Original article

Adolescent Mental Health, Connectedness, and Mode of School Instruction During COVID-19

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A B S T R A C T

Background: Because COVID-19 was declared a pandemic in March 2020, nearly 93% of U.S. students engaged in some distance learning. These school disruptions may negatively influence adolescent mental health. Protective factors, like feeling connected to family or school may demonstrate a buffering effect, potentially moderating negative mental health outcomes. The purpose of the study is to test our hypothesis that mode of school instruction influences mental health and determine if school and family connectedness attenuates these relationships.
Methods: The COVID Experiences Survey was administered online or via telephone from October to November 2020 in adolescents ages 13–19 using National Opinion Research Center's AmeriSpeak Panel, a probability-based panel recruited using random address–based sampling with mail and telephone nonresponse follow-up. The final sample included 567 adolescents in grades 7–12 who received virtual, in-person, or combined instruction. Unadjusted and adjusted associations among four mental health outcomes and instruction mode were measured, and associations with school and family connectedness were explored for protective effects.
Results: Students attending school virtually reported poorer mental health than students attending in-person. Adolescents receiving virtual instruction reported more mentally unhealthy days, more persistent symptoms of depression, and a greater likelihood of seriously considering attempting suicide than students in other modes of instruction. After demographic adjustments school and family connectedness each mitigated the association between virtual versus in-person instruction for all four mental health indicators.
Conclusion: As hypothesized, mode of school instruction was associated with mental health outcomes, with adolescents receiving in-person instruction reporting the lowest prevalence of negative mental health indicators. School and family connectedness may play a critical role in buffering negative mental health outcomes.
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IMPLICATIONS AND CONTRIBUTION

Adolescents receiving virtual instruction reported more stress, mentally unhealthy days, persistent depression symptoms, and likelihood of seriously considering attempting suicide than students in other modes of instruction and may need additional support. School and family connectedness buffered these relationships.

Since the World Health Organization declared COVID-19 a pandemic on March 11, 2020, all 50 states in the U.S. closed schools for in-person learning at some point in time, with extended school closures from March 2020 through the end of the school year (May–June 2020) in 48 states [1]. In total, nearly 93% of U.S. students engaged in some form of distance learning during Spring 2020 [2]. In many cases, these closures continued into the fall of

2020 or winter of 2021, with large portions of students receiving fully virtual modes of learning, some in hybrid (i.e., partially in-person and partially virtual) and a smaller portion going to school fully in-person [3]. Mental health indicators tracked in the nationally representative Youth Risk Behavior Survey and the National Health and Nutrition Examination Survey identified a trend of declining youth mental health prior to the pandemic. For example, on the Youth Risk Behavior Survey, more youth in grades 9–12 reported being sad or hopeless over the past 2 weeks, reported that they stopped doing usual activities [4], and reported their mental health over the past 30 days was "not good" [5]. These declines in youth mental health may have been further exacerbated by the COVID-19 pandemic and associated school closures [6,7]. More recently, analysis of national trends in emergency department visits found increases in suicide-related visits among youth during the pandemic, with significantly greater increases among girls. The mean weekly number of emergency department visits involving suspected suicide for girls ages 12–17 was 50.6% higher in February–March 2021 compared to February–March 2019, with a 3.7% increase among boys of the same age during the same time period [8]. These results are consistent with two international longitudinal studies that also found associations between COVID-19 and youth mental health challenges. An Australian study reported increases in youth depressive symptoms and anxiety and significant decreases in life satisfaction over the course of the pandemic [9]. These negative mental health effects were predicted by COVID-19-related worries, online learning difficulties, and increased conflict with parents, and were reduced by feeling socially connected, defined as feeling connected to those close to them, and society more broadly. The second study, conducted in China with baseline collection in November 2019 (prepandemic) and follow-up data collection 6 months later during the pandemic, found significant increases in nonsuicidal self-injury, and suicidal ideation, plans, and attempts [10].

In prepandemic research, protective factors, like feeling connected to family or school, have demonstrated a buffering effect and moderated negative mental health outcomes, such as depression and anxiety [11] and may present opportunities for building resilience during and following the COVID-19 pandemic. School connectedness has been defined in a myriad of ways, but generally includes the subconstructs of student academic engagement; sense of belonging and fairness; engagement in school activities; positive peer relations; feeling safe at school; and feeling supported by teachers [12]. Family connectedness, or feeling loved, cared for, valued, and respected by one's parents or caregivers, is also critically important, and is similarly associated with buffering against poor mental health. Youth who report feeling close to their parents are less likely to experience depressive symptoms, suicidal ideation, nonsuicidal self-injury, and conduct problems [13]. Research has demonstrated the long-term benefits of both school and family connectedness, with adolescents with high levels of school and family connectedness having lower odds of many negative adult health outcomes, including emotional distress [14].

Research about the protective effects of school or family connectedness specific to youth and COVID-19 is scarce. One U.S. study found that parent-reported youth "positive adjustment" (interacts positively with siblings or family members, has positive social or peer relationships, talks about plans for the near or far future, hopeful or positive, etc.) buffered some negative mental health outcomes [15]. Research with adults on connectedness during COVID-19 and mental health indicates that overall social connectedness can protect against negative mental health, with more robust social connections associated with lower levels of distress and fatigue during the pandemic [16].

This manuscript is grounded in the social–ecological theory that views child and adolescent development as reciprocal processes that evolve over time as an adolescent interacts with individuals and environments including home, school, community, and broader society. Social–ecological theory has been suggested as a theoretical foundation to inform school psychological efforts because of its emphasis on promoting the mental health of all students [17]. During the course of the pandemic, youth may have experienced stress in their home and school environments and in their relationships with peers and family due to changes in school mode or to modifications to in-person school settings. Simultaneously, adolescent access to social support networks such as peers or extended family may have also shifted as a result of school closures and travel restrictions. These changes in the environments in which adolescents live, work, and play, may have influenced their mental health and well-being. Thus, this study investigates: (1) the association between mode of school instruction and mental health challenges, including symptoms of depression, mental health quality of life, stress, and suicidal ideation; (2) how the association between poor mental health and mode of school instruction varies by race/ethnicity, age, sex, and poverty level; and (3) how school and family connectedness influence the relationship between mental health and mode of school instruction.

Given the lack of data on the relationship between mode of school attendance and mental health challenges during the COVID-19 pandemic, the purpose of this study is to address this gap by describing: (1) the association between mode of school instruction and mental health challenges, including symptoms of depression, mental health quality of life, stress, and suicidal ideation; (2) how the association between poor mental health and mode of school instruction varies by race/ethnicity, age, sex, and poverty level; and (3) how school and family connectedness influence the relationship between mental health and mode of school instruction.

Methods

The COVID Experiences nationwide survey was administered online or via telephone from October 16 to November 6, 2020 in adolescents ages 13–19 using National Opinion Research Center's AmeriSpeak Panel, a probability-based panel of approximately 40,000 households recruited using random sampling from an address-based sample, to examine the relationship between adolescent mode of school instruction (i.e., in-person only [hereafter, in-person], virtual-only [hereafter, virtual], or both virtual and in-person [hereafter, combined]), for example, attending school in-person a few days a week and virtually a few days a week. Nonresponse follow-up was conducted via mail, e-mail, Internet, telephone, and in-person. The following groups were recruited for survey participation if they were English-speaking: (1) AmeriSpeak Panel members (ages 18–19); (2) AmeriSpeak Teen Panel members (ages 13–17); and (3) adolescents ages 13–17 residing with an adult AmeriSpeak Panel member but not participants in the Teen Panel. AmeriSpeak invited a single adolescent, randomly selected among all eligible within the household, to the study. Participants age 18 or older provided informed consent for survey participation. For

Table 1
Demographic characteristics by mode of adolescent's school instruction[a]—COVID Experiences Survey,[b] United States, October 16 to November 6, 2020

	Overall (n = 567)		Mode of school instruction, no., % (95% confidence interval)						*p* value
			Virtual only[c] (n = 313)		Combined[d] (n = 141)		In-person only[e] (n = 113)		
Total			313	56.3 (51.0—61.4)	141	24.4 (19.2—30.3)	113	19.4 (15.4—24.0)	
Respondent demographics									
Age (years)									.339
13—15	326	60.3 (55.7—64.8)	174	54.9 (47.3—62.2)	77	22.1 (16.2—29.4)	75	23.0 (16.4—31.3)	
16—19	241	39.7 (35.2—44.3)	139	58.4 (46.9—69.1)	64	27.8 (18.0—40.4)	38	13.8 (8.2—22.3)	
Sex									.699
Male	272	51.1 (45.8—56.4)	150	54.3 (44.6—63.7)	69	26.4 (18.3—36.5)	53	19.3 (12.3—29.0)	
Female	292	48.9 (43.6—54.2)	161	58.4 (50.8—65.6)	71	22.1 (17.6—27.4)	60	19.5 (15.1—24.9)	
Race/ethnicity									.007
White, non-Hispanic	308	50.0 (41.2—58.8)	137	48.1 (40.6—55.7)	90	27.8 (22.3—34.0)	81	24.1 (18.6—30.5)	
Black, non-Hispanic	78	13.5 (8.7—20.1)	60	68.2 (47.0—83.9)	8	12.2 (4.6—28.9)	10	19.5 (6.0—47.8)	
Hispanic	119	26.7 (20.8—33.6)	83	69.0 (57.5—78.5)	24	21.3 (11.6—35.9)	12	9.7 (4.9—18.3)	
All other races, non-Hispanic[f]	62	9.8 (7.4—13.0)	33	46.8 (31.1—63.2)	19	31.8 (20.5—45.7)	10	21.4 (10.5—38.7)	
Poverty level[g]									.046
At or below poverty	132	29.9 (21.3—40.3)	83	65.5 (56.8—73.4)	21	13.7 (7.1—24.8)	28	20.8 (12.2—33.0)	
Above poverty	435	70.1 (59.7—78.7)	230	52.3 (45.2—59.3)	120	28.9 (22.7—36.1)	85	18.8 (14.7—23.7)	

NORC = National Opinion Research Center.
[a] Table shows unweighted numbers, weighted overall and row percentages, and weighted 95% confidence intervals.
[b] See technical overview of the AmeriSpeak Panel: NORC's Probability-Based Household Panel retrieved from https://amerispeak.norc.org/Documents/Research/AmeriSpeak%20Technical%20Overview%202019%2002%2018.pdf.
[c] Virtual indicates 100% virtual school instruction in the 14 days prior to the survey.
[d] In-person indicates 100% in-person school instruction during the 14 days prior to the survey.
[e] Combined indicates a combination of in-person and virtual instruction in the 14 days prior to the survey.
[f] Other race category includes Asian, American Indian or Alaska Native, Native Hawaiian or Pacific Islander, some other race, or selected more than one race category.
[g] Poverty level was approximated using the midpoint of a categorical income variable and household size, inclusive of family and nonfamily household members. Based on 2020 poverty guidelines https://aspe.hhs.gov/2020-poverty-guidelines.

participants under age 18, parent consent and teen assent was obtained. Among adult panelists qualified to go through the nomination/consent for a teen, the completion rate for the consent survey was 69.2%, with 874 teens given consent to be invited to the COVID Experiences survey and 605 adolescents participating in the screening process. The screener completion rate for the parent consenting survey was 39.2%. The incidence rate, the percentage of qualifying respondents, was 69.8%. The interview completion rate for 18- to 19-year-olds was 41.1%. Due to the requirement of enrollment in middle or high school, only fourteen 18- to 19-year-olds are included in this analysis. The median duration for survey completion was 20 minutes; respondents were offered the cash equivalent of $20 for completing the survey. This activity was reviewed by Centers for Disease Control and Prevention and conducted consistent with applicable federal law and Centers for Disease Control and Prevention policy; the study was also reviewed and approved by National Opinion Research Center's Institutional Review Board. In total, 727 adolescents ages 13—19 completed the survey. Respondents not enrolled in grades 7—12 (n = 134) and those reporting home school or "other" (e.g., schools that do not usually offer in-person classes and those that selected "other" for school type) as their mode of instruction in the past 14 days (n = 26) were excluded. The final analytic sample included 567 adolescents, 51.1% (272) of whom were male, 48.9% (292) female (Table 1).

Measures

Four indicators of mental health challenges were assessed: (1) stress levels in four areas (at school, home, work, and with friends) given response options low/moderate/high/very high; responses were coded for high or very high stress in at least one area (hereafter "high/very high stress"); (2) mental health-related quality of life, assessed by number of the past 14 days (response options: 0, 1 or 2, 3—6, 7—14) with mental health not good, dichotomized with a cutoff score of ≥ 7 days (hereafter, ≥ 7 days not good mental health); (3) seriously considering attempting suicide (hereafter, considering suicide) in the past 12 months (response options: yes/no); and (4) persistent symptoms of depression over the past 2 weeks, assessed by the Patient Health Questionnaire 9-item adolescent [18], with students experiencing ≥ 3 symptoms on more than half of the past 14 days (response options: 0, 1 or 2, 3—6, 7—14) considered to have persistent symptoms of depression (hereafter, persistent symptoms of depression). Links to mental health resources and a toll-free national suicide prevention hotline were provided to all respondents.

Scales were used to assess both school connectedness and family connectedness. School connectedness was measured using the six questions from the National Longitudinal Study of Adolescent Health's School Connectedness Scale, including items such as "I feel like I am a part of this school" and "The teachers at this school treat students fairly" [19]. Standardized Cronbach's alpha = .89. Family connectedness was measured using responses to five questions assessing parental monitoring, parent—adolescent communication, and emotional support such as "How often do you and a parent/caregiver eat dinner together" and "How comfortable do you feel talking to a parent or caregiver about how you are feeling (for instance, stress, anxiety, and depression)?" The standardized Cronbach's was alpha = .70. As continuous variables, school connectedness ranged from 6 to 30 and family connectedness ranged from 6 to 20. Low connectedness was defined as at or below the 25th percentile (≤ 16 for school connectedness and ≤ 13 for family connectedness).

Table 2
Mental health indicators by mode of school instruction[a]—COVID Experiences Survey,[b] United States, October 16 to November 6, 2020

Mental health variable	Overall (n = 567)		Mode of school instruction, no., % (95% confidence interval)						p value
			Virtual only[c] (n = 313)		Combined[d] (n = 141)		In-person only[e] (n = 113)		
High or very high stress,[f] past 14 days									.005
Yes	238	41.0 (35.5–46.9)	146	44.7 (38.1–51.6)	59	44.8 (33.3–56.8)	33	25.0 (17.3–34.7)	
No	318	59.0 (53.1–64.5)	162	55.3 (48.4–61.9)	79	55.2 (43.2–66.7)	77	75.0 (65.3–82.7)	
Number of days mental health not good, past 14 days									.003
7–14 days	67	10.8 (7.9–14.5)	45	14.5 (10.0–20.7)	16	7.6 (4.1–13.5)	6	3.9 (1.7–8.7)	
<7 days	499	89.2 (85.5–92.1)	268	85.5 (79.3–90.0)	124	92.4 (86.5–95.9)	107	96.1 (91.3–98.3)	
Seriously consider attempting suicide, past 12 months									.021
Yes	63	10.3 (7.3–14.4)	42	13.5 (8.5–20.8)	14	8.4 (4.1–16.4)	7	3.8 (1.8–7.8)	
No	453	89.7 (85.6–92.7)	239	86.5 (79.2–91.5)	116	91.6 (83.6–95.9)	98	96.2 to rep (92.2–98.2)	
Persistent symptoms of depression[g]									.005
Yes	101	15.9 (12.0–20.8)	70	19.1 (15.0–24.1)	22	15.3 (9.3–24.0)	9	7.6 (3.2–17.1)	
No	457	84.1 (79.2–88.0)	240	80.9 (75.9–85.0)	113	84.7 (76.0–90.7)	104	92.4 (82.9–96.8)	
Connectedness variable									
School connectedness									.006
Low levels of school connectedness[h]	143	26.8 (22.2–32.0)	101	34.8 (26.7–43.9)	27	19.1 (10.9–31.4)	15	13.3 (8.6–20.1)	
Mid-high levels of school connectedness[i]	417	73.2 (68.0–77.8)	209	65.2 (56.1–73.3)	111	80.9 (68.6–89.1)	97	86.7 (79.9–91.4)	
Family connectedness									.212
Low levels of family connectedness[h]	152	24.0 (19.4–29.3)	89	27.4 (21.1–34.7)	38	21.2 (14.8–29.4)	25	17.6 (10.0–29.1)	
Mid-high levels of family connectedness[i]	398	76.0 (70.7–80.6)	214	72.6 (65.3–78.9)	98	78.8 (70.6–85.2)	86	82.4 (70.9–90.0)	

NORC = National Opinion Research Center; PHQ-9, Patient Health Questionnaire-9 item.
[a] Table shows unweighted numbers, weighted overall and column percentages, and weighted 95% confidence intervals.
[b] See technical overview of the AmeriSpeak Panel: NORC's Probability-Based Household Panel retrieved from https://amerispeak.norc.org/Documents/Research/AmeriSpeak%20Technical%20Overview%202019%2002%2018.pdf.
[c] Virtual indicates 100% virtual school instruction in the 14 days prior to the survey.
[d] Combined indicates a combination of in-person and virtual instruction in the 14 days prior to the survey.
[e] In-person indicates 100% in-person school instruction during the 14 days prior to the survey.
[f] Experiencing high or very high stress in at least one area of life: at school, home, or work, or with friends.
[g] Experiencing at least three symptoms of depression in the teen PHQ-9 more than half the days in the past 2 weeks.
[h] Low levels of school and family connectedness are defined as at or below 25th percentile.
[i] Mid-high levels of school and family connectedness are defined as above the 25th percentile.

Analysis

Unweighted frequencies or weighted prevalence estimates and 95% confidence intervals (CIs) of demographic characteristics and mental health indicators and connectedness by school instruction mode were calculated. Chi-squared tests identified unadjusted associations by mode of instruction ($p < .05$). Adjusted prevalence ratios (aPRs) were calculated using predicted marginals in logistic regression, comparing mental health indicators by mode of instruction. The first model controlled for categorical demographic variables for age, race/ethnicity, sex, and poverty level. Subsequent models controlled for demographic variables in addition to continuous variables for school connectedness (Model 2), family connectedness (Model 3), or both school and family connectedness (Model 4). Connectedness variables were considered moderators if the aPR was closer to 1.0 in Models 2, 3, or 4 compared to Model 1. Findings were considered statistically significant if $p < .05$. The complex sample design was accounted for using SAS-callable SUDAAN (version 11.0; RTI International).

Results

Within the final sample of 567 adolescents, 460 (80.2%) reported enrollment in public school, 36 (7.1%) in private school, and 69 (12.6%) in some other type of school, for example, a school that is completely online all of the time, regardless of the pandemic. A majority (56.3%) of respondents received virtual instruction; 24.4% received combined instruction and 19.4% received in-person instruction. Virtual instruction was more prevalent among black (68.2%) and Hispanic students (69.0%) compared to white students (48.1%) (Table 1).

All four mental health indicators were associated with mode of instruction (Table 2). Students in virtual learning were more likely than students attending school in-person to report high or very high stress (44.7% vs. 25.0%). Students in virtual learning more frequently reported negative mental health risk on three indicators than students receiving combined or in-person instruction: ≥7 days not good mental health (14.5%, 7.6%, and 3.9%, respectively); considering suicide (13.5%, 8.4%, and 3.8%, respectively); and persistent symptoms of depression (19.1%, 15.3%, and 7.6%, respectively). When continuous variables for school and family connectedness were dichotomized (lowest quartile compared to the three upper quartiles), low school connectedness was more common for students attending virtually than those receiving combined or in-person instruction (34.8%, 19.1%, and 13.3%, respectively) and the association was statistically significant ($p = .006$). Reported levels of family connectedness did not vary significantly by mode of school instruction (27.4%, 21.2%, 17.6%, respectively) ($p = .212$).

Table 3
aPR for mental health indicators by mode of school instruction—COVID Experiences Survey,[a] United States, October 16 to November 6, 2020

	Model 1: adjusted for demographics[b]	Model 2: adjusted for demographics[b] + school connectedness[c]	Model 3: adjusted for demographics[b] + family connectedness[d]	Model 4: fully adjusted[e]
	aPR[f] (95% CI)	aPR (95% CI)	aPR (95% CI)	aPR (95% CI)
High or very high stress,[g] past 14 days				
Virtual[h] versus in-person[i]	**1.78 (1.26–2.53)**	1.26 (.93–1.71)	**1.58 (1.16–2.13)**	1.30 (.98–1.73)
Virtual versus combined[j]	1.03 (.77–1.39)	.88 (.69–1.11)	1.06 (.83–1.37)	.95 (.74–1.21)
Combined versus in-person	**1.72 (1.14–2.60)**	**1.44 (1.04–1.98)**	**1.48 (1.04–2.11)**	1.37 (.99–1.90)
≥7 days mental health not good, past 14 days				
Virtual versus in-person	**4.13 (1.61–10.55)**	**2.92 (1.15–7.37)**	**2.98 (1.21–7.34)**	**2.72 (1.08–6.86)**
Virtual versus combined	**2.10 (1.10–3.99)**	1.69 (.90–3.19)	1.87 (.93–3.74)	1.69 (.81–3.52)
Combined versus in-person	1.97 (.64–6.06)	1.72 (.58–5.10)	1.60 (.48–5.36)	1.61 (.48–5.39)
Seriously consider attempting suicide, past 12 months				
Virtual versus in-person	**3.52 (1.41–8.79)**	**2.72 (1.15–6.42)**	**2.45 (1.19–5.05)**	**2.45 (1.22–4.90)**
Virtual versus combined	1.40 (.57–3.42)	1.20 (.49–2.94)	1.25 (.50–3.10)	1.26 (.51–3.11)
Combined versus in-person	2.52 (.81–7.83)	2.27 (.73–7.02)	1.97 (.69–5.58)	1.95 (.69–5.52)
Persistent symptoms of depression				
Virtual versus in-person	**2.58 (1.13–5.88)**	1.69 (.86–3.30)	1.89 (.90–3.98)	1.58 (.82–3.02)
Virtual versus combined	1.39 (.89–2.17)	1.25 (.84–1.87)	1.29 (.76–2.19)	1.25 (.75–2.06)
Combined[i] versus in-person	1.85 (.74–4.62)	1.35 (.64–2.85)	1.47 (.59–3.65)	1.26 (.57–2.81)

aPR, adjusted prevalence ratio; CI, confidence interval; NORC, National Opinion Research Center; PHQ-9, Patient Health Questionnaire-9 item.
 [a] See technical overview of the AmeriSpeak Panel: NORC's Probability-Based Household Panel retrieved from https://amerispeak.norc.org/Documents/Research/AmeriSpeak%20Technical%20Overview%202019%2002%2018.pdf.
 [b] Adjusted for age, sex, race/ethnicity, and poverty level based on 2020 poverty guidelines, as described in Table 1.
 [c] Adjusted for a continuous variable measuring a scale of school connectedness (range: 6–30, mean: 19.6).
 [d] Adjusted for a continuous variable measuring a scale of family connectedness (range: 6–20, mean: 15.4).
 [e] Adjusted for age, sex, race/ethnicity, poverty, school connectedness, and family connectedness.
 [f] Each aPR is the ratio of the proportion of adolescents with a mental health indicator attending school with one mode of instruction relative to the other, adjusted for other characteristics in a logistic regression model. Bold font indicates statistical significance at $p < 0.05$.
 [g] Experiencing high or very high stress in at least one area of life: at school, home, or work, or with friends.
 [h] Virtual indicates 100% virtual school instruction in the 14 days prior to the survey.
 [i] In-person indicates 100% in- person school instruction during the 14 days prior to the survey.
 [j] Combined indicates a combination of in-person and virtual instruction in the 14 days prior to the survey.
 [k] Combined indicates a combination of in-person and virtual instruction in the 14 days prior to the survey.

As shown in Model 1 (Table 3), adjusting for demographics, students receiving virtual instruction were more likely than those in-person to report the following: stress/high stress (aPR 1.78; 95% CI 1.26–2.53); ≥7 days mental health not good (aPR 4.13; 95% CI 1.61–10.55); seriously considering suicide (aPR 3.52; 95% CI 1.41–8.79); and persistent symptoms of depression (aPR 2.58; 95% CI 1.13–5.88).

School connectedness (Model 2) and family connectedness (Model 3) (Table 3), each independently buffered the relationship between mode of instruction and all four outcomes examined. Specifically, adjusting for demographics and school connectedness (Model 2) weakened the association and rendered three previously significant associations (Model 1) to nonsignificance; and two associations became weaker and nonsignificant after adjustment for demographics and family connectedness (Model 3). For mentally unhealthy days, controlling for school and family connectedness reduced the magnitude of the association for virtual versus in-person instruction from aPR 4.13 (95% CI 1.61–10.55) to aPR 2.72 (95% CI 1.08–6.86). Similarly, for persistent symptoms of depression, the magnitude of the association for virtual versus in-person instruction reduced from aPR 2.58 (95% CI 1.13–5.88) to aPR 1.58 (95% CI .82–3.02). Reductions also occurred for high/very high stress (aPR 1.78; 95% CI 1.26–2.53 to aPR 1.30; .98–1.73) and suicidal ideation (aPR 3.52; CI 1.41–8.79 to aPR 2.45; CI 1.22–4.90) for students attending school in-person versus virtual school attendance. For all other associations, the aPR was also reduced after controlling for school and family connectedness.

Discussion

To our knowledge, this study is the first to report adolescent data indicating those receiving virtual school instruction may be at increased risk of mental health challenges, including stress, symptoms of depression, and suicidal ideation compared to students attending school in-person or in a combined mode of instruction during the COVID-19 pandemic. Similarly, adolescents receiving combined school instruction may be at increased risk for mental health challenges in comparison to those receiving in-person instruction. However, these associations are significantly reduced when adjusting for feelings of connectedness to school or family. The social–ecological model describes an interrelated process by which positive and negative factors at all levels of the social ecology (e.g., home, school, neighborhood) interact and influence youth well-being. A prevention approach thus must address all of the contexts in which young people interact [20].

Schools remain an environment where most young people spend a significant amount of time. Given that most schools were closed for in-person instruction for a large portion of the 2020–2021 school year and the potentially broad impact of school closures on student mental health, a comprehensive, coordinated, multidisciplinary approach to promoting student mental health and well-being will be needed as students return to in-person learning. This approach could include engaging diverse partners across education, health, and mental health to plan for and meet the needs of students and their families, particularly

those who attended school virtually, is critical [21]. For some students, stressors related to COVID-19 and shifts in schooling may be exacerbated by pre-existing mental health challenges, including depression or anxiety, as well other, prior, or co-occurring traumas, such as witnessing domestic violence, child abuse or neglect, and financial or food insecurities [22,23]. These students may benefit from individual or family mental health services. Schools are one of the leading settings for delivery of mental health services, with 15.4% of students receiving mental health services in schools, surpassed only slightly by specialty mental health settings (16.7%) [24]. However, significant gaps remain between those who need mental health services and those who receive them. In 2019, nearly 57% of adolescents ages 12–17 with major depressive impairment did not receive any treatment in the year prior to the survey [24]. On average, U.S. school systems have only 1 counselor per 491 students and 1 psychologist per 1,400 students, far below recommended ratios [25]. Estimates prior to the COVID-19 pandemic project a potential dire shortage of school counselors, with a projected deficiency of more than 10,000 personnel, relative to projected need by 2025 [26]. This is particularly important given that students who feel like their school counselor knows them personally and responds effectively to their concerns are more likely to report feeling connected to their school [27]. As students return to school, efforts to increase the number of school counselors may be helpful, as they are trained to work with administrators to develop a comprehensive plan for mental health promotion, provide direct student services, and broker partnerships with community mental health agencies [28].

School-based mental health services may meet the needs for many, but not all students and families. Partnerships between health and mental health providers, while always important, may be of heightened importance in the coming months. Schools and healthcare providers can establish memoranda of understanding or other, less formal arrangements to assist students and their families in accessing youth friendly, culturally appropriate, and affordable mental health services, either on or off school property [25]. Health practitioners can also provide training for school staff and workshops for families to promote overall family functioning and enhance connections among caregivers, young people, the school, and health providers. Topics for these efforts may include how to improve communication between parents and youth; monitor behavior and well-being of youth in a developmentally appropriate manner; identify when external mental health assistance may be needed; and access community or school resources [29]. In clinic settings, healthcare providers can also implement practices to increase family connectedness. For example, they can incorporate questions about family and school relationships into routine visits and provide resources and referrals to improve the quality of communication, parental monitoring, and overall family and school functioning. They can also use interactions with parents to emphasize the importance of parent–child communication and encourage joint activities that foster family connectedness, such as eating meals together as a family [30].

However, the need for mental health support resulting from the collective experience of COVID-19 [31] for many students is so pervasive that services alone are necessary, but not sufficient, to promote recovery and well-being [32]. School connectedness represents a public health approach to mental health promotion [33] because of its potential to impact many students simultaneously and evidence of its relationship to promoting positive student mental health outcomes and buffering the impact of traumatic experiences [34]. Effective school connectedness strategies include classroom specific and school-wide programs, school climate change or management and disciplinary strategies, and activities within the broader community environment to promote with parent and family involvement [35]. Connectedness strategies may be increasingly important as students return to in-person instruction and can include practices such as creating decision-making processes that facilitate student, family, and community engagement; providing education and opportunities enabling families to be actively involved in their children's academic and school life; develop students' academic, emotional, and social skills to increase school engagement; implementing effective classroom management and teaching methods to foster a positive learning environment; and creating trusting and caring relationships that promote open communication among administrators, teachers, staff, students, families, and communities [36]. School connectedness approaches can be incorporated within existing school frameworks, such as the Multi-Tiered Systems of Support, and layered with other, universal approaches such as Social–Emotional Learning strategies.

Future research is needed to investigate the finding presented here that students of color were more likely to be in the virtual mode of school instruction compared to white students. It is important to understand how mode of school instruction may be influenced by prevalence of COVID-19 cases in these communities; whether or not these families had a choice in mode of school instruction; and how these disparities in in-person about school attendance may have been influenced by other factors, for example, financial or environmental. In addition, although sample size prohibited the exploration in this paper, future research is needed to assess if and how the relationship between mode of school instruction and mental health and other outcomes may vary by race/ethnicity and by sexual minority status. Finally, as this was a survey of individuals and we were concerned about their ability to accurately report school level data, we were not able to assess the relationship between other school level characteristics (e.g., school size, class size, teacher–student ratio) and student mental health. Additional research exploring school level characteristics that might influence school connectedness and student mental health would be informative for educational policies and practices.

Findings in this report are subject to several limitations. First, although data were weighted to approximate representativeness of U.S. household demographics, findings may not represent all U.S. students ages 13–19 years due to limited sample size and response rate and use of an incentivized, English-language survey. Second, self-reports are subject to social desirability and recall biases. Third, adolescents did not report the duration of in-person or virtual instruction or whether they had a choice in instruction method. Fourth, the study did not adjust for all potential confounders such as community COVID-19 transmission levels, some household characteristics (e.g., urbanicity or rurality), and prior mental health status. Finally, neither causality nor directionality (e.g., it is possible that students with poor mental health were more likely to choose virtual or hybrid instruction) between instruction mode and indicators can be inferred from this cross-sectional study.

As demonstrated by the study's findings, connectedness can play a critical role in buffering student stress experienced during the pandemic. Adolescents receiving in-person instruction reported the lowest prevalence of negative indicators of mental

health. Adolescents receiving virtual or combined instruction may benefit from additional support, including school and family connectedness activities and linkages to mental health services. Understanding the relationship among mode of school instruction, mental health, and connectedness is critically important as students return to school and begin to re-engage with healthcare providers, as the mental health impacts may not be as visible as physical impacts but may necessitate additional actions to reduce risk and foster resiliency.

Funding Sources

Author Contributions

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