents. Data included in this analysis include >99% of deaths occurring in 2022.

[§] The underlying cause of death is the disease or injury that initiated the chain of morbid events leading directly to death.

TABLE. Provisional* number and rate of total deaths and COVID-19–associated deaths, by demographic characteristic — National Vital Statistics System, United States, 2021–2022

Characteristic	No. of deaths (rate [†])			
	2021		2022	
	Total	COVID-19–associated [‡]	Total	COVID-19–associated [‡]
Total	3,464,231 (879.7)	462,193 (115.6)	3,273,705 (832.8)	244,986 (61.3)
Age group, yrs				
<1	19,920 (558.8)	167 (4.7)	20,238 (567.8)	231 (6.5)
1–4	3,816 (25.0)	66 (0.4)	4,107 (26.9)	152 (1.0)
5–14	5,975 (14.3)	185 (0.4)	6,193 (14.8)	203 (0.5)
15–24	38,307 (88.9)	1,652 (3.8)	35,064 (81.4)	641 (1.5)
25–34	82,274 (180.8)	7,033 (15.5)	74,025 (162.7)	2,376 (5.2)
35–44	124,939 (287.9)	17,412 (40.1)	111,151 (256.1)	5,183 (11.9)
45–54	216,037 (531.0)	39,360 (96.7)	182,689 (449.0)	12,169 (29.9)
55–64	478,171 (1,117.1)	79,199 (185.0)	416,393 (972.8)	30,526 (71.3)
65–74	724,266 (2,151.3)	111,412 (330.9)	667,308 (1,982.1)	53,228 (158.1)
75–84	829,653 (5,119.4)	110,536 (682.1)	823,908 (5,083.9)	67,116 (414.1)
≥85	940,780 (15,743.3)	95,168 (1,592.6)	932,528 (15,605.2)	73,157 (1,224.2)
Unknown	93 (—)	3 (—)	101 (—)	4 (—)
Sex				
Female	1,626,123 (733.3)	202,687 (91.8)	1,558,144 (700.9)	112,287 (49.8)
Male	1,838,108 (1,048.0)	259,506 (144.5)	1,715,561 (984.8)	132,699 (76.3)
Race and ethnicity				
AI/AN, NH	26,972 (1,109.2)	5,053 (201.8)	23,440 (973.3)	2,115 (86.8)
Asian, NH	92,432 (461.7)	13,707 (66.6)	88,963 (447.2)	6,786 (34.1)
Black or African American, NH	449,764 (1,118.0)	61,959 (151.4)	410,126 (1,028.0)	28,695 (72.9)
NH/OPI, NH	5,223 (924.3)	1,175 (200.9)	4,590 (824.8)	378 (67.8)
White, NH	2,548,809 (893.9)	304,586 (105.0)	2,444,427 (855.4)	180,212 (61.2)
Hispanic or Latino	315,664 (724.7)	72,910 (161.7)	275,254 (643.4)	25,076 (60.9)
Multiracial, NH	17,316 (406.0)	2,018 (50.7)	16,819 (394.2)	1,045 (26.7)
Unknown	8,051 (—)	785 (—)	10,086 (—)	679 (—)

Abbreviations: AI/AN = American Indian or Alaska Native; NH = non-Hispanic; NH/OPI = Native Hawaiian or other Pacific Islander.

* National Vital Statistics System provisional data for 2022 are incomplete. Data for 2021 are final. These data exclude deaths that occurred in the United States among residents of U.S. territories and foreign countries.

† Deaths per 100,000 standard population. Age-adjusted death rates are provided overall and by sex and race and ethnicity.

‡ Deaths of persons coded to *International Classification of Diseases, Tenth Revision* (code U07.1), with COVID-19 as an underlying or contributing cause of death.

age groups <15 years. As with deaths overall, the age-adjusted COVID-19–associated death rate among males (76.3) was higher compared with that among females (49.8).

Age-adjusted death rates differed by race and ethnicity and decreased for all groups from 2021 to 2022. Overall age-adjusted death rates were lowest among multiracial (394.2) and Asian persons (447.2) and highest among Black (1,028.0) and AI/AN (973.3) persons. COVID-19–associated death rates declined from 2021 to 2022 for all racial and ethnic groups.

During 2022, the three leading causes of death were heart disease (699,659 deaths), cancer (607,790), and unintentional injury (218,064) (Figure 2).[¶] COVID-19, listed as the underlying cause for 186,702 deaths during 2022, ranked as

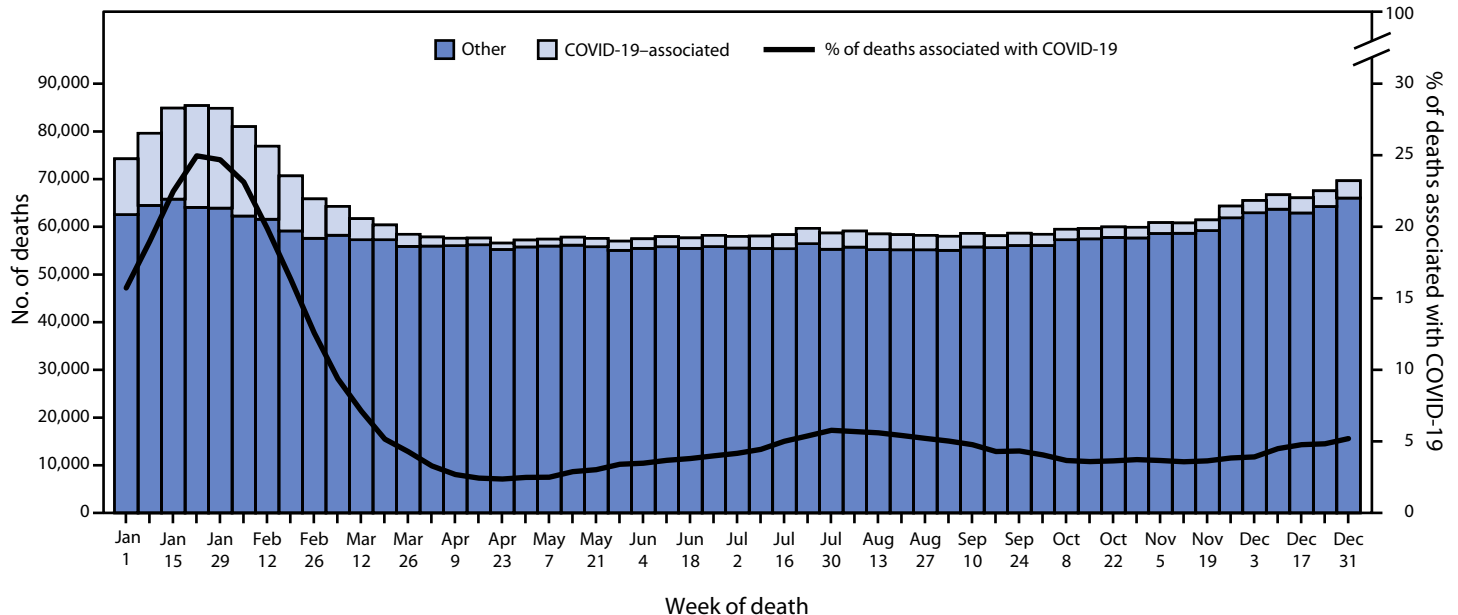
the fourth leading underlying cause of death. COVID-19 was the underlying cause for 5.7% of all deaths in 2022, decreasing from 12.0% (416,893 deaths) in 2021. Heart disease and cancer deaths increased in 2022 compared with 2021 (accounting for 695,547 and 605,213, deaths respectively), while deaths associated with COVID-19 decreased.

Discussion

During January–December 2022, the estimated 2022 U.S. age-adjusted death rate decreased by 5.3% to 832.8 per 100,000 persons, from 879.7 in 2021. Overall death rates were highest among males, older adults, and Black persons. The highest weekly numbers of overall deaths and COVID-19–associated deaths occurred during January and December. The three leading causes of death in 2022 were heart disease, cancer, and unintentional injury. COVID-19, the third leading cause of death in 2021, fell to fourth place in 2022 because of the large decrease in COVID-19–associated deaths compared with those in 2021 (7). The number of deaths caused by unintentional injury, largely driven by a

[¶] In this report, the number of deaths caused by unintentional injury was tabulated using the internal NVSS mortality database and might not match publicly available provisional counts for deaths for unintentional injury because provisional data for injury-related causes of death are publicly released with a lag of 6 months from the date of death. This delay accounts for the additional time typically needed to report injury-related death certificates, and the final 2022 death count might be higher than noted in this report.

FIGURE 1. Provisional* number of COVID-19–associated deaths† and other deaths and percentage of COVID-19–associated deaths, by week of death — National Vital Statistics System, United States, 2022



* National Vital Statistics System provisional data for 2022 are incomplete. Data from December 2022 are less complete because of reporting lags. Data for 2021 are final. These data exclude deaths that occurred in the United States among residents of U.S. territories and foreign countries.

† Deaths of persons coded to *International Classification of Diseases, Tenth Revision* (code U07.1), with COVID-19 as an underlying or contributing cause of death.

high number of drug overdose deaths, remained high in 2022 compared with 2021 (8).

Overall death rates and COVID-19–associated death rates decreased from 2021 to 2022 for most demographic groups, with the exception of certain age groups. COVID-19–associated death rates increased for all persons aged <15 years. Although the overall and COVID-19–associated death rates decreased for persons aged ≥85 years from 2021 to 2022, rates remained higher for this group compared with all other age groups. In addition, although overall and COVID-19–associated death rates decreased among all racial and ethnic groups, age-adjusted total and COVID-19–associated death rates remained high for Black and AI/AN persons compared with other groups. The current report did not examine death rates for causes of death other than COVID-19; however, available provisional data from the CDC WONDER platform indicate death rate patterns for leading causes of death (9). The age-adjusted rate of heart disease deaths increased for the third straight year since 2020. While the age-adjusted rate of cancer deaths had declined steadily during 1999–2020, the cancer death rate increased in 2021 and 2022. Further analysis of provisional data might offer additional insights into demographic patterns of leading causes of death.

The findings in this report are subject to at least three limitations. First, data are provisional, and numbers and rates might

Summary

What is already known about this topic?

More than 3.2 million persons died in the United States during January–December 2022.

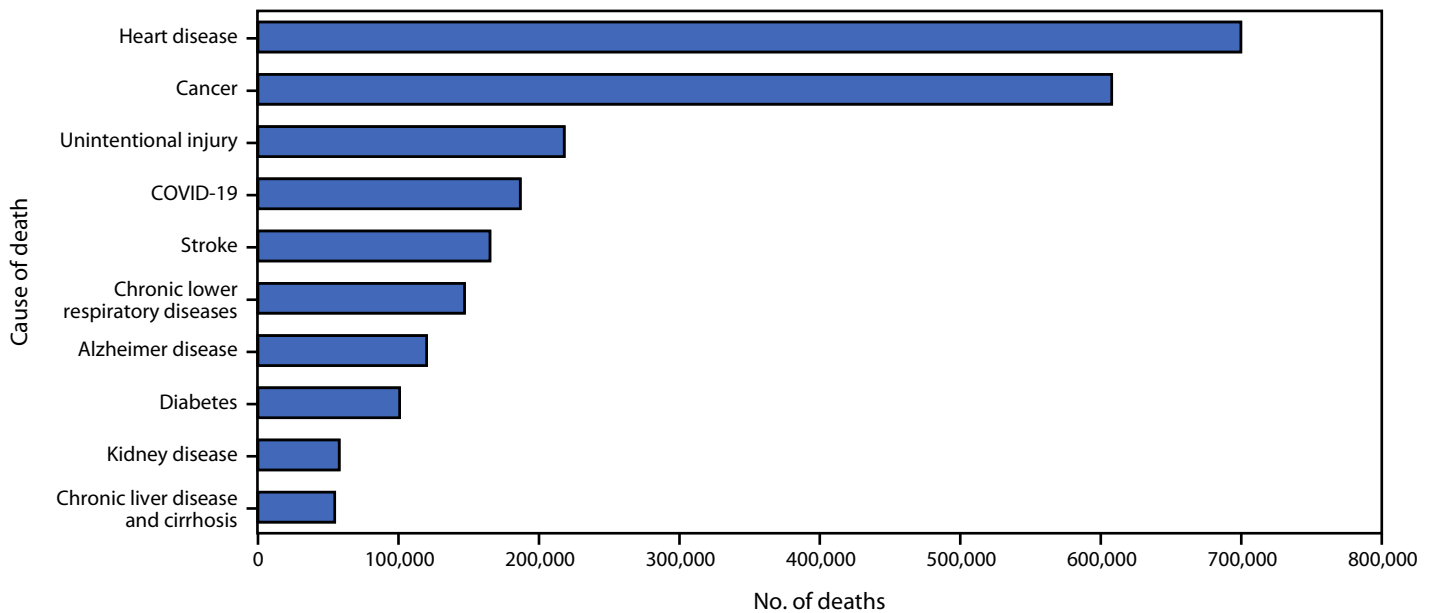
What is added by this report?

The overall age-adjusted U.S. death rate decreased by 5.3% from 2021 to 2022. Overall death rates and COVID-19–associated death rates were highest among non-Hispanic Black or African American persons and non-Hispanic American Indian or Alaska Native persons.

What are the implications for public health practice?

Provisional death estimates provide an early signal about shifts in mortality trends. Timely and actionable data can guide public health policies and interventions for populations experiencing higher mortality.

change as additional information is received. Described changes in mortality trends might be underestimates. Second, timeliness of death certificate submission can vary by jurisdiction. As a result, the national distribution of deaths might be affected by the distribution of deaths reported from jurisdictions reporting later, which might differ from those in the United States overall. Finally, potential exists for misclassification of certain categories of race (i.e., AI/AN and Asian) and Hispanic

FIGURE 2. Leading underlying causes of death*[†] — National Vital Statistics System, United States, 2022

* Data are provisional; National Vital Statistics System provisional data are incomplete, and data from December are less complete because of reporting lags. Deaths that occurred in the United States among residents of U.S. territories and foreign countries were excluded.

[†] Deaths are ranked by number of deaths per underlying cause of death.

ethnicity reported on death certificates (10). Thus, death rates for some groups might be under- or overestimated.

This report provides an overview of provisional mortality in the United States during 2022. Provisional death estimates can offer researchers and policymakers an early signal about shifts in mortality trends and provide actionable information sooner than do the final mortality data, which are released approximately 11 months after the end of the data year. These data can guide public health policies and interventions aimed at reducing mortality directly or indirectly associated with the COVID-19 pandemic and among persons most affected, including persons who are older, male, or from members of certain racial and ethnic minority groups.

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References

- World Health Organization. ICD-10: international statistical classification of diseases and related health problems 10th revision. Geneva, Switzerland: World Health Organization; 2009. <https://icd.who.int/browse10/2008/en>
- CDC. National Center for Health Statistics: National Vital Statistics System. Instructions for classification of underlying and multiple causes of death – Section 1 – 2021. Hyattsville, MD: US Department of Health and Human Services, CDC, National Center for Health Statistics; 2021. <https://www.cdc.gov/nchs/nvss/manuals/2a-section1-2021.htm>
- CDC. National Center for Health Statistics. Technical notes: provisional death counts for coronavirus disease (COVID-19). Hyattsville, MD: US Department of Health and Human Services, CDC, National Center for Health Statistics; 2021. https://www.cdc.gov/nchs/nvss/vsrr/covid19/tech_notes.htm
- Heron M. Deaths: leading causes for 2017. *Nat Vital Stat Rep* 2019;68:1–77. PMID:32501203
- US Census Bureau. National population by characteristics: 2020–2021. Washington, DC: US Department of Commerce, US Census Bureau; 2021. <https://www.census.gov/programs-surveys/popest/technical-documentation/research/evaluation-estimates/2020-evaluation-estimates/2010s-national-detail.html>
- US Census Bureau. Methodology for the United States population estimates: vintage 2021. Washington, DC: US Department of Commerce, US Census Bureau; 2021. <https://www2.census.gov/programs-surveys/popest/technical-documentation/methodology/2020-2021/methods-statement-v2021.pdf>
- Xu JQ, Murphy SL, Kochanek KD, Arias E. Mortality in the United States, 2021. *NCHS data brief* 456. Hyattsville, MD: US Department of Health and Human Services, CDC, National Center for Health Statistics; 2022. <https://www.cdc.gov/nchs/data/databriefs/db456.pdf>
- Ahmad FB, Cisewski JA, Rossen LM, Sutton P. Provisional drug overdose death counts. Hyattsville, MD: US Department of Health and Human Services, CDC, National Center for Health Statistics; 2023. <https://www.cdc.gov/nchs/nvss/vsrr/drug-overdose-data.htm>

9. CDC. CDC WONDER: about provisional mortality statistics, 2018 through last month. Hyattsville, Maryland: US Department of Health and Human Services, CDC, National Center for Health Statistics; 2023. Accessed May 1, 2023. <http://wonder.cdc.gov/mcd-icd10-provisional.html>

10. Arias E, Heron M, Hakes JK. The validity of race and Hispanic-origin reporting on death certificates in the United States: an update. *Vital Health Stat* 2016;2:1–21. PMID:28436642

COVID-19 Mortality Update — United States, 2022

Farida B. Ahmad, MPH¹; Jodi A. Cisewski, MPH¹; Jiaquan Xu, MD¹; Robert N. Anderson, PhD¹

The National Center for Health Statistics' (NCHS) National Vital Statistics System (NVSS) collects and reports annual mortality statistics using U.S. death certificate data. Provisional data, which are based on the current flow of death certificate data to NCHS, provide an early estimate of deaths before the release of final data.* This report summarizes provisional U.S. COVID-19 death data for 2022. In 2022, COVID-19 was the underlying (primary) or contributing cause in the chain of events leading to 244,986 deaths[†] that occurred in the United States. During 2021–2022, the estimated age-adjusted COVID-19–associated death rate decreased 47%, from 115.6 to 61.3 per 100,000 persons. COVID-19 death rates were highest among persons aged ≥85 years, non-Hispanic American Indian or Alaska Native (AI/AN) populations, and males. In 76% of deaths with COVID-19 listed on the death certificate, COVID-19 was listed as the underlying cause of death. In the remaining 24% of COVID-19 deaths, COVID-19 was a contributing cause. As in 2020 and 2021, during 2022, the most common location of COVID-19 deaths was a hospital inpatient setting (59%). However, an increasing percentage occurred in the decedent's home (15%), or a nursing home or long-term care facility (14%).[§] Provisional COVID-19 death estimates provide an early indication of shifts in mortality trends and can help guide public health policies and interventions aimed at reducing COVID-19–associated mortality.

This report analyzed provisional NVSS death certificate data for deaths among U.S. residents within the United States during January–December 2022. COVID-19–associated death counts and rates include deaths for which COVID-19 was listed on the death certificate as an underlying or contributing cause of death. NCHS tabulated the number and rates of COVID-19 deaths by age, sex, and race and ethnicity (categorized as AI/AN, non-Hispanic Asian [Asian], non-Hispanic Black [Black], non-Hispanic Hawaiian or other Pacific Islander, non-Hispanic White [White], Hispanic or Latino [Hispanic], non-Hispanic persons of more than one race [multiracial], and unknown), and U.S. Department of Health and Human Services (HHS) region of residence. NVSS data in this report

exclude deaths among residents of U.S. territories and foreign countries. This activity was reviewed by CDC and was conducted consistent with applicable federal law and CDC policy.[¶]

NCHS coded the causes of death according to the *International Classification of Diseases, Tenth Revision*, which details disease classification and the designation of underlying cause of death (1,2). The underlying cause of death is the disease or injury that initiated the chain of morbid events leading directly to death. Contributing causes are conditions that are also part of the chain of events leading to death. Among all deaths with COVID-19 listed on the death certificate, the leading causes of death were ranked by number of deaths per underlying cause of death (3). Race and ethnicity were unknown for 679 (0.28%) decedents and age was unknown for four (<0.01%). Age-adjusted death rates were calculated by sex, race and ethnicity, and residence. Crude death rates were calculated by age. The population data used to calculate death rates are July 1, 2021 estimates, based on the Blended Base produced by the U.S. Census Bureau (4,5). Place of death is noted on the death certificate and is determined by both the location where the death was pronounced and the physical location where the death occurred (6). In this report, place of death is categorized as decedent's home, hospice facility, hospital inpatient setting, hospital outpatient or emergency department, nursing home or long-term care facility, or other (which includes being dead on arrival, other, and unknown).

In 2022, COVID-19 was listed as an underlying or contributing cause of 244,986 (61.3 per 100,000) deaths (Table 1). COVID-19–associated death rates were lowest among children and adolescents aged 5–14 years (0.5) and highest among adults aged ≥85 years (1,224.2). In 2022, similar to previous years, the age-adjusted COVID-19–associated death rate for males (76.3) was higher than that for females (49.8). Age-adjusted COVID-19 death rates were lowest in multiracial (26.7) and Asian persons (34.1) and highest in AI/AN persons (86.8).

The COVID-19–associated age-adjusted death rate was lowest (49.5 per 100,000) in HHS Region 1 (Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, and Vermont) and highest (69.3) in Region 6 (Arkansas, Louisiana, New Mexico, Oklahoma, and Texas). The second highest age-adjusted COVID-19 death rate (65.5) and highest number of

* <https://wonder.cdc.gov>; <https://www.cdc.gov/nchs/nvss/deaths.htm>

[†] Based on death records received and processed as of April 2, 2023, for deaths occurring in the United States among U.S. residents. Data included in this analysis include >99% of deaths occurring in 2022.

[§] <https://data.cdc.gov/NCHS/Provisional-COVID-19-Deaths-by-Place-of-Death-and-/4va6-ph5s>

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

TABLE 1. Provisional* number and rate† of COVID-19–associated§ deaths, by demographic characteristic and U.S. Department of Health and Human Services region¶ of residence — National Vital Statistics System, United States, 2020–2022

Characteristic	No. of deaths (rate)†		
	2020	2021	2022
Total	384,536 (93.2)	462,193 (115.6)	244,986 (61.3)
Age group, yrs			
<1	52 (1.4)	167 (4.7)	231 (6.5)
1–4	25 (0.2)	66 (0.4)	152 (1.0)
5–14	68 (0.2)	185 (0.4)	203 (0.5)
15–24	612 (1.4)	1,652 (3.8)	641 (1.5)
25–34	2,609 (5.7)	7,033 (15.5)	2,376 (5.2)
35–44	6,756 (16.0)	17,412 (40.1)	5,183 (11.9)
45–54	18,250 (45.2)	39,360 (96.7)	12,169 (29.9)
55–64	45,377 (107.0)	79,199 (185.0)	30,526 (71.3)
65–74	82,055 (252.1)	111,412 (330.9)	53,228 (158.1)
75–84	106,020 (644.4)	110,536 (682.1)	67,116 (414.1)
≥85	122,707 (1,842.9)	95,168 (1,592.6)	73,157 (1,224.2)
Unknown	5 (—)	3 (—)	4 (—)
Sex			
Female	175,818 (73.9)	202,687 (91.8)	112,287 (49.8)
Male	208,718 (117.0)	259,506 (144.5)	132,699 (76.3)
Race and ethnicity			
AI/AN, NH	4,615 (190.8)	5,053 (201.8)	2,115 (86.8)
Asian, NH	13,523 (67.2)	13,707 (66.6)	6,786 (34.1)
Black or African American, NH	61,401 (154.8)	61,959 (151.4)	28,695 (72.9)
NH/OPI, NH	691 (123.5)	1,175 (200.9)	378 (67.8)
White, NH	232,555 (74.1)	304,586 (105.0)	180,212 (61.2)
Hispanic	69,069 (164.8)	72,910 (161.7)	25,076 (60.9)
Multiracial, NH	1,141 (31.9)	2,018 (50.7)	1,045 (26.7)
Unknown	1,541 (—)	785 (—)	679 (—)
HHS region¶			
1	19,725 (94.3)	12,791 (64.1)	9,877 (49.5)
2	56,707 (151.6)	33,778 (90.0)	21,578 (57.4)
3	34,918 (84.7)	42,482 (107.0)	25,722 (64.9)
4	70,574 (78.7)	117,619 (137.4)	56,695 (65.5)
5	66,484 (97.9)	69,627 (106.6)	42,540 (65.1)
6	52,638 (114.0)	72,359 (158.6)	30,847 (69.3)
7	18,521 (99.1)	18,063 (102.7)	11,287 (63.7)
8	11,281 (84.6)	13,102 (98.5)	6,759 (52.2)
9	46,549 (76.3)	68,415 (115.4)	31,262 (53.0)
10	7,139 (41.5)	13,957 (82.4)	8,419 (50.9)

Abbreviations: AI/AN = American Indian or Alaska Native; HHS = U.S. Department of Health and Human Services; NH = non-Hispanic; NH/OPI = Native Hawaiian or other Pacific Islander.

* National Vital Statistics System provisional data for 2022 are incomplete. Data from December 2022 are less complete because of reporting lags. Data for 2020 and 2021 are final. These data exclude deaths that occurred in the United States among residents of U.S. territories and foreign countries.

† Deaths per 100,000 standard population. Age-adjusted death rates are provided overall and by sex, race and ethnicity, and HHS region.

§ Deaths with COVID-19 listed as an underlying or contributing cause of death, with *International Classification of Diseases, Tenth Revision* (code U07.1).

¶ <https://www.hhs.gov/about/agencies/iea/regional-offices/index.html>

COVID-19–associated deaths (56,695) occurred in Region 4 (Alabama, Florida, Georgia, Kentucky, Mississippi, North Carolina, South Carolina, and Tennessee).

For surveillance purposes, and in this report, COVID-19–associated deaths are deaths with COVID-19 as an underlying or contributing cause of death. In 2022, among deaths with COVID-19 listed on the death certificate, COVID-19 was listed as the underlying cause in 76% of deaths (Table 2). For deaths with COVID-19 listed as a contributing cause, heart

disease and cancer were the next most frequent underlying causes, listed in 6% and 4% of deaths, respectively. Other underlying causes of death for COVID-19–associated deaths included chronic lower respiratory diseases, stroke, Alzheimer disease, diabetes, unintentional injuries, kidney disease, and Parkinson disease. COVID-19 was listed as the sole cause of death on 3.6% of death records in 2022, compared with 5.6% in both 2020 and 2021. In 2022, COVID-19 deaths that listed additional causes of death included an average of

TABLE 2. Provisional* leading underlying causes of death with corresponding *International Classification of Diseases, Tenth Revision* codes and number of deaths for COVID-19–associated deaths† — National Vital Statistics System, United States, 2022

Rank	Underlying cause of death (ICD-10 code)	No. (%)
1	COVID-19 (U07.1)	186,702 (76.2)
2	Heart disease (I00–I09, I11, I13, and I20–I51)	14,415 (5.9)
3	Cancer (C00–C97)	9,579 (3.9)
4	Chronic lower respiratory diseases (J40–J47)	3,976 (1.6)
5	Stroke (I60–I69)	3,881 (1.6)
6	Alzheimer disease (G30)	3,112 (1.3)
7	Unintentional injuries (V01–X59 and Y85–Y86)	2,572 (1.0)
8	Diabetes mellitus (E10–E14)	2,399 (1.0)
9	Kidney disease (N00–N07, N17–N19, and N25–N27)	1,259 (0.5)
10	Parkinson disease (G20–G21)	987 (0.4)

Abbreviation: ICD-10 = *International Classification of Diseases, Tenth Revision*.

* National Vital Statistics System provisional data for 2022 are incomplete. Data from December 2022 are less complete because of reporting lags. These data exclude deaths that occurred in the United States among residents of U.S. territories and foreign countries.

† Deaths with COVID-19 listed as an underlying or contributing cause of death, with ICD-10 (code U07.1).

4.5 listed contributing causes, compared with 4.2 in 2021 and 4.0 in 2020.

In 2022, approximately 59% of COVID-19–associated deaths occurred in a hospital inpatient setting, followed by 15% in the decedent’s home, and 14% in a nursing home or long-term care facility. The three most common places of death for COVID-19 deaths have remained similar since the beginning of the pandemic, but the proportion of deaths occurring in each setting has shifted over time (Figure). The percentage of deaths occurring in a hospital inpatient setting decreased from nearly 70% during 2020–2021 to approximately 60% in 2022.

Discussion

During January–December 2022, 244,986 deaths with COVID-19 listed as an underlying or contributing cause of death occurred among U.S. residents. The age-adjusted COVID-19 death rate was 61.3 per 100,000 persons. COVID-19–associated death rates were highest among males, older adults, and AI/AN persons. The COVID-19–associated age-adjusted death rate varied by HHS region, with the lowest rates in New England (Region 1) and highest rates in the south central United States (Region 6).

Some demographic characteristics of COVID-19–associated deaths have remained similar since 2020; however, changes in other characteristics have occurred over time. During the first 2 years of the COVID-19 pandemic, for example, COVID-19 was listed as the underlying cause on approximately 90% of death certificates. In 2022, the percentage of deaths with

Summary

What is already known about this topic?

COVID-19 was associated with approximately 244,000 deaths in the United States during January–December 2022.

What is added by this report?

The age-adjusted COVID-19 death rate declined 47% compared with 2021. As in 2020 and 2021, most COVID-19 deaths occurred in a hospital inpatient setting, but an increasing percentage occurred in the decedent’s home or a nursing home or long-term care facility.

What are the implications for public health practice?

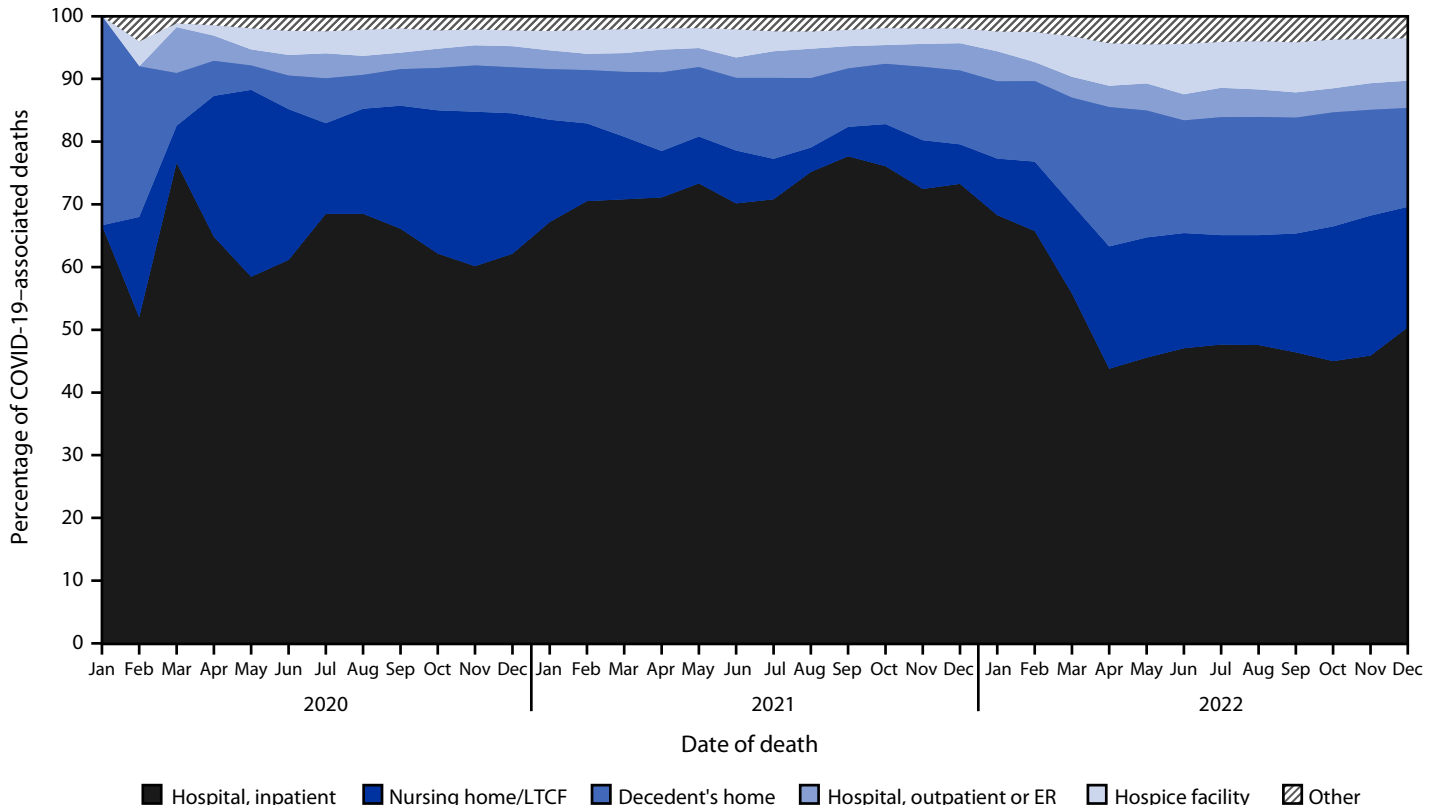
Provisional death estimates provide an early signal about shifts in COVID-19 mortality trends. Timely and actionable data can guide public health policies and interventions for populations experiencing higher COVID-19–associated mortality.

COVID-19 as the underlying cause decreased to 76% (7). Changes were also observed in the setting where COVID-19 deaths are occurring. Whereas most COVID-19 deaths still occur in hospital inpatient settings, the proportion of those deaths decreased in 2022, as more deaths occurred in decedents’ homes and nursing homes or long-term care facilities.

The findings in this report are subject to at least three limitations. First, data are provisional, and numbers and rates might change as additional information is received. Described changes in mortality trends might be underestimates. Second, timeliness of death certificate submission can vary by jurisdiction. As a result, the national or regional distribution of deaths might be affected by the distribution of deaths reported from jurisdictions reporting later, which might differ from those in the United States or in a region overall. Finally, potential exists for misclassification of certain categories of race (i.e., AI/AN and Asian) and Hispanic ethnicity reported on death certificates (8). Thus, death rates for some groups might be under- or overestimated.

This report provides an overview of COVID-19–associated mortality in the United States in 2022 and highlights changes in the characteristics of COVID-19 deaths. These data provide updated information that advances understanding of the impacts of COVID-19 on mortality and how these have continued to shift during the course of the pandemic. These findings also help to guide public health policies and interventions intended to reduce severe COVID-19 impact by providing insight into groups that remain vulnerable to COVID-19–associated mortality.

FIGURE. Percentage* of COVID-19–associated deaths,[†] by location of death — National Vital Statistics System, United States, January 2020–December 2022



Abbreviations: ER = emergency room; LTCF = long-term care facility.

* Percentages are provisional. National Vital Statistics System provisional data for 2022 are incomplete, and data from December 2022 are less complete because of reporting lags. Data for 2020 and 2021 are final. These data include deaths that occurred in the United States among residents of U.S. territories and foreign countries.

[†] Deaths with COVID-19 listed as an underlying or contributing cause of death, with *International Classification of Diseases, Tenth Revision* (code U07.1).

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References

- World Health Organization. International statistical classification of diseases and related health problems, tenth revision (ICD–10). 2008 ed. Geneva, Switzerland: World Health Organization; 2009. <https://icd.who.int/browse10/2008/en>
- National Center for Health Statistics. National Vital Statistics System. Instruction manual, part 2a: instructions for classifying underlying and multiple causes of death, ICD-10. Hyattsville, MD: US Department of Health and Human Services, CDC, National Center for Health Statistics; 2020. <https://www.cdc.gov/nchs/nvss/instruction-manuals.htm>
- Heron M. Deaths: leading causes for 2017. *Natl Vital Stat Rep* 2019;68:1–77. PMID:32501203
- US Census Bureau. National population by characteristics: 2020–2021. Washington, DC: US Department of Commerce, US Census Bureau; 2021. <https://www.census.gov/programs-surveys/popest/technical-documentation/research/evaluation-estimates/2020-evaluation-estimates/2010s-national-detail.html>
- US Census Bureau. Methodology for the United States population estimates: vintage 2021. Washington, DC: US Department of Commerce, US Census Bureau; 2021. <https://www2.census.gov/programs-surveys/popest/technical-documentation/methodology/2020-2021/methods-statement-v2021.pdf>
- CDC. Medical examiners' and coroners' handbook on death registration and fetal death reporting, 2003 revision. Hyattsville, Maryland: US Department of Health and Human Services, CDC, National Center for Health Statistics; 2003. <https://stacks.cdc.gov/view/cdc/6636>
- CDC. Technical notes: provisional death counts for coronavirus disease (COVID-19). Hyattsville, MD: US Department of Health and Human Services, CDC, National Center for Health Statistics; 2023. https://www.cdc.gov/nchs/nvss/vsrr/covid19/tech_notes.htm
- Arias E, Heron M, Hakes J; National Center for Health Statistics; US Census Bureau. The validity of race and Hispanic-origin reporting on death certificates in the United States: an update. *Vital Health Stat* 2016;2:1–21. PMID:28436642

Notes from the Field

Vibriosis Cases Associated with Flood Waters During and After Hurricane Ian — Florida, September–October 2022

Nicole Sodders, MPH¹; Kimberly Stockdale, MSPH¹; Kayla Baker²; Arielle Ghanem, MPH²; Benjamin Vieth, MA³; Terri Harder³

On the afternoon of September 28, 2022 (epidemiologic week 40), Hurricane Ian made landfall on Florida's southwest coast as a category 4 hurricane with maximum sustained winds of 150 miles per hr (241 km per hr). The storm surge (the abnormal rise in seawater related to a storm) reached 12–18 ft (3.6–5.5 m) above ground level in some coastal areas of Lee and Collier counties, on southwest Florida's Gulf coast (1). In the days after the hurricane, a notable increase in cases of vibriosis was observed by the Florida Department of Health: 38 cases and 11 vibriosis-associated deaths were attributed to the storm. During the hurricane response, Florida deployed public health messaging on storm preparedness statewide, advising residents of 1) the importance of not wading in flood waters or in standing water after a storm, especially persons with open wounds; 2) the potential life-threatening illness that can be caused by *Vibrio vulnificus*; and the importance of seeking prompt medical attention if symptoms* are experienced (2).

Vibrio bacteria thrive in warm salty or brackish waters such as those pushed ashore in a storm surge. These virulent gram-negative bacteria can result in gastrointestinal illness after consumption of raw or undercooked shellfish, or a skin infection following exposure of an open wound to salt or brackish water (a mixture of freshwater and seawater) (3). This data was obtained through routine investigation of vibriosis cases and follow-up using Florida's reportable disease surveillance system Merlin. This activity was reviewed by CDC and was conducted consistent with applicable federal law and CDC policy.[†]

In the week preceding the hurricane (week 39), southwest Florida reported no vibriosis cases, which was below the 5-year median (three cases) for that week. Based on epidemiology from previous years, three vibriosis cases were expected to be reported in southwest Florida in the weeks during and after the storm (weeks 40 and 41). However, 38 culture-confirmed vibriosis cases determined to be associated with the impacts of Hurricane Ian occurred in Lee and Collier counties during September 29–October 23, representing an 1,100% increase

over the 5-year median. These cases included 29 (76%) caused by *V. vulnificus*, three cases (8%) by *Vibrio cholerae* type non-O1, and two cases (5%) each by *Vibrio parahaemolyticus*, *Vibrio fluvialis*, and other *Vibrio* spp. One case occurred in a resident of another state who was exposed in Florida, and one patient was co-infected with *V. vulnificus* and *V. parahaemolyticus*. The median patient age was 80 years (range = 51–94 years), and 79% of the 38 cases occurred in men. Date of symptom onset ranged from September 28 to October 9; onset dates for two patients were unknown. Among 36 (95%) patients with known illness onset date, 34 (94%) cases occurred within 6 days of storm landfall (Figure).

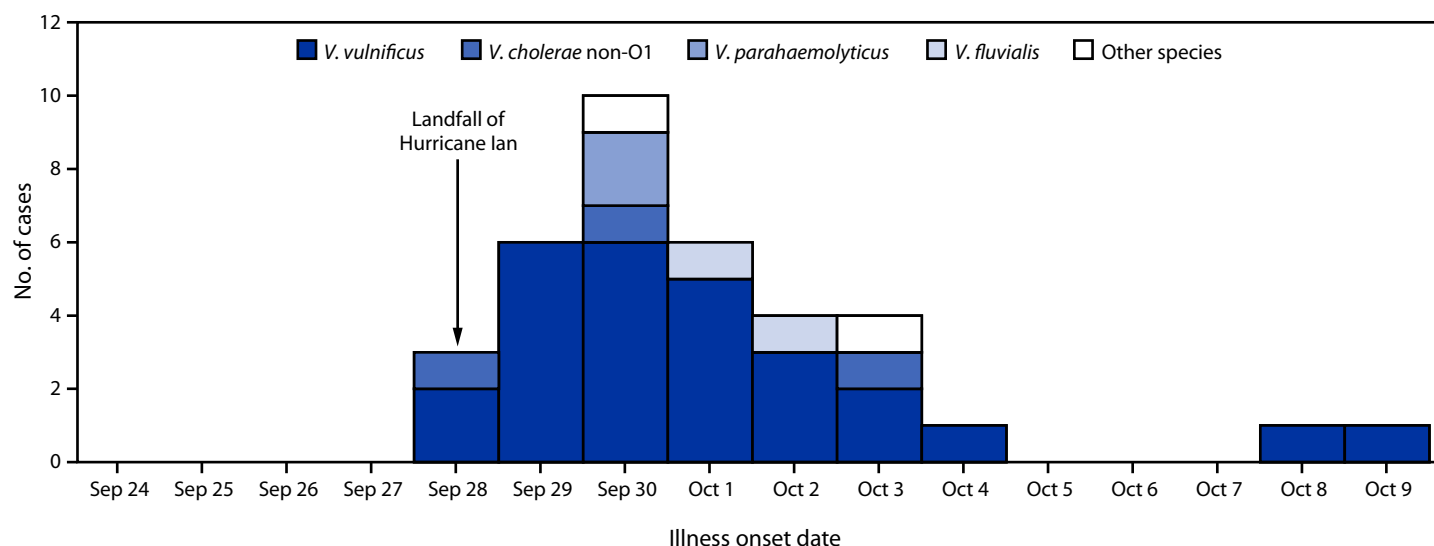
Thirty-three (87%) patients had skin infections associated with exposure to storm surge or flood waters; two (5%) reported wounds with unclear exposures; two (5%) reported prolonged exposure to flood waters after being trapped in their homes or while evacuating; and one patient (3%) reported drinking flood waters. Thirty-six patients were hospitalized for a median of 10 days (range = 1–51 days), and eight (22%) were transferred to skilled nursing facilities or rehabilitation facilities after hospitalization. Eight patients required skin grafts, and three underwent lower extremity amputations. Among the 11 (29%) deaths that occurred, nine occurred in patients infected with *V. vulnificus*, and one death each occurred in patients infected with *V. cholerae* non-O1 and with some other *Vibrio* sp.

This outbreak is notable because of the large number of hurricane-attributable cases that occurred during a short period. The case fatality rate was 28.9%, which might be related to the age of many of the patients. In 2017, after Hurricane Irma, six storm-related vibriosis cases were documented in Florida, approximately one sixth the number documented after Ian, possibly because of the lower storm surge (5–6 ft [1.5–1.8 m]) during Irma. In 2005, Hurricane Katrina resulted in the highest storm surge in U.S. history (>25 ft [7.6 m]); 22 vibriosis cases were linked to that storm, all of which resulted in disease onset within 7 days of storm landfall (4). Communicating risk information to the public and to health care providers before an event with potential for significant storm surge, such as a major hurricane, might prevent cases and assist in the timely diagnosis and treatment of vibriosis. In hurricane-associated wound infections, *V. vulnificus* should be considered as a possible cause, aggressive wound care and prompt administration of antibiotics is essential to improving survival (5).

* Signs and symptoms include fever, chills, decreased blood pressure (septic shock), and skin lesions.

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

FIGURE. Hurricane Ian–associated vibriosis cases* (N = 38) and deaths† (N = 11), by illness onset date and *Vibrio* species — Florida, September 28–October 9, 2022



* Two cases not displayed because illness onset date was unknown.

† Nine *V. vulnificus*–associated deaths occurred in patients with illness onset dates of September 29 (three), September 30 (four), and October 9 (one); the onset date for one *V. vulnificus*–associated case was not known; one *V. cholerae* non-O1–associated death occurred in a patient with illness onset on September 28, and one death associated with another *Vibrio* sp. occurred in a patient with illness onset on September 30. One *V. vulnificus*–associated death was in a patient coinfecting with *V. parahaemolyticus*.

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References

1. National Environmental Satellite Data and Information Service. Hurricane Ian's path of destruction. Washington, DC: US Department of Commerce, National Oceanic and Atmospheric Administration; 2022. <https://www.nesdis.noaa.gov/news/hurricane-ians-path-of-destruction>
2. Florida Health. Storm preparedness: *Vibrio vulnificus*. Tallahassee, FL: Florida Department of Health; 2022. https://www.floridahealth.gov/about/_documents/emergency-information-factsheet-vibrio.pdf
3. CDC. *Vibrio* species causing vibriosis: questions and answers. Atlanta, GA: US Department of Health and Human Services, CDC; 2019. <https://www.cdc.gov/vibrio/faq.html>
4. Engelthaler D, Lewis K, Anderson S, et al.; CDC. *Vibrio* illnesses after Hurricane Katrina—multiple states, August–September 2005. *MMWR Morb Mortal Wkly Rep* 2005;54:928–31. PMID:16177685
5. CDC. *Vibrio* species causing vibriosis: information for health professionals and laboratorians. Atlanta, GA: US Department of Health and Human Services, CDC; 2023. <https://www.cdc.gov/vibrio/healthcare.html>

Erratum

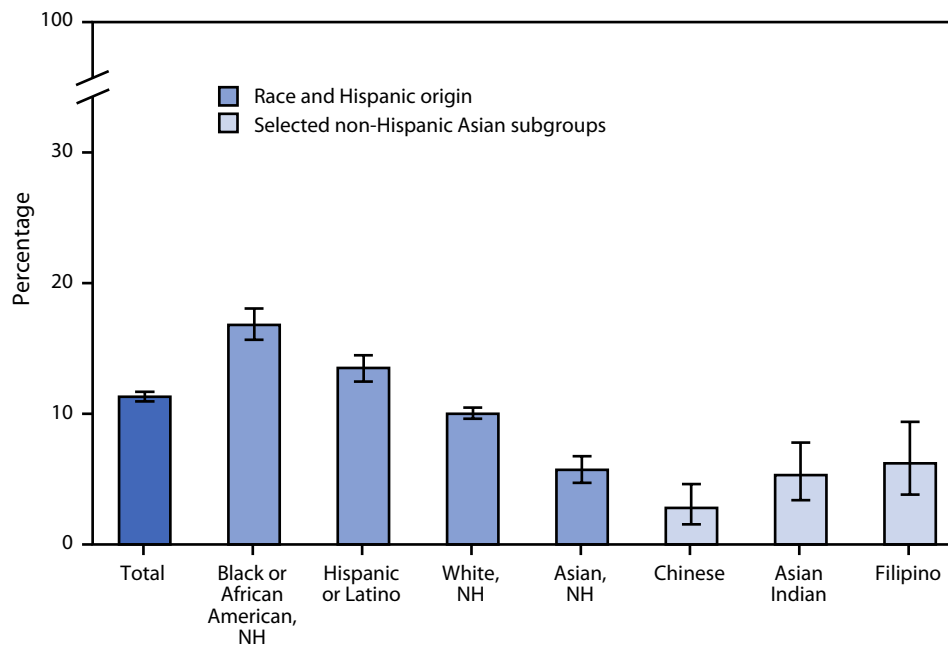
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In the report “Trends in Nonfatal Falls and Fall-Related Injuries Among Adults Aged ≥ 65 Years — United States 2012–2018,” on page 876, in Table 1, for the category “Total, all aged ≥ 65 years,” among Black persons, the number reporting a fall should have read **957,303**, and among American Indian or Alaska Native persons, should have read **104,915**. On page 878, in Table 2, for the category “65–74 years,” among American Indian or Alaska Native persons, the percentage of fall-related injuries and corresponding 95% CI should have read **16.9 (11.9–23.3)**.

QuickStats

FROM THE NATIONAL CENTER FOR HEALTH STATISTICS

Percentage* of Adults[†] Who Were in Families Having Problems Paying Medical Bills During the Previous 12 Months,[§] by Race, Hispanic Origin, and Selected Asian[¶] Subgroups — National Health Interview Survey, United States, 2020–2021**



Abbreviation: NH = non-Hispanic.

* With 95% CIs indicated by error bars.

[†] Estimates are based on household interviews of a sample of the civilian, noninstitutionalized U.S. population and are derived from the 2020 and 2021 National Health Interview Survey.

[§] “Problems paying medical bills” is based on a positive response to a question asking, “In the past 12 months, did you/anyone in the family have problems paying or were unable to pay any medical bills? Include bills for doctors, dentists, hospitals, therapists, medication, equipment, nursing home, or home care.”

[¶] “Non-Hispanic Asian” includes all non-Hispanic Asian adults, including other Asian subgroups not shown separately.

** Total includes all adults, including other race groups not shown separately.

During 2020–2021, the percentage of U.S. adults who were in families having problems paying medical bills during the previous 12 months was 11.3%. Non-Hispanic Asian adults (5.7%) were the least likely to be in families having problems paying medical bills, followed by non-Hispanic White (10.0%), Hispanic or Latino (13.5%), and non-Hispanic Black or African American (16.8%) adults. Among adults within the non-Hispanic Asian origin subgroups shown, those of Chinese origin (2.8%) were less likely to be in families having problems paying medical bills than were adults of Filipino origin (6.2%). Other observed differences were not statistically significant.

Source: National Center for Health Statistics, National Health Interview Survey, 2020 and 2021 data. <https://www.cdc.gov/nchs/nhis.htm>

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