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An Outbreak of *Salmonella* Typhimurium Infections Linked to Ready-To-Eat Tofu in Multiple Health Districts — Ontario, Canada, May–July 2021

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Abstract

From May to mid-August 2021, the Ontario, Canada provincial public health agency, Public Health Ontario, in collaboration with local public health authorities and federal food safety partners, investigated a spatiotemporal cluster of 38 patients with *Salmonella* Typhimurium infections across multiple public health districts in Ontario. Five (13%) patients were hospitalized; no deaths were reported. The outbreak was linked to consumption of ready-to-eat seasoned tofu from one manufacturer that was distributed to multiple Ontario restaurants. Isolates from the seasoned tofu were within one or fewer allele differences to the outbreak strain by whole genome sequencing. Evidence from food safety investigations conducted by local public health authorities and the Canadian Food Inspection Agency (CFIA) revealed that unsanitary conditions could have led to cross-contamination of the tofu, and insufficient heating of the tofu at the production level likely resulted in failure to eliminate the pathogen. The CFIA issued a food recall for the tofu at hotel, restaurant, and institution levels. Tofu was identified as a novel outbreak-associated food vehicle for *S.* Typhimurium in this outbreak. Interventions that target the production level and all parts of the supply chain and include additional safeguarding steps that minimize microbial growth are important.

Epidemiologic Investigation and Findings

On July 5, 2021, Public Health Ontario (PHO) identified, via routine surveillance, three cases of *S.* Typhimurium infections across multiple public health districts (known as public health units) in Ontario, with four or fewer allele differences in isolates by whole genome multilocus sequence typing (wgMLST), suggesting a common exposure source. By July 9, six more cases were reported to PHO. In collaboration with local, provincial, and federal health authorities, PHO initiated an outbreak investigation. Cases continued to be reported across Ontario through mid-August; among 10 public health districts, incidence ranged from ≤0.2 to 2.9 cases per 100,000 persons. Although *S.* Typhimurium is one of the most common serovars in Ontario, the outbreak strain was not related to any existing clusters or isolates in PulseNet Canada, a national surveillance system that collects information on foodborne-related illnesses caused by specific pathogens. This activity did not require ethics approval because the operations were within the purview of PHO's legislated mandate.*

PHO defined a confirmed case as an infection with *S.* Typhimurium in a resident of or a visitor to Ontario occurring after April 30, 2021, with a genomic sequence pattern consistent with (≤10 wgMLST allele differences) the outbreak strain. Thirty-eight cases were reported across 10 of 34 public

* Ontario Agency for Health Protection and Promotion Act, SO 2007, c 10, Sch K.

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health districts in Ontario. Symptom onset dates ranged from May 16 to July 31, 2021. The median patient age was 27 years (range = 1–87 years); 25 (66%) patients were aged ≥24 years, and 21 (55%) identified as female. Five (13%) patients were hospitalized, and no deaths were reported.

Patients with laboratory-confirmed *Salmonella* infections related to the whole genome sequencing (WGS) cluster were interviewed by local and provincial public health investigators in the 10 affected Ontario public health districts. Using standardized hypothesis-generating questionnaires, investigators recorded food exposure and other risk factors associated with animal and occupational exposure during the 7-day period preceding symptom onset. Information on restaurants and shops visited during the exposure period was collected to further identify any common food locations reported among the patients.

The proportions of reported risk factors were compared with corresponding reference values from the Foodbook report, a population-based telephone survey conducted in all Canadian provinces within a 1-year period during 2014–2015 that focused on describing foods eaten by Canadians during a 7-day period, to guide outbreak investigations and responses (*1*). An exact probability test was applied to measure the statistical significance of the consumption rates of patients with outbreak-confirmed illness when compared with the Foodbook reference values. Differences with associated p-values <0.05 were considered statistically significant.

Illness onset dates clustered from late June through mid-July (Figure), suggesting an ongoing common-source exposure. Thirty patients were interviewed (response rate = 79%), and 19 (63%) reported being on a vegetarian or vegan diet. Among the 25 patients who provided a response for "consumption of tofu," 19 (76%) responded that they had consumed or probably consumed tofu, representing a significantly higher proportion than the proportion of the general population surveyed in the Foodbook report who reported eating tofu (3%; p<0.001). Other food items reported by patients that were statistically significantly more likely to be consumed were explored (such as non-dairy milk, vegetables, nuts, and avocado), but they lacked specificity by product type, brand name, and place of purchase. Among the 19 patients who reported consuming tofu, 16 purchased seasoned tofu either at one of 11 restaurant franchise locations or one of three nonfranchise restaurant locations across Ontario, before their illness onset.

Food Safety and Laboratory Investigation and Findings

All nonclinical specimens and isolates from clinical specimens were submitted to Public Health Ontario's laboratory (PHOL), a clinical and environmental reference laboratory in Ontario, for analysis. Isolates from all outbreak-confirmed cases underwent WGS at PHOL and the Public Health Agency of Canada's National Microbiology Laboratory. Isolates with four or fewer wgMLST allele differences were considered related

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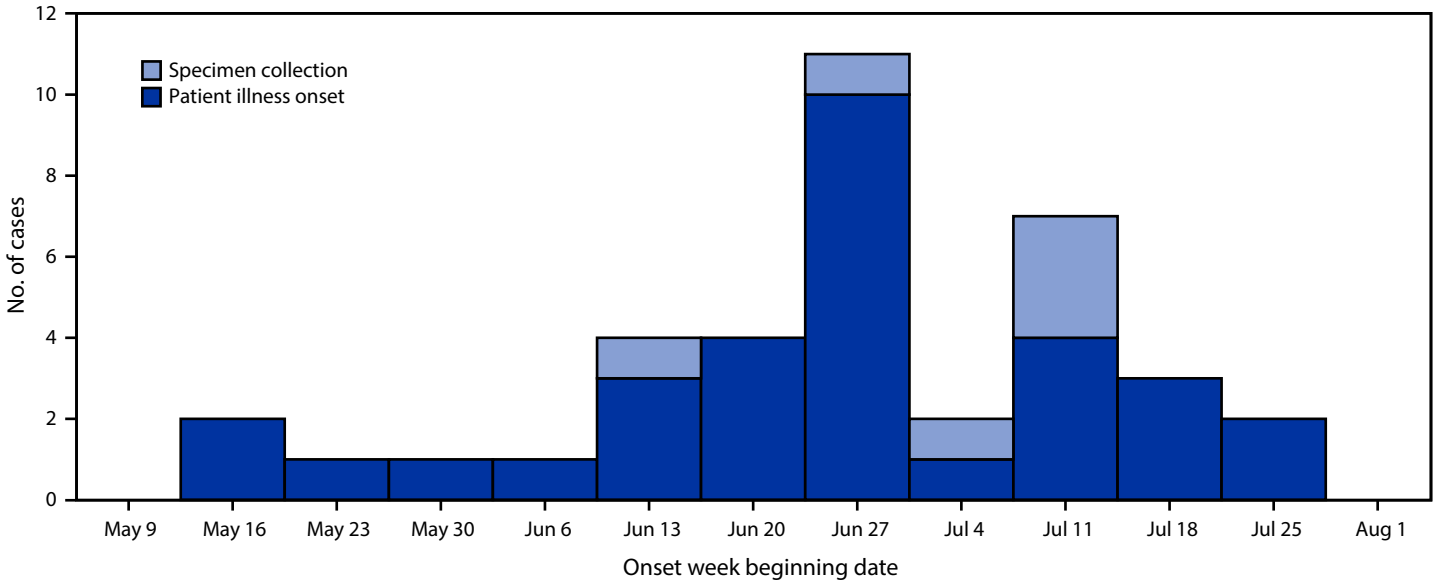
FIGURE. Week of illness onset and specimen collection (N = 6) for patients infected with a *Salmonella* Typhimurium outbreak strain (N = 32) — Ontario, Canada, May–August 2021



by WGS. During the outbreak investigation, an isolate from a case in Quebec closely related by WGS to the outbreak strain was identified in PulseNet Canada.

As a result of the epidemiologic evidence, local investigators and Canadian Food Inspection Agency (CFIA) authorities conducted investigations at restaurants where patients reported consuming seasoned tofu during the 7-day period before symptom onset. Additional investigations were conducted once a common manufacturer was identified. A total of 16 opened and closed specimens of the seasoned tofu product were collected from 10 restaurants and the manufacturer. After extensive food safety investigations, *S.* Typhimurium was isolated from three open specimens of seasoned tofu obtained from one of the restaurant franchise locations; the sequenced isolates were closely related by WGS to those from outbreak-confirmed cases. *Salmonella* was not detected in other food specimens produced by the manufacturer.

Food safety investigations revealed that seasoned tofu from the same manufacturer was served across all 14 restaurants. The tofu was identified as a ready-to-eat food product that was produced by a manufacturer in Ontario and commercially sold in 250-g (8.8-oz) and 500-g (17.6-oz) packages. Restaurants purchased the product as a 500-g vacuum-sealed package.

Food safety investigations identified the absence of a heat treatment process after the addition of seasoning to the packaged 500-g product, which was also sold online to other provinces including Quebec; the 250-g packaged product did undergo additional heat treatment. No illnesses were linked to the 250-g packaged product. Several infractions were observed at the manufacturing plant, including poor sanitation of the processing equipment and the absence of a food safety plan or a food sampling program.

Public Health Response

CFIA issued a food recall for the 500-g tofu product. Local public health inspectors ensured that existing products were removed from distribution and destroyed across implicated restaurants and the manufacturing plant. As a corrective action within the manufacturing facility, a heat treatment step after the addition of the seasoning before packaging was applied.

Discussion

Tofu was identified as the source of an outbreak of *S.* Typhimurium in Ontario in 2021. Investigators hypothesized that unsanitary conditions at the production facility could have led to contamination of the tofu after production and before packaging, but the absence of an additional heating step during production likely resulted in failure to eliminate the pathogen. Tofu is a novel outbreak-associated food vehicle for this pathogen and has not been implicated in previous outbreaks. Soy products, including tofu, are uncommon vehicles for foodborne illnesses. Among previously published outbreaks linked to soy products, only one outbreak involved *Salmonella* (*Salmonella enterica* paratyphi) (*2*). Although tofu has been implicated in outbreaks associated with other pathogens, there are no published reports of tofu-associated nontyphoidal *Salmonella* outbreaks (*3*,*4*); however, the growth or presence of *S.* Typhimurium on soy products has been detected in microbiological food studies (*5*,*6*).

Summary

What is already known about this topic?

Salmonella Typhimurium is a serovar commonly implicated in foodborne illnesses linked to animal product consumption.

What is added by this report?

During May–July 2021, an outbreak of *S.* Typhimurium involving 38 cases in 10 public health districts in Ontario, Canada was linked to consumption of tofu, suggesting a novel outbreak-associated *S.* Typhimurium food vehicle. Lapses in sanitation and recommended heat processing likely resulted in product contamination.

What are the implications?

Tofu has not been previously linked to nontyphoidal *Salmonella* outbreaks. Public health communications to consumers and food establishments should aim to increase awareness of the possible transmission of *Salmonella* through ready-to-eat soy products. In addition, interventions need to target production and all parts of the supply chain, with additional safeguarding steps that minimize growth of *Salmonella* in soy-based products.

Novel outbreak-associated food vehicles can emerge because of evolution of a pathogen or a change in dietary trends (*7*). This outbreak largely affected patients who had adopted a vegan or vegetarian diet. An estimated 5% of Canadians adhere to a plant-based diet (*8*). In addition, age and gender differences are apparent among persons adhering to plant-based diets such as vegetarianism, which is practiced more commonly among females and younger adults (*9*), consistent with the patient demographics in this outbreak.

The implication of detecting *S.* Typhimurium in tofu as a novel outbreak-associated food vehicle is of public health importance because of the global increase in the consumption of plant-based proteins and the associated high disability-adjusted life years associated with *S.* typhimurium infection[†] (*10*). Improved guidance regarding the processing and handling of plant-based proteins in the supply chain is warranted to eliminate the growth and transmission of foodborne disease pathogens.

[†] https://www.bloomberg.com/company/press/plant-based-foods-market-to-hit-162-billion-in-next-decade-projects-bloomberg-intelligence/

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Prevalence of Symptoms ≤12 Months After Acute Illness, by COVID-19 Testing Status Among Adults — United States, December 2020–March 2023

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Abstract

To further the understanding of post-COVID conditions, and provide a more nuanced description of symptom progression, resolution, emergence, and reemergence after SARS-CoV-2 infection or COVID-like illness, analysts examined data from the Innovative Support for Patients with SARS-CoV-2 Infections Registry (INSPIRE), a prospective multicenter cohort study. This report includes analysis of data on self-reported symptoms collected from 1,296 adults with COVID-like illness who were tested for SARS-CoV-2 using a Food and Drug Administration–approved polymerase chain reaction or antigen test at the time of enrollment and reported symptoms at 3-month intervals for 12 months. Prevalence of any symptom decreased substantially between baseline and the 3-month follow-up, from 98.4% to 48.2% for persons who received a positive SARS-CoV-2 test results (COVID test–positive participants) and from 88.2% to 36.6% for persons who received negative SARS-CoV-2 test results (COVID test–negative participants). Persistent symptoms decreased through 12 months; no difference between the groups was observed at 12 months (prevalence among COVID test–positive and COVID test–negative participants = 18.3% and 16.1%, respectively; p>0.05). Both groups reported symptoms that emerged or reemerged at 6, 9, and 12 months. Thus, these symptoms are not unique to COVID-19 or to post-COVID conditions. Awareness that symptoms might persist for up to 12 months, and that many symptoms might emerge or reemerge in the year after COVID-like illness, can assist health care providers in understanding the clinical signs and symptoms associated with post-COVID–like conditions.

Introduction

Post-COVID conditions, or long COVID, comprise a range of symptoms that persist or develop ≥4 weeks after initial SARS-CoV-2 infection, and which are associated with substantial morbidity and reduced quality of life (*1*). Estimates of prevalence vary across settings, periods, and patient populations; and many studies lack comparison groups (*2*). Symptom trajectory over time using serial measurements has received little attention. Symptoms might either persist or emerge, and previous prevalence estimates typically include both persisting and emerging symptoms, without distinguishing between them (*1*,*2*).

Methods

Innovative Support for Patients with SARS-CoV-2 Infections Registry (INSPIRE) is a prospective study including eight participating major health care systems,* designed to assess long-term symptoms and outcomes among persons with COVID-like illness at study enrollment who received a positive or negative SARS-CoV-2 test result[†,§,¶] (COVID test–positive or COVID test–negative participants, respectively) (*2*). Participants could report subsequent SARS-CoV-2 positive test results at each follow-up survey. Participants who completed baseline and 3-, 6-, 9-, and 12-month follow-up surveys were included to facilitate distinguishing between emerging and ongoing symptoms. Outcomes included self-reported symptoms across eight symptom categories: 1) head, eyes, ears, nose,

* The eight institutions are Rush University, Chicago, Illinois; Thomas Jefferson University, Philadelphia, Pennsylvania; University of California, Los Angeles, Los Angeles, California; University of California, San Francisco, San Francisco, California; University of Texas Southwestern Medical Center, Dallas, Texas; UTHealth Houston, Houston, Texas; University of Washington, Seattle, Washington; and Yale University, New Haven, Connecticut.

† Participants were eligible to enroll if they met the following inclusion criteria: 1) aged ≥18 years, 2) fluent in English or Spanish, 3) self-reported symptoms suggestive of acute SARS-CoV-2 infection at time of testing, and 4) received testing for SARS-CoV-2 with a Food and Drug Administration–approved or authorized molecular or antigen-based assay within the preceding 42 days. COVID test–positive and COVID test–negative participants were eligible to enroll. Participants with previous SARS-CoV-2 infection >42 days before enrollment and those without access to an internet-connected device for survey completion were excluded.

§ Participants were recruited through advertisements at testing sites, outreach through electronic health records (EHRs), and coordination with testing sites and health departments. To distinguish from asymptomatic persons being tested for exposure, surveillance, and preprocedural protocols, participants with acute COVID-like illness were enrolled by SARS-CoV-2 test result (positive or negative). Participants were asked to share access to their EHR data, which were used to verify SARS-CoV-2 infection status and to supplement vaccination data from surveys. If history of COVID-19 diagnosis or testing for SARS-CoV-2 information was unavailable in the EHR, participants were required to provide photographic proof of test results.

¶ Participants signed informed consent forms and completed a baseline survey and follow-up surveys every 3 months for up to 18 months postenrollment. All sites broadly recruited participants regardless of state of residence; there were no geographic or health system limitations.

and throat (HEENT); 2) constitutional; 3) pulmonary; 4) musculoskeletal; 5) gastrointestinal; 6) cardiovascular; 7) cognitive difficulties; and 8) extreme fatigue (based on fatigue severity scales, which measure the occurrence and severity of eight symptoms associated with postinfectious syndrome; scores range from 10 to 80 and scores ≥25 correspond with previously established threshold for extreme fatigue).[**,††] At each period, a participant was defined as having a persistent symptom if he or she had the symptom at that visit and all previous periods. Emerging symptoms were those present at a given time point but not present at the previous time point, including symptoms that resolved and reemerged after an absence.

Analyses included descriptions of the participants' sociodemographic and clinical characteristics; statistical comparisons of the COVID test–positive and COVID test–negative groups were performed using Pearson's chi-square tests. The prevalence of symptom persistence was defined as the proportion of participants with persistent symptoms at each time point; binomial 95% CIs were calculated for each outcome within each group and Pearson's chi-square tests were used to test for differences in proportions. Symptom trajectories were reported as symptom prevalences at each time point, and the proportion of participants with emerging symptoms was also reported. All results are presented by symptom category, stratified by participants' COVID test–positive and COVID test–negative status. Participants who reported a subsequent positive SARS-CoV-2 test result during the follow-up period were excluded from the analysis; as a sensitivity analysis, the same analysis was conducted for the entire cohort. Statistical analyses were performed using SAS software (version 9.4; SAS Institute). This study was approved by the institutional review boards at all eight institutions.[§§]

Results

Among 6,075 enrolled participants, 3,726 (61%) completed the 12-month survey, 1,741 (47%) of whom completed all quarterly surveys through 12 months, including 1,288 COVID test–positive and 453 COVID test–negative participants, and are included in this study. Overall, 271 (21%) COVID test–positive participants reported a reinfection and 174 (38%) COVID test–negative participants reported a new infection during the 12-month follow-up period (p<0.01) and were excluded from the main analysis (Supplementary Figure 1, https://stacks.cdc.gov/view/cdc/131538). Approximately two thirds of participants identified as female (842; 67.4%) and 905 (72%) as non-Hispanic White (Table 1). Compared with the COVID test–negative group, a lower percentage of participants in the COVID test–positive group identified as female (65.2% versus 75.2%; p<0.01), and a higher percentage reported being married or living with a partner (60.3% versus 48.9%; p<0.01), and having been hospitalized for acute COVID-like illness (5.6% versus 0.4%; p<0.01). The prevalence of asthma was higher in the COVID test–negative group (18.3% versus 11.6%; p<0.01), as were the prevalences of kidney disease (2.5% versus 0.6%; p<0.01) and other unspecified conditions (20.1% versus 14.5%; p = 0.02).

Symptom prevalence at baseline and persistence through 12 months varied according to symptom category (Table 2). A higher proportion of COVID test–positive participants reported symptoms in each category, except for extreme fatigue, at baseline compared with COVID test–negative participants. Symptom prevalence declined over time within each symptom category: 18.3% of COVID test–positive participants and 16.1% of COVID test–negative participants reported persistent symptoms of any type through 12 months. Symptom persistence through 12 months for a given symptom category ranged from 0.3% (gastrointestinal symptoms) to 5.9% (HEENT symptoms) among COVID test–positive participants and from 1.1% (cardiovascular symptoms or pulmonary symptoms) to 6.8% (extreme fatigue) among COVID test–negative participants. Only the persistence of extreme fatigue was statistically significantly different at 12 months between COVID test–positive participants (3.5%) and COVID test–negative participants (6.8%).

During the follow-up period, the symptom prevalences in each category except for extreme fatigue were similar at each time point for both COVID test–positive and COVID test–negative participants (Figure). Overall, no difference in symptom prevalence between COVID test–positive and COVID test–negative participant groups was observed across the four periods for the nine total symptom categories. Among COVID test–negative participants, prevalence of extreme fatigue was higher at 9 and 12 months compared to the COVID test–positive group. Approximately one half of participants in each group experienced any symptom at 12 months. Emerging symptoms were reported for every symptom category at each follow-up period for both groups. COVID test–negative participants reported higher prevalences of emerging symptoms at 6 and 12 months in each of the symptom categories, except severe fatigue (Table 1). When participants who reported a subsequent positive SARS-CoV-2

** https://www.cdc.gov/me-cfs/pdfs/wichita-data-access/symptom-inventory-doc.pdf

†† Symptom categories were any symptom (one or more symptoms), HEENT (headache, runny nose, loss of smell, loss of taste, sore throat, and loss of hair), constitutional (tired, chills, feeling hot, fever, and shakes), pulmonary (cough, shortness of breath, and wheezing), musculoskeletal (aches and joint pains), gastrointestinal (diarrhea, nausea or vomiting, and abdominal pain), cardiovascular (chest pain and palpitations), cognitive difficulties (forgetfulness/memory problems, difficulty thinking, or difficulty concentrating), and extreme fatigue (fatigue severity score ≥25).

§§ 45 C.F.R. part 46; 21 C.F.R. part 56.

TABLE 1. Self-reported characteristics of adults with acute COVID-like illness, by confirmed SARS-CoV-2 test result status* at time of enrollment — Innovative Support for Patients with SARS-CoV-2 Infections Registry study, United States, December 2020–March 2023

Characteristic†	No. (%)§ Overall (N = 1,296)	Positive test result (n = 1,017)	Negative test result (n = 279)	p-value
Age group, yrs				
18–34	**505 (39.3)**	388 (38.5)	117 (42.4)	0.31
35–49	**402 (31.3)**	327 (32.4)	75 (27.2)	
50–64	**266 (20.7)**	210 (20.8)	56 (20.3)	
≥65	**112 (8.7)**	84 (8.3)	28 (10.1)	
Missing	**11 (0.8)**	8 (0.8)	3 (1.1)	
Gender				
Female	**842 (67.4)**	642 (65.2)	200 (75.2)	<0.01
Male	**392 (31.4)**	329 (33.4)	63 (23.7)	
Transgender/ Nonbinary/Other	**16 (1.3)**	13 (1.3)	3 (1.1)	
Missing	**46 (3.5)**	33 (3.2)	13 (4.7)	
Hispanic or Latino¶				
No	**1,105 (87.1)**	869 (87.2)	236 (86.4)	0.73
Yes	**164 (12.9)**	127 (12.8)	37 (13.6)	
Missing	**27 (2.1)**	21 (2.1)	6 (2.2)	
Race¶				
Asian	**149 (11.9)**	107 (10.9)	42 (15.6)	0.13
Black or African American	**96 (7.6)**	73 (7.4)	23 (8.5)	
White	**905 (72.1)**	724 (73.5)	181 (67.0)	
Other/Multiple	**105 (8.4)**	81 (8.2)	24 (8.9)	
Missing	**41 (3.2)**	32 (3.1)	9 (3.2)	
Education				
Less than high school diploma	**11 (0.9)**	9 (0.9)	2 (0.7)	0.11
High school graduate or GED certificate	**82 (6.5)**	65 (6.5)	17 (6.3)	
Some college but did not complete degree	**195 (15.4)**	143 (14.4)	52 (19.1)	
2-year college degree	**100 (7.9)**	75 (7.5)	25 (9.2)	
4-year college degree	**420 (33.1)**	348 (35.0)	72 (26.5)	
More than 4-year college degree	**459 (36.2)**	355 (35.7)	104 (38.2)	
Missing	**29 (2.2)**	22 (2.2)	7 (2.5)	
Marital status				
Never married	**416 (32.1)**	309 (30.4)	107 (38.5)	<0.01
Married/Living with a partner	**749 (57.8)**	613 (60.3)	136 (48.9)	
Divorced/Widowed/ Separated	**130 (10.0)**	95 (9.3)	35 (12.6)	
Missing	**1 (0.1)**	0 (—)	1 (0.4)	
Where COVID-19 testing was received				
At-home testing kit	**75 (5.8)**	57 (5.6)	18 (6.5)	<0.01
Tent/Drive-up testing site	**726 (56.2)**	601 (59.4)	125 (44.8)	
Clinic including an urgent care clinic	**212 (16.4)**	161 (15.9)	51 (18.3)	
Hospital	**114 (8.8)**	82 (8.1)	32 (11.5)	
Emergency department	**69 (5.3)**	46 (4.5)	23 (8.2)	
Other	**95 (7.4)**	65 (6.4)	30 (10.8)	
Missing	**5 (0.4)**	5 (0.5)	0 (—)	
Health insurance				
Private and public	**52 (4.0)**	34 (3.3)	18 (6.5)	<0.01
Private only	**935 (72.1)**	749 (73.6)	186 (66.7)	
Public only	**264 (20.4)**	195 (19.2)	69 (24.7)	
None	**45 (3.5)**	39 (3.8)	6 (2.2)	

TABLE 1. (*Continued*) Self-reported characteristics of adults with acute COVID-like illness, by confirmed SARS-CoV-2 test result status* at time of enrollment — Innovative Support for Patients with SARS-CoV-2 Infections Registry study, United States, December 2020–March 2023

Characteristic†	No. (%)§ Overall (N = 1,296)	Positive test result (n = 1,017)	Negative test result (n = 279)	p-value
Hospitalization				
No	**1,218 (95.5)**	943 (94.4)	275 (99.6)	<0.01
Yes	**57 (4.5)**	56 (5.6)	1 (0.4)	
Missing	**21 (1.6)**	18 (1.8)	3 (1.1)	
Preexisting medical condition				
Asthma (moderate or severe)	**169 (13.0)**	118 (11.6)	51 (18.3)	<0.01
Hypertension or high blood pressure	**182 (14.0)**	137 (13.5)	45 (16.1)	0.26
Diabetes	**72 (5.6)**	50 (4.9)	22 (7.9)	0.06
Overweight or obesity	**352 (27.2)**	272 (26.7)	80 (28.7)	0.52
Emphysema or COPD	**12 (0.9)**	9 (0.9)	3 (1.1)	0.77
Heart conditions such as CAD, heart failure, or cardiomyopathies	**30 (2.3)**	19 (1.9)	11 (3.9)	0.04
Tobacco use (currently using any type of tobacco, including smokeless tobacco)	**61 (4.7)**	44 (4.3)	17 (6.1)	0.22
Kidney disease	**13 (1.0)**	6 (0.6)	7 (2.5)	<0.01
Liver disease	**15 (1.2)**	9 (0.9)	6 (2.2)	0.08
Other	**203 (15.7)**	147 (14.5)	56 (20.1)	0.02
Participants reporting emerging symptoms at 6–12 mos**				
Any symptom††	**11 (0.9)**	1 (0.1)	10 (3.7)	<0.01
HEENT	**30 (2.4)**	10 (1.0)	20 (7.5)	<0.01
Constitutional	**27 (2.1)**	9 (0.9)	18 (6.7)	<0.01
Pulmonary	**51 (4.1)**	28 (2.8)	23 (8.6)	<0.01
Musculoskeletal	**66 (5.3)**	42 (4.2)	24 (9.0)	<0.01
Gastrointestinal	**56 (4.5)**	34 (3.4)	22 (8.2)	<0.01
Cardiovascular	**60 (4.8)**	42 (4.2)	18 (6.7)	0.09
Cognitive difficulties	**107 (8.3)**	68 (6.7)	39 (14.0)	<0.01
Extreme fatigue	**90 (7.0)**	65 (6.5)	25 (9.1)	0.13

Abbreviations: CAD = coronary artery disease; COPD = chronic obstructive pulmonary disease; GED = general educational development; HEENT = head, ears, eyes, nose, and throat.

* Excluding participants who reported receiving a negative test result during follow-up.

† Data were recorded at time of enrollment. The preexisting conditions data were collected at 3 months follow-up, which resulted in the high level of missingness in these variables.

§ Calculation of percentage and p-values excluded cases with missing values.

¶ Persons of Hispanic or Latino (Hispanic) origin might be of any race but are categorized as Hispanic; all racial groups are non-Hispanic.

** Symptom categories were any symptom (one or more symptoms), HEENT (headache, runny nose, loss of smell, loss of taste, sore throat, and loss of hair), constitutional (tired, chills, feeling hot, fever, and shakes), pulmonary (cough, shortness of breath, and wheezing), musculoskeletal (aches and joint pains), gastrointestinal (diarrhea, nausea or vomiting, and abdominal pain), cardiovascular (chest pain and palpitations), cognitive difficulties (forgetfulness/memory problems, difficulty thinking, or difficulty concentrating), and extreme fatigue (fatigue severity score ≥25).

†† Among participants who did not have any symptom at time of enrollment or 3 months after a COVID-like illness.

TABLE 2. Self-reported symptom* prevalence at baseline and persistence† through 12 months after a COVID-like illness among adults, by SARS-CoV-2 test status§ — Innovative Support for Patients with SARS-CoV-2 Infections Registry, United States, December 2020–March 2023

Symptoms	Test result	Prevalence, % (95% CI)				
		Baseline	3 mos	6 mos	9 mos	12 mos
Any symptom	Positive	98.4 (97.7–99.2)	48.2 (45.1–51.3)	31.2 (28.3–34.0)	24.4 (21.7–27.0)	18.3 (15.9–20.7)
	Negative	88.2 (84.4–92.0)	36.6 (30.9–42.2)	22.2 (17.3–27.1)	17.9 (13.4–22.4)	16.1 (11.8–20.4)
HEENT	Positive	93.2 (91.7–94.8)	30.6 (27.7–33.4)	15.2 (13.0–17.4)	9.2 (7.5–11.0)	5.9 (4.5–7.3)
	Negative	73.5 (68.3–78.7)	19.0 (14.4–23.6)	10.0 (6.5–13.6)	7.5 (4.4–10.6)	5.4 (2.7–8.0)
Constitutional	Positive	86.4 (84.3–88.5)	22.5 (20.0–25.1)	9.4 (7.6–11.2)	4.8 (3.5–6.1)	2.9 (1.8–3.9)
	Negative	62.7 (57.1–68.4)	17.6 (13.1–22.0)	8.2 (5.0–11.5)	5.0 (2.5–7.6)	2.9 (0.9–4.8)
Pulmonary	Positive	68.0 (65.2–70.9)	11.0 (9.1–12.9)	3.9 (2.7–5.1)	2.0 (1.1–2.8)	1.4 (0.7–2.1)
	Negative	44.1 (38.3–49.9)	7.2 (4.1–10.2)	2.2 (0.4–3.9)	1.4 (0–2.8)	1.1 (0–2.3)
Musculoskeletal	Positive	60.6 (57.6–63.6)	13.3 (11.2–15.4)	6.1 (4.6–7.6)	3.6 (2.5–4.8)	2.0 (1.1–2.8)
	Negative	40.9 (35.1–46.6)	8.6 (5.3–11.9)	3.2 (1.2–5.3)	2.5 (0.7–4.3)	2.2 (0.4–3.9)
Gastrointestinal	Positive	34.0 (31.1–36.9)	4.8 (3.5–6.1)	1.7 (0.9–2.5)	0.7 (0.2–1.2)	0.3 (0–0.6)
	Negative	26.5 (21.3–31.7)	5.7 (3.0–8.5)	1.8 (0.2–3.3)	1.4 (0–2.8)	1.1 (0–2.3)
Cardiovascular	Positive	25.3 (22.6–27.9)	4.7 (3.4–6.0)	1.5 (0.7–2.2)	1.0 (0.4–1.6)	0.7 (0.2–1.2)
	Negative	17.2 (12.8–21.6)	3.6 (1.4–5.8)	1.4 (0–2.8)	1.1 (0–2.3)	1.1 (0–2.3)
Cognitive difficulties	Positive	25.0 (22.3–27.6)	9.2 (7.5–11.0)	6.4 (4.9–7.9)	4.5 (3.2–5.8)	3.8 (2.7–5.0)
	Negative	21.5 (16.7–26.3)	7.5 (4.4–10.6)	5.7 (3.0–8.5)	3.6 (1.4–5.8)	3.2 (1.2–5.3)
Extreme fatigue	Positive	21.1 (18.6–23.7)	8.1 (6.4–9.7)	6.0 (4.5–7.5)	4.4 (3.2–5.7)	3.5 (2.4–4.7)
	Negative	25.4 (20.3–30.6)	11.5 (7.7–15.2)	7.5 (4.4–10.6)	7.2 (4.1–10.2)	6.8 (3.9–9.8)

Abbreviation: HEENT = head, ears, eyes, nose, and throat.

* Symptom categories were any symptom (one or more symptoms), HEENT (headache, runny nose, loss of smell, loss of taste, sore throat, and loss of hair), constitutional (tired, chills, feeling hot, fever, and shakes), pulmonary (cough, shortness of breath, and wheezing), musculoskeletal (aches and joint pains), gastrointestinal (diarrhea, nausea or vomiting, and abdominal pain), cardiovascular (chest pain and palpitations), cognitive difficulties (forgetfulness/memory problems, difficulty thinking, or difficulty concentrating), and extreme fatigue (fatigue severity score ≥25). Percentage of participants reporting symptoms at each of the time points is presented for each symptom category, stratified by SARS-CoV-2 test result status at time of enrollment.

† Persistent symptoms were defined as those present at time of enrollment and reported at each follow-up time point. Binomial 95% CIs were calculated for each outcome within each group. Pearson's chi-square tests were used to test for differences in proportions at each time point.

§ Without evidence of new SARS-CoV-2 infection.

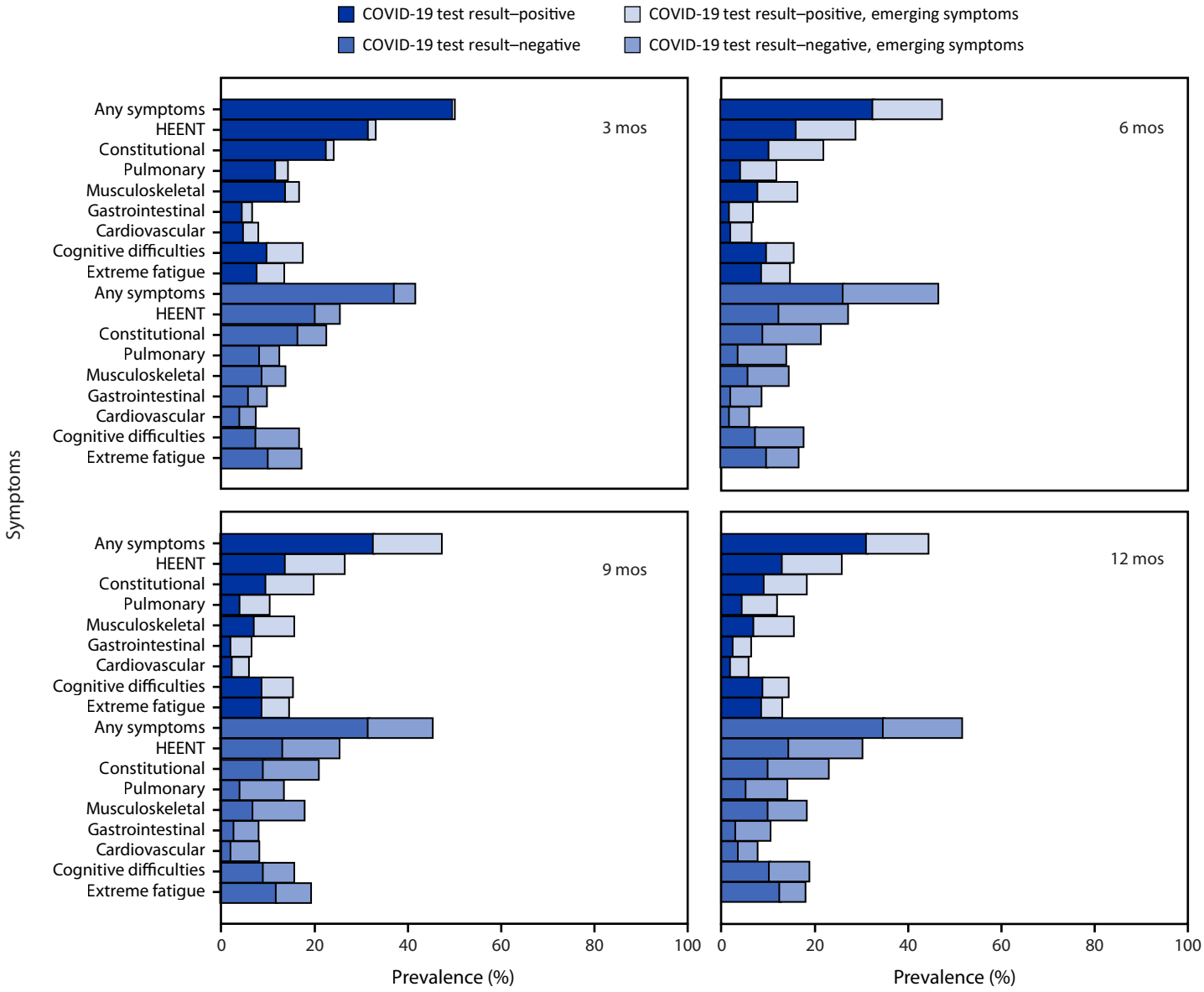
test result were included, the observed pattern was similar to that in the primary analysis, with more statistically significant differences in symptom prevalence during the follow-up period (Supplementary Figure 2, https://stacks.cdc.gov/view/cdc/131538) (Supplementary Figure 3, https://stacks.cdc.gov/view/cdc/131538).

Discussion

In this prospective, multicenter study of 1,296 persons with acute COVID-like illness, approximately 16% of participants reported persistent symptoms 12 months after their illness, irrespective of their SARS-CoV-2 test result status at baseline. A higher proportion of COVID test–positive than COVID test–negative participants reported symptoms in each symptom category at baseline. The prevalence of symptoms declined substantially in both groups from baseline to the 3-month follow-up assessment and continued to gradually decrease at the 6-, 9-, and 12-month follow-up assessments; persistence of any symptom prevalence at 12 months was not statistically significantly different between the COVID test–positive (18.3%) and COVID test–negative (16.1%) participant groups.

These findings expand the understanding of post-COVID conditions. Previous studies have reported symptom prevalence estimates across varied, nonstandardized periods or at a single point in time, resulting in challenges comparing studies and difficulty distinguishing among the presence of reported persistent symptoms at the time of COVID-19 diagnosis, those that resolved and then reemerged, and those that emerged after initial recovery (*3*–*9*). Few previous longitudinal studies have compared symptoms in COVID test–positive participants with those in persons with a COVID-like illness and who received negative SARS-CoV-2 test results. By conducting serial measurements of emerging and ongoing symptoms, this study was able to ascertain that participants who were symptomatic at a given time point included participants with ongoing symptoms as well as those with emerging symptoms (i.e., symptoms that were not present 3 months earlier). The inclusion of participants with COVID-like illness and negative test results guides discussions on characterizing symptoms associated with post-COVID conditions (*10*). This differentiation adds nuance and clarity to the natural history of post-COVID conditions and characterizes the fluctuating nature of symptoms over time and recognizes that these symptoms are not unique to COVID-19 or to post-COVID conditions. Many participants experienced new symptoms ≥6 months after the acute illness, suggesting that the prevalence of emerging symptoms in the months after acute COVID-like illness might be considerable. Cognitive difficulties and extreme fatigue were two common symptoms that

FIGURE. Self-reported prevalence of emerging and reemerging symptoms,*,†,§ by symptom category during 12 months¶ among adults with an acute COVID-like illness with no evidence of new or reinfection by SARS-CoV-2 test result status — Innovative Support for Patients with SARS-CoV-2 Infections Registry, United States, December 2020–March 2023**



Abbreviation: HEENT = head, ears, eyes, nose, and throat.

* Symptom categories were any symptom (one or more symptoms), HEENT (headache, runny nose, loss of smell, loss of taste, sore throat, and loss of hair), constitutional (tired, chills, feeling hot, fever, and shakes), pulmonary (cough, shortness of breath, and wheezing), musculoskeletal (aches and joint pains), gastrointestinal (diarrhea, nausea or vomiting, and abdominal pain), cardiovascular (chest pain and palpitations), cognitive difficulties (forgetfulness/memory problems, difficulty thinking, or difficulty concentrating), and extreme fatigue (fatigue severity score ≥25).

† Emerging symptoms were symptoms present at a given time point but not at the previous time point, including symptoms that resolved and reemerged after an absence.

§ https://www.cdc.gov/me-cfs/pdfs/wichita-data-access/symptom-inventory-doc.pdf

¶ Point prevalence at each time point is presented for the COVID test result–positive and COVID test result–negative groups for each symptom category.

** Without evidence of reinfection.

Summary

What is already known about this topic?

Post-COVID conditions, or long COVID, can persist for months or years after an acute COVID-19 illness and can include emergence of new symptoms or the occurrence of symptoms that come and go.

What is added by this report?

In a multicenter study of adults with a COVID-like illness, symptom prevalence decreased over time after the acute illness. Approximately 16% of adults with COVID-like symptoms reported persistent symptoms 12 months after a positive or negative SARS-CoV-2 test result. At 3, 6, 9, and 12 months after testing, some symptomatic persons had ongoing symptoms, and others had emerging symptoms not reported during the previous period.

What are the implications for public health practice?

Health care providers should be aware that symptoms can persist, emerge, reemerge, or resolve after COVID-like illness and are not unique to COVID-19 or to post-COVID conditions.

emerged after 6 months and are often reported to occur with post-COVID conditions (*1*,*3*,*6*,*9*). Differentiating between symptoms that resolve and emerge over time helps to characterize post-COVID conditions and suggests that measurements at single time points underestimate or mischaracterize the true effects of disease.

Limitations

The findings in this report are subject to at least four limitations. First, among the COVID test–negative group, no information on any other condition that might have caused the reported acute symptoms is available. Second, although the number of participants who subsequently reported a positive SARS-CoV-2 test result was higher in the COVID test–negative than in the COVID test–positive group, the rate of nonresponse to the question about having a subsequent SARS-CoV-2 test result was relatively higher in the COVID test–negative group. Testing was not systematically performed and participants with a subsequent SARS-CoV-2 infection might have not tested or might have received a false-negative test result. However, analysis including participants who reported subsequent positive test results did not differ substantially; thus, the results are not likely driven by subsequent SARS-CoV-2 infections. Infection with any other pathogen or the occurrence of other medical problems might have been experienced by persons in either group and could account for some reported symptoms. Third, the survey did not include all possible symptoms; therefore, other symptoms might not have been captured. Finally, this study did not report symptom severity or impact on daily activities, thus the functional significance of these findings could not be assessed.

Implications for Public Health Practice

Given the findings that approximately 16% of persons who have had an acute COVID-like illness might experience persistent symptoms through 12 months, post-COVID–like conditions could represent a substantial impact on health and the health care system. This report highlights the patterns of symptoms after acute COVID-like illness by providing estimates of symptom prevalence for both ongoing and emerging symptoms. Improved understanding of the persistent and fluctuating nature of symptoms could guide clinical care and public health response to post-COVID–like conditions.

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Long COVID and Significant Activity Limitation Among Adults, by Age — United States, June 1–13, 2022, to June 7–19, 2023

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Abstract

Long COVID is a condition encompassing a wide range of health problems that emerge, persist, or return following COVID-19. CDC analyzed national repeat cross-sectional Household Pulse Survey data to estimate the prevalence of long COVID and significant related activity limitation among U.S. adults aged ≥18 years by age group. Data from surveys completed between June 1–13, 2022, and June 7–19, 2023, indicated that long COVID prevalence decreased from 7.5% (95% CI = 7.1–7.9) to 6.0% (95% CI = 5.7–6.3) among the overall U.S. adult population, irrespective of history of previous COVID-19, and from 18.9% (95% CI = 17.9–19.8) to 11.0% (95% CI = 10.4–11.6) among U.S. adults reporting previous COVID-19. Among both groups, prevalence decreased from June 1–13, 2022, through January 4–16, 2023, before stabilizing. When stratified by age, only adults aged <60 years experienced significant rates of decline (p<0.01). Among adults reporting previous COVID-19, prevalence decreased among those aged 30–79 years through fall or winter and then stabilized. During June 7–19, 2023, 26.4% (95% CI = 24.0–28.9) of adults with long COVID reported significant activity limitation, the prevalence of which did not change over time. These findings help guide the ongoing COVID-19 prevention efforts and planning for long COVID symptom management and future health care service needs.

Introduction

Long COVID includes a wide range of ongoing respiratory, neurologic, cardiovascular, and other symptoms that can last for weeks, months, or years following SARS-CoV-2 infection. Estimates of long COVID incidence among nonhospitalized adults with COVID-19 range from 7.5% to 41% (*1*). Long COVID places substantial strain on the health care system (*2*). A retrospective cohort study among eight large integrated U.S. health systems found that SARS-CoV-2 infection was associated with a 4% increase in health care utilization over the 6 months following a positive SARS-CoV-2 test result (*2*). Further, long COVID can have a significant impact on quality of life, functional status, and ability to work (*3*). A study of the 2021–2022 Omicron BA.1/BA.2 wave in Australia found that long COVID was responsible for 74% of the years lived with disability (YLD) from SARS-CoV-2 infections (*4*).

Some populations might be at increased risk for long COVID, including those who experience more severe acute SARS-CoV-2 infection.* Adults aged ≥50 years are more likely to have severe COVID-19 than are younger persons†; however, the risk for long COVID and significant activity limitation by age is not well characterized.

Methods

CDC analyzed data from the Census Bureau's Household Pulse Survey (HPS) from June 1–13, 2022 to June 7–19, 2023, with the exception of August 24–September 13, 2022 and November 30–December 8, 2022, when no data were collected. The HPS is a rapidly deployed, cross-sectional national survey with a 2 weeks on, 2 weeks off collection and dissemination approach designed to measure the social and economic effects of COVID-19 on U.S. households.§ Long COVID questions were added to the survey beginning June 1, 2022. The HPS sampling frame was derived from the U.S. Census Bureau Master Address File and included all valid addresses with an associated mobile phone number or an email address.¶ Respondents reported previous COVID-19 diagnosis** (i.e., ever tested positive for COVID-19 or were told by a doctor or other health care provider they had COVID-19) and current long COVID via an online survey.†† Beginning

* https://www.cdc.gov/coronavirus/2019-ncov/long-term-effects/index.html
† https://covid.cdc.gov/covid-data-tracker/#demographics
§ https://www.census.gov/data/experimental-data-products/household-pulse-survey.html
¶ The HPS sampling frame included approximately 88% of valid addresses. Sampled housing units were contacted by both email and text message if both were available. One respondent from each sampled housing unit answered for themselves. https://www2.census.gov/programs-surveys/demo/technical-documentation/hhp/Phase3-9_Source_and_Accuracy_Week58.pdf
** Previous SARS-CoV-2 infection was ascertained by an affirmative response to the question, "Have you ever tested positive for COVID-19 (using a rapid point-of-care test, self-test, or laboratory test) or been told by a doctor or other health care provider that you have or had COVID-19?"
†† Among respondents reporting previous COVID-19, currently experiencing long COVID was ascertained by affirmative responses to two questions: "Did you have any symptoms lasting 3 months or longer that you did not have prior to having coronavirus or COVID-19? (long term symptoms might include: tiredness or fatigue; difficulty thinking, concentrating, forgetfulness, or memory problems [sometimes referred to as "brain fog"]; difficulty breathing or shortness of breath; joint or muscle pain; fast-beating or pounding heart [also known as heart palpitations]; chest pain; dizziness on standing; menstrual changes; changes to taste/smell; or inability to exercise)" and "Do you have symptoms now?" Respondents who reported no previous COVID-19 were classified as not having long COVID.

September 14, 2022, participants were asked about significant activity limitation from long COVID (i.e., long-term symptoms significantly reduced ability to carry out day-to-day activities compared with the time before having COVID-19).[§§]

Two-week weighted period prevalence (%) and 95% CIs were estimated for long COVID among those reporting previous COVID-19. In the interest of generating estimates for the overall adult U.S. population, prevalence (with 95% CIs) were also estimated among all adults irrespective of reported prior COVID infection. Significant activity limitation prevalence (with 95% CIs) was estimated among those with long COVID. Two-week weighted period prevalence (with 95% CIs) for long COVID and significant activity limitation were also estimated by age group. Estimates were weighted to adjust for nonresponse, survey coverage, and number of adults per household, and to match Census Bureau estimates of the population by age, sex, race and ethnicity, and educational attainment.[¶¶] All estimates in these analyses meet the National Center for Health Statistics Data Presentation Standards[***] and are publicly available. [†††] Change in 2-week period prevalence of long COVID and significant activity limitation was evaluated using Joinpoint regression. Joinpoint regression uses permutation tests to identify statistically significant points where linear trends change in direction or magnitude (i.e., joinpoints). The rate of change was tested for each trend to determine whether it was significantly different from zero, and each trend was described in the final model by percentage change (with 95% CIs) for each 2-week survey cycle. All analyses were conducted using Joinpoint (version 5.0; National Cancer Institute). This activity was reviewed by CDC and was conducted consistent with applicable federal law and CDC policy.[§§§]

Results

Prevalence of long COVID among all U.S. adults decreased from 7.5% (95% CI = 7.1–7.9) during June 1–13, 2022, to 6.0% (95% CI = 5.7–6.3) during June 7–19, 2023 (Figure 1). From June 1–13, 2022, through January 4–16, 2023, prevalence decreased 0.28% per survey cycle (p = 0.001), then remained stable (0.006% change per cycle, p = 0.95). Statistically significant rates of decline only occurred among adults aged <60 years. Among adults aged 50–59 years, long COVID prevalence decreased 0.32% per survey cycle through February 1–23, 2023 (p = 0.001), then remained stable (0.21% change per survey cycle, p = 0.22).

Among adults reporting previous COVID-19, long COVID prevalence decreased from 18.9% (95% CI = 17.9–19.8) to 11.0% (95% CI = 10.4–11.6) during the study period (Figure 2). Prevalence decreased 1.16% per survey cycle from June 1–13, 2022, until January 4–16, 2023 (p<0.0001), then remained stable (–0.01% change per cycle, p = 0.91). Prevalence of long COVID among adults aged 30–79 years declined through fall or winter, after which it remained stable; the inflection point where long COVID prevalence stabilized varied in timing by age group, ranging from November 2–14, 2022 (adults aged 70–79 years) to February 1–13, 2023 (adults aged 30–39 years and 50–59 years). Among all adults and among those reporting previous COVID-19, long COVID prevalence tended to be lower among the youngest and the oldest age groups (i.e., 18–29 years and ≥60 years).

During June 7–19, 2023, 26.4% (95% CI = 24.0%–28.9%) of adults with long COVID reported significant activity limitations (Figure 3), the prevalence of which remained stable during the study period (–0.05% change per survey cycle, p = 0.72). No clear pattern emerged for prevalence of significant activity limitation across age groups.

Discussion

The findings from this analysis of a national sample of U.S. adults indicated that long COVID prevalence decreased from June 1–13, 2022 to June 7–19, 2023. The joinpoint identified during January 4–16, 2023 suggests that, after an initial decline, long COVID prevalence remained unchanged. The decline during the study period might be reflective of decreasing prevalence of SARS-CoV-2 infection,[¶¶¶] changes in the severity of acute infection,[****] interventions offered during acute infection (e.g., antivirals) (*5*), vaccination coverage (*5*), or other factors. Long COVID prevalence has not changed since January 2023, and approximately 1 in 10 adults with previous COVID-19 were experiencing long COVID at the end of the study period, highlighting the ongoing importance of COVID-19 prevention actions, including vaccination.[††††]

Long COVID prevalence among adults tended to be lower in the youngest (18–29 years) and the oldest (≥60 years) age groups, consistent with findings from both U.K. and U.S. studies. In a study of long COVID during the Omicron BA.4/BA.5 surge (June–July 2022), the sex-standardized prevalence of long

[§§] When asked, "Do these long-term symptoms reduce your ability to carry out day-to-day activities compared with the time before you had COVID-19?" participants responding "yes, a lot" were classified as having significant activity limitation.

[¶¶] https://www2.census.gov/programs-surveys/demo/technical-documentation/hhp/Phase3-9_Source_and_Accuracy_Week58.pdf

[***] https://www.cdc.gov/nchs/data/series/sr_02/sr02_175.pdf

[†††] https://www.cdc.gov/nchs/covid19/pulse/long-covid.htm

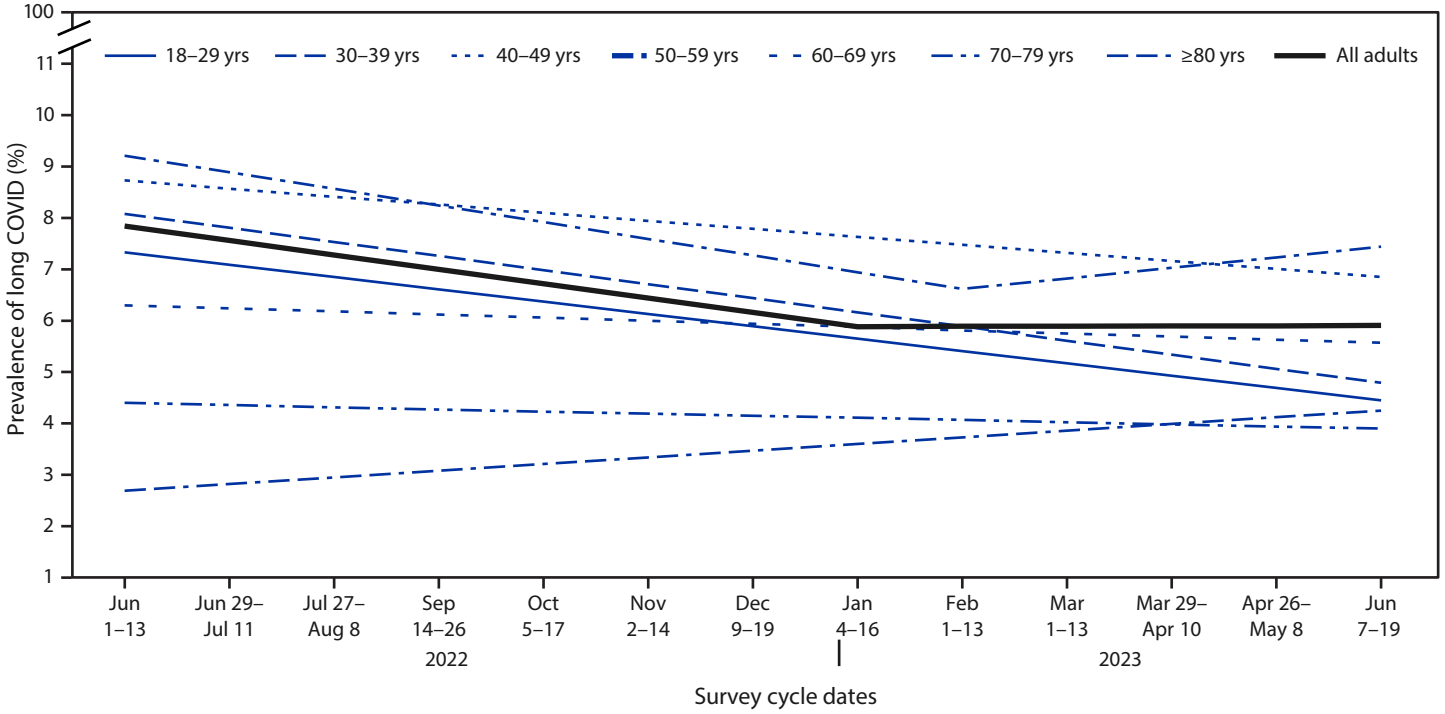
[§§§] 45 C.F.R. part 46.102(l)(2), 21 C.F.R. part 56; 42 U.S.C. Sect. 241(d); 5 U.S.C. Sect. 552a; 44 U.S.C. Sect. 3501 et seq.

[¶¶¶] https://covid.cdc.gov/covid-data-tracker/#datatracker-hom

[****] https://covid.cdc.gov/covid-data-tracker/#trends_weeklyhospitaladmissions_select_00

[††††] https://www.cdc.gov/coronavirus/2019-ncov/prevent-getting-sick/prevention.html

FIGURE 1. Trend lines for the prevalence of self-reported long COVID among all adults,* by age group — Household Pulse Survey, United States, June 1–June 13, 2022 to June 7–June 19, 2023†



Abbreviation: HPS = Household Pulse Survey.

* Estimate for all adults (slope for June 1–13, 2022 to January 4–16, 2023 = –0.28, p = 0.001; slope for January 4–16, 2023 to June 7–19, 2023 = 0.006, p = 0.95). Estimates of rate of change by age group: 18–29 years (slope for June 1–13, 2022 to June 7–19, 2023 = –0.24, p<0.001); 30–39 years (slope for June 1–13, 2022 to June 7–19, 2023 = –0.27, p<0.001); 40–49 years (slope for June 1–13, 2022 to June 7–19, 2023 = –0.16, p = 0.003); 50–59 years (slope for June 1–13, 2022 to February 1–13, 2023 = –0.32, p = 0.001; slope for February 1–13, 2023 to June 7–19, 2023 = 0.21, p = 0.22); 60–69 years (slope for June 1–13, 2022 to June 7–19, 2023 = –0.06, p = 0.18); 70–79 years (slope for June 1–13, 2022 to June 7–19, 2023 = –0.04, p = 0.40); and ≥80 years (slope for June 1–13, 2022 to June 7–19, 2023 = 0.13, p = 0.13).

† No HPS data were collected during the 2-week period August 24–September 13, 2022, or during November 30–December 8, 2022.

COVID was lowest among U.S. respondents aged ≥65 years (14.8%, 95% CI = 10.8%–19.9%) and highest among those aged 35–44 years (27.6%, 95% CI = 19.3%–37.8%) (*6*). In the United Kingdom, long COVID prevalence was highest among adults aged 35–49 years.[§§§§] Lower prevalence of long COVID among older adults might be a consequence of survivor bias, lower prevalence of ever having COVID-19, [¶¶¶¶] or differences in behavior, such as bivalent vaccination receipt,[*****] or other[†††††] self-reported COVID mitigation behaviors (*7*).

More than one in four adults with long COVID reported significant activity limitations during June 7–19, 2023, and prevalence did not change over time. No significant activity limitation prevalence patterns were apparent across age groups. Limited ability to carry out day-to-day activities because of long COVID symptoms can have a significant impact on quality of life, functional status, and ability to work or provide care to others (*3*). Health-related quality of life scores among long COVID patients in the United Kingdom were similar to those of patients with advanced cancers, and 53% reported moderately severe functional impairment, worse than that associated with stroke (*3*). Long COVID in U.S. adults has also been associated with lower likelihood of working full time and higher likelihood of being unemployed (*8*). According to data from the New York State Insurance Fund, 18% of claimants with long COVID could not return to work for more than 1 year.[§§§§§] The larger economic and societal impact of long COVID could be far-reaching if working-age adults are unable to maintain employment or care for children or aging parents.

[§§§§] https://www.ons.gov.uk/peoplepopulationandcommunity/healthandsocialcare/conditionsanddiseases/bulletins/

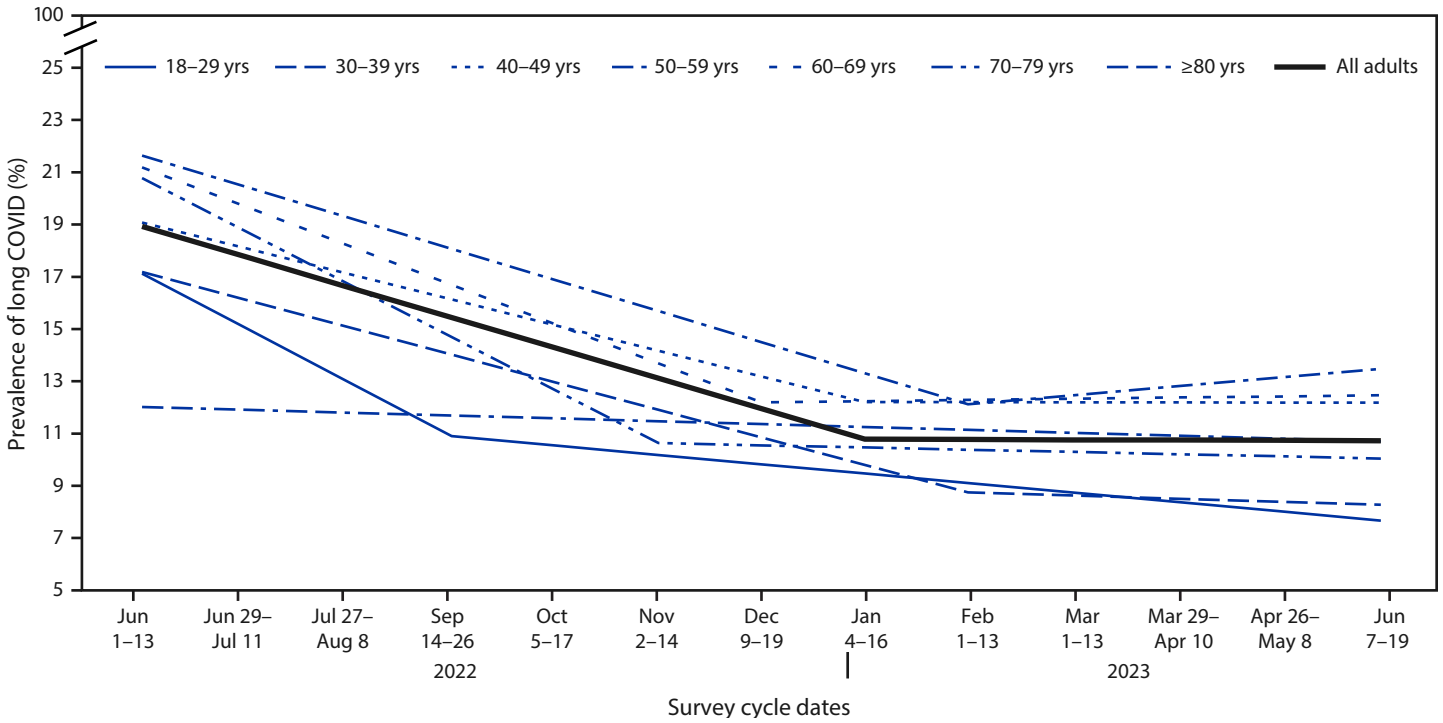
[¶¶¶¶] In the HPS during June 7–19, 2023, 60.6% of adults aged 18–29 years reported ever having SARS-CoV-2 infection compared with 35.7% of adults aged ≥80 years. https://www.cdc.gov/nchs/covid19/pulse/long-covid.htm

[*****] As of May 10, 2023, bivalent vaccination coverage among adults aged ≥65 years was 43.3% compared with 20.5% among adults aged ≥18 years. https://covid.cdc.gov/covid-data-tracker/#vaccination-states-jurisdictions

[†††††] Early in the pandemic, self-reported COVID mitigation behaviors including mask wearing, handwashing, physical distancing, crowd and restaurant avoidance, and cancellation of social activities were highest among adults aged >60 years.

[§§§§§] https://ww3.nysif.com/en/FooterPages/Column1/AboutNYSIF/NYSIF_News/2023/20230124LongCovid

FIGURE 2. Trend lines for the prevalence of self-reported long COVID among adults with reported previous COVID-19,* by age group — Household Pulse Survey, United States, June 1–June 13, 2022, to June 7–June 19, 2023†



Abbreviation: HPS = Household Pulse Survey.

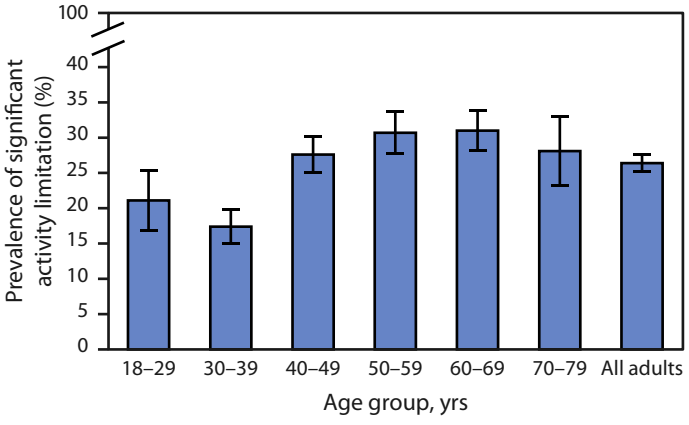
* Estimate for all adults (slope for June 1–13, 2022 to January 4–16, 2023 = −1.16, p<0.001; slope for January 4–16, 2023 to June 7–19, 2023 = −0.01, p = 0.91). Estimates of rate of change by age group: 18–29 years (slope for June 1–13, 2022 to September 14–26, 2022= −2.07, p = 0.07; slope for September 14–26, 2022 to June 7–19, 2023 = −0.36, p = 0.04); 30–39 years (slope for June 1–13, 2022 to February 1–13, 2023 = −1.05, p = p<0.001; slope for February 1–13, 2023 to June 7–19, 2023 = −0.12, p = 0.76); 40–49 years (slope for June 1–13, 2022 to January 4–16, 2023 = −0.98 , p<0.001; slope for January 4–16, 2023 to June 7–19, 2023 = −0.005, p = 0.98); 50–59 years (slope for June 1–13, 2022 to February 1–13, 2023 = −1.19, p<0.001; slope for February 1–13, 2023 to June 7–19, 2023 = 0.34, p = 0.15); 60–69 years (slope for June 1–13, 2022 to December 9–19, 2022 = −1.50 , p<0.001; slope for December 9–19, 2022 to June 7–19, 2023 = 0.05, p = 0.8); 70–79 years (slope for June 1–13, 2022 to November 2–14, 2022 = −2.03, p = 0.04; slope for November 2–14, 2022 to June 7–19, 2023 = −0.09, p = 0.75); and ≥80 years (slope for June 1–13, 2022 to June 7–19, 2023 = −0.11, p = 0.73).

† No HPS data were collected during the 2-week period August 24–September 13, 2022, or during November 30-December 8, 2022.

Limitations

The findings in this study are subject to at least three limitations. First, the HPS samples from housing units with at least one matched mobile phone number or email address, and thus is subject to coverage bias. Second, response rate was low for all survey cycles (range = 3.9%–7.0%). Even after weighting and adjustments for coverage and nonresponse, person-level coverage varied by some demographic characteristics. Finally, the survey did not capture duration of symptoms, COVID-19 vaccination status, time since COVID-19 illness, or treatment during acute COVID infection, each of which could influence the reported prevalence of long COVID. Despite these limitations, population-based observational studies, like the HPS, might complement studies based on administrative data by providing insight into experiences of long COVID, including among persons who might not have accessed care.

FIGURE 3. Prevalence of significant activity limitation among adults reporting long COVID* — Household Pulse Survey, United States, June 7–19, 2023



Abbreviation: NCHS = National Center for Health Statistics.

* With 95% CIs represented by error bars. Estimates for the adults aged ≥80 years do not meet NCHS Data Presentation Standards and are not included in the figure as a separate group; however, they are included in the estimate for all adults.

Summary

What is already known about this topic?

Long COVID includes a wide range of ongoing symptoms that can last for weeks, months, or years following SARS-CoV-2 infection.

What is added by this report?

Prevalence of long COVID among noninstitutionalized U.S. adults aged ≥18 years decreased from 7.5% (95% CI = 7.1–7.9) during June 1–13, 2022 to 6.0% (95% CI = 5.7–6.3) during June 7–19, 2023 and from 18.9% (95% CI = 17.9–19.8) to 11.0% (95% CI = 10.4–11.6) among adults reporting previous COVID-19. After an initial decline, prevalence remained unchanged beginning January 4–16, 2023. Approximately one quarter of adults with long COVID report significant activity limitations.

What are the implications for public health practice?

COVID-19 prevention efforts, including staying up to date with recommended COVID-19 vaccination and planning for long COVID symptom management and health care service needs, remain important.

Implications for Public Health Practice

After an initial decline during the study period, the prevalence of long COVID has not decreased. The percentage of persons with long COVID who are experiencing significant activity limitations did not change over time. These findings highlight the importance of COVID prevention, including staying up to date with recommended COVID-19 vaccination, and could inform health care service needs planning, disability policy, and other support services for persons experiencing severe activity limitation from long COVID.

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All authors have completed and submitted the International Committee of Medical Journal Editors form for disclosure of potential conflicts of interest. Douglas Slaughter reports volunteering with the Hood Medicine Initiative during the COVID-19 pandemic. No other potential conflicts of interest were disclosed.

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SARS-CoV-2 Infection and Death Rates Among Maintenance Dialysis Patients During Delta and Early Omicron Waves — United States, June 30, 2021–September 27, 2022

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Abstract

Persons receiving maintenance dialysis are at increased risk for SARS-CoV-2 infection and its severe outcomes, including death. However, rates of SARS-CoV-2 infection and COVID-19–related deaths in this population are not well described. Since November 2020, CDC's National Healthcare Safety Network (NHSN) has collected weekly data monitoring incidence of SARS-CoV-2 infections (defined as a positive SARS-CoV-2 test result) and COVID-19–related deaths (defined as the death of a patient who had not fully recovered from a SARS-CoV-2 infection) among maintenance dialysis patients. This analysis used NHSN dialysis facility COVID-19 data reported during June 30, 2021–September 27, 2022, to describe rates of SARS-CoV-2 infection and COVID-19–related death among maintenance dialysis patients. The overall infection rate was 30.47 per 10,000 patient-weeks (39.64 among unvaccinated patients and 27.24 among patients who had completed a primary COVID-19 vaccination series). The overall death rate was 1.74 per 10,000 patient-weeks. Implementing recommended infection control measures in dialysis facilities and ensuring patients and staff members are up to date with recommended COVID-19 vaccination is critical to limiting COVID-19–associated morbidity and mortality.

Introduction

Persons receiving maintenance dialysis are at increased risk for SARS-CoV-2 infection (*1*) and its severe outcomes, including death (*2*). However, rates of SARS-CoV-2 infection and COVID-19–related death among dialysis patients, and the impact of COVID-19 vaccination on these rates, are not well described. CDC's National Healthcare Safety Network (NHSN) collects weekly facility-level data monitoring incidence of SARS-CoV-2 infection and death among maintenance dialysis patients.* During the COVID-19 Public Health Emergency, the Centers for Medicare & Medicaid Services instituted emergency requirements through the End-stage Renal Disease Network, mandating that COVID-19 cases, deaths, and vaccination status of dialysis facility patients and staff members be reported to NHSN.

Methods

A SARS-CoV-2 infection was defined as any positive SARS-CoV-2 test result for a dialysis patient during the preceding 7 days. A COVID-19–related death was defined as a death occurring in a patient who had not fully recovered from a SARS-CoV-2 infection. Facility-level data on SARS-CoV-2 infections and deaths were stratified into waves (periods between weeks with the lowest infection rates among NHSN dialysis patients). Waves corresponded to the dominant circulating SARS-CoV-2 variant: Delta (June 30–October 26, 2021), first Omicron (October 27, 2021–March 22, 2022), and second Omicron (March 23–September 27, 2022). Pooled mean SARS-CoV-2 infection and death rates (events per 10,000 patient-weeks) among dialysis patients were calculated as the sum of weekly cases divided by the weekly patient census during each wave. COVID-19–related deaths were ascribed to the week during which the death occurred. The rates by wave, with 95% CIs, were calculated and stratified by rural-urban continuum code,† county-level social vulnerability index tertiles (low, medium, and high),§ state, region,¶ dialysis facility size, and primary series and monovalent booster dose vaccination completion status. Age group–stratified COVID-19 rates among the U.S. population (cases per 10,000 population) were calculated as the total number of cases (by specific age group) reported during a week divided by the estimated age-specific U.S. population, using COVID-19 case surveillance public use data.** Analyses were performed using SAS software (version

* https://www.cdc.gov/nhsn/pdfs/newsletters/dec20-nl-508.pdf

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

§ https://www.atsdr.cdc.gov/placeandhealth/svi/index.html

¶ *South:* Alabama, Arkansas, Delaware, Florida, Georgia, Kentucky, Louisiana, Maryland, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, Virginia, West Virginia, and District of Columbia; *Midwest*: Ilinois, Indiana, Iowa, Kansas, Michigan, Minesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota, and Wisconsin; *Mountain*: Arizona, Colorado, Idaho, Montana, New Mexico, Nevada, Utah, and Wyoming; *Pacific:* California, Oregon, and Washington; *Northeast:* Connecticut, Maine, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, and Vermont; *Noncontiguous:* Alaska and Hawaii.

** https://data.cdc.gov/Case-Surveillance/COVID-19-Case-Surveillance-Public-Use-Data/vbim-akqf

9.4; SAS Institute). This activity was reviewed by CDC and was conducted consistent with applicable federal law and CDC policy.[††]

Results

A total of 7,848 dialysis facilities reported weekly SARS-CoV-2 infections and COVID-19–related deaths among 518,798 patients to NHSN during June 30, 2021–September 27, 2022. The overall pooled mean SARS-CoV-2 infection rate among maintenance dialysis patients was 30.47 per 10,000 patient-weeks, with a pooled mean COVID-19–related death rate of 1.74 per 10,000 patient-weeks (Table). The highest infection and death rates were observed during the first Omicron wave (Figure 1).

The overall incidence of SARS-CoV-2 infection among unvaccinated dialysis patients was 39.64 per 10,000 patient-weeks, compared with 27.24 per 10,000 among those who had received a complete primary COVID-19 vaccination series (Table). During the first and second Omicron waves (October 27, 2021–March 22, 2022), the overall infection rate among dialysis patients who had received ≥1 monovalent booster dose was 30.62, compared with 33.69 among vaccinated patients who had not received a monovalent booster dose. During the Delta and first Omicron waves, the infection rate among vaccinated patients was lower than that among unvaccinated patients (Figure 1), and during the first Omicron wave, the infection rate was lower among patients who had received a monovalent booster dose than among those who had not.

Among the U.S. population, SARS-CoV-2 infection and death rates varied by age group, and the differences were most pronounced during the first Omicron wave (Figure 2). The SARS-CoV-2 infection rate in the U.S. population was 20.73 per 10,000 population-weeks during the Delta wave, 43.62 per 10,000 population-weeks during the first Omicron wave, and 17.13 per 10,000 population-weeks during the second Omicron wave. COVID-19–related death rates in the U.S. population were 0.24 per 10,000 population-weeks during the Delta wave, 0.26 per 10,000 population-weeks during the first Omicron wave, and 0.06 per 10,000 population-weeks during the second Omicron wave. The infection and death rates among maintenance dialysis patients followed similar patterns over time to those in the overall U.S. population (Figure 2).

Discussion

During June 30, 2021–September 27, 2022, the overall SARS-CoV-2 infection rate among maintenance dialysis patients was 30.47 per 10,000 patient-weeks. During the Delta and first Omicron waves, differences in SARS-CoV-2 infection rates between vaccinated and unvaccinated dialysis patients were identified, a finding that has not been well documented in the literature for this population (*3*). However, no difference in infection rate among those who were vaccinated and unvaccinated was noted during the second Omicron wave. This might be because of lower overall infection rates and declining vaccine effectiveness over time, as well as the emergence of new variants (*4*). Although formal studies of vaccine effectiveness have not been conducted in this population, data suggest that receipt of a 2-dose primary mRNA COVID-19 vaccination series is protective in dialysis patients despite their having a slightly attenuated immune response (*5*). Approximately 70% of dialysis patients have completed a primary vaccination series, but only 54% received additional primary or booster doses, indicating substantial potential for improvement in vaccination coverage.[§§] The reported side effects of SARS-CoV-2 vaccination did not differ between dialysis patients and persons not receiving dialysis (*6*). The need for patient education, efforts to combat vaccine misinformation, and on-site vaccination at dialysis facilities is ongoing.

The SARS-CoV-2 infection rate among both dialysis patients and the overall U.S. population was highest during the first Omicron wave. However, the infection rate among dialysis patients was mitigated by primary series vaccination, despite concerns about an attenuated immune response to vaccines among patients receiving dialysis. Although the SARS-CoV-2 infection rates were similar among dialysis patients and the U.S. population, patients receiving dialysis are generally older (*1*), and the infection rate among dialysis patients was higher than that among the U.S. population aged >65 years. The COVID-19–related death rate among dialysis patients was higher than that among the U.S. population with the highest death rates (i.e., persons aged >75 years). Compared with the U.S. population, patients receiving dialysis likely had higher rates of both SARS-CoV-2 infection and COVID-19–related death.

Most patients receiving dialysis must visit dialysis facilities to receive lifesaving treatment, which is performed in close proximity to other patients and facility staff members, three times each week. Many patients rely on shared transportation (e.g., public transit or medical transport van), and approximately 7% live in long-term care facilities (*6*), placing these persons at particularly high risk for infection and death related to COVID-19 (*7*). The infection rate among persons receiving dialysis can be reduced by adherence to recommended infection prevention practices, including early detection of symptomatic illness, appropriate location of infected patients during in-facility dialysis treatments, correct use of personal

[††] 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.

[§§] https://www.cdc.gov/nhsn/covid19/dial-vaccination-dashboard.html

TABLE. Pooled mean SARS-CoV-2 incidence and COVID-19–associated death rates* per 10,000 patient-weeks among maintenance dialysis patients during each COVID-19 wave,† by region, urbanicity, social vulnerability index, facility size, primary vaccination status, and monovalent booster dose receipt status — National Healthcare Safety Network, United States, June 30, 2021–September 27, 2022

Characteristic	SARS-CoV-2 incidence, by wave (95% CI)				COVID-19–associated death rates, by wave (95% CI)			
	Overall	Delta	First Omicron	Second Omicron	Overall	Delta	First Omicron	Second Omicron
Overall§	**30.47 (29.02–31.97)**	**20.13 (18.99–21.36)**	**46.45 (44.64–48.30)**	**25.05 (23.74–26.44)**	**1.74 (1.44–2.12)**	**1.96 (1.62–2.34)**	**2.66 (2.26–3.11)**	**0.59 (0.43–0.81)**
Region¶								
Midwest	**27.64 (27.26–28.02)**	16.92 (16.29–17.56)	52.48 (51.47–53.51)	23.55 (22.95–24.16)	**1.65 (1.56–1.75)**	1.43 (1.25–1.62)	3.52 (3.26–3.79)	0.54 (0.45–0.64)
Mountain	**28.12 (27.45–28.81)**	24.35 (23.03–25.72)	51.81 (50.04–53.62)	22.02 (21.00–23.08)	**1.89 (1.72–2.07)**	1.91 (1.56–2.31)	4.12 (3.64–4.65)	0.66 (0.50–0.86)
Northeast	**28.26 (27.83–28.70)**	9.90 (9.37–10.46)	52.72 (51.57–53.89)	28.87 (28.11–29.64)	**1.63 (1.53–1.74)**	1.00 (0.83–1.18)	2.90 (2.64–3.18)	0.87 (0.75–1.01)
Pacific	**24.71 (24.34–25.09)**	13.31 (12.74–13.91)	41.54 (40.61–42.49)	29.28 (28.57–30.00)	**1.01 (0.94–1.09)**	1.19 (1.02–1.37)	1.83 (1.65–2.04)	0.44 (0.36–0.53)
South	**26.11 (25.87–26.35)**	26.60 (26.09–27.12)	43.39 (42.79–43.99)	21.63 (21.25–22.01)	**1.68 (1.62–1.74)**	2.74 (2.58–2.91)	2.48 (2.34–2.63)	0.54 (0.48–0.60)
Noncontiguous	**43.56 (41.55–45.64)**	40.00 (36.01–44.31)	52.40 (48.18–56.89)	58.45 (54.48–62.63)	**1.57 (1.22–2.00)**	3.36 (2.31–4.74)	1.60 (0.96–2.51)	0.96 (0.54–1.60)
Urbanicity,††								
Large core metro	**28.33 (27.26–28.02)**	16.16 (16.29–17.56)	45.03 (51.47–53.51)	23.02 (22.95–24.16)	**1.26 (1.56–1.75)**	1.37 (1.25–1.62)	2.19 (3.26–3.79)	0.45 (0.45–0.64)
Large fringe metro	**28.14 (27.45–28.81)**	16.33 (23.03–25.72)	43.78 (50.04–53.62)	23.53 (21.00–23.08)	**1.41 (1.72–2.07)**	1.49 (1.56–2.31)	2.49 (3.64–4.65)	0.51 (0.50–0.86)
Medium metro	**33.16 (27.83–28.70)**	24.49 (9.37–10.46)	48.40 (51.57–53.89)	26.75 (28.11–29.64)	**1.84 (1.53–1.74)**	2.36 (0.83–1.18)	2.88 (2.64–3.18)	0.67 (0.75–1.01)
Small metro	**32.78 (24.34–25.09)**	25.43 (12.74–13.91)	48.64 (40.61–42.49)	25.14 (28.57–30.00)	**2.15 (0.94–1.09)**	2.92 (1.02–1.37)	3.40 (1.65–2.04)	0.66 (0.36–0.53)
Rural	**35.70 (25.87–26.35)**	27.66 (26.09–27.12)	52.62 (42.79–43.99)	27.73 (21.25–22.01)	**2.62 (1.62–1.74)**	3.75 (2.58–2.91)	3.94 (2.34–2.63)	0.85 (0.48–0.60)
Noncore	**34.59 (41.55–45.64)**	27.09 (36.01–44.31)	49.66 (48.18–56.89)	27.69 (54.48–62.63)	**2.39 (1.22–2.00)**	3.43 (2.31–4.74)	3.48 (0.96–2.51)	0.83 (0.54–1.60)
SVI§§								
Low	**30.92 (30.57–31.27)**	18.21 (17.69–18.74)	46.93 (46.17–47.69)	26.55 (26.04–27.06)	**1.64 (1.56–1.72)**	1.75 (1.59–1.92)	2.83 (2.65–3.03)	0.61 (0.54–0.70)
Medium	**30.99 (30.66–31.32)**	21.02 (20.51–21.55)	47.37 (46.66–48.10)	24.58 (24.12–25.05)	**1.77 (1.69–1.85)**	2.06 (1.90–2.23)	2.93 (2.76–3.12)	0.65 (0.58–0.72)
High	**30.06 (29.76–30.37)**	21.23 (20.73–21.73)	45.74 (45.07–46.41)	23.43 (23.01–23.86)	**1.59 (1.53–1.67)**	2.25 (2.09–2.41)	2.44 (2.29–2.59)	0.50 (0.44–0.56)
Facility size¶¶								
Small	**32.50 (32.13–32.88)**	23.28 (22.68–23.89)	48.88 (48.08–49.69)	25.63 (25.12–26.15)	**1.66 (1.58–1.75)**	1.91 (1.74–2.09)	2.81 (2.62–3.01)	0.60 (0.52–0.68)
Medium	**30.30 (29.95–30.67)**	20.53 (19.97–21.11)	46.21 (45.43–46.99)	24.16 (23.66–24.66)	**1.66 (1.58–1.75)**	2.02 (1.84–2.20)	2.78 (2.59–2.97)	0.55 (0.48–0.63)
Large	**30.28 (29.99–30.57)**	18.38 (17.95–18.82)	46.09 (45.46–46.72)	25.57 (25.15–25.99)	**1.65 (1.58–1.72)**	1.93 (1.79–2.07)	2.68 (2.53–2.83)	0.63 (0.57–0.70)
Primary vaccination status* **								
Full primary series	**27.24 (25.65–28.90)**	13.10 (12.00–14.28)	40.89 (38.91–42.91)	25.10 (23.58–26.71)	—	—	—	—
Not vaccinated	**39.64 (36.60–42.91)**	36.12 (33.39–39.05)	61.86 (57.90–66.08)	23.91 (21.50–26.60)	—	—	—	—
**Monovalent booster dose status††† **								
Full primary series and ≥1 booster dose	**30.62 (28.24–33.21)**	—	38.32 (35.16–41.62)	26.70 (24.62–28.86)	—	—	—	—
No booster dose	**33.69 (31.27–36.24)**	—	42.21 (39.76–44.80)	22.93 (20.75–25.30)	—	—	—	—

Abbreviations: NHSN = National Healthcare Safety Network; SVI = social vulnerability index.

* Cases and deaths per 10,000 patient-weeks. COVID-19–related deaths were defined as those among patients who died before fully recovering from SARS-CoV-2 infection; NHSN receives aggregate facility-level data; therefore, death rates could not be calculated by vaccination status.

† Delta (June 30–October 26, 2021), first Omicron (October 27, 2021–March 22, 2022), and second Omicron (March 23–September 27, 2022).

§ Pooled rates within each category might differ from overall rates because of smaller sized subcategories.

¶ *South:* Alabama, Arkansas, Delaware, Florida, Georgia, Kentucky, Louisiana, Maryland, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, Virginia, West Virginia, and District of Columbia; *Midwest:* Illinois, Indiana, Iowa, Kansas, Michigan, Minesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota, and Wisconsin; *Mountain:* Arizona, Colorado, Idaho, Montana, New Mexico, Nevada, Utah, and Wyoming; *Pacific:* California, Oregon, and Washington; *Northeast:* Connecticut, Maine, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, and Vermont; *Noncontiguous:* Alaska and Hawaii.

** Washington, DC, Puerto Rico, and U.S. Virgin Islands were not included in urbanicity subanalysis.

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

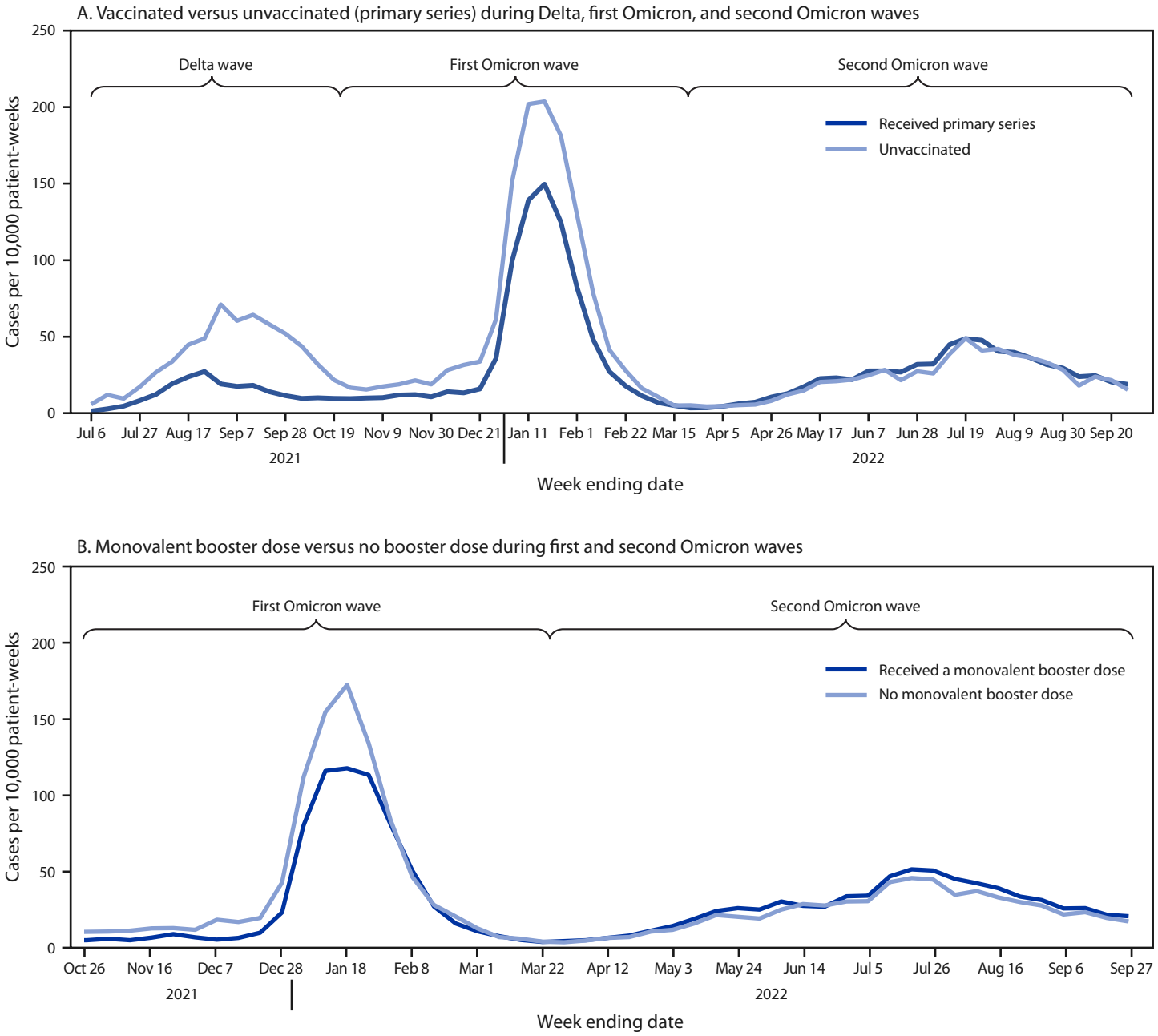
§§ https://www.atsdr.cdc.gov/placeandhealth/svi/index.html

¶¶ Small, medium, and large facilities are defined as having 0–16, 17–22, and ≥23 dialysis stations, respectively.

*** Primary vaccination data were available during all three waves (June 30, 2021–September 27, 2022).

††† Monovalent booster dose vaccination data were only available during first and second Omicron waves (October 27, 2021–September 27, 2022).

FIGURE 1. SARS-CoV-2 infections per 10,000 patient-weeks among maintenance dialysis patients, by COVID-19 primary (A) and booster dose (B) vaccination status — National Healthcare Safety Network, United States, June 30, 2021–September 27, 2022



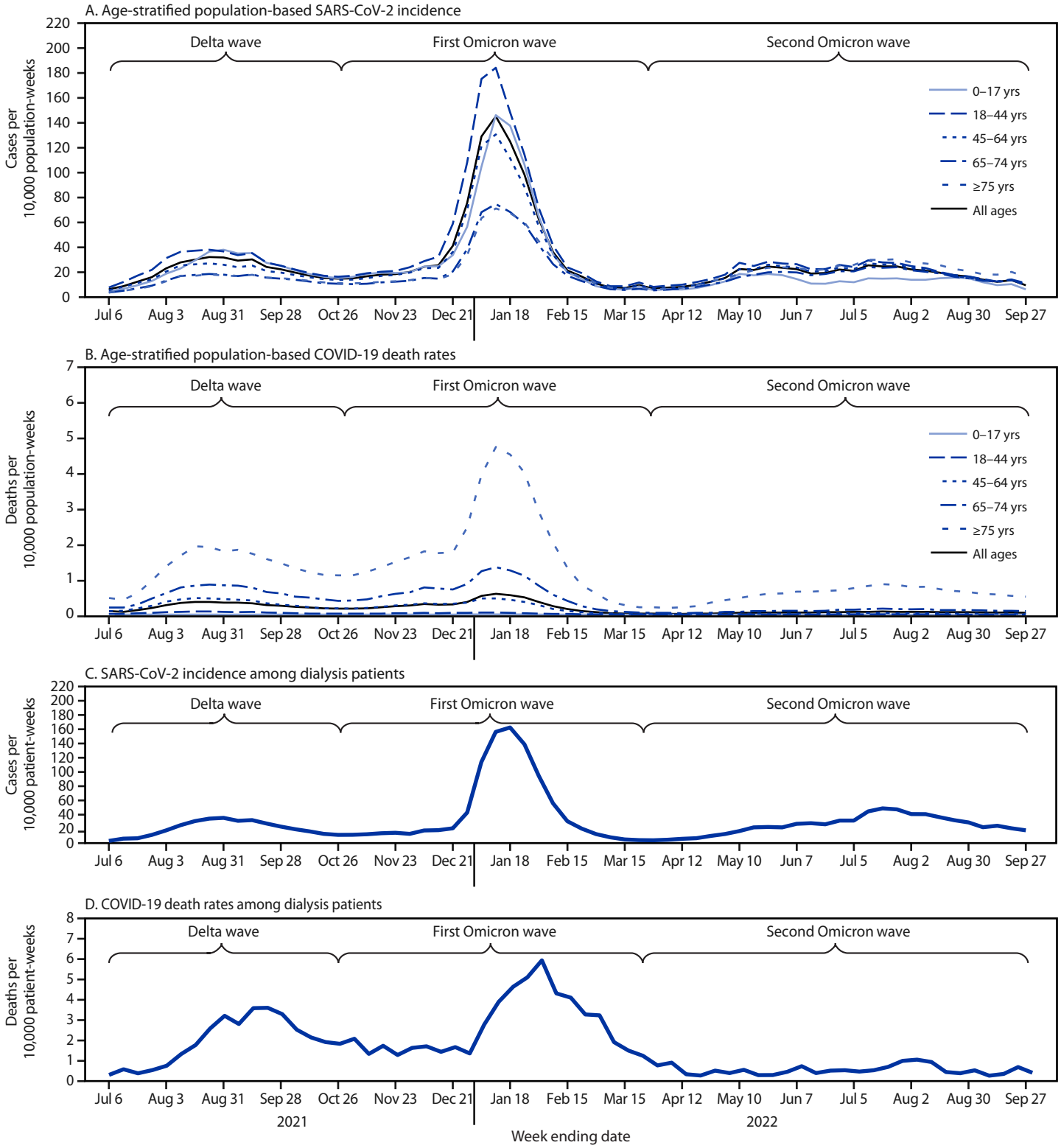
protective equipment, and implementation of protocols to safely discontinue transmission-based precautions for affected patients (*8*,*9*). Using engineering controls, including barriers between patients and improved ventilation and indoor air quality, might further reduce exposure to COVID-19 and other respiratory viruses.[¶¶]

[¶¶] https://www.ashrae.org/technical-resources/bookstore/health-care-facilities-resources

Limitations

The findings in this report are subject to at least five limitations. First, this report included data submitted by outpatient facilities to NHSN. Although the dataset included over 90% of the estimated total maintenance dialysis patients in the United States (*1*), patients receiving inpatient dialysis, home hemodialysis, and peritoneal dialysis might be underrepresented in this

FIGURE 2. Age-stratified population-based SARS-CoV-2 incidence (A) and COVID-19–related death rates (B) among the overall U.S. population* and SARS-CoV-2 incidence (C) and COVID-19–related deaths (D)† among maintenance dialysis patients§ — United States, June 30, 2021–September 27, 2022



* COVID-19 case surveillance public use data. https://data.cdc.gov/Case-Surveillance/COVID-19-Case-Surveillance-Public-Use-Data/vbim-akqf
† COVID-19–related deaths were defined as those among patients who died before fully recovering from SARS-CoV-2 infection.
§ Data source: National Healthcare Safety Network.

Summary

What is already known about this topic?

Patients receiving maintenance dialysis are at increased risk for complications related to SARS-CoV-2 infection, including death.

What is added by this report?

During June 30, 2021–September 27, 2022, rates of SARS-CoV-2 infection and COVID-19–related death were higher among maintenance dialysis patients compared with rates in the U.S. population. These higher infection rates were attenuated by vaccination.

What are the implications for public health practice?

Patients receiving maintenance dialysis benefit from staying up to date with recommended COVID-19 vaccination. Continued efforts to mitigate transmission of respiratory viruses in dialysis facilities are warranted.

analysis. Second, facilities self-report data to NHSN, which might limit the validity of the information submitted. Third, the NHSN definition of a COVID-19–related death was not limited to a death in which COVID-19 was listed as a cause of death on the death certificate or one that occurred during a specific time frame after COVID-19 infection. Therefore, it is possible that some deaths were misclassified as COVID-19–related deaths, resulting in an inflated COVID-19–related death rate. Fourth, NHSN received aggregate facility-level data. Therefore, death rates could not be calculated by vaccination status, nor could patient-level covariates, including time since vaccination, previous COVID-19 infection, age, ethnicity, or comorbidities that play a role in the high death rate of patients receiving dialysis be considered. Finally, this analysis did not account for differences in COVID-19 testing and reporting between dialysis patients and the U.S. population. It is possible that a higher rate of COVID-19 testing among dialysis patients (*9*) might have affected the results.

Implications for Public Health Practice

These findings underscore the need for dialysis patients and staff members to stay up to date with primary COVID-19 vaccine and booster dose recommendations*** and for dialysis facilities to implement effective infection control strategies††† (*10*). To protect patients from SARS-CoV-2 and other respiratory viruses, facilities should continue to adhere to recommended infection prevention practices and work to improve facility design and layout.

*** https://www.cdc.gov/coronavirus/2019-ncov/vaccines/stay-up-to-date.html
††† https://www.cdc.gov/coronavirus/2019-ncov/hcp/infection-control-recommendations.html?CDC_AA_refVal

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All authors have completed and submitted the International Committee of Medical Journal Editors form for disclosure of potential conflicts of interest. No potential conflicts of interest were disclosed.

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Errata

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In the Recommendation and Report, "Screening and Testing for Hepatitis B Virus Infection: CDC Recommendations — United States, 2023," on page 20, in line 4 under Contributors, the affiliation for Elisa Choi should have read, "Harvard **Medical School** and American College of Physicians."

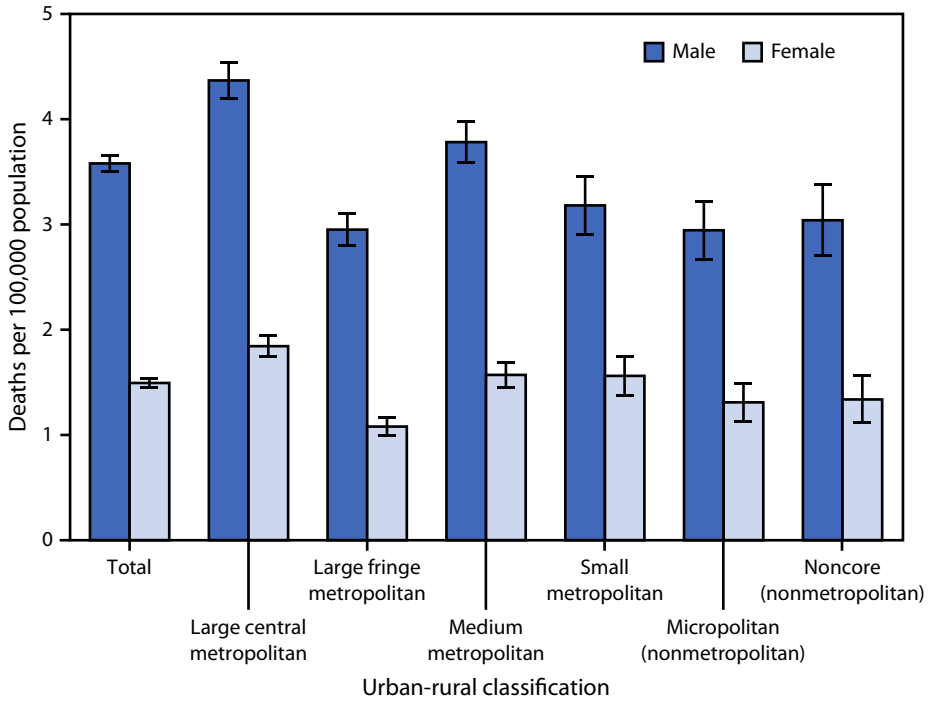
Vol. 72, No. SS-7

In the Surveillance Summary, "Travel-Related Diagnoses Among U.S. Nonmigrant Travelers or Migrants Presenting to U.S. GeoSentinel Sites — GeoSentinel Network, 2012–2021," on page 1, in the listing of author affiliations, number 12 should have read, "[12]**The New York Center for Travel and Tropical Medicine, Weill Cornell Medical College, New York, New York**."

QuickStats

FROM THE NATIONAL CENTER FOR HEALTH STATISTICS

Death Rates* for Pedestrians Involved in Collision with Motor Vehicles,† by Sex and Urbanization Level§ — National Vital Statistics System, United States, 2021



* Deaths per 100,000 U.S. population with 95% CIs indicated by error bars.
† Deaths from pedestrians involved in collision with motor vehicles including traffic and nontraffic accident as the underlying cause of death were identified using the *International Classification of Diseases, Tenth Revision* codes V02–V04 and V09[.0,.2]. A total of 5,887 deaths for males and 2,505 for females from pedestrians involved in collision with motor vehicles occurred during 2021.
§ Counties were classified using the 2013 National Center for Health Statistics Urban-Rural Classification Scheme for Counties. https://www.cdc.gov/nchs/data/series/sr_02/sr02_166.pdf

In 2021, death rates for pedestrians involved in collision with motor vehicles were 3.6 per 100,000 population for males and 1.5 for females. Rates were higher for males than for females at each urbanization level. Rates were the highest for males (4.4) and females (1.8) in large central metropolitan areas.

Source: National Vital Statistics System, Underlying Cause of Death, 2018–2021, https://wonder.cdc.gov/ucd-icd10-expanded.html

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