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Association of Children's Mode of School Instruction with Child and Parent Experiences and Well-Being During the COVID-19 Pandemic — COVID Experiences Survey, United States, October 8–November 13, 2020

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In March 2020, efforts to slow transmission of SARS-CoV-2, the virus that causes COVID-19, resulted in widespread closures of school buildings, shifts to virtual educational models, modifications to school-based services, and disruptions in the educational experiences of school-aged children. Changes in modes of instruction have presented psychosocial stressors to children and parents that can increase risks to mental health and well-being and might exacerbate educational and health disparities (*1*,*2*). CDC examined differences in child and parent experiences and indicators of well-being according to children's mode of school instruction (i.e., in-person only [in-person], virtual-only [virtual], or combined virtual and in-person [combined]) using data from the COVID Experiences nationwide survey. During October 8–November 13, 2020, parents or legal guardians (parents) of children aged 5–12 years were surveyed using the NORC at the University of Chicago AmeriSpeak panel,* a probability-based panel designed to be representative of the U.S. household population. Among 1,290 respondents with a child enrolled in public or private school, 45.7% reported that their child received virtual instruction, 30.9% in-person instruction, and 23.4% combined instruction. For 11 of 17 stress and well-being indicators concerning child mental health and physical activity and parental emotional distress, findings were worse for parents of children receiving virtual or combined instruction than were those for parents of children receiving in-person instruction. Children not receiving in-person instruction and their parents might experience increased risk for negative mental, emotional, or physical health outcomes and might need additional support to mitigate pandemic effects. Community-wide actions to reduce COVID-19 incidence and support mitigation strategies in schools are critically important to support students' return to in-person learning.

*The AmeriSpeak panel includes approximately 40,000 households recruited using random sampling from an address-based sample with mail, e-mail, Internet, telephone, and in-person follow-up. https://amerispeak.norc.org/Documents/Research/AmeriSpeak%20Technical%20Overview%202019%2002%2018.pdf

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The COVID Experiences nationwide survey was administered online or via telephone during October 8–November 13, 2020 to parents of children aged 5–12 years (1,561) using NORC's AmeriSpeak panel (*3*).† A sample of adults in the AmeriSpeak panel identified as potential respondents was selected using sampling strata based on age, race/ethnicity, education, and sex of the adult. Parents with multiple children were asked to report on their child aged 5–12 years with the most recent birthday. Analyses were limited to parents of children attending a public or private school during the 2020–21 school year.§ On the basis of parent responses about the mode of school instruction,¶ three unweighted categories were constructed: in-person (434), virtual (530), and combined (326). Parents who did not select one of the prespecified modes of instruction categories or did not report their child attended a public or private school (271) were excluded from analyses. The final sample included 1,290 parents of children, 1,169 (92.9%) of whom were enrolled in public school and 121 (7.1%) enrolled in private school. Parents reported on children's experiences and well-being, including changes since the pandemic began in physical activity and time spent outside; physical, mental, and emotional health status before and during the pandemic; and measures of current anxiety and depression.** In addition, parents reported on their own well-being and experiences, including job stability, child care challenges, and emotional distress. Unweighted frequencies or weighted prevalence estimates and 95% confidence intervals of demographic characteristics, experiences, and well-being indicators by school instruction mode were calculated. Chi-square tests identified differences by demographic characteristics. Controlling for child's age and parent's race/ethnicity, sex, and

† Among persons sampled, 32.9% completed a screener to determine eligibility; among those eligible, the survey completion rate was 97.4%. AmeriSpeak panel members receive modest incentives in the form of "AmeriPoints" for participation in surveys.

§ Question asked was "Is [the child] enrolled in any of the following for the 2020/21 school year?" Possible responses were "public school," "private school," "homeschool," or "is not enrolled in any school." Only respondents selecting public or private school were included.

¶ Among those who responded that their child attended a public or private school in the 2020–21 school year, mode of instruction categories were based on response to the question "During the current school year (2020/21), how has [the child] attended school? Select all that apply." Possible responses were "in-person full time," "virtual/online full-time," "in-person part-time and virtual part-time (meaning in school several days a week or several weeks each month, and virtual learning the other days/weeks)," or "other, please specify." Three mutually exclusive categories were based on the selection of 1) only in-person full time; 2) only virtual/online full-time; or 3) combination of in-person full time, virtual/online full-time, or in-person part-time and virtual part-time.

** Patient Reported Outcomes Measurement Information System (http://www.healthmeasures.net/) parent proxy report scales short forms, depressive symptoms, anxiety symptoms, and psychological stress. Raw scores are converted to T-scores, with a mean of 50 and standard deviation (SD) of 10 referenced to a healthy cohort. High scores indicate more of the concept measured. The reported elevated symptoms of depression (moderately severe/severe), anxiety (moderately severe/severe), and psychological stress (moderately high/very high) include those with T-scores ≥65, 1.5 SDs higher than the mean of the reference population. Automated scoring was provided through Northwestern University, HealthMeasures. https://www.assessmentcenter.net/ac_scoringservice

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household income, the study calculated adjusted prevalence ratios using predicted margins in logistic regression, comparing experiences and well-being indicators by mode of instruction. P-values <0.05 were considered statistically significant. The complex sample design was accounted for using SAS-callable SUDAAN (version 11.0; RTI International). This activity was reviewed by CDC and was conducted consistent with applicable federal law and CDC policy; the study was also reviewed and approved by the Institutional Review Board of NORC at the University of Chicago.[††]

Approximately one half of parents (45.7%) reported that their child received virtual instruction, 30.9% reported in-person instruction, and 23.4% reported combined instruction (Table 1). Parents of children enrolled in public school more commonly reported that their children received virtual instruction (47.6%) compared with parents of children enrolled in private school (20.3%). Virtual instruction was also more commonly reported by Hispanic parents (65.9%), non-Hispanic other/multiracial parents (64.0%), and non-Hispanic Black parents (54.9%) than by non-Hispanic White parents (31.9%).

Parents of children receiving virtual instruction were more likely than were parents of children receiving in-person instruction to report that their children experienced decreased physical activity (62.9% versus 30.3%), time spent outside (58.0% versus 27.4%), in-person time with friends (86.2% versus 69.5%), virtual time with friends (24.3% versus 12.6%), and worsened mental or emotional health (24.9% versus 15.9%) (Table 2). Parents of children receiving combined instruction were also more likely than were those of children receiving in-person instruction to report that their children experienced decreased physical activity (52.1% versus 30.3%), time spent outside (42.4% versus 27.4%), in-person time with friends (84.1% versus 69.5%), and worsened mental or emotional health (24.7% versus 15.9%). Parents of children receiving virtual instruction were more likely than were parents of children receiving combined instruction to report that their children experienced decreased physical activity (62.9% versus 52.1%) and time spent outside (58.0% versus 42.4%).

Parents of children receiving virtual instruction were also more likely than were parents of children receiving in-person instruction to report loss of work[§§] (42.7% versus 30.6%), job stability concerns (26.6% versus 15.2%), child care challenges (13.5% versus 6.8%), conflict between working and providing child care (14.6% versus 8.3%), emotional distress (54.0% versus 38.4%), and difficulty sleeping (21.6% versus 12.9%) (Table 3). Parents of children receiving combined instruction were more likely than were those of children receiving in-person instruction to report loss of work (40.1% versus 30.6%) and conflict between working and providing child care (14.2% versus 8.3%). Parents of children receiving virtual instruction were more likely than were parents of children receiving combined instruction to report experiencing emotional distress (54.0% versus 42.9%).

Discussion

Findings from this survey of parents of children aged 5–12 years indicate that parents whose children received virtual or combined instruction were more likely to report higher prevalence of risk on 11 of 17 indicators of child and parental well-being than were parents whose children received in-person instruction. Among nine examined indicators of children's well-being, five differed significantly by the instruction mode that children received. These differences reflected higher prevalences of negative indicators of well-being for children receiving virtual or combined instruction than for children receiving in-person instruction. Parents of children receiving virtual or combined instruction more frequently reported that their child's mental or emotional health worsened during the pandemic and that their time spent outside, in-person with friends, and engaged in physical activity decreased. Regular physical activity is associated with children's improved cardiorespiratory fitness, increased muscle and bone strength, and reduced risk for depression, anxiety, and chronic health conditions (e.g., diabetes); therefore, these differences in physical activity are concerning (*4*,*5*). Likewise, isolation and limited physical and outside activity can adversely affect children's mental health (*6*).

Among the eight examined indicators of parental well-being, six differed significantly by mode of instruction received by the children. Parents of children receiving virtual instruction more frequently reported their own emotional distress, difficulty sleeping, loss of work, concern about job stability, child care challenges, and conflict between working and providing child care than did parents whose children were receiving in-person instruction. Parents of children receiving combined instruction also reported conflict between working and providing child care and loss of work more often than did parents of children receiving in-person instruction. Chronic stress can negatively affect physical and mental health of both children and parents, especially without social and economic supports, and could contribute to widening of educational and health disparities (*2*,*3*,*7*,*8*). In this study, Black, Hispanic, and non-Hispanic other or multiracial parents were more likely than White parents to report children receiving virtual instruction. Further

[††] 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. 45 C.F.R. part 46; 21 C.F.R. part 56.

[§§] Question assessed whether the parent experienced or was experiencing any of the following as a result of the COVID-19 pandemic: loss of work, decreased hours or wages, furloughed, or laid off.

TABLE 1. Respondent, child and household characteristics, by mode of child's school instruction* — COVID Experiences Survey,† United States, October 8–November 13, 2020

Characteristic	Mode of child's§ school instruction,¶ no., % (95% CI)								p-value††
	Overall		In-person only		Virtual only		Combined**		
Total	**1,290**	**100.0**	**434**	**30.9 (26.3–35.9)**	**530**	**45.7 (40.0–51.5)**	**326**	**23.4 (19.9–27.4)**	
Child characteristic									
Sex§§									**0.23**
Male	519	51.7 (47.1–56.3)	180	29.5 (23.9–35.7)	201	45.4 (39.2–51.8)	138	25.1 (20.2–30.7)	
Female	455	48.3 (43.7–52.9)	151	30.6 (24.0–38.1)	201	50.3 (41.1–59.4)	103	19.2 (15.1–24.0)	
Age group, yrs									**0.03**
5–8	550	41.5 (38.3–44.9)	206	35.4 (29.3–42.0)	214	45.2 (39.1–51.4)	130	19.4 (15.0–24.7)	
9–12	739	58.5 (55.1–61.7)	228	27.8 (22.7–33.4)	315	45.9 (38.8–53.1)	196	26.4 (21.5–31.9)	
Existing emotional, mental, developmental, or behavioral condition¶¶									**0.56**
Yes	255	18.9 (16.0–22.1)	81	30.6 (23.3–39.1)	112	49.2 (38.8–59.7)	62	20.2 (14.8–27.0)	
No	1,032	81.1 (77.9–84.0)	352	31.0 (26.2–36.3)	417	45.0 (39.5–50.6)	263	24.0 (20.2–28.4)	
Child's school type									**<0.01**
Public	1,169	92.9 (91.3–94.3)	352	28.3 (23.6–33.4)	507	47.6 (41.6–53.7)	310	24.1 (20.5–28.2)	
Private	121	7.1 (5.7–8.7)	82	65.6 (54.5–75.2)	23	20.3 (13.0–30.2)	16	14.2 (9.0–21.5)	
Child receives free or reduced cost lunch***									**0.85**
Yes	746	59.7 (56.7–62.7)	245	30.7 (26.3–35.4)	310	46.5 (40.1–53.0)	191	22.8 (18.3–28.0)	
No	541	40.3 (37.3–43.3)	189	31.4 (25.3–38.3)	218	44.6 (37.6–51.7)	134	24.0 (19.9–28.7)	
Parent and household characteristic									
Sex									**0.81**
Male	427	44.5 (40.8–48.3)	155	32.2 (26.2–38.9)	166	44.5 (37.3–52.0)	106	23.3 (17.6–30.1)	
Female	863	55.5 (51.7–59.2)	279	29.8 (24.4–35.9)	364	46.6 (40.1–53.2)	220	23.6 (20.4–27.0)	
Race/Ethnicity									**<0.01**
White, non-Hispanic	870	55.8 (51.3–60.3)	352	39.5 (33.6–45.7)	271	31.9 (26.4–38.0)	247	28.6 (23.7–34.0)	
Black, non-Hispanic	132	9.4 (7.3–12.1)	31	30.7 (19.8–44.1)	80	54.9 (44.9–64.5)	21	14.5 (7.3–26.6)	
Hispanic	163	23.8 (19.2–29.0)	28	17.5 (9.6–29.5)	106	65.9 (55.2–75.2)	29	16.6 (10.5–25.3)	
Other, non-Hispanic†††	125	11.0 (8.9–13.5)	23	16.4 (9.9–25.9)	73	64.0 (48.3–77.2)	29	19.6 (11.0–32.5)	
Marital status									**0.39**
Married or living with partner	1,050	82.5 (79.7–85.0)	366	30.9 (26.1–36.3)	429	46.6 (40.3–53.0)	255	22.5 (18.7–26.8)	
Never married, divorced, widowed, or separated	240	17.5 (15.0–20.3)	68	30.6 (24.2–37.8)	101	41.5 (33.7–49.7)	71	27.9 (21.1–35.9)	
Parental education									**0.29**
Less than high school or high school graduate	203	31.2 (27.0–35.8)	71	33.6 (25.8–42.4)	82	45.9 (35.5–56.6)	50	20.5 (14.4–28.5)	
Some college or technical school or associate degree	493	26.3 (23.6–29.2)	166	31.8 (25.2–39.2)	201	43.1 (36.9–49.4)	126	25.2 (19.9–31.3)	
Bachelor's degree or higher	594	42.5 (38.7–46.3)	197	28.3 (23.3–33.9)	247	47.2 (41.1–53.3)	150	24.5 (20.7–28.8)	
Annual household income									**0.56**
≤$34,999	279	26.3 (22.9–30.0)	82	33.0 (25.2–41.9)	123	48.5 (38.4–58.6)	74	18.5 (13.4–25.1)	
$35,000–$49,999	157	13.6 (11.2–16.3)	51	27.2 (18.1–38.7)	64	50.1 (37.3–62.9)	42	22.7 (14.4–33.8)	
$50,000–$74,999	266	17.4 (15.2–19.9)	89	32.8 (26.5–39.8)	110	42.2 (32.9–52.0)	67	25.0 (18.4–33.1)	
$75,000–$99,999	228	14.6 (12.4–17.1)	87	31.4 (24.5–39.3)	90	42.5 (34.9–50.5)	51	26.1 (18.0–36.2)	
≥$100,000	360	28.2 (24.7–31.8)	125	29.2 (22.7–36.7)	143	44.8 (37.0–52.8)	92	26.0 (20.9–31.9)	

Abbreviation: CI = confidence interval.

* Table shows unweighted frequencies, weighted overall and row percentages, and weighted 95% CIs.

† https://amerispeak.norc.org/Documents/Research/AmeriSpeak%20Technical%20Overview%202019%2002%2018.pdf

§ Sampled parents with multiple children were asked to report on their child aged 5–12 years with the most recent birthday.

¶ Among those who responded that their child attended a public or private school in the 2020–21 school year, mode of instruction categories are based on response to the question "During the current school year (2020/21), how has [the child] attended school? Select all that apply." Possible responses were "in-person full time," "virtual/online full-time," "in-person part-time and virtual part-time (meaning in school several days a week or several weeks each month, and virtual learning the other days/weeks)," or "other, please specify." Three mutually exclusive categories were based on the selection of: 1) only in-person full time; 2) only virtual/online full-time; or 3) combination of in-person full time, virtual/online full-time, or in-person part-time and virtual part-time.

** Indicates a combination of in-person and virtual instruction.

†† Chi-square test was used to identify overall differences in child and parent demographics and household characteristics by mode of school instruction.

§§ First name-based imputation was used to impute sex for 148 children who were missing information on sex. After imputation, child's sex remained missing for 316 records (24.5%).

¶¶ Any emotional, mental, developmental, or behavioral condition for which the child needed or received treatment, therapy, or counseling. Examples include anxiety, depression, attention deficit disorder or attention deficit hyperactivity disorder, autism spectrum disorder, or intellectual disability.

*** Question assessed whether child ever received free or reduced-cost school meals (i.e., breakfast, lunch, or both).

††† Includes other non-Hispanic races and non-Hispanic multiracial persons.

TABLE 2. Weighted prevalence (%) and adjusted prevalence ratios (aPRs) of parent report of child experiences and well-being indicators, by mode of child's school instruction* — COVID Experiences Survey,† United States, October 8–November 13, 2020

Characteristic	Mode of child's§ school instruction,¶ % (95% CI)				Adjusted comparisons for child experiences and well-being by mode of child's school instruction, aPR** (95% CI)		
	Overall (N = 1,290)	In-person only (n = 434)	Virtual only (n = 530)	Combined†† (n = 326)	Virtual only versus in-person only	Combined versus in-person only	Virtual only versus combined
Child experience							
Change in physical activity§§							
Decreased	50.3 (46.5–54.0)	30.3 (25.1–36.1)	62.9 (58.1–67.4)	52.1 (45.8–58.3)	1.9 (1.6–2.3)¶¶	1.6 (1.3–1.9)¶¶	1.2 (1.0–1.4)¶¶
No impact or increased	49.7 (46.0–53.5)	69.7 (63.9–74.9)	37.1 (32.6–41.9)	47.9 (41.7–54.2)	—	—	—
Change in spending time outside§§							
Decreased	44.9 (40.9–48.9)	27.4 (21.9–33.8)	58.0 (52.2–63.5)	42.4 (36.1–49.0)	1.8 (1.4–2.2)¶¶	1.4 (1.1–1.8)¶¶	1.3 (1.1–1.6)¶¶
No impact or increased	55.1 (51.1–59.1)	72.6 (66.2–78.1)	42.0 (36.5–47.8)	57.6 (51.0–63.9)	—	—	—
Change in spending time with friends in-person§§							
Decreased	80.5 (76.9–83.7)	69.5 (62.7–75.5)	86.2 (81.4–89.9)	84.1 (76.3–89.6)	1.2 (1.1–1.3)¶¶	1.2 (1.1–1.3)¶¶	1.1 (0.9–1.2)
No impact or increased	19.5 (16.3–23.1)	30.5 (24.5–37.3)	13.8 (10.1–18.6)	15.9 (10.4–23.7)	—	—	—
Change in spending time with friends virtually for non-educational purposes§§							
Decreased	18.6 (15.6–22.0)	12.6 (8.6–18.2)	24.3 (19.1–30.4)	15.3 (10.6–21.5)	1.7 (1.1–2.7)¶¶	1.2 (0.8–2.0)	1.4 (0.9–2.1)
No impact or increased	81.4 (78.0–84.4)	87.4 (81.8–91.4)	75.7 (69.6–80.9)	84.7 (78.5–89.4)	—	—	—
Child well-being							
Change in physical health***							
Worse	12.6 (10.2–15.6)	9.3 (6.2–13.6)	14.7 (10.3–20.5)	13.0 (9.4–17.8)	1.4 (0.8–2.3)	1.3 (0.8–2.2)	1.1 (0.7–1.7)
Better or no change	87.4 (84.4–89.8)	90.7 (86.4–93.8)	85.3 (79.5–89.7)	87.0 (82.2–90.6)	—	—	—
Change in mental or emotional health†††							
Worse	22.1 (19.8–24.7)	15.9 (12.5–20.1)	24.9 (21.4–28.8)	24.7 (20.4–29.5)	1.6 (1.2–2.2)¶¶	1.5 (1.1–2.0)¶¶	1.1 (0.9–1.4)
Better or no change	77.9 (75.3–80.2)	84.1 (79.9–87.5)	75.1 (71.2–78.6)	75.3 (70.5–79.6)	—	—	—
Depression§§§							
With elevated symptoms	4.4 (2.8–6.9)	3.6 (1.9–6.9)	5.3 (2.7–10.3)	3.7 (1.8–7.3)	1.4 (0.6–3.1)	1.0 (0.4–2.5)	1.4 (0.6–3.3)
Without elevated symptoms	95.6 (93.1–97.2)	96.4 (93.1–98.1)	94.7 (89.7–97.3)	96.3 (92.7–98.2)	—	—	—
Anxiety§§§							
With elevated symptoms	6.3 (5.0–7.8)	6.7 (4.4–10.1)	7.0 (5.1–9.5)	4.4 (2.5–7.6)	1.1 (0.6–2.0)	0.7 (0.3–1.4)	1.6 (0.8–3.2)
Without elevated symptoms	93.7 (92.2–95.0)	93.3 (89.9–95.6)	93.0 (90.5–94.9)	95.6 (92.4–97.5)	—	—	—
Psychological stress§§§							
With elevated symptoms	9.2 (7.3–11.5)	9.5 (6.7–13.4)	9.2 (6.2–13.3)	8.7 (6.2–12.0)	1.0 (0.6–1.7)	0.9 (0.6–1.4)	1.2 (0.7–1.9)
Without elevated symptoms	90.8 (88.5–92.7)	90.5 (86.6–93.3)	90.8 (86.7–93.8)	91.3 (88.0–93.8)	—	—	—

Abbreviation: CI = confidence interval.

* Table shows weighted overall and column percentages and corresponding 95% CIs, and adjusted prevalence ratios and 95% CIs.

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** aPR adjusted for parent's race/ethnicity and sex, household income, and child's age. aPR was not adjusted for all child characteristics (sex; existing emotional, mental, developmental, or behavioral condition; school type; receipt of free or reduced-cost lunch) and parent characteristics (marital status or education).

†† Indicates a combination of in-person and virtual instruction.

§§ Question assessed how the COVID-19 pandemic has affected each behavior or experience.

¶¶ p-values <0.05 were considered statistically significant. Some 95% CIs include 1.0 because of rounding.

*** Question items asked parents to rate child's physical health (very good, good, fair, or poor) before the COVID-19 pandemic (February 2020) and current physical health. Any decline in physical health was categorized as "worse" and any improvement or no change in physical health was categorized as "better or no change."

††† Question items asked parents to rate the child's mental and emotional health (very good, good, fair, or poor) before the COVID-19 pandemic (February 2020) and current mental or emotional health. Any decline in mental or emotional health was categorized as "worse" and any improvement or no change in mental or emotional health was categorized as "better or no change."

§§§ Patient Reported Outcomes Measurement Information System (http://www.healthmeasures.net/) parent proxy report scales short forms, depressive symptoms, anxiety symptoms, and psychological stress. Raw scores are converted to T-scores, with a mean of 50 and standard deviation (SD) of 10 referenced to a healthy cohort. High scores indicate more of the concept measured. Elevated symptoms of depression (moderately severe/severe), anxiety (moderately severe/severe), and psychological stress (moderately high/very high) include those with T-scores ≥65, 1.5 SDs higher than the mean of the reference population. Automated scoring was provided through Northwestern University, HealthMeasures. https://www.assessmentcenter.net/ac_scoringservice

TABLE 3. Weighted prevalence (%) and adjusted prevalence ratios (aPRs) of parent experiences and well-being indicators, by mode of child's school instruction* — COVID Experiences Survey,† United States, October 8–November 13, 2020

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	Overall (N = 1,290)	In-person only (n = 434)	Virtual only (n = 530)	Combined** (n = 326)	Virtual only versus in-person only	Combined** versus in-person only	Virtual only versus combined**
Parent experience							
Loss of work††							
Yes	38.3 (34.5–42.3)	30.6 (25.4–36.3)	42.7 (36.5–49.1)	40.1 (31.9–48.8)	1.4 (1.1–1.8)§§	1.4 (1.0–1.8)§§	1.0 (0.8–1.3)
No	61.7 (57.7–65.5)	69.4 (63.7–74.6)	57.3 (50.9–63.5)	59.9 (51.2–68.1)	—	—	—
Concern about job stability¶¶							
Often	21.5 (18.2–25.1)	15.2 (12.0–19.2)	26.6 (21.5–32.4)	19.6 (14.1–26.5)	1.6 (1.3–2.1)§§	1.3 (0.9–1.9)	1.2 (0.8–1.8)
Sometimes or never	78.5 (74.9–81.8)	84.8 (80.8–88.0)	73.4 (67.6–78.5)	80.4 (73.5–85.9)	—	—	—
Child care challenges¶¶							
Often	10.5 (8.6–12.7)	6.8 (4.5–10.3)	13.5 (10.3–17.4)	9.5 (6.5–13.7)	1.7 (1.1–2.7)§§	1.4 (0.9–2.2)	1.2 (0.7–2.0)
Sometimes or never	89.5 (87.3–91.4)	93.2 (89.7–95.5)	86.5 (82.6–89.7)	90.5 (86.3–93.5)	—	—	—
Conflict between working and providing child care¶¶							
Often	12.6 (10.5–14.9)	8.3 (5.9–11.5)	14.6 (11.7–18.1)	14.2 (10.0–19.7)	1.5 (1.0–2.3)§§	1.7 (1.1–2.5)§§	0.9 (0.6–1.5)
Sometimes or never	87.4 (85.1–89.5)	91.7 (88.5–94.1)	85.4 (81.9–88.3)	85.8 (80.3–90.0)	—	—	—
Increased substance use***							
Yes	16.5 (13.8–19.6)	13.7 (10.5–17.8)	16.4 (12.0–21.9)	20.5 (15.1–27.1)	1.2 (0.8–1.7)	1.5 (1.0–2.3)	0.8 (0.5–1.1)
No	83.5 (80.4–86.2)	86.3 (82.2–89.5)	83.6 (78.1–88.0)	79.5 (72.9–84.9)	—	—	—
Parent well-being							
Emotional Distress†††							
A lot or moderate	46.6 (43.3–49.9)	38.4 (32.7–44.5)	54.0 (48.8–59.1)	42.9 (35.9–50.1)	1.4 (1.2–1.6)§§	1.1 (0.9–1.4)	1.2 (1.1–1.5)§§
Little or no	53.4 (50.1–56.7)	61.6 (55.5–67.3)	46.0 (40.9–51.2)	57.1 (49.9–64.1)	—	—	—
Difficulty managing emotions¶¶							
Often	13.5 (11.1–16.3)	11.0 (7.8–15.2)	14.3 (11.0–18.5)	15.2 (10.5–21.5)	1.1 (0.7–1.7)	1.4 (0.9–2.0)	0.8 (0.5–1.2)
Sometimes or never	86.5 (83.7–88.9)	89.0 (84.8–92.2)	85.7 (81.5–89.0)	84.8 (78.5–89.5)	—	—	—
Difficulty sleeping or insomnia¶¶							
Often	17.7 (15.3–20.5)	12.9 (9.8–16.8)	21.6 (17.8–26.1)	16.4 (11.8–22.5)	1.6 (1.2–2.2)§§	1.2 (0.9–1.7)	1.3 (0.9–1.8)
Sometimes or never	82.3 (79.5–84.7)	87.1 (83.2–90.2)	78.4 (73.9–82.2)	83.6 (77.5–88.2)	—	—	—

Abbreviation: CI = confidence interval.

* Table shows weighted overall and column percentages and corresponding 95% CIs, and adjusted prevalence ratios and 95% confidence intervals.

† https://amerispeak.norc.org/Documents/Research/AmeriSpeak%20Technical%20Overview%202019%2002%2018.pdf

§ Among those who responded that their child attended a public or private school in the 2020–21 school year, mode of instruction categories are based on response to the question "During the current school year (2020/21), how has [the child] attended school? Select all that apply." Possible responses were "in-person full time," "virtual/online full-time," "in-person part-time and virtual part-time (meaning in school several days a week and virtual learning the other days/weeks)," or "other, please specify." Three mutually exclusive categories were based on the selection of: 1) only in-person full time; 2) only virtual/online full-time; or 3) combination of in-person full time, virtual/online full-time, or in-person part-time and virtual part-time.

¶ aPR adjusted for parent's race/ethnicity and sex, household income, and child's age. aPR was not adjusted for all child characteristics (sex; existing emotional, mental, developmental, or behavioral condition; school type; receipt of free or reduced-cost lunch) and parent characteristics (marital status or education).

** Indicates a combination of in-person and virtual instruction.

†† Question assessed whether the respondent experienced or was experiencing any of the following as a result of the pandemic: loss of work, decreased hours or wages, furloughed, or laid off.

§§ p-values <0.05 were considered statistically significant. Some 95% CIs include 1.0 because of rounding.

¶¶ Question assessed how frequently the respondent experienced the following since the COVID-19 pandemic began: concern about job stability, child care challenges, conflict between working and providing child care, difficulty managing emotions, difficulty sleeping or insomnia.

*** Question assessed whether the respondent started or increased using substances to help cope with stress or emotions during the COVID-19 pandemic. Substance use includes alcohol, legal or illegal drugs, or prescription drugs that are taken in a way not recommended by a doctor.

††† Question assessed how much emotional distress such as increased sadness, anxiety, and worry the respondent experienced related to the COVID-19 pandemic.

research is needed to understand whether virtual instruction has disproportionately negative impacts on child and parent health outcomes among racial and ethnic minorities and communities disproportionately affected by COVID-19. The role of other contextual and interpersonal factors on experiences of stress and risks to well-being in relation to the pandemic needs further exploration.

Schools are central to supporting children and families, providing not only education, but also opportunities to engage in activities to support healthy development and access to social, mental health, and physical health services, which can buffer stress and mitigate negative outcomes. However, the pandemic is disrupting many school-based services, increasing parental responsibilities and stress, and potentially affecting long-term health outcomes for parents and children alike, especially among families at risk for negative health outcomes from social and environmental factors (*2*,*7*,*9*,*10*). These findings suggest that virtual instruction might present more risks than

Summary

What is already known about the topic?

COVID-19–associated schooling changes present stressors to children and parents that might increase risks to mental health and well-being.

What is added by this report?

In a probability-based survey of parents of children aged 5–12 years, 45.7% reported that their children received virtual instruction only, 30.9% in-person only, and 23.4% combined virtual and in-person instruction. Findings suggest that virtual instruction might present more risks than does in-person instruction related to child and parental mental and emotional health and some health-supporting behaviors.

What are the implications for public health practice?

Children not receiving full-time, in-person instruction and their parents might need additional supports to mitigate pandemic impacts.

does in-person instruction related to child and parental mental and emotional health and some health-supporting behaviors, such as engaging in physical activity, with combined instruction falling between.

The findings in this report are subject to at least six limitations. First, responses from this incentivized, English-language survey might not represent the broader U.S. population, and the limited sample size and response rate might affect generalizability. Second, although survey responses were weighted to approximate representativeness of U.S. household demographics, findings might not be representative of all U.S. students and children aged 5–12 years. Third, parent self-reports and proxy reports for children are subject to social desirability, proxy-response, and recall biases. Fourth, parents of children receiving combined instruction did not provide details on how often children received in-person or virtual instruction; additional variation within this category might exist. Fifth, the study did not adjust for all potential confounders such as community COVID-19 transmission levels and some household and individual characteristics (e.g., urbanicity or rurality, or number of children in the household). Finally, causality between instruction mode and examined indicators of well-being cannot be inferred from this cross-sectional study.

Parents of children receiving in-person instruction reported the lowest prevalence of negative indicators of child and parental well-being. Children receiving virtual or combined instruction and their parents might need additional support to mitigate stress, including linkage to social and mental health services and opportunities to engage in safe physical activity to reduce risks associated with chronic health conditions. Culturally applicable support programming and resources might be warranted to meet community needs, ensure equitable access to services, and address health or educational inequities for families from racial and ethnic minority groups. These findings highlight the importance of in-person learning for children's physical and mental well-being and for parents' emotional well-being. Community-wide actions[¶¶] to reduce COVID-19 incidence and support mitigation strategies in schools[***] are critically important to support students' return to in-person learning.

[¶¶] https://www.cdc.gov/coronavirus/2019-ncov/community/community-mitigation.html

[***] https://www.cdc.gov/coronavirus/2019-ncov/community/schools-childcare/operation-strategy.html

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Minimal SARS-CoV-2 Transmission After Implementation of a Comprehensive Mitigation Strategy at a School — New Jersey, August 20–November 27, 2020

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During fall 2020, many U.S. kindergarten through grade 12 (K–12) schools closed campuses and instituted remote learning to limit in-school transmission of SARS-CoV-2, the virus that causes COVID-19 (*1*,*2*). A New Jersey grade 9–12 boarding school with 520 full-time resident students, 255 commuter students, and 405 faculty and staff members implemented a comprehensive mitigation strategy that included universal masking, testing, upgraded air-handling equipment to improve ventilation, physical distancing of ≥6 ft, contact tracing, and quarantine and isolation protocols to prevent and control transmission of SARS-CoV-2 among students, faculty, and staff members. Mandatory twice-weekly screening using real-time reverse transcription–polymerase chain reaction (RT-PCR) testing of all students and staff members during August 20–November 27, 2020, resulted in the testing of 21,449 specimens. A total of 19 (5%) of 405 faculty and staff members and eight (1%) of 775 students received positive test results; only two identified cases were plausibly caused by secondary transmission on campus. Comprehensive mitigation approaches including frequent testing and universal masking can help prevent outbreaks in in-person high school settings even when community transmission is ongoing.

During August 20–November 27, 2020, a private boarding school in New Jersey implemented rigorous, comprehensive strategies to prevent introduction and transmission of SARS-CoV-2, including requiring students to quarantine for 2 weeks before arriving, and, upon arrival, to provide documentation of a negative RT-PCR test result performed within 7–10 days before campus arrival (Box). Upon opening in the fall, the school conducted twice-weekly RT-PCR screening of all students, faculty, and staff members during August 20–November 27. Students' specimens were tested by using Broad Laboratories anterior nasal swab, high-throughput version of the CDC 2019-nCoV RT-PCR Diagnostic Panel, validated in accordance with guidance by the College of American Pathologists (issued on March 19, 2020) and the Food and Drug Administration (issued on February 29, 2020).* Faculty and staff member saliva samples were processed by Accurate Diagnostic Laboratories† (Salivary SARS-COV2 COVID-19 by RT-PCR) and could be collected without supervision. Anterior nasal swabs and saliva specimens were collected, stored, and processed according to the manufacturer's Emergency Use Authorization (EUA) instructions. The interval between specimen collection and availability of results was 24–36 hours for students and 54–78 hours for faculty and staff members (inclusive of transit time). In addition, rapid antigen tests (Quidel Sofia SARS Antigen FIA)§ were administered per EUA instructions to test anyone who reported COVID-19–compatible symptoms.¶ A confirmed case was defined as a positive RT-PCR test result in any person (student, faculty, or staff member). Persons with a positive rapid antigen test result or symptoms consistent with COVID-19 while awaiting RT-PCR confirmation were immediately isolated either on campus in single rooms with an unshared bathroom or off campus under the supervision of a parent or guardian if a student. Students, faculty, and staff members with COVID-19–compatible symptoms and negative rapid antigen test results received confirmatory RT-PCR testing. Staff members who were trained and certified through the New Jersey Department of Health conducted case investigations and contact tracing. Initially, contacts of patients with confirmed COVID-19 were defined as persons with >10 minutes of continuous exposure within 6 ft of a person with COVID-19 during the 48 hours before testing. In November, this definition was changed to include persons with 15 minutes of cumulative exposure during the same timeframe (*3*).

As part of the comprehensive mitigation strategy, all students, faculty, and staff members were asked to comply with a Best for All** agreement that reinforced personal responsibility for community well-being (Box). This agreement included maintaining a distance of 6 ft from others whenever feasible; wearing a mask in all shared community or public spaces; full participation in the testing, symptom tracking, and contact

* https://www.fda.gov/medical-devices/coronavirus-disease-2019-covid-19-emergency-use-authorizations-medical-devices/vitro-diagnostics-euas

† https://www.fda.gov/media/137773/download?utm_campaign=050820_PR_Coronavirus%20%28COVID9%29%20Update%3A%20Daily%20Roundup%20May%208%2C%202020&utm_medium=email&utm_source=Eloqua

§ https://www.quidel.com/immunoassays/rapid-sars-tests/sofia-sars-antigen-fia

¶ https://www.cdc.gov/coronavirus/2019-ncov/symptoms-testing/symptoms.html

** https://lawrenceville.myschoolapp.com/ftpimages/928/download/download_5262472.pdf

BOX. Mitigation approaches used for SARS-CoV-2 prevention and control at a school — New Jersey, August 20–November 27, 2020

Establish prearrival protocol
- Ask students and staff members to engage in a 2-week prearrival quarantine that includes physical distancing, mask-wearing when not at home, avoiding unnecessary travel, and refraining from indoor social gatherings.
- Provide arriving students with a mail-in SARS-CoV-2 testing kit.*
- Require proof of a negative RT-PCR† test result.
- Delay arrival for students with confirmed positive test results.
- Establish on-campus 10-day quarantine for out-of-state and international students until they have three negative test results 3 days apart.

Implement classroom safety measures
- Require universal masking inside classrooms and classroom buildings.
- Maintain physical distancing: seat students at least 6 ft apart in classrooms.
- Limit number of students on campus by having a subset of students participate virtually on a rotating basis (approximately one third of the time).
- Equip classrooms, dining pick-up areas, and bathrooms with HEPA filters, and MERV 13 filters in air handling equipment throughout campus.

Maintain physical distance outside of the classroom
- Require universal masking outside of student dormitory rooms except during distanced dining and during supervised outdoor athletics.
- Limit team practices and suspend competition with other schools.
- Provide single rooms for boarding students and prohibit visitation in dormitory rooms.

Develop testing and screening protocols
- Monitor symptoms daily and check temperature twice daily.
- Have students collect anterior nasal swabs under clinical supervision for RT-PCR testing twice weekly.
- Arrange for faculty and staff members to self-collect saliva specimens for RT-PCR testing twice weekly.
- Administer rapid antigen tests† at any time for anyone with COVID-19–compatible symptoms.§
- Confirm any antigen test results in symptomatic persons with RT-PCR.

Implement innovative contact tracing tools and robust quarantine measures
- Issue proximity tracing devices to be worn at all time on campus, except in dorm room, shower, or pool.
- Enforce CDC-recommended definition of a close contact.
- Use tracing system data to determine induration and proximity to identify close contacts.
- Provide single rooms for resident contacts and parental monitoring of at-home quarantine.

Reinforce compliance with protocols: Best for All agreement¶
- Continue biweekly testing of contacts while in quarantine.
- Conduct educational webinars, conduct question-and-answer sessions with the leadership team on specific areas of the re-opening plan, send formal emails with linked resources, post important documents and updated frequently asked questions on the school's website, and display omnipresent signage for all students, parents, faculty, and staff members.
- For students, conduct virtual school meetings, class and dormitory group sessions, and reminders of best practices through social media presentations (such as Tik-Tok) to reinforce the messages.
- Use a motivational contract for behavioral reinforcement and establish social norms around wearing masks and maintaining distance to protect one another.
- Implement a "strike" system to establish consequences for students who do not comply with mitigation measures and testing protocols.

Abbreviations: HEPA = high-efficiency particulate arrestance; MERV = minimum efficiency reporting value; RT-PCR = reverse transcription–polymerase chain reaction.
* Vault Test Kit, www.vaulthealth.com/covid
† Quidel Sofia rapid antigen test, https://www.quidel.com/immunoassays/rapid-sars-tests/sofia-sars-antigen-fia
§ https://www.cdc.gov/coronavirus/2019-ncov/symptoms-testing/symptoms.html
¶ https://lawrenceville.myschoolapp.com/ftpimages/928/download/download_5262472.pdf

tracing protocols; hygiene protocol compliance; wearing a personal tracer device; and following rules about house and campus life regarding meals and dormitory visitation.

Students, faculty, and staff members were required to maintain 6 ft of distance whenever possible, cafeterias provided take-out service only, meals were eaten outdoors, and nonboarding students were not allowed in the residential dormitories. Classrooms, dining pick-up areas, and bathrooms were equipped with HEPA filters, and minimum efficiency reporting value (MERV) 13 filters were inserted in air handling equipment throughout campus. Athletic activities were conducted outdoors whenever possible, during which coaches remained masked at all times. Student participants were also required to be masked during athletic activities unless masking was not feasible because of the intensity of the aerobic activity. Indoor athletic activities required masking at all times by both coaches and players, except in the case of swimming, and the number of participants was kept to a minimum in the maximal space available for them to compete. No interscholastic competitions were allowed, and student participation in outside club sports was forbidden.

Although interscholastic athletics were cancelled, teams held daily practice sessions. Extracurricular activities also took place using similar approaches to those used in the classrooms (i.e., universal masking and physical distance of ≥6 ft). To support the identification of contacts, the school employed a Bluetooth-enabled personal tracer, "Peace of Mind" (POM),[††] that persons were required to wear at all times on campus except while in the shower or in their rooms or the pool. This device, originally designed to be an emergency alerting system, was repurposed to enhance contact tracing efforts by collecting information on duration and proximity of interpersonal contact, thus providing contact tracers with objective data to aid with recall and help determine whether potential exposures were of sufficient risk to require quarantine (*3*). Persons identified as contacts were quarantined for 14 days and continued to be tested twice a week through the school's screening program. Violations of rules included in the Best for All agreement would generate a "strike"; students who received three "strikes" were sent home and not allowed to attend in-person school for 2 weeks.

During August 20–November 27, RT-PCR tests were performed on 8,955 saliva specimens from 405 faculty and staff members and 12,494 nasal swab specimens from 775 students (Table). Overall, 17 (0.18%) faculty and staff member specimens and eight (0.06%) student specimens tested positive, representing 4% of faculty and staff members and 1% of students. An additional two faculty and staff members were tested outside of the school's protocols and received positive test results off campus (Table). All persons whose screening test results were positive were asymptomatic at the time of testing. Among all persons with positive test results, five of 17 faculty and staff members and two of eight students reported mild symptoms after diagnosis; no one required hospitalization. A median of one faculty case (range = 0–4) and one student case (range = 0–1) was identified each week. Overall, 66 antigen tests were performed for 59 students and seven faculty and staff members with COVID-19–compatible symptoms; all results were negative.

TABLE. SARS-CoV-2 testing results and tracing of cases and contacts at a school — New Jersey, August 20–November 27, 2020

SARS-CoV-2 testing results	Faculty/Staff members (n = 405)	Students (n = 775)
No. of specimens tested (average per person)	8,955 (22.1)	12,494 (15.1)
No. of RT-PCR–positive tests	19*	8
Specimens tested, %	0.21	0.06
Persons receiving testing, %	4.7	1.0
No. (%) of cases linked to on-campus transmission	0 (—)	2 (25)[†]
No. of contacts identified and quarantined	17	14
No. of contacts with positive test results	0	0

Abbreviation: RT-PCR = reverse transcription–polymerase chain reaction.
* Two faculty or staff members with positive test results were linked to off-campus cases and are included for completeness of results.
† No plausible off-campus source could be identified.

Case investigations suggested that the source of infection in 25 of 27 (93%) cases was likely off-campus contacts, including exposure to family members or friends with COVID-19 who lived off campus, external workplace exposures for spouses of faculty and staff members, or community exposures outside the school campus. For two boarding students with a new diagnosis of COVID-19, case investigators were unable to identify a likely off-campus source or find evidence of contact with persons on campus with COVID-19.

Contact tracing, based on reported duration of contact of within 6 ft of a person with COVID-19 aided by data from personal tracing devices, identified 14 school-based contacts of student patients and 17 school-based contacts of faculty and staff member patients. All contacts quarantined for 14 days, and none received a positive test result during quarantine, suggesting that the risk mitigation strategies put into place were effective in preventing transmission from patients to their contacts.

Overall, compliance with the Best for All agreement and student adherence to mitigation protocols were high. All staff members and faculty on campus were authorized to enforce the agreement through the observations of students as part of

[††] https://pomtracer.com

their regular daily duties, which served as reminders to students about the importance of ongoing compliance to reduce the risk for transmission from patients to contacts. Over the course of the semester, 10 (1.3%) of 775 students garnered three "strikes" and were sent home for 2 weeks.

Discussion

A comprehensive mitigation strategy that included compulsory prearrival isolation and screening, twice-weekly SARS-CoV-2 testing, technology-enhanced contact tracing and quarantine, and an enforced behavioral agreement was effective in preventing in-school transmission of SARS-CoV-2 at a campus with substantial daily on- and off-campus interactions. During August–December 2020, many U.S. K–12 schools implemented fully online (12%) or hybrid models (58%) of instruction because of concerns about transmission in schools (*4*). In spring 2020 in Israel, a large SARS-CoV-2 outbreak in a high school was documented (*5*); however, a recent analysis of schools across Europe found relatively low levels of school-related transmission (*6*). Earlier in the U.S. pandemic, outbreaks were detected in camps at which campers did not wear masks and close contact occurred (*7*). Although risk for transmission has appeared lower in elementary schools, data about transmission in K–12 educational settings are lacking because of limited screening (*6*). Schools can minimize SARS-CoV-2 transmission during in-person learning if well-designed risk mitigation protocols are followed, including frequent facility-wide testing and universal masking.

Twice-weekly screening testing of the entire school population identified COVID-19 cases in eight students and 17 faculty and staff members over a 14-week period, which would approximate 74 cases per 100,000 for students and 300 per 100,000 for faculty and staff members during a 7-day period. During the same period, the county in which the school is located had a 7-day total incidence ranging from a low of 17 (late August through early September) to 402 (November 24) cases per 100,000 persons (*8*). Community testing did not include frequent, systematic testing of all persons and, for this reason, rates are not directly comparable. However, despite a substantial increase in the number of weekly cases in the county during this period[§§] and the potential exposure of nonresident students, staff members, and faculty or their families to persons with cases in the community, the school did not experience any epidemiologically linked cases leading to clusters or outbreaks during this period. Whereas cases in the broader community were likely underascertained and the incidence underestimated, the ability of the boarding school to maintain a consistent incidence over time while the surrounding community experienced a substantial increase in cases suggests that the mitigation measures instituted by the school were effective. Similar to other school settings (*1*), the initial sources of infection for most identified cases were likely outside the school. Mandatory twice-weekly screening indicated minimal on-campus transmission, suggesting that routine testing and mitigation protocols focused on distancing and universal masking that are consistently implemented can succeed in reducing the likelihood of on-campus transmission (*8*).

For a campus to remain open, persons with newly identified cases should be rapidly isolated to reduce transmission; a strict regimen of physical distancing and universal masking is a necessary component of the comprehensive approach to preventing transmission of COVID-19. Among 27 persons with confirmed cases, 31 contacts were identified through the combined use of patient interviews and analysis of proximity data from tracing devices, which provided objective information that aided the inclusion and exclusion of contacts. Moreover, wearing POM devices highlighted the importance of complying with physical distancing guidelines for all students, faculty, and staff members. Although all contacts were required to quarantine, none received a positive test result, suggesting that adherence to the physical distancing protocols and mandated mask wearing was high among members of the school community. The contractual Best for All agreement, in which lack of compliance with protocols monitored by faculty and staff members resulted in disciplinary action for a few

Summary

What is already known about this topic?

During fall 2020, many U.S. kindergarten through grade 12 (K–12) schools closed campuses and instituted remote learning because of concerns that significant in-school transmission of SARS-CoV-2 was not preventable.

What is added by this report?

Frequent facility-wide SARS-CoV-2 testing in a high school with both residential and commuter students was part of a comprehensive strategy, including universal masking, that reduced in-school SARS-CoV-2 transmission while allowing significant daily on- and off-campus movement. Of 19 cases among faculty and staff members and eight among students, two (7%) were considered to represent on-campus transmission.

What are the implications for public health practice?

Comprehensive mitigation approaches including frequent testing and universal masking can help prevent outbreaks in in-person high school settings even when community transmission is ongoing.

[§§] https://usafacts.org/visualizations/coronavirus-covid-19-spread-map/state/new-jersey/county/mercer-county

students, likely contributed in motivating students to adhere to the on-campus protocols. All the mitigation measures used could readily be applied to nonboarding schools or day camps.

The findings in this report are subject to at least two limitations. First, although most of the mitigation measures (masking, physical distancing, and hand hygiene) could be implemented at low cost, extensive screening and use of proximity devices for enhanced contact tracing activities might be less feasible in other settings because of cost. Setting up an extensive logistical operation to conduct twice weekly sample collection on campus of all students, faculty, and staff members with relatively fast turn-around-times was required, which also involved considerable expense. Second, the source of a given infection, especially if off campus, typically could not be independently verified; therefore, the estimate of the number of cases transmitted on campus might not be exact.

This investigation suggested that adherence to physical distancing, universal masking, and behavioral reinforcement in conjunction with improved air filtration, and frequent testing can be effective in preventing transmission within campus settings (*8*). As testing becomes more widely available, the findings from this study might help educators consider testing strategies for screening of students, faculty, and staff members to contain COVID-19 transmission while supporting in-person learning for high school students. Secondary schools, whether boarding or day schools or hybrids, can implement a combination of testing and mitigation strategies to help reduce transmission of SARS-CoV-2 at schools to support in-person learning. Comprehensive mitigation approaches including frequent testing and universal masking can help prevent outbreaks in in-person high school settings even when there is ongoing community transmission.

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Racial and Ethnic Disparities in COVID-19 Incidence by Age, Sex, and Period Among Persons Aged <25 Years — 16 U.S. Jurisdictions, January 1–December 31, 2020

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The COVID-19 pandemic has disproportionately affected racial and ethnic minority groups in the United States. Whereas racial and ethnic disparities in severe COVID-19–associated outcomes, including mortality, have been documented (*1*–*3*), less is known about population-based disparities in infection with SARS-CoV-2, the virus that causes COVID-19. In addition, although persons aged <30 years account for approximately one third of reported infections,[§] there is limited information on racial and ethnic disparities in infection among young persons over time and by sex and age. Based on 689,672 U.S. COVID-19 cases reported to CDC's case-based surveillance system by jurisdictional health departments, racial and ethnic disparities in COVID-19 incidence among persons aged <25 years in 16 U.S. jurisdictions[¶] were described by age group and sex and across three periods during January 1–December 31, 2020. During January–April, COVID-19 incidence was substantially higher among most racial and ethnic minority groups compared with that among non-Hispanic White (White) persons (rate ratio [RR] range = 1.09–4.62). During May–August, the RR increased from 2.49 to 4.57 among non-Hispanic Native Hawaiian and Pacific Islander (NH/PI) persons but decreased among other racial and ethnic minority groups (RR range = 0.52–2.82). Decreases in disparities were observed during September–December (RR range = 0.37–1.69); these decreases were largely because of a greater increase in incidence among White persons, rather than a decline in incidence among racial and ethnic minority groups. NH/PI, non-Hispanic American Indian or Alaska Native (AI/AN), and Hispanic or Latino (Hispanic) persons experienced the largest persistent disparities over the entire period. Ensuring equitable and timely access to preventive measures, including testing, safe work and education settings, and vaccination when eligible is important to address racial/ethnic disparities.

Population-based COVID-19 incidence (cases per 100,000 persons) by race and ethnicity, sex, and age was calculated for January 1–December 31, 2020, overall, and for three approximately equal 4-month periods (January 1–April 30, May 1–August 31, and September 1–December 31) using COVID-19 cases reported to CDC's case-based surveillance system[**] by jurisdictional health departments. Incompleteness of race and ethnicity data is a widespread challenge in analyses of COVID-19 disparities.[††] To minimize the impact of missing data, jurisdictions selected for analyses reported ≥30% of the total number of jurisdictional aggregate cases[§§] to CDC and had ≥70% of race and ethnicity information complete among cases reported during January 1–December 31, 2020. Fifteen U.S. states and the District of Columbia were included, with a total of 689,672 cases among persons aged <25 years with information on race and ethnicity and sex.[¶¶] Population denominators were obtained from the 2019 U.S. Census Bureau's Annual County Resident Population Estimates by Age, Sex, Race, and Hispanic Origin.[***]

Seven racial and ethnic categories (AI/AN, non-Hispanic Asian [Asian], non-Hispanic Black or African-American [Black], NH/PI, White, Hispanic, and non-Hispanic multiple race [multiracial]) and five age categories (0–4, 5–9, 10–14, 15–19, and 20–24 years) were examined. RRs with 95%

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[§] https://covid.cdc.gov/covid-data-tracker/ (accessed February 14, 2021)
[¶] Arkansas, District of Columbia, Florida, Hawaii, Kansas, Kentucky, Maine, Massachusetts, Michigan, Minnesota, New Mexico, Oklahoma, Oregon, Utah, Vermont, and Wisconsin.

[**] CDC implemented a data integration and management platform, Data Collation and Integration for Public Health Event Response (DCIPHER), for use in outbreak responses (https://data.cdc.gov/browse?tags = covid-19). This platform enables jurisdictions to directly enter or import and view their data. Individual-level case report data for COVID-19 cases were accessed through the DCIPHER system on January 27, 2021. Data were classified using the earliest available date related to the illness, specimen collection or reporting to CDC. Case surveillance data were received directly from two jurisdictional health departments (Hawaii State Department of Health and New Mexico Department of Health) for all racial/ethnic groups to allow for separate reporting of NH/PI persons. Data from these two jurisdictions were combined in analyses with data accessed through the DCIPHER system from the 14 other jurisdictions.
[††] https://www.cdc.gov/coronavirus/2019-ncov/covid-data/faq-surveillance.html
[§§] Aggregate counts from reporting jurisdictions were downloaded through HHS Protect Public Database. https://protect-public.hhs.gov/ (accessed January 27, 2021)
[¶¶] Among the identified 919,652 persons aged <25 years with COVID-19 in the 16 jurisdictions, 210,353 (23%) persons were missing information on race and ethnicity and/or sex during January 1–December 31, 2020. Among the 210,353 persons missing information on race and ethnicity and/or sex, 207,659 (99%) were missing information on race and ethnicity. The percentages of persons aged <25 years with COVID-19 in the 16 jurisdictions missing information on race and ethnicity and/or sex were 20.2% during January 1–April 30, 18.9% during May 1–August 31, and 24.3% during September 1–December 31.
[***] https://www.census.gov/programs-surveys/popest/technical-documentation/file-layouts.html (accessed August 20, 2020)

confidence intervals (CIs) comparing rates by race and ethnicity (combined), age, and/or sex overall and for each period were calculated. Statistical analyses were conducted using SAS software (version 9.4; SAS Institute). Rate ratios with 95% CIs excluding 1.0 were considered to be statistically significant. This activity was reviewed by CDC and was conducted consistent with applicable federal law and CDC policy.[†††]

The sample of 689,672 cases included 15,068 (2%) cases identified during January–April; 177,778 (26%) during May–August and 496,826 (72%) during September–December (Table 1). During January–April, COVID-19 incidence ranged from 35 cases per 100,000 among White persons to 163 per 100,000 among AI/AN persons. Compared with White persons, rates were higher among AI/AN (RR = 4.62), Hispanic (RR = 3.87), NH/PI (RR = 2.49), Black (RR = 2.46), and Asian persons (RR = 1.53) and were approximately equal among multiracial persons (RR = 1.09).

From January–April to May–August, COVID-19 incidence increased among all racial and ethnic groups, ranging from 275 per 100,000 among multiracial persons to 2,418 per 100,000 among NH/PI persons. The largest relative increase occurred among NH/PI persons, with incidence increasing 26-fold, from 88 to 2,418 per 100,000. Rate ratios increased among NH/PI persons but decreased among other racial and ethnic minority groups. During May–August, compared with that among White persons, incidence remained higher among NH/PI (RR = 4.57), Hispanic (RR = 2.82), AI/AN (RR = 1.86), and Black persons (RR = 1.63), but was lower among Asian (RR = 0.77) and multiracial persons (RR = 0.52).

From May–August to September–December, COVID-19 incidence increased among all racial and ethnic groups. The largest relative increase occurred among White persons, with incidence increasing approximately 320%, from 530 to 2,222 cases per 100,000 from May–August to September–December. Disparities decreased among all racial and ethnic minority groups. During September–December, compared with that among White persons, incidence remained higher among NH/PI (RR = 1.69), AI/AN (RR = 1.62), and Hispanic persons (RR = 1.18), but was lower among Asian (RR = 0.57), Black (RR = 0.51), and multiracial persons (RR = 0.37).

Incidence was higher among females than among males during all of 2020 and across periods. Incidence also tended to be lowest among younger children across periods. Lowest incidence was observed among children aged 5–9 years during January–April, those aged 0–9 years during May–August, and those aged 0–4 years during September–December.

During January–December, overall, the highest COVID-19 incidence relative to that among White persons was among

[†††] 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 1. COVID–19 incidence* and rate ratios, by race/ethnicity, sex, and age group among persons aged <25 years across three periods — 16 U.S. jurisdictions,† January 1–December 31, 2020

Date/Characteristic	No. of cases	Cases per 100,000 population (95% CI)	RR (95% CI)
January 1–April 30, 2020			
All	**15,068**	**63 (62–64)**	**—**
Sex			
Male	6,884	57 (55–58)	0.80 (0.78–0.83)
Female	8,184	70 (69–72)	Ref
Race/Ethnicity			
AI/AN, non-Hispanic	536	163 (150–177)	4.62 (4.22–5.05)
Asian, non-Hispanic	498	54 (49–59)	1.53 (1.39–1.67)
Black, non-Hispanic	2,461	87 (83–90)	2.46 (2.34–2.58)
NH/PI, non-Hispanic	73	88 (70–111)	2.49 (1.98–3.14)
White, non-Hispanic	4,947	35 (34–36)	Ref
Hispanic/Latino	6,129	137 (133–140)	3.87 (3.73–4.02)
Multiple, non-Hispanic	424	38 (35–42)	1.09 (0.98–1.20)
Age group (yrs)			
0–4	956	21 (20–23)	1.28 (1.17–1.41)
5–9	772	17 (16–18)	Ref
10–14	1,184	25 (23–26)	1.49 (1.36–1.63)
15–19	3,267	67 (65–70)	4.03 (3.72–4.36)
20–24	8,889	175 (171–178)	10.47 (9.72–11.26)
May 1–August 31, 2020			
All	**177,778**	**747 (744–751)**	**—**
Sex			
Male	84,270	693 (688–698)	0.86 (0.85–0.87)
Female	93,508	804 (799–809)	Ref
Race/Ethnicity			
AI/AN, non-Hispanic	3,245	986 (952–1,020)	1.86 (1.80–1.93)
Asian, non-Hispanic	3,781	409 (396–422)	0.77 (0.75–0.80)
Black, non-Hispanic	24,501	862 (852–873)	1.63 (1.61–1.65)
NH/PI, non-Hispanic	2,007	2,418 (2,314–2,526)	4.57 (4.37–4.77)
White, non-Hispanic	74,259	530 (526–533)	Ref
Hispanic/Latino	66,938	1,493 (1,481–1,504)	2.82 (2.79–2.85)
Multiple, non-Hispanic	3,047	275 (266–285)	0.52 (0.50–0.54)
Age group (yrs)			
0–4	14,017	314 (309–319)	1.01 (0.98–1.03)
5–9	14,406	312 (307–317)	Ref
10–14	20,490	430 (424–436)	1.38 (1.35–1.41)
15–19	50,210	1,034 (1,025–1,043)	3.32 (3.26–3.38)
20–24	78,655	1,547 (1,536–1,557)	4.96 (4.88–5.05)
September 1–December 31, 2020			
All	**496,826**	**2,088 (2,082–2,094)**	**—**
Sex			
Male	236,237	1,943 (1,935–1,951)	0.87 (0.86–0.87)
Female	260,589	2,240 (2,231–2,248)	Ref
Race/Ethnicity			
AI/AN, non-Hispanic	11,870	3,605 (3,541–3,671)	1.62 (1.59–1.65)
Asian, non-Hispanic	11,680	1,263 (1,240–1,286)	0.57 (0.56–0.58)
Black, non-Hispanic	32,200	1,133 (1,121–1,146)	0.51 (0.50–0.52)
NH/PI, non-Hispanic	3,119	3,757 (3,628–3,891)	1.69 (1.63–1.75)
White, non-Hispanic	311,591	2,222 (2,214–2,230)	Ref
Hispanic/Latino	117,305	2,616 (2,601–2,631)	1.18 (1.17–1.19)
Multiple, non-Hispanic	9,061	819 (803–836)	0.37 (0.36–0.38)
Age group (yrs)			
0–4	33,595	752 (744–760)	0.71 (0.70–0.72)
5–9	48,824	1,056 (1,047–1,066)	Ref
10–14	76,922	1,615 (1,604–1,627)	1.53 (1.51–1.55)
15–19	149,660	3,083 (3,067–3,098)	2.92 (2.89–2.95)
20–24	187,825	3,693 (3,677–3,710)	3.50 (3.46–3.53)

See table footnotes on the next page.

TABLE 1. (*Continued*) COVID–19 incidence* and rate ratios, by race/ethnicity, sex, and age group among persons aged <25 years across three periods — 16 U.S. jurisdictions,† January 1–December 31, 2020

Date/Characteristic	No. of cases	Cases per 100,000 population (95% CI)	RR (95% CI)
January 1–December 31, 2020			
All	**689,672**	**2,899 (2,892–2,906)**	**—**
Sex			
Male	327,391	2,693 (2,684–2,702)	0.86 (0.86–0.87)
Female	362,281	3,114 (3,104–3,124)	Ref
Race/Ethnicity			
AI/AN, non-Hispanic	15,651	4,754 (4,680–4,829)	1.71 (1.68–1.73)
Asian, non-Hispanic	15,959	1,725 (1,699–1,752)	0.62 (0.61–0.63)
Black, non-Hispanic	59,162	2,083 (2,066–2,099)	0.75 (0.74–0.75)
NH/PI, non-Hispanic	5,199	6,263 (6,095–6,436)	2.25 (2.19–2.31)
White, non-Hispanic	390,797	2,787 (2,778–2,795)	Ref
Hispanic/Latino	190,372	4,245 (4,226–4,264)	1.52 (1.52–1.53)
Multiple, non-Hispanic	12,532	1,133 (1,113–1,153)	0.41 (0.40–0.41)
Age group (yrs)			
0–4	48,568	1,087 (1,078–1,097)	0.79 (0.78–0.79)
5–9	64,002	1,385 (1,374–1,395)	Ref
10–14	98,596	2,070 (2,057–2,083)	1.50 (1.48–1.51)
15–19	203,137	4,184 (4,166–4,202)	3.02 (2.99–3.05)
20–24	275,369	5,415 (5,394–5,435)	3.91 (3.88–3.94)

Abbreviations: AI/AN = American Indian or Alaska Native; CI = confidence interval; NH/PI = Native Hawaiian and Pacific Islander; Ref = referent group; RR = rate ratio.

* Rates for each period and for the full period were calculated using the following equation: (cases/population) x 100,000 persons. COVID–19 cases were identified using CDC's Data Collation and Integration for Public Health Event Response system (https://data.cdc.gov/browse?tags=covid-19 [accessed January 27, 2021]). Case surveillance data were received directly from two jurisdictional health departments (Hawaii State Department of Health and New Mexico Department of Health) for all racial/ethnic groups to allow for separate reporting of NH/PI persons. Population estimates were provided by the 2019 U.S. Census Bureau's Annual County Resident Population Estimates by Age, Sex, Race, and Hispanic Origin (https://www.census.gov/programs-surveys/popest/technical-documentation/file-layouts.html [accessed August 20, 2020]). 2019 population estimates in the 16 selected jurisdictions were as follows: persons aged <25 years: all (23,792,864), males (12,157,933), females (11,634,931), non-Hispanic AI/AN (329,235), non-Hispanic Asian (925,072), non-Hispanic Black or African-American (2,840,777), non-Hispanic NH/PI (83,012), non-Hispanic White (14,024,304), Hispanic or Latino (4,484,434), and non-Hispanic persons of multiple races (1,106,030); and persons aged 0–4 years (4,467,369), 5–9 years (4,622,261), 10–14 years (4,762,433), 15–19 years (4,855,127), and 20–24 years (5,085,674). No measures were calculated for non-Hispanic persons of other races with COVID-19 (n = 19,627) because of lack of population denominator information from U.S. Census Bureau.

† Arkansas, District of Columbia, Florida, Hawaii, Kansas, Kentucky, Maine, Massachusetts, Michigan, Minnesota, New Mexico, Oklahoma, Oregon, Utah, Vermont, and Wisconsin.

NH/PI persons of most age groups, with the largest differences among those aged 0–4 (RR = 4.03) and 5–9 years (RR = 3.21) (Figure) (Supplementary Table, https://stacks.cdc.gov/view/cdc/103733). During January–December, among persons aged ≤14 years, incidence relative to White persons was initially higher among Black and Asian persons and persistently higher among NH/PI, AI/AN, and Hispanic persons; among persons aged 15–24 years, incidence relative to White persons was initially higher among Black, Asian, and multiracial persons, and persistently higher among NH/PI, AI/AN, and Hispanic persons. Overall, during January–December, differences compared with White persons among AI/AN, NH/PI, and Hispanic persons were larger in persons aged ≤14 years than among those aged 15–24 years. Racial and ethnic disparities were similar in magnitude and direction for both females and males across age groups (Table 2).

Discussion

Analysis of CDC's case-based surveillance data in 16 U.S. jurisdictions during January–December 2020 indicates that racial and ethnic differences in COVID-19 incidence among persons aged <25 years changed over time. Disparities were substantial early in the pandemic among most racial and ethnic minority groups compared with White persons and then decreased over time, largely because of a greater increase in incidence among White persons. Among NH/PI persons, disparities increased from January–April to May–August and then decreased by September–December. The largest persistent disparities in COVID-19 incidence were among NH/PI, AI/AN, and Hispanic persons. Other studies have reported disproportionately higher percentages of COVID-19 cases among Hispanic, Black, Asian, and AI/AN children (*4*,*5*); however, no published studies to date have described national COVID-19 incidence among NH/PI children.

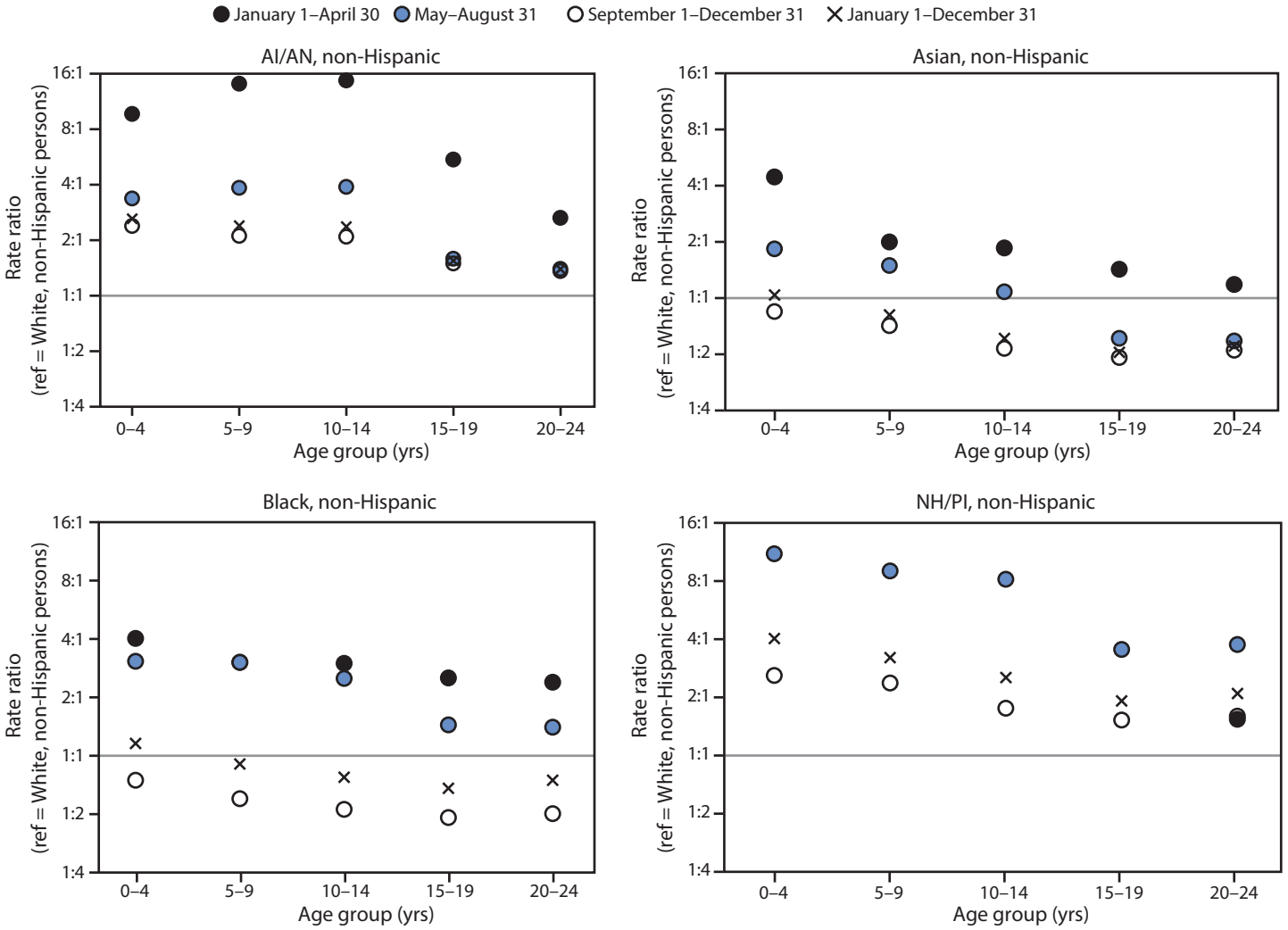
Social determinants of health influence racial and ethnic disparities in case incidence.§§§ The large racial and ethnic COVID-19 disparities identified early in the pandemic in this analysis might reflect differential ability to participate in early mitigation measures, such as stay-at-home orders (*6*). Racial and ethnic minority groups are disproportionately represented in essential work settings, making it difficult for youths and parents to stay at home; a higher likelihood of living in a multigenerational household also increases the risk for household exposures to SARS-CoV-2.¶¶¶ For example, NH/PI persons, a group with some of the largest persistent disparities in this analysis, most often reside in multigenerational homes compared with other racial and ethnic groups (*7*). Despite on average having lower income and educational attainment, NH/PI persons are often grouped in analyses with Asian persons (*8*), thereby obscuring disparities influenced by these social determinants of health.

The decrease in racial and ethnic disparities observed over time was largely driven by a greater increase in COVID-19 incidence among White persons, rather than a decrease among racial and ethnic minority groups. This narrowing in differences should be considered in the context of geographic

§§§ https://www.cdc.gov/coronavirus/2019-ncov/community/health-equity/race-ethnicity.html

¶¶¶ https://www.cdc.gov/coronavirus/2019-ncov/community/health-equity/racial-ethnic-disparities/increased-risk-exposure.html

FIGURE. Rate ratios* comparing COVID-19 incidence† among racial and ethnic minority persons to COVID-19 incidence among non-Hispanic White persons, among persons aged <25 years, by age group in three periods — 16 U.S. jurisdictions,§ January 1–December 31, 2020



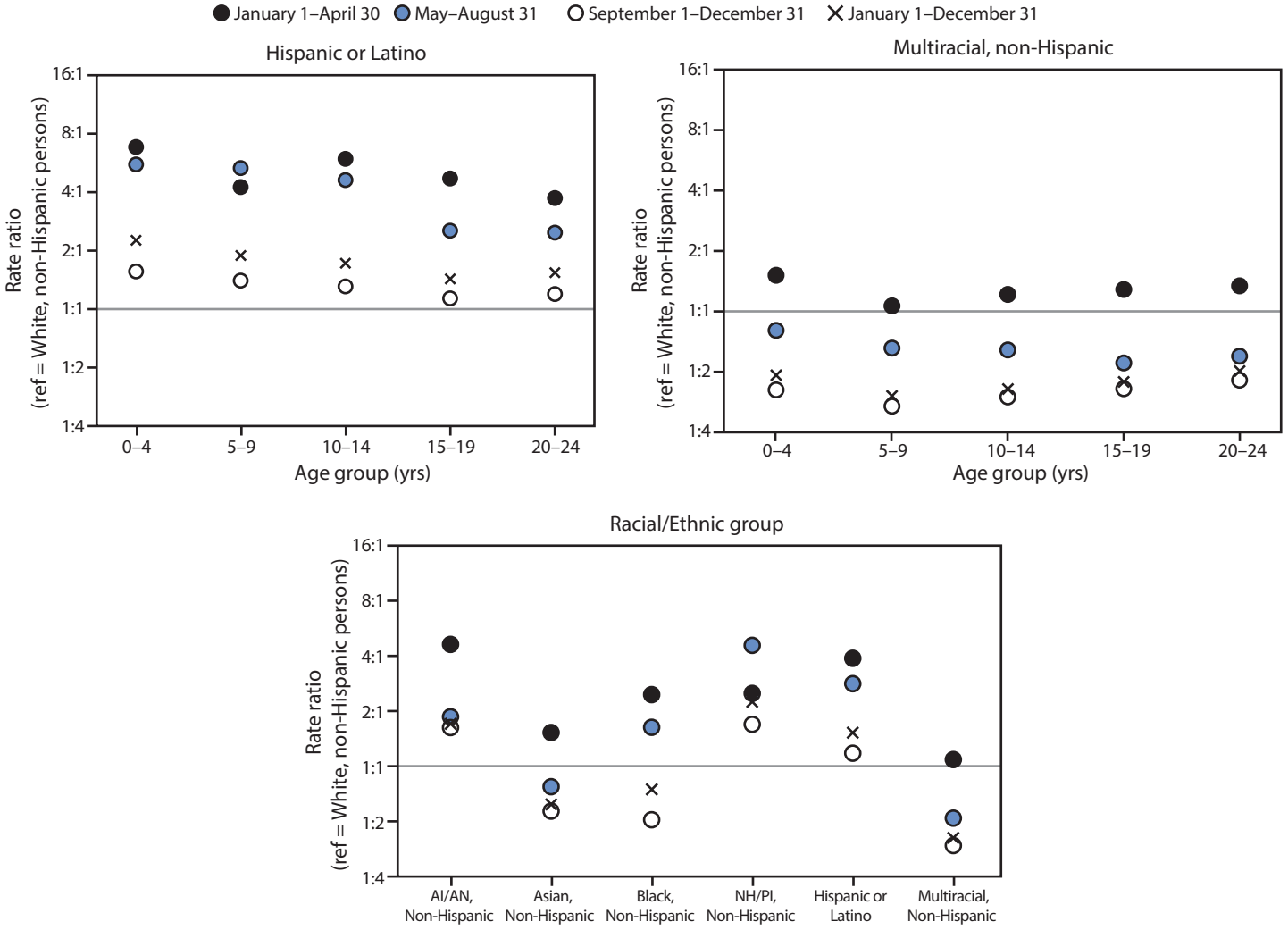
See figure footnotes on the next page.

aspects of community spread over time and potential changes in access to or participation in mitigation measures or testing over time by race and ethnicity. For example, future studies could consider whether variations in state-mandated mitigation policies and other aspects of the policy environment led to the observed differential adherence in some mitigation measures by race/ethnicity (*9*). Further study of whether some testing strategies (e.g., repeat testing of students in some academic settings****) might have been differentially available by race and ethnicity over time is also needed.

The findings in this report are subject to at least five limitations. First, reporting of detailed case data and race and ethnicity to CDC is incomplete. Although this analysis was restricted to 16 jurisdictions with more complete case and race and ethnicity information, 23% of cases from these jurisdictions were missing data on race and ethnicity. Differences in data completeness by race and ethnicity could lead to underestimation of disparities (*10*). Restriction to 16 jurisdictions also limits the generalizability of these findings, because they are based on only 23% of the national population of persons aged <25 years; in addition, disparities could vary at geographic subdivisions within states. Second, these data likely underestimate the incidence of COVID-19 among persons aged <25 years because individual-level cases reported to CDC represent a portion of jurisdictional aggregate cases and asymptomatic persons are less likely to be tested. Third, cases among racial and ethnic minority groups might be disproportionately underreported given disparities

**** https://www.washingtonpost.com/local/education/welcome-to-college-now-get-tested-for-the-coronavirus--again-and-again/2020/09/04/2d087722-ed2f-11ea-b4bc-3a2098fc73d4_story.html

FIGURE. (*Continued*) Rate ratios* comparing COVID-19 incidence† among racial and ethnic minority persons to COVID-19 incidence among non-Hispanic White persons, among persons aged <25 years, by age group in three periods — 16 U.S. jurisdictions,§ January 1–December 31, 2020



Abbreviations: AI/AN=American Indian or Alaska Native; NH/PI=Native Hawaiian and Pacific Islander; ref = referent group.

* Rate ratios were calculated during each period and overall. Data used to generate this figure are included in the Supplementary Table, https://stacks.cdc.gov/view/cdc/103733. Rate ratios are not available in situations where data were suppressed because of <20 cases being reported for a given race/ethnicity and age group during a period. During January 1–April 30, 2020, <20 cases were reported for non-Hispanic NH/PI persons aged 0–4, 5–9, 10–14, and 15–19 years. Rate ratios were similar and thus corresponding rate ratio symbols overlap in the figure for the following categories: AI/AN persons aged 15–19 and 20–24 years during May 1–August 31 and September 1–December 31; Black persons aged 5–9 years during January 1–April 30 and May 1–August 31; and NH/PI persons aged 20–24 years during January 1–April 30 and September 1–December 31.

† Rates for each period and for the full period were calculated using the following equation: (cases/population) x 100,000 persons. COVID-19 cases were identified using CDC's Data Collation and Integration for Public Health Event Response system (https://data.cdc.gov/browse?tags=covid-19 [accessed January 27, 2021]). Case surveillance data were received directly from two jurisdictional health departments (Hawaii State Department of Health and New Mexico Department of Health) for all racial/ethnic groups to allow for separate reporting of NH/PI persons. Population estimates were provided by the 2019 U.S. Census Bureau's Annual County Resident Population Estimates by Age, Sex, Race, and Hispanic Origin (https://www.census.gov/programs-surveys/popest/technical-documentation/file-layouts.html [accessed August 20, 2020]).

§ Arkansas, District of Columbia, Florida, Hawaii, Kansas, Kentucky, Maine, Massachusetts, Michigan, Minnesota, New Mexico, Oklahoma, Oregon, Utah, Vermont, and Wisconsin.

in access to testing, leading to underestimation of disparities. Fourth, potential differences in testing, reporting, and completeness of data by race and ethnicity over time call for caution in interpretation of the observed changes in racial and ethnic disparities in this report. Finally, racial and ethnic disparities in COVID-19 incidence (and changes over time) might not reflect disparities in severe outcomes (*1–3*).††††

†††† https://www.cdc.gov/coronavirus/2019-ncov/community/health-equity/racial-ethnic-disparities/disparities-illness.html

TABLE 2. Sex-specific COVID-19 incidence* and rate ratios among persons aged <25 years, by age group, sex, and race/ethnicity — 16 U.S. jurisdictions,† January 1–December 31, 2020

	Sex					
	Female			Male		
Age group, race/ethnicity	No. of cases	Cases per 100,000 population (95% CI)	Rate ratio (95% CI)	No. of cases	Cases per 100,000 population (95% CI)	Rate ratio (95% CI)
0–4 yrs						
All	**23,272**	**1,067 (1,053–1,081)**	—	**25,296**	**1,107 (1,093–1,120)**	—
AI/AN, non-Hispanic	658	2,247 (2,082–2,425)	2.69 (2.49–2.91)	677	2,208 (2,048–2,381)	2.54 (2.35–2.75)
Asian, non-Hispanic	642	858 (794–927)	1.03 (0.95–1.11)	721	913 (849–982)	1.05 (0.98–1.13)
Black, non-Hispanic	2,541	940 (904–977)	1.13 (1.08–1.18)	2,844	1,028 (991–1,067)	1.18 (1.14–1.23)
NH/PI, non-Hispanic	266	3,576 (3,171–4,033)	4.28 (3.79–4.83)	258	3,306 (2,926–3,735)	3.81 (3.37–4.31)
White, non-Hispanic	10,391	835 (820–852)	Ref	11,382	868 (852–884)	Ref
Hispanic/Latino	8,299	1,901 (1,861–1,943)	2.28 (2.21–2.34)	8,889	1,951 (1,910–1,992)	2.25 (2.19–2.31)
Multiple, non-Hispanic	475	399 (365–436)	0.48 (0.44–0.52)	525	420 (386–458)	0.48 (0.44–0.53)
5–9 yrs						
All	**31,333**	**1,389 (1,374–1,404)**	—	**32,669**	**1,381 (1,366–1,396)**	—
AI/AN, non-Hispanic	917	2,901 (2,719–3,095)	2.40 (2.24–2.56)	941	2,861 (2,684–3,050)	2.39 (2.24–2.56)
Asian, non-Hispanic	741	904 (841–971)	0.75 (0.69–0.80)	890	1,048 (981–1,119)	0.88 (0.82–0.94)
Black, non-Hispanic	3,019	1,081 (1,043–1,120)	0.89 (0.86–0.93)	3,155	1,096 (1,058–1,135)	0.92 (0.88–0.95)
NH/PI, non-Hispanic	287	3,676 (3,275–4,127)	3.04 (2.70–3.42)	326	4,040 (3,624–4,503)	3.38 (3.03–3.77)
White, non-Hispanic	15,609	1,210 (1,191–1,229)	Ref	16,280	1,195 (1,177–1,214)	Ref
Hispanic/Latino	10,174	2,271 (2,227–2,315)	1.88 (1.83–1.92)	10,564	2,264 (2,221–2,308)	1.89 (1.85–1.94)
Multiple, non-Hispanic	586	501 (462–543)	0.41 (0.38–0.45)	513	414 (380–452)	0.35 (0.32–0.38)
10–14 yrs						
All	**49,235**	**2,112 (2,094–2,131)**	—	**49,361**	**2,030 (2,012–2,048)**	—
AI/AN, non-Hispanic	1,477	4,461 (4,239–4,694)	2.31 (2.19–2.44)	1,520	4,492 (4,272–4,723)	2.42 (2.30–2.55)
Asian, non-Hispanic	949	1,089 (1,022–1,160)	0.56 (0.53–0.60)	1,066	1,210 (1,140–1,285)	0.65 (0.61–0.69)
Black, non-Hispanic	4,192	1,510 (1,465–1,556)	0.78 (0.76–0.81)	4,042	1,416 (1,373–1,461)	0.76 (0.74–0.79)
NH/PI, non-Hispanic	424	4,803 (4,367–5,283)	2.49 (2.26–2.74)	445	4,779 (4,355–5,245)	2.58 (2.35–2.83)
White, non-Hispanic	26,147	1,930 (1,907–1,954)	Ref	26,360	1,853 (1,831–1,876)	Ref
Hispanic/Latino	15,128	3,335 (3,282–3,389)	1.73 (1.69–1.76)	15,020	3,175 (3,125–3,226)	1.71 (1.68–1.75)
Multiple, non-Hispanic	918	794 (744–847)	0.41 (0.39–0.44)	908	760 (712–811)	0.41 (0.38–0.44)
15–19 yrs						
All	**109,350**	**4,601 (4,574–4,628)**	—	**93,787**	**3,784 (3,760–3,808)**	—
AI/AN, non-Hispanic	2,432	7,218 (6,937–7,511)	1.55 (1.49–1.61)	1,971	5,634 (5,391–5,889)	1.54 (1.47–1.61)
Asian, non-Hispanic	2,133	2,181 (2,090–2,275)	0.47 (0.45–0.49)	1,960	2,065 (1,975–2,158)	0.56 (0.54–0.59)
Black, non-Hispanic	8,056	2,915 (2,852–2,979)	0.63 (0.61–0.64)	7,774	2,715 (2,655–2,776)	0.74 (0.72–0.76)
NH/PI, non-Hispanic	715	8,679 (8,066–9,339)	1.86 (1.73–2.01)	633	7,253 (6,709–7,840)	1.98 (1.83–2.14)
White, non-Hispanic	66,431	4,655 (4,620–4,691)	Ref	54,869	3,661 (3,630–3,691)	Ref
Hispanic/Latino	27,571	6,361 (6,286–6,436)	1.37 (1.35–1.39)	24,846	5,497 (5,430–5,566)	1.50 (1.48–1.52)
Multiple, non-Hispanic	2,012	2,010 (1,924–2,100)	0.43 (0.41–0.45)	1,734	1,689 (1,612–1,771)	0.46 (0.44–0.48)
20–24 yrs						
All	**149,091**	**5,987 (5,957–6,018)**	—	**126,278**	**4,865 (4,839–4,892)**	—
AI/AN, non-Hispanic	2,881	8,386 (8,086–8,698)	1.43 (1.38–1.48)	2,177	6,253 (5,995–6,521)	1.34 (1.29–1.40)
Asian, non-Hispanic	3,558	2,997 (2,900–3,097)	0.51 (0.49–0.53)	3,299	2,805 (2,711–2,903)	0.60 (0.58–0.62)
Black, non-Hispanic	12,708	4,316 (4,241–4,391)	0.74 (0.72–0.75)	10,831	3,534 (3,468–3,601)	0.76 (0.74–0.78)
NH/PI, non-Hispanic	941	11,453 (10,744–12,209)	1.95 (1.83–2.08)	904	10,546 (9,880–11,256)	2.27 (2.12–2.42)
White, non-Hispanic	89,490	5,867 (5,829–5,906)	Ref	73,838	4,649 (4,615–4,682)	Ref
Hispanic/Latino	36,744	8,775 (8,685–8,865)	1.50 (1.48–1.51)	33,137	7,418 (7,339–7,499)	1.60 (1.58–1.62)
Multiple, non-Hispanic	2,769	3,059 (2,947–3,175)	0.52 (0.50–0.54)	2,092	2,251 (2,156 –2,349)	0.48 (0.46–0.51)

Abbreviations: AI/AN = American Indian or Alaska Native; CI = confidence interval; NH/PI = Native Hawaiian and Pacific Islander; Ref = referent group.

* Rates for each period and for the full period were calculated using the following equation: (cases/population) x 100,000 persons. COVID-19 cases were identified using CDC's Data Collation and Integration for Public Health Event Response system (https://data.cdc.gov/browse?tags=covid-19 [accessed January 27, 2021]). Case surveillance data were received directly from two jurisdictional health departments (Hawaii State Department of Health and New Mexico Department of Health) for all racial/ethnic groups to allow for separate reporting of NH/PI persons. Population estimates were provided by the 2019 U.S. Census Bureau's Annual County Resident Population Estimates by Age, Sex, Race, and Hispanic Origin (https://www.census.gov/programs-surveys/popest/technical-documentation/file-layouts.html [accessed August 20, 2020]).

† Arkansas, District of Columbia, Florida, Hawaii, Kansas, Kentucky, Maine, Massachusetts, Michigan, Minnesota, New Mexico, Oklahoma, Oregon, Utah, Vermont, and Wisconsin.

Summary

What is already known about this topic?

U.S. racial and ethnic minority groups have been disproportionately affected by COVID-19.

What is added by this report?

Racial and ethnic disparities in COVID-19 incidence among persons aged <25 years in 16 U.S. jurisdictions evolved during the pandemic. Disparities were substantial during January–April and generally decreased during May–December, largely because of a greater increase in incidence among White persons, rather than a decline among racial and ethnic minority groups. The largest persistent disparities involved Native Hawaiian and Pacific Islander, American Indian or Alaska Native, and Hispanic persons.

What are the implications for public health practice?

Ensuring equitable and timely access to preventive measures, including testing, safe work and education settings, and vaccination when eligible is important to address racial/ethnic disparities.

During January 1–December 31, 2020, substantial racial and ethnic disparities in COVID-19 incidence, observed early in the pandemic among persons aged <25 years in 16 jurisdictions, decreased over time, driven largely by a greater increase in reporting of cases among White persons. The largest persistent disparities were among NH/PI, AI/AN, and Hispanic persons. Ensuring equitable and timely access to preventive measures, including testing, safe work and education settings and vaccination when eligible is important to address racial/ethnic disparities.[§§§§]

[§§§§] https://www.cdc.gov/coronavirus/2019-ncov/community/health-equity/racial-ethnic-disparities/what-we-do.html

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COVID-19 Vaccine Second-Dose Completion and Interval Between First and Second Doses Among Vaccinated Persons — United States, December 14, 2020–February 14, 2021

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In December 2020, two COVID-19 vaccines (Pfizer-BioNTech and Moderna) received Emergency Use Authorization from the Food and Drug Administration.*,† Both vaccines require 2 doses for a completed series. The recommended interval between doses is 21 days for Pfizer-BioNTech and 28 days for Moderna; however, up to 42 days between doses is permissible when a delay is unavoidable.§ Two analyses of COVID-19 vaccine administration data were conducted among persons who initiated the vaccination series during December 14, 2020–February 14, 2021, and whose doses were reported to CDC through February 20, 2021. The first analysis was conducted to determine whether persons who received a first dose and had sufficient time to receive the second dose (i.e., as of February 14, 2021, >25 days from receipt of Pfizer-BioNTech vaccine or >32 days from receipt of Moderna vaccine had elapsed) had received the second dose. A second analysis was conducted among persons who received a second COVID-19 dose by February 14, 2021, to determine whether the dose was received during the recommended dosing interval, which in this study was defined as 17–25 days (Pfizer-BioNTech) and 24–32 days (Moderna) after the first dose. Analyses were stratified by jurisdiction and by demographic characteristics. In the first analysis, among 12,496,258 persons who received the first vaccine dose and for whom sufficient time had elapsed to receive the second dose, 88.0% had completed the series, 8.6% had not received the second dose but remained within the allowable interval (≤42 days since the first dose), and 3.4% had missed the second dose (outside the allowable interval, >42 days since the first dose). The percentage of persons who missed the second dose varied by jurisdiction (range = 0.0%–9.1%) and among demographic groups was highest among non-Hispanic American Indian/Alaska Native (AI/AN) persons (5.1%) and persons aged 16–44 years (4.0%). In the second analysis, among 14,205,768 persons who received a second dose, 95.6% received the dose within the recommended interval, although percentages varied by jurisdiction (range = 79.0%–99.9%). Public health officials should identify and address possible barriers to completing the COVID-19 vaccination series to ensure equitable coverage across communities and maximum health benefits for recipients. Strategies to ensure series completion could include scheduling second-dose appointments at the first-dose administration and sending reminders for second-dose visits.

During December 14, 2020–February 14, 2021, a total of 40,517,900 persons initiated the COVID-19 vaccination series and had vaccine administration data reported to CDC by February 20, 2021. Providers submitted COVID-19 vaccine administration data to CDC via immunization information systems (IIS), the Vaccine Administration Management System (VAMS), or direct data submission.¶ First and second doses were linked based on a recipient ID assigned by the reporting entity (e.g., jurisdictions, territories, and federal entities) and the three-digit reporting entity code.**

Two analyses were conducted that included 58 jurisdictions (49 states, the District of Columbia, and eight territories or freely associated states††; 37,421,619 persons) (Figure). The first analysis assessed the series completion status among 12,496,258 persons who had received the first vaccine dose and for whom sufficient time had elapsed to receive the second dose. The second analysis examined the interval between the first and second doses among 14,205,768 persons who had received a second dose. Persons for whom the manufacturer of the first dose was unknown (0.2%; 86,480) were excluded from both analyses. Persons with mismatched vaccine manufacturers for the first and second doses (0.2%; 90,484) were categorized

* https://www.fda.gov/emergency-preparedness-and-response/coronavirus-disease-2019-covid-19/pfizer-biontech-covid-19-vaccine

† https://www.fda.gov/emergency-preparedness-and-response/coronavirus-disease-2019-covid-19/moderna-covid-19-vaccine

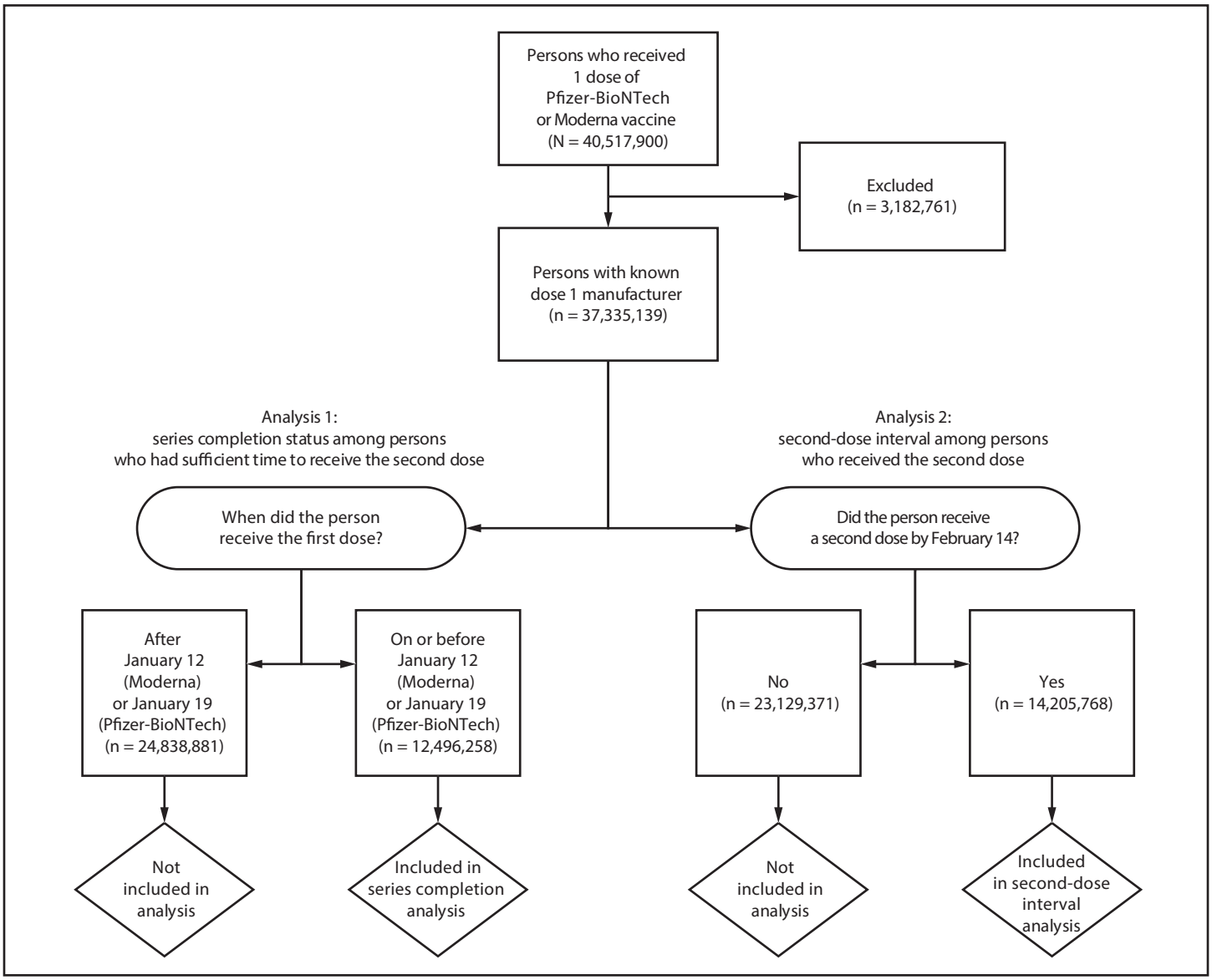
§ Data on the efficacy of mRNA COVID-19 vaccines beyond this window are limited. If the second dose is administered beyond these intervals, the current recommendation is that the series does not need to be restarted. https://www.cdc.gov/vaccines/covid-19/info-by-product/clinical-considerations.html

¶ https://www.cdc.gov/vaccines/covid-19/vaccination-provider-support.html

** Each jurisdiction that submits COVID-19 vaccine administration data to CDC is assigned a three-digit reporting entity code that references the entity that submitted the vaccination record to CDC.

†† Texas did not submit individual-dose vaccination data; therefore, the 3,096,281 persons who received ≥1 dose in Texas were excluded. Five federal agencies (Federal Bureau of Prisons, U.S. Department of Defense, U.S. Department of State, Indian Health Services, and Veterans Health Administration) and 21 pharmacy outlets received a direct allocation of vaccine and are included in this analysis within state totals.

FIGURE. Inclusion criteria for analysis of COVID-19 vaccine series completion and second-dose interval* — United States,† December 14, 2020–February 14, 2021



* The recommended interval between the first and second dose is 21 days for Pfizer-BioNTech and 28 days for Moderna; in this study, second doses received 17–25 days (Pfizer-BioNTech) and 24–32 days (Moderna) after the first dose were included.

† Texas did not submit individual-dose vaccination data; therefore, persons who received ≥1 dose in Texas (n = 3,096,281) were excluded; persons for whom the manufacturer of the first dose was unknown (from any jurisdiction) were also excluded (n = 86,480).

according to the first-dose manufacturer's recommended vaccination schedule. Persons for whom sufficient time to receive the second dose had not elapsed were excluded from analysis of completion status (66.4%; 24,838,881); persons who did not receive a second dose by February 14, 2021, were excluded from the second-dose interval analysis (61.8%; 23,129,371).

To assess second-dose completion status, persons who had sufficient time to receive the second dose (i.e., received the first dose on or before January 12 [Moderna] or January 19 [Pfizer-BioNTech] and >32 days or >25 days, respectively, had elapsed between the first dose and February 14) were included and categorized into three mutually exclusive groups: 1) completed series (received 2 doses on separate days within any time interval); 2) no second dose received but remained within the allowable interval (26–42 days [Pfizer-BioNTech] or 33–42 days [Moderna] after first dose); or 3) missed the second dose (>42 days after first dose) (Supplementary Figure 1, https://stacks.cdc.gov/view/cdc/103854).

To examine the interval between doses, persons who received the second dose at any time during

December 14, 2020–February 14, 2021, were categorized into four mutually exclusive groups according to timing of receipt of the second dose: 1) early (before the recommended interval), 2) during the recommended interval, 3) after the recommended interval but within the allowable interval, or 4) late (outside the allowable interval). Both analyses were conducted at the national level and analyzed by jurisdiction and demographic characteristics (race/ethnicity, age, and sex) using information reported with the first-dose record. Persons with missing data for race/ethnicity, age, or sex were excluded from the respective demographic analyses. Analyses were conducted using SAS (version 9.4; SAS Institute). This activity was reviewed by CDC and was conducted consistent with applicable federal law and CDC policy.[§§]

Among 12,496,258 persons who received a first COVID-19 vaccine dose and for whom sufficient time to receive the second dose had elapsed (Figure), 88.0% had completed the series, 8.6% had not received the second dose but remained within the allowable interval, and 3.4% had missed the second dose (Table 1). Substantial differences in completion status were observed across jurisdictions (median = 88.9%, range = 75.3%–99.7%) (Table 2) (Supplementary Figure 2, https://stacks.cdc.gov/view/cdc/103854). In 10 jurisdictions, <85%[¶¶] of persons who received a first dose had completed the series. In addition, the percentage of persons who missed the second dose varied by jurisdiction, ranging from 0.0% to 9.1% (median = 2.8%), with >5% of persons having missed the second dose in eight jurisdictions.

Race/ethnicity was reported for 6,764,604 (54.1%) persons who had sufficient time to receive the second dose. Among persons for whom information on race/ethnicity was reported, demographic differences in completion status were also observed (Table 2) (Supplementary Figure 3, https://stacks.cdc.gov/view/cdc/103854). The lowest series completion rate (83.7%) and the highest prevalence of missing the second dose (5.1%) was among AI/AN persons. Series completion rates among non-Hispanic persons of multiple/other races (86.1%) and Hispanic persons (87.0%) were lower than the rates among non-Hispanic Native Hawaiian or other Pacific Islander (90.3%) and non-Hispanic White (90.3%) persons. Age was reported for >99% of vaccine recipients. Series completion was lowest among adults aged ≥65 years (87.2%); however, adults in this age group also had the lowest percentage of missed second doses (2.3%). Among persons aged 16–44 years, 4.0% missed the second dose. Differences in series completion and missed second doses by sex were minimal.

[§§] 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.

[¶¶] The cut-off values were selected to identify the approximately 10%–15% of jurisdictions with outlier values.

Summary

What is already known about this topic?

During December 2020, two 2-dose COVID-19 vaccines received Emergency Use Authorization from the Food and Drug Administration.

What is added by this report?

Among persons who received a first dose and for whom sufficient time had elapsed to receive the second dose, 88.0% had completed the series; 8.6% had not received the second dose but were still within the allowable interval to receive it. Among all 2-dose recipients, 95.6% received the second dose within the recommended interval. Differences in missed doses or second doses administered outside the recommended interval were identified among jurisdictions and demographic groups.

What are the implications for public health practice?

Identifying and addressing possible barriers to completing the COVID-19 vaccination series can help ensure equitable coverage across communities and optimal health benefits for recipients.

Among 14,205,768 persons who received a second COVID-19 vaccine dose, 95.6% received the second dose within the recommended interval, 1.5% received the dose early, 2.8% received it after the recommended interval but within the allowable interval, and 0.1% received the dose late. Differences in receipt of the second dose within the recommended interval were observed across jurisdictions (median = 96.4%; range = 79.0%–99.9%), with >10% of vaccine recipients receiving the second dose outside the recommended interval in four jurisdictions. A median of 1.0% of persons across jurisdictions received the second dose early (range = 0.1%–8.7%); >2% of persons received the second dose early in 10 of the 58 jurisdictions. Late receipt of the second dose ranged from 0.0% (14 jurisdictions) to 0.8% (median = 0.1%); approximately 0.4%–0.8% of vaccine recipients received the second dose late in three jurisdictions. Differences in receipt of the second dose within the recommended interval by demographic characteristics were minimal.

Discussion

Two doses of the Pfizer-BioNTech and Moderna COVID-19 vaccines are required for optimal vaccine effectiveness (*1*). During the first 2 months of the U.S. COVID-19 vaccination program, among persons who received a first dose and had sufficient time to receive the second dose, 88.0% had completed the series and 3.4% had missed the second dose. Among all persons who received a second dose, the majority (95.6%) had done so within the recommended interval. These data are reassuring; however, the groups prioritized to receive vaccine during this period were more likely to have been vaccinated

TABLE 1. Second-dose completion status and interval between first and second dose among persons who initiated the COVID-19 vaccination series, by vaccine manufacturer — United States, December 14, 2020–February 14, 2021*

Completion status and dosing interval	No. (%)†		
	Total	Pfizer-BioNTech	Moderna
Received ≥1 dose	**37,335,139**	18,161,871	19,173,268
Completion status§ among persons with sufficient time to receive second dose	**12,496,258**	7,750,089	4,746,169
Completed series	**10,999,097 (88.0)**	6,791,301 (87.6)	4,207,796 (88.7)
No second dose but remained within allowable interval¶	**1,078,336 (8.6)**	693,650 (9.0)	384,686 (8.1)
Missed second dose**	**418,825 (3.4)**	265,138 (3.4)	153,687 (3.2)
Dosing interval among persons who received second dose	**14,205,768**	8,400,210	5,805,558
Early††	**216,905 (1.5)**	98,585 (1.2)	118,320 (2.0)
During recommended interval§§	**13,582,544 (95.6)**	8,053,661 (95.9)	5,528,883 (95.2)
After recommended interval but within allowable interval¶¶	**392,935 (2.8)**	240,329 (2.9)	152,606 (2.6)
Late***	**13,384 (0.1)**	7,635 (0.1)	5,749 (0.1)

* Vaccines administered during December 14, 2020–February 14, 2021, and reported to CDC by February 20, 2021.
† Because of rounding, column percentages might not sum to 100%.
§ Among persons who received their first dose on or before January 19 for Pfizer-BioNTech (>25 days between the first dose and February 14) or January 12 for Moderna (>32 days between the first dose and February 14).
¶ 26–42 days (Pfizer-BioNTech) or 33–42 days (Moderna) after first dose; no second dose received.
** >42 days after first dose; no second dose received.
†† Received second dose <17 days (Pfizer-BioNTech) or <24 days (Moderna) after first dose.
§§ Received second dose 17–25 days (Pfizer-BioNTech) or 24–32 days (Moderna) after first dose.
¶¶ Received second dose 26–42 days (Pfizer-BioNTech) or 33–42 days (Moderna) after first dose.
*** Received second dose >42 days after first dose.

at their work site or residence, including health care workers (*2*) and long-term care facility residents*** (*3*), which might have facilitated adherence to the recommended schedule. As priority groups broaden, adherence to the recommended dosing interval might decrease. Although the second dose should be administered as close to the recommended interval as possible, it may be administered up to 42 days after the first dose when a delay is unavoidable.††† If the second dose is administered beyond the allowable interval, the series does not need to be restarted.§§§ Providers should not administer second doses before the recommended interval or hold or save doses for patients who have not returned >42 days after their first dose. Providers should regularly assess missed second doses and repurpose those doses as first doses for eligible persons to initiate the vaccination series.

This interim analysis identified differences in completion status among jurisdictions and some demographic groups, findings that can be used to inform and enhance technical assistance for COVID-19 vaccination. Series completion was lowest among older adults, a finding that is similar to results from an initial nationwide examination of coverage (*4*). However, this group was also the least likely to miss the second dose; a large percentage remained within the allowable interval for the second dose. Among racial and ethnic groups, series completion was lowest among AI/AN persons, who also had the highest prevalence of missed second doses. To improve accessibility to and acceptance of second doses and maximize timely series completion, public health officials should work to better understand whether missed doses or delays are caused by challenges to vaccine access (e.g., supply, clinic availability, or community disadvantages) or because of other challenges related to vaccine confidence or acceptance.

The findings in this report are subject to at least four limitations. First, second-dose status was unknown for 7.9% of first-dose recipients (i.e., persons with an unknown manufacturer for the first dose and persons who lived in one state with limited data reporting). Second, persons might have been counted twice if they received doses from two different reporting entities or if their first and second doses were not linked because they were assigned a different recipient ID at their second-dose administration, possibly resulting in an underestimate of series completion. This jurisdiction mismatch could have contributed to the series completion and missed dose rates for AI/AN persons because tribal nations can border multiple jurisdictions and also because they might have received their vaccine through a separate allocation to the Indian Health Service. Conversely, if the same recipient ID was assigned to two or more persons in the same reporting entity, doses administered to two separate persons might have been coded as a first and second dose, possibly resulting in an overestimate of series completion. Third, several winter weather events led to canceled vaccination clinics and distribution challenges, which might have played a role in certain differences among jurisdictions. Finally, race/ethnicity data were missing for 45.9% of persons who had sufficient time to receive the second dose, limiting the ability to interpret differences in vaccination completion and timing of receipt of the second dose by race/ethnicity.

*** https://www.cdc.gov/coronavirus/2019-ncov/vaccines/recommendations.html
††† https://www.cdc.gov/vaccines/covid-19/info-by-product/clinical-considerations.html
§§§ https://www.cdc.gov/vaccines/covid-19/vaccine-inventory-management.html

TABLE 2. Second-dose completion status and interval between first and second dose among persons who initiated the COVID-19 vaccination series, by jurisdiction and demographic characteristics — United States, December 14, 2020–February 14, 2021*

Jurisdiction and demographic characteristic	Completion status† among persons with sufficient time to receive second dose (%)				Dosing interval among persons who received second dose (%)				
	No.	Completed series	No second dose but remained within allowable interval§	Missed second dose¶	No.	Early**	During recommended interval††	After recommended interval but within allowable interval§§	Late¶¶
Total, no. (%)	**12,496,258**	**10,999,097 (88.0)**	**1,078,336 (8.6)**	**418,825 (3.4)**	**14,205,768**	**216,905 (1.5)**	**13,582,544 (95.6)**	**392,935 (2.8)**	**13,384 (0.1)**
State/Area									
Alabama	**129,629**	(87.3)	(9.9)	(2.8)	**150,202**	(2.1)	(95.7)	(2.1)	(0.1)
Alaska	**57,293**	(90.5)	(6.9)	(2.6)	**68,344**	(0.9)	(97.9)	(1.2)	(0.0)
Arizona	**274,548**	(85.4)	(11.6)	(2.9)	**300,844**	(3.2)	(90.8)	(5.9)	(0.1)
Arkansas	**147,459**	(82.8)	(12.4)	(4.7)	**148,477**	(1.4)	(96.6)	(2.0)	(0.1)
California	**1,269,213**	(87.2)	(9.0)	(3.8)	**1,538,150**	(1.2)	(96.4)	(2.3)	(0.1)
Colorado	**280,523**	(94.2)	(4.1)	(1.7)	**328,338**	(0.9)	(97.4)	(1.6)	(0.1)
Connecticut	**234,761**	(82.9)	(14.5)	(2.6)	**256,784**	(7.5)	(86.4)	(5.3)	(0.8)
Delaware	**35,454**	(87.6)	(9.9)	(2.5)	**37,387**	(1.0)	(92.1)	(6.8)	(0.1)
District of Columbia	**45,206**	(85.6)	(10.4)	(4.0)	**46,137**	(1.3)	(96.4)	(2.2)	(0.0)
Florida	**1,094,586**	(87.8)	(9.1)	(3.1)	**1,218,397**	(2.0)	(95.4)	(2.6)	(0.1)
Georgia	**362,414**	(88.9)	(8.4)	(2.7)	**443,669**	(1.8)	(94.9)	(3.2)	(0.1)
Hawaii	**19,023**	(88.9)	(6.8)	(4.3)	**20,147**	(0.8)	(93.3)	(5.8)	(0.1)
Idaho	**54,880**	(93.1)	(4.9)	(2.0)	**70,856**	(1.4)	(97.2)	(1.3)	(0.1)
Illinois	**419,419**	(85.5)	(9.4)	(5.0)	**449,475**	(1.1)	(97.2)	(1.7)	(0.1)
Indiana	**275,381**	(90.3)	(8.7)	(1.0)	**312,681**	(1.0)	(96.8)	(2.1)	(0.1)
Iowa	**138,418**	(81.8)	(16.2)	(2.0)	**129,403**	(0.5)	(93.5)	(5.8)	(0.2)
Kansas	**116,535**	(87.0)	(7.6)	(5.4)	**122,686**	(2.0)	(94.6)	(3.4)	(0.1)
Kentucky	**199,398**	(84.0)	(10.2)	(5.8)	**210,892**	(0.6)	(96.1)	(3.3)	(0.1)
Louisiana	**234,624**	(94.4)	(4.7)	(0.9)	**274,481**	(0.9)	(98.3)	(0.8)	(0.0)
Maine	**62,633**	(89.2)	(5.8)	(4.9)	**68,479**	(0.3)	(98.2)	(1.3)	(0.1)
Maryland	**231,172**	(91.4)	(6.9)	(1.7)	**266,356**	(0.8)	(94.2)	(4.9)	(0.1)
Massachusetts	**294,106**	(82.1)	(11.4)	(6.6)	**305,083**	(1.3)	(96.6)	(2.0)	(0.1)
Michigan	**447,555**	(95.4)	(3.4)	(1.2)	**538,614**	(0.6)	(97.3)	(2.1)	(0.1)
Minnesota	**217,567**	(90.5)	(6.3)	(3.2)	**255,434**	(2.1)	(95.4)	(2.5)	(0.0)
Mississippi	**103,965**	(89.8)	(8.8)	(1.3)	**128,671**	(1.1)	(95.9)	(3.0)	(0.1)
Missouri	**216,227**	(93.0)	(4.5)	(2.5)	**265,192**	(0.6)	(96.9)	(2.4)	(0.1)
Montana	**50,572**	(90.9)	(5.4)	(3.6)	**57,032**	(1.4)	(95.4)	(3.1)	(0.2)
Nebraska	**94,464**	(90.3)	(5.4)	(4.3)	**102,101**	(0.7)	(96.5)	(2.7)	(0.1)
Nevada	**95,396**	(91.7)	(5.7)	(2.6)	**125,342**	(1.0)	(96.7)	(2.2)	(0.1)
New Hampshire	**84,323**	(93.5)	(4.2)	(2.3)	**95,776**	(8.7)	(82.3)	(8.3)	(0.7)
New Jersey	**324,161**	(87.7)	(9.1)	(3.1)	**388,744**	(0.6)	(97.5)	(1.9)	(0.0)
New Mexico	**142,008**	(87.4)	(8.5)	(4.1)	**163,459**	(1.4)	(96.0)	(2.5)	(0.1)
New York	**823,922**	(87.2)	(8.6)	(4.2)	**968,811**	(1.0)	(96.9)	(2.1)	(0.1)
North Carolina	**419,220**	(91.0)	(5.7)	(3.3)	**534,863**	(0.7)	(96.4)	(2.8)	(0.1)
North Dakota	**47,682**	(93.3)	(4.2)	(2.5)	**53,008**	(3.1)	(94.1)	(2.7)	(0.1)
Ohio	**436,574**	(89.6)	(7.7)	(2.7)	**515,733**	(1.4)	(95.0)	(3.5)	(0.1)
Oklahoma	**231,600**	(87.7)	(9.6)	(2.7)	**240,072**	(0.6)	(96.8)	(2.6)	(0.1)
Oregon	**189,028**	(92.9)	(5.5)	(1.6)	**213,812**	(0.6)	(96.7)	(2.6)	(0.1)
Pennsylvania	**479,037**	(87.6)	(9.2)	(3.2)	**522,255**	(1.6)	(96.0)	(2.4)	(0.1)
Rhode Island	**47,308**	(93.8)	(4.3)	(2.0)	**53,769**	(0.8)	(95.9)	(3.2)	(0.1)
South Carolina	**181,871**	(80.6)	(16.9)	(2.5)	**197,410**	(3.2)	(94.5)	(2.3)	(0.0)
South Dakota	**58,551**	(89.7)	(6.7)	(3.5)	**62,266**	(0.3)	(96.6)	(3.0)	(0.1)
Tennessee	**311,579**	(91.9)	(4.9)	(3.2)	**329,446**	(1.6)	(95.5)	(2.8)	(0.1)
Utah	**147,885**	(75.3)	(20.7)	(4.0)	**126,507**	(2.1)	(90.5)	(7.2)	(0.1)
Vermont	**36,563**	(91.9)	(5.3)	(2.8)	**38,759**	(1.2)	(97.6)	(1.2)	(0.0)
Virginia	**345,645**	(82.6)	(9.6)	(7.8)	**386,384**	(0.8)	(96.3)	(2.8)	(0.1)
Washington	**285,288**	(87.5)	(9.4)	(3.2)	**321,080**	(1.7)	(95.4)	(2.8)	(0.1)
West Virginia	**167,867**	(95.8)	(2.5)	(1.7)	**201,504**	(6.6)	(85.5)	(7.4)	(0.4)
Wisconsin	**216,685**	(93.5)	(5.2)	(1.3)	**260,163**	(0.6)	(96.5)	(2.9)	(0.0)
Wyoming	**27,746**	(88.2)	(9.5)	(2.3)	**31,486**	(1.4)	(95.8)	(2.8)	(0.1)

See table footnotes on the next page.

TABLE 2. (*Continued*) Second-dose completion status and interval between first and second dose among persons who initiated the COVID-19 vaccination series, by jurisdiction and demographic characteristics — United States, December 14, 2020–February 14, 2021*

Jurisdiction and demographic characteristic	Completion status† among persons with sufficient time to receive second dose (%)				Dosing interval among persons who received second dose (%)				
	No.	Completed series	No second dose but remained within allowable interval§	Missed second dose¶	No.	Early**	During recommended interval††	After recommended interval but within allowable interval§§	Late¶¶
Territories and freely associated states									
American Samoa	**3,509**	(95.9)	(2.9)	(1.3)	**6,047**	(0.2)	(99.4)	(0.4)	(0.0)
Federated States of Micronesia	**577**	(85.1)	(14.9)	(0.0)	**895**	(1.0)	(79.0)	(20.0)	(0.0)
Guam	**10,447**	(87.0)	(8.3)	(4.7)	**12,557**	(0.5)	(98.9)	(0.6)	(0.0)
Marshall Islands	**707**	(76.8)	(14.1)	(9.1)	**725**	(0.4)	(98.3)	(1.2)	(0.0)
Northern Mariana Islands	**4,408**	(98.7)	(0.6)	(0.7)	**5,266**	(0.1)	(99.7)	(0.2)	(0.1)
Palau	**726**	(99.7)	(0.3)	(0.0)	**1,566**	(0.1)	(99.9)	(0.1)	(0.0)
Puerto Rico	**138,612**	(79.0)	(15.1)	(5.9)	**128,887**	(1.0)	(98.5)	(0.5)	(0.0)
U.S. Virgin Islands	**4,107**	(85.1)	(9.2)	(5.6)	**4,211**	(1.9)	(94.8)	(3.1)	(0.1)
Demographic characteristics									
Race/Ethnicity***	**6,764,604**	—	—	—	**8,002,280**	—	—	—	—
AI/AN, non-Hispanic	**145,449**	(83.7)	(11.2)	(5.1)	**148,823**	(1.5)	(96.0)	(2.4)	(0.1)
Asian, non-Hispanic	**365,379**	(90.2)	(7.0)	(2.8)	**428,595**	(1.2)	(95.9)	(2.8)	(0.1)
Black, non-Hispanic	**366,442**	(88.8)	(8.6)	(2.6)	**436,647**	(1.8)	(95.1)	(3.1)	(0.1)
Hispanic	**718,384**	(87.0)	(9.5)	(3.5)	**812,235**	(1.4)	(95.8)	(2.8)	(0.1)
Multiple/Other, non-Hispanic	**1,013,031**	(86.1)	(10.7)	(3.2)	**1,152,231**	(1.4)	(96.5)	(2.0)	(0.1)
NHPI, non-Hispanic	**17,755**	(90.3)	(6.8)	(2.9)	**20,042**	(1.0)	(96.1)	(2.7)	(0.1)
White, non-Hispanic	**4,138,164**	(90.3)	(7.4)	(2.3)	**5,003,707**	(1.7)	(95.0)	(3.1)	(0.1)
Age group, yrs	**12,489,174**	—	—	—	**14,202,212**	—	—	—	—
16–44	**4,507,276**	(88.1)	(7.9)	(4.0)	**4,653,564**	(1.3)	(95.0)	(3.6)	(0.1)
45–64	**4,211,791**	(88.7)	(7.7)	(3.6)	**4,453,503**	(1.4)	(95.5)	(3.0)	(0.1)
≥65	**3,770,107**	(87.2)	(10.5)	(2.3)	**5,095,145**	(1.9)	(96.3)	(1.8)	(0.0)
Sex	**12,128,929**	—	—	—	**13,866,864**	—	—	—	—
Female	**7,675,229**	(88.4)	(8.4)	(3.2)	**8,630,313**	(1.5)	(95.6)	(2.8)	(0.1)
Male	**4,453,700**	(87.8)	(8.9)	(3.2)	**5,236,551**	(1.6)	(95.6)	(2.7)	(0.1)

Abbreviations: AI/AN = American Indian/Alaska Native; NHPI = Native Hawaiian or other Pacific Islander.

* Vaccines administered during December 14, 2020–February 14, 2021, and reported to CDC by February 20, 2021.

† Among persons who received their first dose on or before January 19 for Pfizer-BioNTech (>25 days between the first dose and February 14) or January 12 for Moderna (>32 days between the first dose and February 14).

§ 26–42 days (Pfizer-BioNTech) or 33–42 days (Moderna) after first dose; no second dose received.

¶ >42 days after first dose; no second dose received.

** Received second dose <17 days (Pfizer-BioNTech) or <24 days (Moderna) after first dose.

†† Received second dose 17–25 days (Pfizer-BioNTech) or 24–32 days (Moderna) after first dose.

§§ Received second dose 26–42 days (Pfizer-BioNTech) or 33–42 days (Moderna) after first dose.

¶¶ Received second dose >42 days after first dose.

*** Percentages were calculated among persons with available demographic characteristics.

Nearly 9 in 10 persons with sufficient time to receive their second COVID-19 vaccine dose completed the series and did so within the recommended interval. Missed doses and second doses administered outside the recommended interval were infrequent but varied by jurisdiction and demographic groups. Public health officials and providers should work to better understand the reasons for lack of completion of the COVID-19 vaccination series and early and delayed intervals. To ensure completeness and equity in series completion, CDC provides technical assistance[¶¶¶] to improve strategies for completion within the recommended time intervals. Jurisdictions can work with providers to prioritize second doses to ensure vaccination series completion, reschedule persons whose vaccination appointments were canceled, repurpose missed second doses, and promote the importance of receiving a second dose for achieving maximum vaccine effectiveness. Providers can focus on support strategies such as scheduling follow-up visits during initial scheduling or first-dose administration and sending reminder notices before and after the recommended second-dose interval. Continued monitoring of series completion status across jurisdictions and by demographic characteristics is important to ensure equity in vaccine administration and vaccination coverage, especially as vaccination efforts expand to additional population groups.

¶¶¶ https://www.cdc.gov/vaccines/covid-19/toolkits/index.html

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Effectiveness of the Pfizer-BioNTech COVID-19 Vaccine Among Residents of Two Skilled Nursing Facilities Experiencing COVID-19 Outbreaks — Connecticut, December 2020–February 2021

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Residents of long-term care facilities (LTCFs), particularly those in skilled nursing facilities (SNFs), have experienced disproportionately high levels of COVID-19–associated morbidity and mortality and were prioritized for early COVID-19 vaccination (*1*,*2*). However, this group was not included in COVID-19 vaccine clinical trials, and limited postauthorization vaccine effectiveness (VE) data are available for this critical population (*3*). It is not known how well COVID-19 vaccines protect SNF residents, who typically are more medically frail, are older, and have more underlying medical conditions than the general population (*1*). In addition, immunogenicity of the Pfizer-BioNTech vaccine was found to be lower in adults aged 65–85 years than in younger adults (*4*). Through the CDC Pharmacy Partnership for Long-Term Care Program, SNF residents and staff members in Connecticut began receiving the Pfizer-BioNTech COVID-19 vaccine on December 18, 2020 (*5*). Administration of the vaccine was conducted during several on-site pharmacy clinics. In late January 2021, the Connecticut Department of Public Health (CT DPH) identified two SNFs experiencing COVID-19 outbreaks among residents and staff members that occurred after each facility's first vaccination clinic. CT DPH, in partnership with CDC, performed electronic chart review in these facilities to obtain information on resident vaccination status and infection with SARS-CoV-2, the virus that causes COVID-19. Partial vaccination, defined as the period from >14 days after the first dose through 7 days after the second dose, had an estimated effectiveness of 63% (95% confidence interval [CI] = 33%–79%) against SARS-CoV-2 infection (regardless of symptoms) among residents within these SNFs. This is similar to estimated effectiveness for a single dose of the Pfizer-BioNTech COVID-19 vaccine in adults across a range of age groups in noncongregate settings (*6*) and suggests that to optimize vaccine impact among this population, high coverage with the complete 2-dose series should be recommended for SNF residents and staff members.

After identification of the first infected SNF resident or staff member through weekly surveillance testing, expanded facility-wide outbreak SARS-CoV-2 testing was performed frequently for residents and staff members at both facilities in accordance with CDC and CT DPH guidelines (*7*). All residents who had not received a positive test result in the preceding 90 days, regardless of symptoms, received a once-weekly (facility A) or twice-weekly (facility B) polymerase chain reaction (PCR) test. Staff members were also tested regularly (once-weekly antigen and once-weekly PCR test at facility A, and once-weekly PCR test at facility B). At both facilities, supplementary antigen testing was performed immediately for any resident or staff member who developed COVID-19 symptoms and for residents who had known COVID-19 exposures.

A retrospective cohort investigation using data from electronic medical record chart abstraction was conducted to assess vaccine effectiveness. This activity was reviewed by CDC and was conducted consistent with applicable federal law and CDC policy.[§] The investigation period started on the date of each SNF's first vaccination clinic (December 29, 2020 for facility A and December 21, 2020 for facility B) and ended on February 9, 2021 and February 12, 2021, respectively. Residents were included if they were admitted at either facility during one or more rounds of facility-wide SARS-CoV-2 testing during the week before or any time after their facility's first vaccination clinic. Data on residents were abstracted starting on the date of their SNF's first vaccination clinic or their admission into the facility, whichever occurred later. Electronic medical record data included demographic characteristics, facility admission and discharge dates, vaccination dates, symptoms of COVID-19 occurring within 7 days before or 14 days after a positive test result, presence of underlying medical conditions associated with potential increased risk for severe COVID-19 illness,[¶] and measures of outcome, including hospitalization

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[§] This investigation was defined as having met the requirements for public health surveillance as outlined in 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.

[¶] Conditions based on CDC guidelines identifying conditions associated or potentially associated with risk for severe COVID-19 illness. List of conditions available at https://www.cdc.gov/coronavirus/2019-ncov/need-extra-precautions/people-with-medical-conditions.html.

and death. SARS-CoV-2 test dates, test types, and results were also obtained from the electronic medical record.

A case was defined as any positive PCR- or antigen-based SARS-CoV-2 test result during the investigation period in a resident meeting the cohort inclusion criteria. Case date was defined as either the date of symptom onset or positive SARS-CoV-2 test result, whichever occurred earlier. Positive SARS-CoV-2 test results received before the investigation period were identified for each resident using the Connecticut Electronic Disease Surveillance System.

Person-time began on the date of the facility's first vaccination clinic or the date the resident was admitted, whichever occurred later. Residents stopped contributing person-time to the investigation on the case date, the final facility discharge date or date of death if applicable, or the final day of the investigation period, whichever occurred earlier. Resident person-time was categorized as 1) unvaccinated (days from cohort entry until receipt of first vaccine dose), 2) time before first vaccine dose effect (day 0 [date of vaccination] through day 14 after first dose), 3) partially vaccinated (>day 14 after first dose through day 7 after second dose), or 4) fully vaccinated (>7 days after second dose).

Assuming a common VE against SARS-CoV-2 infection at both facilities, a Cox proportional hazards model with baseline hazard rates stratified by facility was applied to estimate the VE, with VE = 100% × (1–hazard ratio); 95% CIs were calculated using robust CI methods.** Use of a time-to-event analysis was necessary to adjust for expected heterogeneity in risk for infection across the investigation period attributable to underlying outbreak dynamics. Kaplan-Meier curves of SARS-CoV-2 infection were constructed to visualize the cumulative infection-free proportion of residents; 95% CIs were calculated using Greenwood's method.†† Sensitivity analyses were conducted with exclusion of residents with past confirmed SARS-CoV-2 infection and using two alternative endpoints for partial vaccination (ending on second dose +0 days and second dose +14 days). The time before first dose vaccine effect was excluded from the analysis, because immune status could not be clearly categorized. Small sample sizes precluded separate analyses of VE against symptomatic or severe disease. R statistical software (version 4.0.2; The R Foundation) was used to conduct all analyses.

A total of 463 residents were enrolled, including 142 (31%) from facility A and 321 (69%) from facility B. Demographic characteristics such as age and race were similar in residents at each facility (although ethnicity could not be reported because ethnicity data were missing for 30% of residents); prevalences of underlying conditions that increase the risk for severe COVID-19 illness were also similar in residents at each facility (Table). The median number of high-risk conditions per resident was three; five (1.1%) residents had no underlying high-risk conditions. Among the 463 residents, 115 (24.8%) had confirmed SARS-CoV-2 infection before the investigation period; two of 34 (6%) residents at facility A and 68 of 81 (84%) residents at facility B with past confirmed SARS-CoV-2 infection had a positive test result ≤3 months prior to investigation start.

During the investigation period, 97 cases of SARS-CoV-2 infection occurred, including 40 (41%) at facility A and 57 (59%) at facility B (Figure 1). Including nonspecific symptoms such as malaise, lethargy, and decreased appetite, at least one COVID-19 symptom was reported in 86 (88.7%) cases.§§ By the date of discharge or the last day of the investigation, 304 residents (65.7%) had received 2 vaccine doses, 72 (15.6%) had received 1 dose only, and 87 (18.8%) had not received any doses. A total of 16,969 person-days were observed during the investigation period, with 39 cases occurring during 3,573 days categorized as unvaccinated person-time, 26 cases during 4,588 days of person-time before first vaccine dose effect, 25 cases during 4,147 days of partially vaccinated person-time, and seven cases during 4,661 days of fully vaccinated person-time.

Estimated effectiveness of partial vaccination in preventing SARS-CoV-2 infection was 63% (95% CI = 33%–79%) and was similar when residents with past SARS-CoV-2 were excluded (VE = 60%, 95% CI = 30%–77%). VE estimates were also similar in both partial vaccination endpoint sensitivity analyses (second dose +0 days VE = 66%, 95% CI = 29%–83%; second dose +14 days VE = 60%, 95% CI = 33%–77%). As a result of the course of the outbreaks at both facilities, most cases occurred toward the start of the investigation period (Figure 2), and because the cohort began at the first vaccination clinic, most of the unvaccinated person-time also occurred toward the start of the investigation period. Thus, once residents became fully vaccinated (second dose +7 days) toward the end of the investigation period, there were insufficient new cases and remaining person-time in the unvaccinated group to serve as a comparator for estimation of full 2-dose VE.

** Halloran ME, Longini IM Jr, Struchiner CJ. Design and analysis of vaccine studies. Statistics for biology and health. New York, NY: Springer; 2009.

†† Greenwood M. The natural duration of cancer. In: Reports on public health and medical subjects. London, United Kingdom: Her Majesty's Stationery Office; 1926:1–26.

§§ Clinician judgement during chart abstraction was used to distinguish COVID-19 symptoms from those potentially associated with vaccination or other illness. Symptoms had to be new onset within 7 days before or 14 days after a positive test result. Symptom-onset date was available for 80 of 86 cases classified as symptomatic (93%). Among those 80 cases for which symptom-onset date was available, only four (5%) had a symptom-onset date within the 48 hours after receiving a vaccine.

TABLE. Demographic characteristics, COVID-19 vaccination status, and SARS-CoV-2 infection, symptom, and outcome information among residents of two skilled nursing facilities — Connecticut, December 21, 2020–February 12, 2021

Characteristic	No. (%) of residents* Total (N = 463)	Facility A (n = 142)	Facility B (n = 321)	p-value†,§
Sex				
Female	**294 (63.5)**	82 (57.8)	212 (66.0)	0.09
Male	**169 (36.5)**	60 (42.3)	109 (34.0)	
Age group, yrs				
<60	**23 (5.0)**	18 (12.7)	5 (1.6)	<0.001
60–64	**19 (4.1)**	12 (8.5)	7 (2.2)	
65–69	**34 (7.3)**	16 (11.3)	18 (5.6)	
70–74	**46 (9.9)**	14 (9.9)	32 (10.0)	
75–79	**56 (12.1)**	17 (12.0)	39 (12.2)	
80–84	**54 (11.7)**	15 (10.6)	39 (12.2)	
≥85	**231 (49.9)**	50 (35.2)	181 (56.4)	
Race¶				
American Indian/Alaska Native	**1 (0.2)**	0 (0.0)	1 (0.3)	0.57§
Asian	**5 (1.1)**	1 (0.7)	4 (1.3)	
Black	**16 (3.5)**	5 (3.5)	11 (3.4)	
Native Hawaiian/Pacific Islander	**1 (0.2)**	0 (0.0)	1 (0.3)	
White	**428 (92.4)**	135 (95.1)	293 (91.3)	
Unknown	**12 (2.6)**	1 (0.7)	11 (3.4)	
High-risk medical conditions**				
Obesity	**44 (9.5)**	16 (11.3)	28 (8.7)	0.39
Chronic kidney disease	**92 (19.9)**	32 (22.5)	60 (18.7)	0.34
End-stage renal disease requiring dialysis	**3 (0.7)**	2 (1.4)	1 (0.3)	0.22§
Diabetes mellitus (type I or II)	**131 (28.3)**	51 (35.9)	80 (24.9)	0.02
Cancer (not in remission)	**28 (6.1)**	9 (6.3)	19 (5.9)	0.86
Autoimmune disease	**33 (7.1)**	13 (9.2)	20 (6.2)	0.26
Chronic heart or cardiovascular disease	**186 (40.2)**	55 (38.7)	131 (40.8)	0.67
Hypertension	**352 (76.0)**	103 (72.5)	249 (77.6)	0.24
COPD/Sleep apnea/Other chronic respiratory condition	**94 (20.3)**	34 (23.9)	60 (18.7)	0.20
Immunocompromising conditions††	**9 (1.9)**	4 (2.8)	5 (1.6)	0.47§
Neurologic/Neurodevelopmental disorders§§	**346 (74.7)**	105 (73.9)	241 (75.1)	0.80
Other chronic diseases	**66 (14.3)**	7 (4.9)	59 (18.4)	0.001
None of these conditions	**5 (1.1)**	1 (0.7)	4 (1.2)	0.10§
History of past COVID-19				
Yes	**115 (24.8)**	34 (23.9)	81 (25.2)	0.76
>3 months before investigation start	**45 (9.7)**	32 (22.5)	13 (4.0)	<0.001
≤3 months before investigation start	**70 (15.1)**	2 (1.4)	68 (21.2)	
Vaccination coverage among all residents¶¶				
None	**87 (18.8)**	32 (22.5)	55 (17.1)	0.09
1 dose only	**72 (15.6)**	27 (19.0)	45 (14.0)	
2 doses	**304 (65.7)**	83 (58.5)	221 (68.8)	
Interval between vaccine doses				
Days between doses 1 and 2, median (range)	**21 (21–42)**	21 (21–42)	21 (21–32)	N/A
Cases				
All cases	**97 (21.0)**	40 (28.2)	57 (17.8)	0.01
Symptomatic, no. (% of cases)	**86 (88.7)**	33 (82.5)	53 (93.0)	0.19§

See table footnotes on the next page.

Discussion

Partial vaccination with the Pfizer-BioNTech COVID-19 vaccine was 63% effective in preventing new SARS-CoV-2 infections in SNF residents, a disproportionately affected population excluded from initial preauthorization vaccine clinical trials. Even during a large disease outbreak in a long-term care setting, the Pfizer-BioNTech vaccine provided protection against SARS-CoV-2 infection, including in older adults aged ≥65 years with a high prevalence of underlying medical conditions. The findings in this report are comparable to other first-dose vaccine efficacy and effectiveness estimates for the Pfizer-BioNTech vaccine for the broader adult population in noncongregate settings. In the phase 3 clinical trial, efficacy during the interval between first and second doses was estimated at 52% (95% CI = 30%–68%) (*8*). In a recent study of the Pfizer-BioNTech vaccine in Israel, effectiveness against PCR-confirmed infection in the general adult population

TABLE. (*Continued*) Demographic characteristics, COVID-19 vaccination status, and SARS-CoV-2 infection, symptom, and outcome information among residents of two skilled nursing facilities — Connecticut, December 21, 2020–February 12, 2021

Characteristic	No. (%) of residents* Total (N = 463)	Facility A (n = 142)	Facility B (n = 321)	p-value†,§
Reported symptoms, no. (% of cases)				
None	**11 (11.3)**	7 (17.5)	4 (7.0)	0.19§
Fever and chills	**24 (24.7)**	5 (12.5)	19 (33.3)	0.02
Cough	**63 (65.0)**	21 (52.5)	42 (73.7)	0.03
Shortness of breath/Difficulty breathing	**18 (18.6)**	8 (20.0)	10 (17.5)	0.76
Myalgias	**7 (7.2)**	0 (0.0)	7 (12.3)	0.04§
Headaches	**3 (3.1)**	2 (5.0)	1 (1.8)	0.57§
Sore throat	**5 (5.2)**	0 (0.0)	5 (8.8)	0.08§
New loss of taste or smell	**1 (1.0)**	0 (0.0)	1 (1.8)	N/A
Congestion/Rhinorrhea	**16 (16.5)**	6 (15.0)	10 (17.5)	0.74
Abdominal pain	**3 (3.1)**	2 (5.0)	1 (1.8)	0.57§
Nausea/Vomiting	**12 (12.4)**	2 (5.0)	10 (17.5)	0.11§
Diarrhea	**6 (6.2)**	1 (2.5)	5 (8.8)	0.40§
Confusion/Altered mental status	**21 (21.7)**	11 (27.5)	10 (17.5)	0.24
Other***	**65 (67.0)**	26 (65.0)	39 (68.4)	0.72
Vaccination status on case date, no. (% of cases)				
Unvaccinated	**39 (40.2)**	15 (37.5)	24 (42.1)	0.16§
Before dose 1 effect (day 0 through day 14 after dose 1)	**26 (26.8)**	15 (37.5)	11 (19.3)	
Partially vaccinated (>day 14 after dose 1 through day 7 after dose 2)	**25 (25.8)**	9 (22.5)	16 (28.1)	
Fully vaccinated (>7 days after dose 2)	**7 (7.2)**	1 (2.5)	6 (10.5)	
Outcomes,††† no. (% of cases)				
Hospitalization	**15 (15.5)**	4 (10.0)	11 (19.3)	0.21
Vital status dead or unknown				
Death from COVID-19	**17 (17.5)**	7 (17.5)	10 (17.5)	0.55§
Death after diagnosis (no cause specified)	**4 (4.1)**	1 (2.5)	3 (5.3)	
Vital status unknown	**3 (3.1)**	0 (0.0)	3 (5.3)	

Abbreviations: COPD = chronic obstructive pulmonary disease; N/A = not applicable.

* Percentages might not sum to 100% because of rounding.

† P-values for the comparisons between facilities apply Pearson's chi-square test for independence unless marked. For mutually exclusive categories of a characteristic a single p-value is reported. For characteristics for which more than one category might be true for a resident (e.g., symptoms), individual p-values are reported for each category.

§ In cases with cell counts <5, Fisher's exact test was used to calculate the p-value.

¶ Ethnicity is not reported because data were missing for 30% of residents.

** Conditions associated with potential increased risk for severe COVID-19 illness per CDC guidelines.

†† HIV coinfection (not virally suppressed), chemotherapy within past 12 months, solid-organ or bone marrow transplant, long-term steroid use (20 mg per day for >1 month), taking immunosuppressants, or taking tumor necrosis factor-alpha inhibitors.

§§ Examples include seizure disorders such as epilepsy, Alzheimer disease, dementia, traumatic brain injuries, and stroke.

¶¶ Vaccination is reported as the percentage of all residents included in the investigation that received no dose, 1 dose, or 2 doses of Pfizer-BioNTech COVID-19 vaccine by the date of their discharge from the facility or the end of the investigation if they were still admitted to the facility. Absolute coverage in the facility changed daily because of changes in census.

*** Other symptoms included lethargy, fatigue, generalized weakness, malaise, decreased appetite or loss of appetite, and agitation.

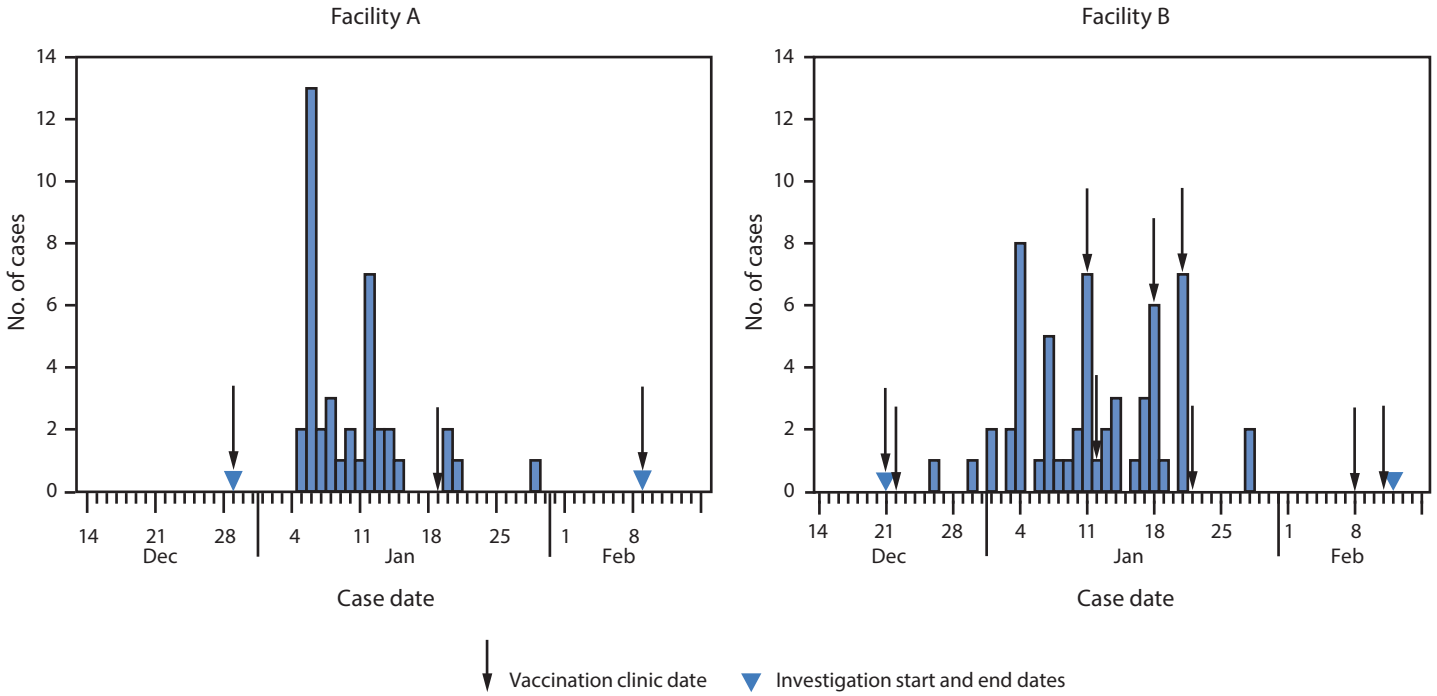
††† Case outcomes include minimum number of confirmed COVID-19–related hospitalizations and COVID-19 deaths confirmed by the Office of the Chief Medical Examiner. Hospitalizations and deaths that occurred after the investigation period were not ascertained.

during days 14–20 and 21–27 after the first dose was 46% (95% CI = 40%–51%) and 60% (95% CI = 53%–66%, respectively) (*6*). Effectiveness was somewhat lower during days 14–20 and 21–27 among persons aged ≥70 years (22%; 95% CI = −9%–44% and 50%; 95% CI = 19%–72%, respectively) and among those with three or more underlying medical conditions (37%; 95% CI = 12%–55% and 37%; 95% CI = −1%–62%) (*6*).

In this investigation, nearly 25% of residents had confirmed past SARS-CoV-2 infection. Serologic studies have indicated that preexisting immunity might strengthen the response to a single dose of COVID-19 vaccine (*9*). A sensitivity analysis excluding person-time contributed by residents with confirmed past infections did not substantially alter VE estimates for residents receiving the first vaccine dose. Among residents in this investigation with past confirmed SARS-CoV-2 infection, first-dose vaccination rates were >90%, and only one reinfection was documented, limiting the ability to determine the impact of past infection.

The findings in this report are subject to at least seven limitations. First, because there were no clear factors that would differentially affect the risk for infection among residents within either facility, such as units with higher attack rates or different infection prevention practices, each observation in the model was treated as independent. If risk was not independent, this could have biased the VE estimates. Second, 2-dose VE

FIGURE 1. New SARS-CoV-2 cases* among residents of two skilled nursing facilities, by case date† — Connecticut, December 21, 2020–February 12, 2021§



* Any positive SARS-CoV-2 polymerase chain reaction or antigen test result.
† Symptom onset date or positive test result date, whichever occurred earlier.
§ Investigation period was December 29, 2020–February 9, 2021 for facility A and December 21, 2020–February 12, 2021 for facility B.

estimates were not possible because unvaccinated cases and person-time after second-dose vaccination clinics were insufficient. Third, small sample sizes did not allow for analyses of secondary endpoints, such as effectiveness against symptomatic illness, hospitalization, or death. Fourth, although there was no change in guidance around outbreak control measures such as cohorting and other infection prevention and control strategies concurrent with vaccine introduction, had these measures been implemented differently for vaccinated and unvaccinated residents, VE estimates could have been biased. Fifth, racial minority groups were underrepresented in this investigation compared with the general population of older adults, and ethnicity data were missing for approximately one third of residents, which might affect generalizability to other SNF populations. Sixth, although excluding person-time from residents with known past confirmed SARS-CoV-2 infection did not influence VE estimates in this analysis, there could have been residents with unknown past infection who could still have acted as a source of potential bias. Finally, unrecognized underlying differences between vaccinated and unvaccinated residents might have confounded the effectiveness estimates. Strengths of the investigation include accurate collection of vaccination data through direct abstraction from resident electronic medical records and active ascertainment of SARS-CoV-2 infection through frequent, facility-wide resident testing.

Findings from this retrospective cohort analysis demonstrate that partial vaccination with the Pfizer-BioNTech COVID-19 vaccine was associated with a significant reduction in the risk for SARS-CoV-2 infection among SNF residents. These results, coupled with the findings from a previous study among comparable older adult populations in Israel that reported more robust protection after the second dose (*6*), suggest that complete 2-dose vaccination is an important strategy for preventing COVID-19 in this disproportionately affected population. Further study of this population should continue as larger sample sizes become available. LTCFs and jurisdictions should actively ensure that they have plans in place for continued allocation and administration of COVID-19 vaccines to residents and staff members (*10*).

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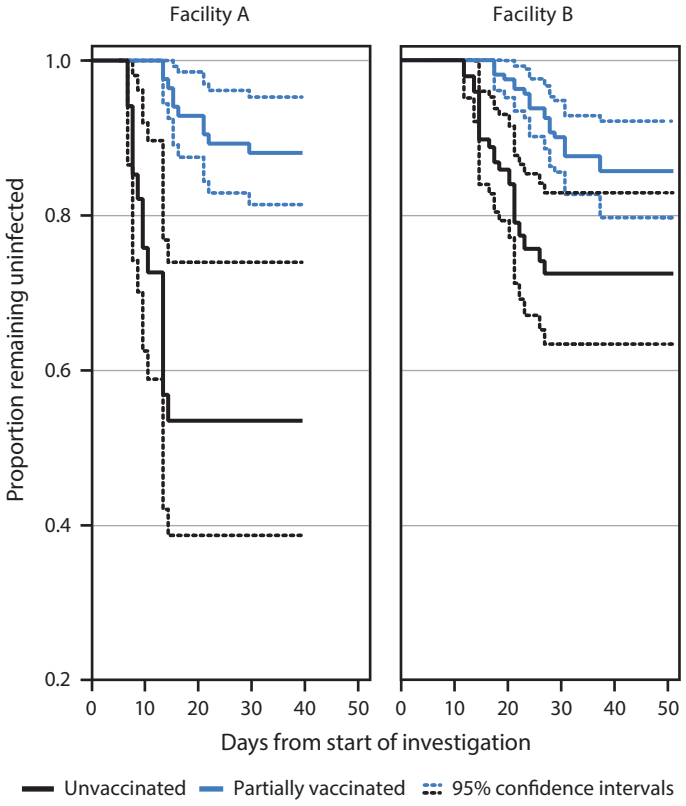
FIGURE 2. Proportion of skilled nursing facility residents who remained uninfected with SARS-CoV-2 during the investigation period,* by COVID-19 vaccination status† and facility — Connecticut, December 21, 2020–February 12, 2021



* Investigation period was December 29, 2020–February 9, 2021 for facility A and December 21, 2020–February 12, 2021 for facility B.

† Vaccination status is classified as unvaccinated or partially vaccinated. Partially vaccinated refers to the time from day 14 after first dose of Pfizer-BioNTech COVID-19 vaccine through day 7 after the second dose. Greenwood's method was used to estimate confidence intervals around the Kaplan-Meier estimator.

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Summary

What is already known about this topic?

Skilled nursing facility (SNF) residents, generally older and with more underlying medical conditions than community-dwelling adults, were not included in COVID-19 vaccine clinical trials. Little is known about COVID-19 vaccine effectiveness in SNF residents.

What is added by this report?

A retrospective cohort analysis in two Connecticut SNFs found partial vaccination with Pfizer-BioNTech COVID-19 vaccine (from >14 days after dose 1 through 7 days after dose 2) to be 63% (95% confidence interval = 33%–79%) effective against SARS-CoV-2 infection.

What are the implications for public health practice?

Even with partial vaccination, Pfizer-BioNTech COVID-19 vaccine provides protection to SNF residents. To optimize vaccine impact among this population, high coverage with the complete 2-dose series is recommended.

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Notes from the Field

SARS-CoV-2 Transmission Associated with High School Football Team Members — Florida, September–October 2020

Molly Siegel, MPH[1]; Bernhard Kloppenburg, MPH[1]; Samantha Woerle[1]; Scott Sjoblom, MDiv[1]; Gregory Danyluk, PhD[1]

On September 23, 2020, administrators from a Florida high school were notified of a confirmed COVID-19* case in a player on the school's football team (the index patient). The administrators informed the Florida Department of Health (FDOH), which determined that all other team members (49 players and four coaches) should be quarantined† because of close contact§ with the index patient. By September 26, 2020, FDOH was notified of six additional team members with COVID-19 who were linked to the index patient by contact tracing.¶ FDOH assessed the extent of transmission of SARS-CoV-2, the virus that causes COVID-19, among team members who had received positive SARS-CoV-2 test results as of September 26 and on October 6, conducted a school environmental assessment** to identify factors that might have contributed to transmission. Through a review of case reports received from health care providers and interviews with close contacts, FDOH identified 19 COVID-19 patients linked to the team, including 14 team members (12 of 50 players and two of four coaches), two nonplayer classroom contacts, and three household contacts of other team members; 18 cases were confirmed, and one was classified as probable. Thirty-one of 50 players and one of four coaches did not have test results available for review. Because the investigation was deemed a public health response, approval by the FDOH Institutional Review Board was not required.

Among the 14 team members with COVID-19, seven were symptomatic††; among these patients, the first onset date was September 17 (Figure). During the preceding 2 weeks, the team had held afternoon practices Monday through Thursday. Practices included outdoor exercise drills, scrimmages, play run-throughs, and hydration breaks and indoor film reviews and strength conditioning. The team played against opposing teams on September 11, 17, and 18. Mask use was infrequent during practice, and masks were not worn when playing other teams. No players from opposing teams were known to have COVID-19. The 14-day incidence was 163 cases per 100,000 persons within the school zone population,§§ compared with 199 within the county (*1*). Because of potential close contact between team members with COVID-19 and classmates, 267 students at the football team's school were quarantined, resulting in approximately 2,243 person-days of lost in-person learning.¶¶

Factors that likely contributed to team transmission included 1) infrequent mask use in the weight room or during practice; 2) inadequate physical distancing and air ventilation on buses transporting players (windows remained closed); 3) infrequent cleaning and disinfection of locker rooms, weight room equipment, and communal areas (e.g., hallways and bathrooms) before and after practices; and 4) insufficient sanitizing of shared hydration system drinking nozzles between uses.

* According to the Florida Department of Health, a confirmed case was defined as receipt of a positive SARS-CoV-2 reverse transcription–polymerase chain reaction (RT-PCR) test result. A probable case was defined as the occurrence of signs and symptoms of COVID-19 (e.g., cough, dyspnea, fever, myalgia, or headache) in a person who had close contact with someone who had received a positive SARS-CoV-2 RT-PCR result in the 14 days preceding illness onset during the investigation period. http://www.floridahealth.gov/diseases-and-conditions/disease-reporting-and-management/disease-reporting-and-surveillance/_documents/covid-19-case-definition.pdf

† At the time, asymptomatic close contacts were advised to quarantine for 14 days from the date of last exposure to a patient with a confirmed or probable case of COVID-19. Close contacts who developed symptoms within the 14-day quarantine period were advised to seek medical care and testing. If the symptomatic contact received a negative test result by RT-PCR for SARS-CoV-2, the person was advised that he or she could return to school and activities after the 14-day quarantine period and symptoms had resolved. Contacts who tested positive were advised to isolate for 10 days.

§ Close contact was defined as being ≥6 ft of a person with confirmed or probable COVID-19 for 15 minutes or longer within 24 hours beginning 2 days before the person became symptomatic or 2 days before specimen collection for asymptomatic persons.

¶ Contact tracing included reviewing classroom seating charts to determine which students had come into close contact with team members who had tested positive for COVID-19. If a class did not have a seating chart, the entire class was quarantined.

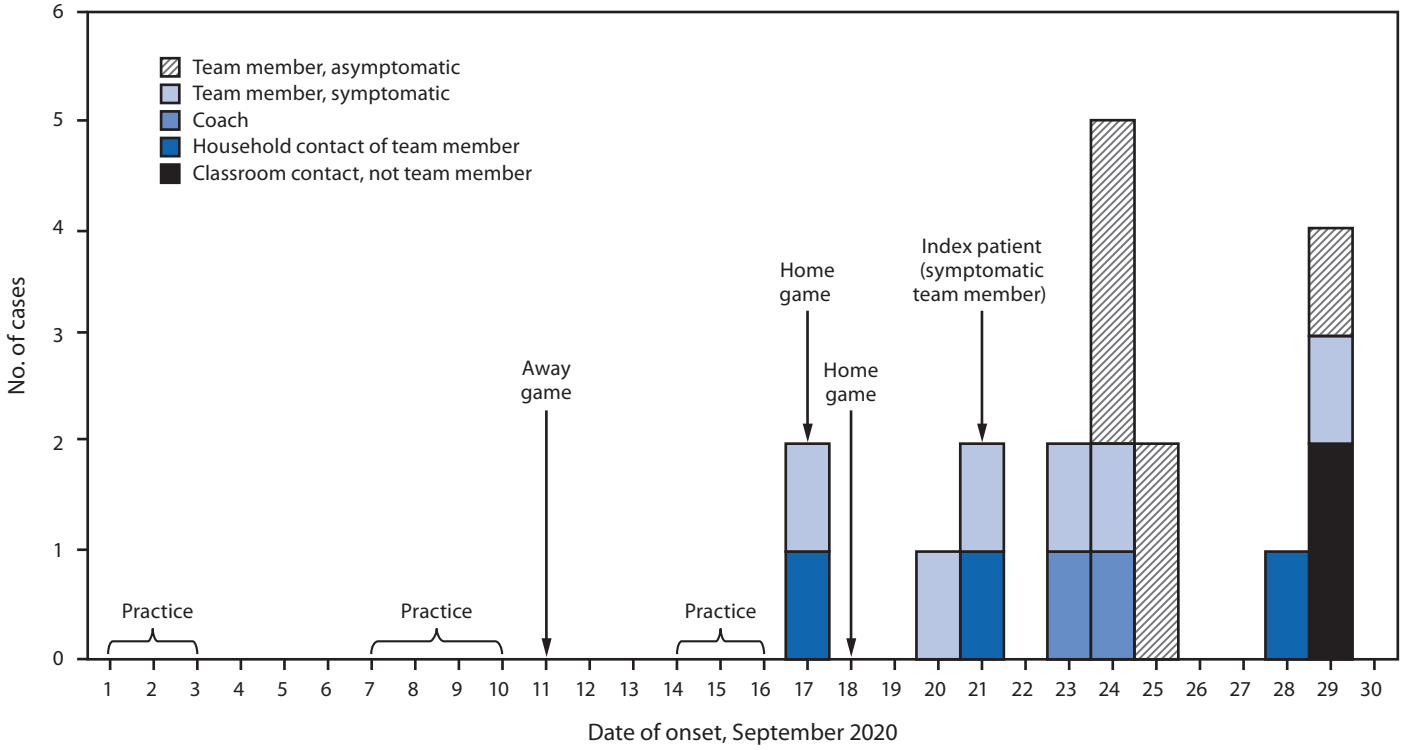
** The environmental assessment was based on a modified infection control assessment and response for nursing homes from CDC (https://www.cdc.gov/coronavirus/2019-ncov/hcp/assessment-tool-for-nursing-homes.html). Various areas of the school were assessed for transmission, including practice areas, buses, weight room, locker room, classrooms, bathrooms, and common areas. Interviews with students and staff members confirmed and explained how these areas were used.

†† https://www.cdc.gov/coronavirus/2019-ncov/symptoms-testing/symptoms.html

§§ The school zone is the geographic boundary that the school district uses in determining which students should attend a particular school based on their home address. Incidence was calculated using the total population of residents living within that boundary as the denominator, and the number of cases identified within the school zone (using geographic information system software to geocode reported cases by address) during September 17–30, as the numerator.

¶¶ The school reported that 51% of their high school students were in-person learners. Using the date of specimen collection for patients and exposure date for contacts, the number of missed days of school was calculated, accounting for weekends. Patients isolated for 10 days and contacts quarantined for 14 days. The number of missed school days for patients and contacts was summed and multiplied by the percentage of in-person learners (51%) to arrive at the estimated number of lost in-person school days.

FIGURE. Transmission of SARS-CoV-2 among persons associated with a high school football team,* by date of onset† — Florida, September 2020



* A total of 19 persons with COVID-19 who were linked to the team, including 12 players, two coaches, two classmate contacts who were not team members, and three household contacts of the team members. This included persons who received a positive SARS-CoV-2 test result from reverse transcription–polymerase chain reaction or who met the probable symptomatic case definition for COVID-19 during the investigation period.
† Date of symptom onset for persons with symptomatic COVID-19 and specimen collection date for persons with asymptomatic COVID-19.

SARS-CoV-2 transmission among team members likely occurred during practice. Football and other contact sports involve frequent, direct contact, as well as physical exertion that can result in heavy respiration and higher rates of emission of virus particles (*2*–*4*). FDOH recommended that the school address the identified factors likely contributing to transmission and that the football team conduct nonphysical activities (e.g., play reviews) virtually rather than in-person. The school prevented additional exposures among staff members and students by quarantining the football team after being notified of the first player with COVID-19.

The findings in this report are subject to at least two limitations. First, testing was voluntary; not all players and classroom close contacts sought testing during their quarantine. Second, some asymptomatic persons with COVID-19 might not have been identified; therefore, the extent of SARS-CoV-2 transmission might have been underestimated.

To prevent school transmission of SARS-CoV-2 and lost quarantine-related in-person school days, school sports teams should implement recommended CDC strategies to prevent spread of COVID-19, including maintaining a distance of ≥6 ft between persons, routine mask use during practice, and testing to identify asymptomatic infected players and staff members.*** Schools should also limit extracurricular activities, including in-person sports, to minimize risk for transmission in schools and protect in-person learning as part of their mitigation strategy.†††

*** https://www.cdc.gov/coronavirus/2019-ncov/community/schools-childcare/schools.html
††† https://www.cdc.gov/coronavirus/2019-ncov/community/schools-childcare/operation-strategy.html

Acknowledgments

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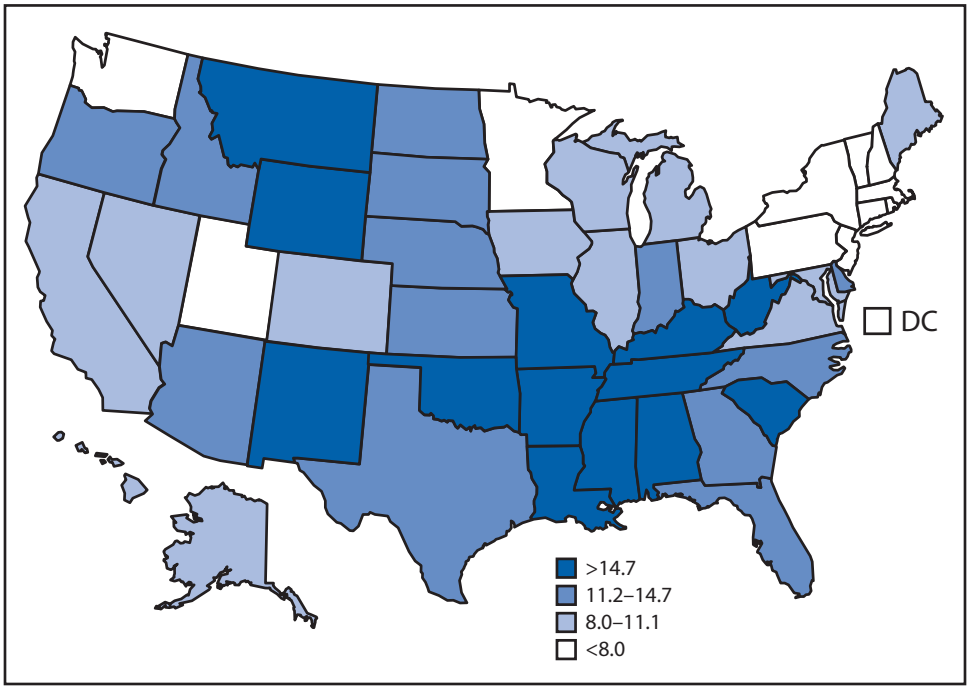
QuickStats

FROM THE NATIONAL CENTER FOR HEALTH STATISTICS

Age-Adjusted Death Rates* for Motor Vehicle Traffic Injury† — United States, 2019



Abbreviation: DC = District of Columbia.

* Age-adjusted death rates (deaths per 100,000 standard population) were calculated using the direct method and the 2000 U.S. standard population. The 2019 U.S. rate was 11.1.

† Motor vehicle traffic injuries are identified with *International Classification of Diseases, Tenth Revision* (ICD–10) codes V02–V04[.1,.9], V09.2, V12–V14[.3–.9], V19[.4–.6], V20–V28[.3–.9], V29–V79[.4–.9], V80[.3–.5], V81.1, V82.1, V83–V86[.0–.3], V87[.0–.8], and V89.2. Decedents included motor vehicle occupants, motorcyclists, pedal cyclists, and pedestrians.

In 2019, the death rate in the United States for motor vehicle traffic injury was 11.1 per 100,000 standard population. The four states with the highest age-adjusted death rates were Mississippi (24.2), Alabama (19.8), New Mexico (19.1), and South Carolina (18.9). The four jurisdictions with the lowest age-adjusted death rates were Rhode Island (6.1), District of Columbia (6.1), New York (5.1), and Massachusetts (4.9).

Source: National Vital Statistics System, Mortality, 2019. https://www.cdc.gov/nchs/nvss/deaths.htm

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

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