


ORIGINAL RESEARCH

Pediatrics

Association between school learning models and psychological and social health visits to the emergency room

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Funding information

CTSA, Grant/Award Number: UL1 TR002377; MSTP, Grant/Award Number: T32 GM65841

Abstract

Objectives: We aimed to assess the impact of in-person and distance school learning models on children's visits to the emergency department (ED) for psychological or social ("psychosocial") complaints.

Methods: We analyzed presentations to one emergency department in a mid-sized Midwestern city. We used the public school system schedule to determine in-person and distance learning periods by the grade level. We calculated the incidence of visits to the emergency department during academic years 2018–2019, 2019–2020, and 2020–2021, with particular attention to the time after March 13, 2020, which was the pandemic period. We compared the incidence of visits during in-person versus distance learning school models.

Results: A total of 7181 visits occurred during the academic years studied, 17.1% due to psychosocial complaints. The incidence of psychosocial visits to the ED was lower during distance learning than during the pandemic in-person learning period (given per 1000 student years: 20.5 vs. 24.1, $p = 0.14$). This difference was statistically significant among middle schoolers (23.3 vs. 46.6, $p < 0.001$). While not statistically significant, the difference among high schoolers was pragmatically relevant (38.2 vs. 49.3, $p = 0.086$).

Conclusions: Distance learning was associated with a decrease in the incidence of psychosocial visits to the emergency department relative to in-person learning. Future investigation is required to verify results and better understand any causative relationships.

KEYWORDS

child abuse, distance, education, emergencies, emergency services, pediatric emergency medicine, population health, psychiatric, public health, return to school

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1 | INTRODUCTION

1.1 | Background

Emergency department (ED) visits for child and adolescent mental health concerns dramatically decreased (>50%) in the first 3 months of the COVID-19 lockdown in both small and large cities across the United States.^{1–3} Decreases in help-seeking for mental health care in the ED exceeded that of other medical or surgical conditions (68% decrease for mental health vs. 56% decrease for medical and surgical conditions).¹ The initial decrease in child and adolescent ED visits for mental health concerns was believed to be due in large part to decreased help-seeking in the setting of shelter-in-place orders rather than decreases in mental health morbidity.² Previous research demonstrates that increased time in the home environment for children and adolescents in homes with untreated substance abuse in a caregiver, a caregiver mental illness, and homes experiencing domestic violence or child maltreatment may heighten the chance of adverse childhood experiences and subsequent short- and long-term risks to their health.⁴

1.2 | Importance

A longitudinal study of ED presentations for children and adolescent mental health concerns rebounded and surpassed pre-COVID numbers.^{5,6} One theory for these variations in ED usage is the disruption of the vital role schools play in students' mental health. School provides regular routines, social engagement with peers, and the presence of a positive adult figure in the lives of children outside the home. These are considered protective factors for children otherwise at risk for psychological or social problems.^{7,8} Schools can also serve as an intermediary between children in the community and the medical system by identifying and connecting students with emergent and ongoing mental health supports.⁹ Schools shifted between in-person, hybrid, and distance learning models throughout the pandemic. The different learning models led to increased time in the home during distance learning, disruption of routines, and less social engagement with peers.¹⁰

1.3 | Goals of this investigation

The impact of school learning models during the pandemic on psychological or social welfare concerns from a medical standpoint and has not been fully investigated. Therefore, we set out to study whether there was a difference in the incidence of ED visits by school-aged patients with psychiatric or social health ("psychosocial") chief complaints during in-person versus distance learning school models.

2 | METHODS

The study was exempted from review by the institutional review board under 45 CFR 46.104d, category 4, and is consistent with all ethical standards. The authors took care to omit any details that might identify participants. Only individuals who consented to the use of their medical records in research were included in the study. We present our work in accordance with the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement.¹¹

2.1 | Design

This was a retrospective observational study of visits by school-aged children to a single ED.

2.2 | Setting

Rochester, Minnesota is a mid-size city in the midwestern United States with a population estimated at approximately 120,000 on July 1, 2021.¹² The Mayo Clinic Rochester ED is a level I trauma center. The ED is subdivided into one pediatric acute care area with four other areas generally used for adult patients. Given the Mayo Clinic's role as a quaternary care center, the ED serves people from across the country and the globe in addition to the local community. The ED is staffed by up to five board-certified or board-eligible emergency medicine or pediatric emergency medicine fellowship-trained physicians during the day and at least one overnight. The ED has continuous on-site emergency psychiatric consultation services. There is an affiliated inpatient psychiatric hospital with a dedicated pediatric psychiatry unit.

2.3 | Selection of participants

We analyzed all ED visits during the academic years (AYs) 2018–2019, 2019–2020, and 2020–2021 as part of the study, and Figure S1 provides an overview of our study population. Inclusion criteria were age under 18 years at the time of the ED visit and a local zip code primarily served by Rochester Public School District on file as the primary residence (55901, 55902, 55903, 55904, 55905, 55906). A limiting assumption of the study was that all students attended Rochester Public Schools; we could not abstract private school information for the study. Each visit was considered unique, and thus multiple patient visits were included. Patients were excluded if they were 18 years or older, visited during the summer vacation period (detailed in Figure S2), or had a primary address zip code outside of Rochester, MN. The summer vacation period for each Rochester Public School District school was the same across grade levels, as summarized in Figure S2.

The International Classification of Primary Care codes was used to identify visits with psychological, psychiatric, or social welfare (“psychosocial”) chief concerns (Table S1), mirroring the categorization outlined in t 4 of Malmström et al.¹³ Psychosocial chief complaints included psychiatric, psychological, and social welfare concerns or diagnoses seen in the ED. We identified the primary diagnosis code ultimately assigned for each ED visit and used it to categorize visits as psychosocial or medical/surgical using the International Classification of Disease (Table S2) without regard to previous or existing psychiatric diagnoses. Any chief complaints or diagnoses not included in the psychosocial visit codes were classified as medical/surgical visits.

Recognizing that (1) psychosocial concerns tend to change in nature and prevalence over the course of development and (2) because elementary, middle, and high school levels had slightly differing return-to-learning timelines, participants were grouped by school level. Categories included elementary (made up of early elementary [K-2] and elementary [3-5]), middle school (6-8), and high school (9-12). Classification into these groups was based on patient age and was relative to the current school year at the time of the ED visit. We used the standard Minnesota age cutoffs of 09/01/YYYY to group students according to their expected grade level (Table S3).

2.4 | Measures/outcomes

The primary outcome of interest was ED visits for psychosocial chief complaints across different learning models, which may identify concerns directly related to and reflective of the educational method. Independent variables included in-person learning and distance learning. For the purposes of our paper, we defined in-person learning as models where students attended school while physically in the school buildings. In contrast, distance learning included distance and hybrid learning models, where students were primarily engaged in education remotely. Psychosocial visits were then further divided into select subgroups paralleling the existing literature, including alcohol abuse, anxiety or anxious state, behavioral concerns, depressive disorders, drug abuse or toxicity, and suicide attempt or suicidal ideation. We utilized visit incidence to standardize the times for in-person and distance learning. For incidence determination, 1 student-year represents one student enrolled in school for a single AY, and this was used to calculate the denominator value. As a secondary outcome measure, diagnosis codes were analyzed using the ICD-10 classification system to sort patient diagnoses as psychosocial or medical/surgical (Table S2).

We sourced outcomes data from the electronic medical record (Epic, Verona, WI) for each ED visit. The data retrieval process was automatic through the medical record. Chief complaints and ICD-10 codes were reviewed and sorted by K.K. The individual charts were reviewed to determine patient demographics, including age, sex, race, arrival method, and disposition. The date March 13, 2020 was used as a cut-off for the first day of the pandemic period since this was the date both Minnesota and the United States declared a peacetime emergency, and it was followed closely by temporary school closure (March 18, 2020)

and shelter-in-place orders (March 27, 2020). Pre-pandemic refers to dates prior to March 13, 2020.

Publicly available information on the Rochester Public School District website allowed the authors to create a timeline of in-person, distance learning, and hybrid learning models (Figure S2). The timeline of learning models used was consistent across the public schools in the district by grade level (early elementary, elementary, middle, and high school). Only elementary students had a hybrid learning model, and therefore, this model was combined with distance learning. Age cutoffs for school-level groupings were determined based on information from the Minnesota Department of Education website (Table S2). School-level and learning model groupings were applied by AM prior to statistical analysis.

2.5 | Data analysis

The authors summarized continuous features with means, standard deviations, medians, and interquartile ranges, while categorical features were summarized with frequency counts and percentages. We then compared the incidence of psychosocial ED visits between learning types and school years using incidence rate ratios (IRRs) with 95% confidence intervals (CIs). Interaction effects between learning type and school year were assessed using log-linear models. All tests were two-sided, and p -values <0.05 were considered significant. We performed the analysis using R version 4.0.3.

3 | RESULTS

This study included 7181 visits to a single ED from school-age pediatric patients in the 2018-2019, 2019-2020, and 2020-2021 AYs (Table 1). As expected, most chief complaints were medical/surgical in nature, with 17.1% psychosocial (psychiatric or social welfare) visits.

Overall, ED visits and visits for psychosocial chief complaints initially declined following the onset of the COVID-19 pandemic (overall for AY 2018-2019: 2797 [39.0%], AY 2019-2020: 2377 [33.1%], and AY 2020-2021: 2007 [27.9%]) (Table 1). Psychosocial visits rebounded after an initial decrease with the pandemic onset (AY 2018-2019: 451 [36.6%], AY 2019-2020: 366 [29.7%], and AY 2020-2021 414 [33.6%]) (Table 1).

When broken down by AY, the proportion of psychosocial to total ED visits was highest in the 2020-2021 AY (414 psychosocial visits out of 2007 school-age ED visits). Psychosocial visits were more frequent among high school students (60.8% of visits) than among middle school (27.9%) and elementary school (11.3%) students (Table 2).

The incidence of psychosocial ED visits during the distance learning period was 20.5 visits per 1000 student-years, compared with 24.1 visits per 1000 student-years during pandemic in-person learning. This difference was not statistically significant (IRR = 0.85, 95% CI: 0.69-1.05, $p = 0.14$). For the pandemic period, comparisons for the subset of elementary, middle school, and high school-age children are presented in Table 2. Our data demonstrated a statistically significant

TABLE 1 Cohort demographics.

	All ED visits (N = 7181)	Psychosocial visits (N = 1231)
Age, years		
Median (IQR)	13 (9–16)	15 (13–16)
Sex, n (%)		
Female	3722 (51.8%)	734 (59.6%)
Male	3459 (48.2%)	497 (40.4%)
Race, n (%)		
American Indian or Alaskan Native	54 (0.8%)	13 (1.1%)
Asian	341 (4.7%)	45 (3.7%)
Black	1192 (16.6%)	170 (13.8%)
Native Hawaiian or Pacific Islander	12 (0.2%)	1 (0.1%)
White	4252 (59.2%)	776 (63.0%)
Other/unknown	1330 (18.5%)	226 (18.4%)
Arrival method, n (%)		
Ambulance/emergency transport	540 (7.5%)	216 (17.5%)
Law enforcement	230 (3.2%)	224 (18.2%)
Walk-in	6401 (89.2%)	785 (63.8%)
Other	10 (0.1%)	6 (0.5%)
ED disposition, n (%)		
Admission/observation	998 (13.9%)	548 (44.5%)
Discharge	6078 (84.6%)	665 (54.0%)
Further treatment	40 (0.6%)	0 (0%)
Patient left	46 (0.6%)	4 (0.3%)
Transfer	13 (0.2%)	12 (1.0%)
Other	6 (0.1%)	2 (0.2%)
School year of visit, n (%)		
2018–2019	2797 (39.0%)	451 (36.6%)
2019–2020	2377 (33.1%)	366 (29.7%)
2020–2021	2007 (27.9%)	414 (33.6%)
School group, n (%)		
Elementary	2768 (38.5%)	139 (11.3%)
Middle school	1570 (21.9%)	344 (27.9%)
High school	2843 (39.6%)	748 (60.8%)

Note: It includes demographics for all ED visits and a breakdown of those categorized as psychosocial visits. All ED visits include visits during the 2018–2022 academic years for any medical, surgical, or psychosocial chief complaints. Psychosocial visits include visits during the 2018–2022 academic year for any psychosocial chief complaints.

Abbreviations: ED, emergency department; IRQ, interquartile range.

difference for middle school-age children (IRR = 0.50, 95% CI: 0.34–0.72, $p < 0.001$) but not other school levels. Across all school levels, the incidence of psychosocial ED visits was higher during in-person schooling than distance learning (Table 2). Given that all learning prior to the pandemic (March 13, 2020) was in-person, we also compared the incidence of the distance-learning experience with the cumula-

TABLE 2 Incidence of psychosocial emergency department (ED) visits per 1000 student-years.

Patient grade level	In-person	Distance	IRR (95% CI)	p-Value
All emergency department visits				
Overall	25.2	20.5	0.82 (0.72, 0.92)	0.001*
Elementary	6.6	4.2	0.63 (0.42, 0.94)	0.028*
Middle school	32.8	23.3	0.71 (0.56, 0.90)	0.004*
High school	48.1	38.2	0.79 (0.68, 0.93)	0.003*
Pandemic emergency department visits				
Overall	24.1	20.5	0.85 (0.69, 1.05)	0.14
Elementary	4.9	4.2	0.84 (0.44, 1.61)	0.61
Middle school	46.6	23.3	0.50 (0.34, 0.72)	<0.001*
High school	49.3	38.2	0.77 (0.58, 1.03)	0.086

Note: The incidence of psychosocial ED visits during in-person learning was compared to the incidence of visits during distance learning to assess whether there was an association between the incidence and learning models. All visits included both pre-pandemic and pandemic visits during the 2018–2022 academic years. Pandemic visits included only those visits in the academic year following the declaration of peacetime emergency (March 13, 2020).

Abbreviations: CI, confidence interval; IRR, incidence rate ratio.

*Statistically significant.

tive in-person experience (pre-pandemic and pandemic). There were lower incidences of psychosocial ED visits within each of the assessed age groups and overall for school-age children studied during distance learning compared to in-person learning periods (Table 2).

During the pandemic, individual chief complaint categories were not statistically different in incidence (Table 3). As a validation measure, visits were grouped based on the primary end-of-visit diagnosis assigned for the visit. The incidence by diagnosis follows a similar trend, with fewer visits during distance learning than in-person learning (distance learning 19.9 vs. in-person learning 27.3; IRR = 0.73, 95% CI: 0.59–0.89, $p = 0.002$). Both the overall incidence and the incidence of visits with a primary diagnosis of suicide ideation or attempt were significantly different for in-person and distance learning models (Table 3).

Our data show conflicting trends when evaluating the ratio of psychosocial ED visits to the total number of non-psychosocial ED visits during distance learning compared to in-person learning. We noted a higher proportion of visits during distance learning than in-person learning periods (Figure S3). Conversely, the incidence of visits for school age children relative to the community was lower during distance learning.

4 | Limitations

This study is exploratory and retrospective and should be considered hypothesis-generating rather than conclusive. The study represents one ED in the Midwestern United States and will not be representative of all populations. Additionally, the emergency department setting

TABLE 3 Incidence of specific psychosocial chief complaints and emergency department (ED) diagnoses during the pandemic period per 1000 student-years.

Psychosocial chief complaint	Pandemic in-person		Pandemic distance learning		IRR (95% CI)	p-Value
	Visits	Incidence	Visits	Incidence		
Any psychosocial complaints	134	24.1	364	20.5	0.85 (0.69, 1.05)	0.14
SA/SI	64	11.5	173	9.8	0.85 (0.63, 1.13)	0.25
Behavioral concern	9	1.6	27	1.5	0.94 (0.44, 2.00)	0.87
Drug abuse or toxicity	14	2.5	31	1.7	0.69 (0.37, 1.30)	0.25
Alcohol abuse	1	0.2	7	0.4	2.19 (0.27, 17.8)	0.45
Anxiety or anxious state	4	0.7	19	1.1	1.49 (0.51, 4.37)	0.47
Depressive disorder	6	1.1	9	0.5	0.47 (0.17, 1.32)	0.14
Psychosocial diagnosis						
Any psychosocial diagnosis	128	27.3	352	19.9	0.73 (0.59, 0.89)	0.002*
SA/SI	74	15.8	193	10.9	0.69 (0.53, 0.90)	0.006*
Behavior disorder	19	4.1	51	2.9	0.71 (0.42, 1.20)	0.20
Drug abuse or toxicity	11	3.4	26	1.5	0.62 (0.31, 1.26)	0.19
Anxiety	8	1.7	33	1.9	1.09 (0.50, 2.36)	0.83
Depressive/mood disorder	8	1.7	20	1.1	0.66 (0.29, 1.50)	0.32
Suspected childhood abuse or neglect	6	1.3	9	0.5	0.40 (0.14, 1.11)	0.069
Agitation/emotional state	0	0.0	7	0.4	–	0.17
Self-harm	1	0.2	4	0.2	1.06 (0.12, 9.45)	0.96
Other	1	0.2	9	0.5	2.38 (0.30, 18.8)	0.40

Note: The incidence of presentation to the ED for visits with a primary psychosocial chief complaint was compared between distance learning and in-person learning periods during the pandemic. Comparisons were made for all psychosocial chief complaints and selected subcategories of psychosocial diagnoses. All incidences given per 1000 student-years.

Abbreviations: SA/SI, suicide attempt/suicidal ideation; IRR, incidence rate ratio.

*Statistically significant.

will not capture all psychosocial concerns in the community. Examples include patients whose concerns are significant but addressed by outpatient or inpatient treatments accessed outside of the ED setting, or those that go undetected or untreated. This study can serve as a representation of the rate of medically concerning psychosocial issues in the community deemed urgent enough by individuals to warrant emergent care.

By nature of the retrospective cross-sectional design, various confounding factors could not be controlled. Several assumptions were made in order to make the study feasible: patients' primary zip code from the address on file was used to approximate school districts, the approach did not account for private schools or homeschooled students, and standard Minnesota school age cutoffs were used to group students according to their expected grade level. All of these factors could lead to the miscategorization of some students. Concurrent social changes could not be captured, including financial strain and exposure to parents, siblings, or other caretakers. Due to the smaller sample size, we looked at students overall, including elementary, middle, and high schoolers, and psychosocial chief complaints/diagnoses together rather than separately. We acknowledge that the particular issues and dynamics for elementary versus middle versus high school

age groups differ. Since this is an associative study, we cannot make a definitive conclusion, and future study would be necessary to evaluate the relationship of these subcategories to learning models versus pandemic-related effects.

5 | DISCUSSION

We observed that overall ED visits and visits for psychosocial chief complaints initially decreased following the onset of the pandemic. Similar to national trends, the number of visits for psychosocial concerns rebounded following the initial decline.⁵ High school students and, to a lesser extent, middle school students made up the majority of psychosocial visits compared to elementary students. This finding was expected, given the known uptick in mental illness during adolescence.⁸

Our primary objective was to investigate whether there was a difference in the incidence of ED visits by school-aged patients with psychiatric or social health ("psychosocial") chief complaints during in-person versus distance learning school models. When we compared the incidence of visits during the distance learning model to in-person

schooling across all three AYs (2018–2021), we found that distance learning was associated with a lower incidence of psychosocial visits. When comparing incidence for the pandemic period only, the trend of decreased incidence during distance learning persisted but was only significantly different for middle school students. This finding suggests that the pandemic itself may have affected incidence rates of visits to the ED with psychosocial concerns distinct from any effect associated with the learning models themselves. Even so, the decrease in incidence for middle and high school students in distance learning during the pandemic as compared to in-person learning was not trivial.

Middle school and high school students in the community had a different experience than elementary students, spending far more time in distance learning than in-person learning during the pandemic. Previous research suggests that major disruptions or disasters cause psychosocial harm by disrupting daily routines and structure.^{4,14–18} One study from the early pandemic period suggests that the adjustment back to in-person learning may be as disruptive as the transition to distance learning. This disruption could, in part, account for the higher incidence of visits during in-person learning than distance learning we observed.¹⁰ The increased incidence of visits during in-person learning could also be explained by more overall recognition and referral to the ED during distance learning. This likely relates to more frequent and effective interactions with other adult figures during in-person learning. Previous research demonstrates that having fewer adult contacts such as teachers and other school staff to identify and refer children for medical intervention can be a driver behind decreases in presentation.⁴ Similarly, research in suspected child abuse and neglect suggests the observed reduction in diagnoses may represent a lack of recognition rather than a true reduction in the incidence or prevalence.⁴

Bullying is known to be linked with suicidality.^{19,20} A working paper using online search data to study bullying and cyberbullying in the United States before and during COVID-19 demonstrated that metrics of bullying decreased substantially during distance learning.²¹ On return to in-person schooling, bullying re-escalated to near pre-pandemic levels.²¹ Despite K-12 students having an increased online presence during distance learning, measures suggest cyberbullying did not substantially increase during distance learning.^{21–23} Through decreased rates of bullying, the pandemic may have had some indirect positive effects on certain aspects of student well-being.

In contrast to the decreased incidence of ED visits during distance learning relative to in-person learning, we observed an increase in the proportion of ED visits by school-age children with psychosocial chief complaints and diagnoses. Our finding of an increased proportion of ED visits with psychosocial concerns to the ED was consistent with other studies of the initial lockdown periods following the pandemic.^{5,6} Possibly, less in-person interaction with bullies or other social pressures led to less psychosocial stressors and thus lower incidence of psychosocial ED visits; yet, factors affecting the incidences of nonpsychosocial ED visits (such as anaphylaxis, minor traumatic injuries, or illness) seem to have been more impactful, thereby inversely adjusting the proportion of ED visits.

The rise in anxiety-related chief complaints and disorders observed in our study aligns with observations from studies of other disasters.¹⁴ The steep increase in suicide ideation or attempt and moderate increase in drug abuse and toxicity parallel the findings of other COVID-19 studies in the emergency department setting.^{5,24} In 2019, intentional self-harm or suicide was the second highest cause of death for children 10–14 years and adolescents 15–19 years in the United States.²⁵ The increasing rates for suicide ideation or attempt, drug abuse, and toxicity warrant special attention of parents, schools, medical centers, and public health efforts to treat or prevent against long-term consequences.

In summary, this study identified an association between distance learning and decreased incidence of pediatric visits to the ED with psychosocial chief complaints. This study was not designed to identify causes for these trends.

AUTHOR CONTRIBUTIONS

Kit Knier and Venkatesh R. Bellamkonda conceived and designed the study. Kit Knier, Venkatesh R. Bellamkonda, and Aliza Weinman supervised the conduct of the study and data collection and management. Aidan Mullan provided statistical advice and analyzed the data. Kit Knier drafted the manuscript, and all authors contributed substantially to its revision.

ACKNOWLEDGMENTS

We would like to acknowledge Drs. Annie Sadosty, Molly Jeffery, and Ronna Campbell for their mentorship and guidance. Kit Knier was supported by CTSA Grant Number UL1 TR002377 from the National Center for Advancing Translational Science and MSTP Grant Number T32 GM65841 from the National Institute of General Medical Sciences. Its contents are solely the responsibility of the authors and do not necessarily represent the official views of the NIH.

CONFLICT OF INTEREST STATEMENT

The authors declare no conflicts of interest.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

How to cite this article: Knier K, Weinman A, Mullan A, Cain M, Hevesi S, Bellamkonda VR. Association between school learning models and psychological and social health visits to the emergency room. *JACEP Open*. 2024;5:e13157. <https://doi.org/10.1002/emp2.13157>

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