

# Technical Appendix

## *Connection, Trust, and Learning: Student Attendance in the Middle and High School Grades Following the COVID-19 Pandemic*

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This appendix provides information about the data and methodology used in the main report, as well as the full range of findings for points that were demonstrated with a subset of the analyses for the purpose of keeping the report short and easy to read.

# Data

The data come from Chicago Public Schools (CPS) administrative data files that contain data on:

- The number of days a student was absent
- The number of days a student was enrolled
- Standardized test scores: PARCC and IAR for middle grade students and PSAT and SAT for high school students
- Course grades
- Demographic information
- Census tract where student resided
- Data from the annual *5Essentials* Surveys of students and teachers.

We also use publicly available census data at the tract level to calculate measures of poverty and social status.

Absence rate is calculated as the number of days a student missed in a school year divided by the number of days enrolled.

## Sample selection

The analyses included students in grades 6-11 in CPS in school years 2016–17, 2017–18, 2018–19, 2021–22, 2022–23, and 2023–24. We omitted the 2019–20 and 2020–21 school years because of the disruptions of the COVID-19 pandemic, when instruction for part, or all, of the school year was virtual or hybrid. Students who transferred during the school year are included with their first school.

Our initial sample includes all active middle and high school students (grades 6 -12). Almost all students in the sample (98.8%) have attendance data, leaving us with 1,091,091 observations. We perform the following additional sample restrictions:

- We include students with a minimum enrollment of 20 days for the entire year, aligned with how CPS collects student enrollment data on the 20th day (0.34% of observations dropped). This differs from the CPS inclusion rule which includes students with a minimum of 11 days of enrollment for the year, resulting in slightly different numbers from those produced by the district.
- We exclude school-grades that have fewer than 10 students. (0.19% dropped)
- We exclude students in fully remote academies, Options schools, and alternative schools (4.75% dropped). Students in charter schools are included in all analyses except for the analysis of the relationship between attendance and GPAs. Analysis of students' GPAs does not include students in charter schools as their transcript data are not collected centrally.
- We also exclude students from grade 12 for the analyses (12.80% dropped), because we learned that they could be counted as absent in the final weeks of school when they were no longer required to attend after their graduation. This inaccurately inflates absence rates for twelfth-graders.

After sample restrictions and excluding twelfth-graders, our main analytic sample consists of 901,290 observations (all students in grades 6-11 in each year studied, with students included as an observation for each year they were in one of the included grades). Table A.1 presents descriptive statistics for middle and high school students separately for pre- and post-pandemic years.

**Table A.1. Descriptive statistics of the analytic sample**

	Middle school students (Grades 6-8)				High school students (Grades 9-11)			
	Pre-pandemic years (2016–17 to 2018–19)		Post-pandemic years (2021–22 to 2023–24)		Pre-pandemic years (2016–17 to 2018–19)		Post-pandemic years (2021–22 to 2023–24)	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
<i>Demographics</i>								
Female	0.495	(0.500)	0.493	(0.500)	0.503	(0.500)	0.502	(0.500)
White	0.099	(0.299)	0.106	(0.308)	0.091	(0.288)	0.098	(0.298)
Black	0.360	(0.480)	0.359	(0.480)	0.365	(0.481)	0.339	(0.473)
Latinx	0.486	(0.500)	0.475	(0.499)	0.487	(0.500)	0.504	(0.500)
Asian	0.039	(0.193)	0.043	(0.203)	0.042	(0.201)	0.043	(0.204)
Free/reduced-price lunch	0.825	(0.380)	0.778	(0.416)	0.815	(0.388)	0.769	(0.422)
Special education	0.158	(0.365)	0.159	(0.366)	0.150	(0.357)	0.153	(0.360)
English Learner	0.115	(0.319)	0.218	(0.413)	0.094	(0.292)	0.178	(0.382)
<i>Attendance</i>								
Attendance rate	95.155	(5.886)	91.176	(9.174)	89.815	(12.544)	83.634	(17.292)
Absence rate	4.845	(5.886)	8.824	(9.174)	10.185	(12.544)	16.366	(17.292)
Chronically absent	0.110	(0.313)	0.298	(0.457)	0.313	(0.464)	0.510	(0.500)
<i>Academic</i>								
GPA MS	3.126	(0.661)	3.276	(0.591)				
GPA HS (core courses, credit weighted)					2.543	(0.996)	2.653	(1.023)
Avg math and English PARCC scores	726.250	(31.220)						
Avg math and English IAR scores	725.324	(31.642)	723.979	(31.660)				
Avg math and English PSAT scores					438.324	(87.787)	421.144	(94.336)
Avg math and English SAT scores					482.285	(94.984)	460.534	(101.655)
N	241,928	(26.8%)	214,299	(23.8%)	227,261	(25.2%)	217,802	(24.2%)

## Additional information on Key Finding 2

### Academic achievement continues to be strongly related to students' absences in post-pandemic years

The sections below show the relationships of absences with achievement for all grades, as well as the relationships of absences with test score gains.

### Relationships of achievement with standardized test scores for all grades

Table A.2 shows that there were moderately-sized correlations of absence rates with test scores in both post-pandemic and pre-pandemic years at each grade level, and moderate-to-strong relationships of absences with GPAs. The correlations were larger after the pandemic than before the pandemic. This occurred because there were more students with high absence rates in post-pandemic years, allowing the relationship between high absence rates and achievement to be defined more clearly than when few students had very high absence rates. Correlations measure how closely two variables move together, so they can increase when there is more variation in one of the variables, making patterns between the two variables clearer.

The slope (regression coefficient) shows how much one variable changes when the other changes; it can be smaller even if the overall correlation is stronger, because it is based on a broader range of values. The bivariate regression coefficients representing the slope (change in achievement per change in absence rate) are not larger in post-pandemic years, and in some cases are smaller than in pre-pandemic years, as shown in Table A.3.

**Table A.2. Correlations of absences with achievement**

Grade	Test Score Pre-Pandemic	Test Score Post-Pandemic	GPA Pre-Pandemic	GPA Post-Pandemic
6	-0.21	-0.29	-0.30	-0.41
7	-0.22	-0.29	-0.33	-0.43
8	-0.19	-0.26	-0.33	-0.43
9	-0.31	-0.33	-0.59	-0.65
10	-0.30	-0.35	-0.58	-0.68
11	-0.29	-0.36	-0.56	-0.67

**Note:** Correlations show the strength of the relationship between two variables and range from -1 to 1, where 0 means no relationship and 1 indicates the strongest possible positive relationship, while -1 indicates the strongest possible negative relationship (where achievement goes down when absences go up).

**Table A.3. Bivariate regressions of achievement on absences**

Grade	Test Score Pre-Pandemic	Test Score Post-Pandemic	GPA Pre-Pandemic	GPA Post-Pandemic
6	-1.26	-1.10	-0.04	-0.03
7	-1.35	-1.06	-0.04	-0.03
8	-1.24	-1.15	-0.04	-0.03
9	-3.14	-2.81	-0.05	-0.04
10	-2.97	-2.49	-0.05	-0.04
11	-2.82	-2.54	-0.05	-0.04

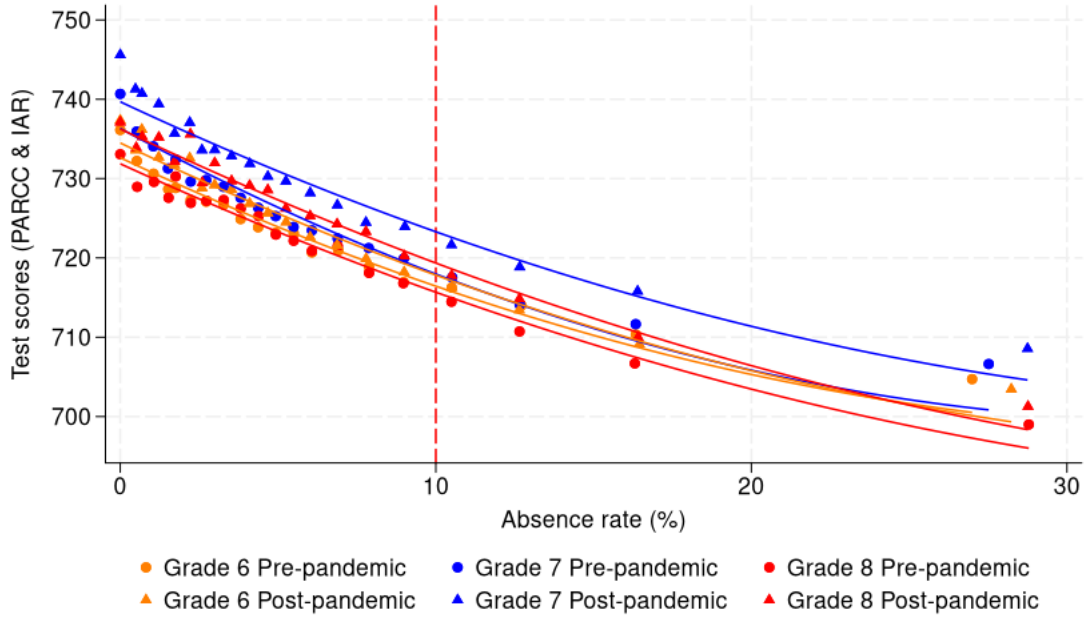
**Note:** Table shows bivariate regression coefficients after regressing test scores (in raw scores) or GPA on absence rates.

The figures in the main report show relationships between students' absences and achievement descriptively, grouping student absence rates into 20 equally-size groups, and then calculating the average achievement level of the different indicators for students in those groups, as well as a regression line that provides the best fit for the points using a quadratic model. The main report focuses on grades six and nine. Figure A.1 shows the relationships of absence with test scores for all grades, while Figure A.2 shows the relationships between absences and GPAs. All analyses of GPA data do not include charter school students.

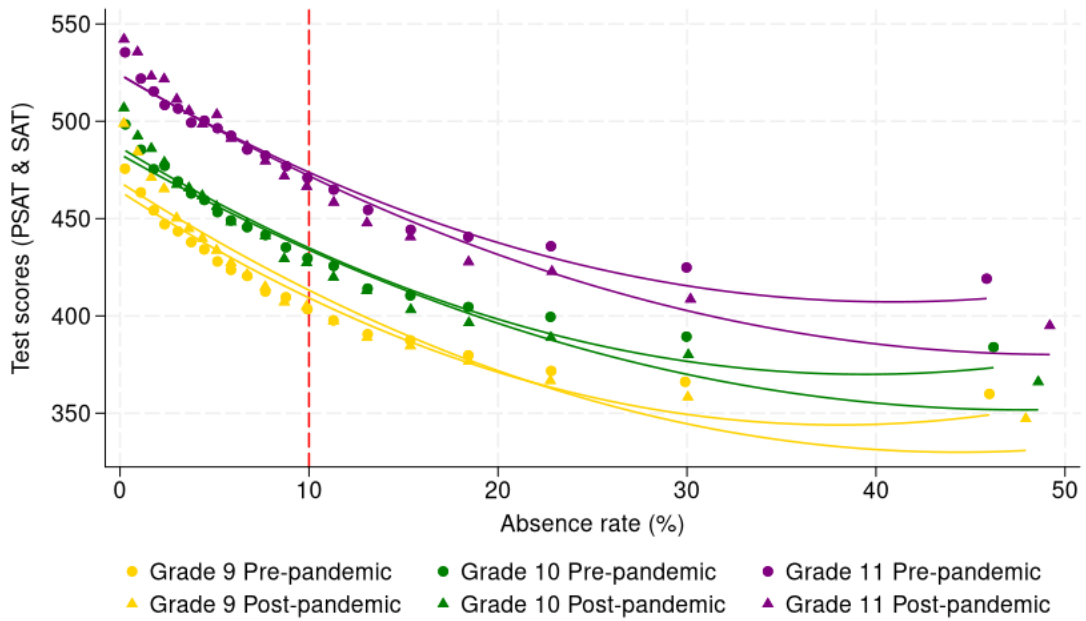
The patterns are similar to those for grades six and nine. The relationships show similar slopes in pre- and post-pandemic years, indicating the strength of the relationships are the same. Yet, the average GPAs are higher in post-pandemic years for students with the same absence rates. One difference from grades six and nine is that in grades seven and eight, test scores in post-pandemic years were also higher than in pre-pandemic years for students with the same absence rates.

**Figure A.1. Students with higher absence rates had lower test scores in all grades**

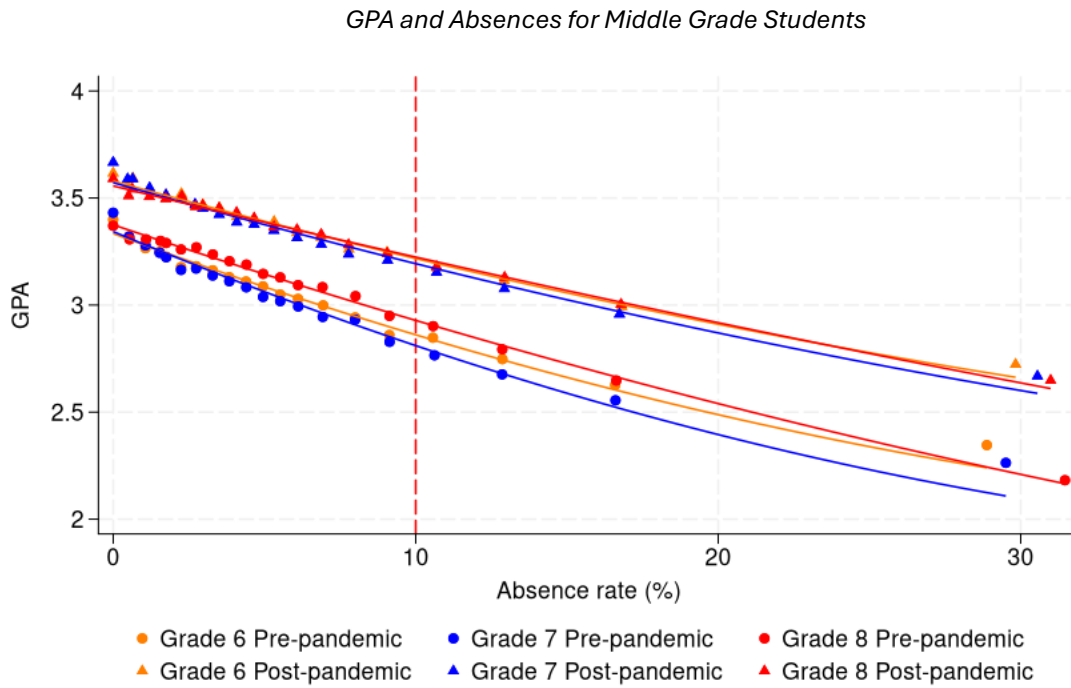
*PARCC & IAR Test Scores and Absences for Middle Grade Students*



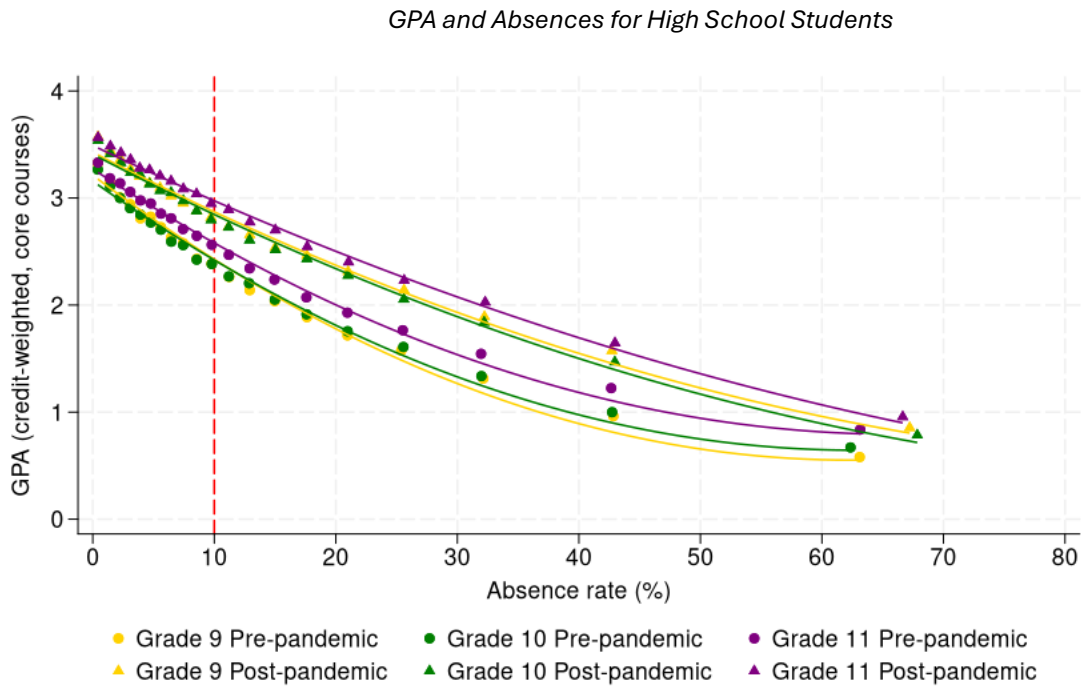
*PSAT & SAT Test Scores and Absences for HS Students*



**Figure A.2 - Students with higher absence rates had lower GPAs in all grades**



**Note:** GPA data do not include charter school students.



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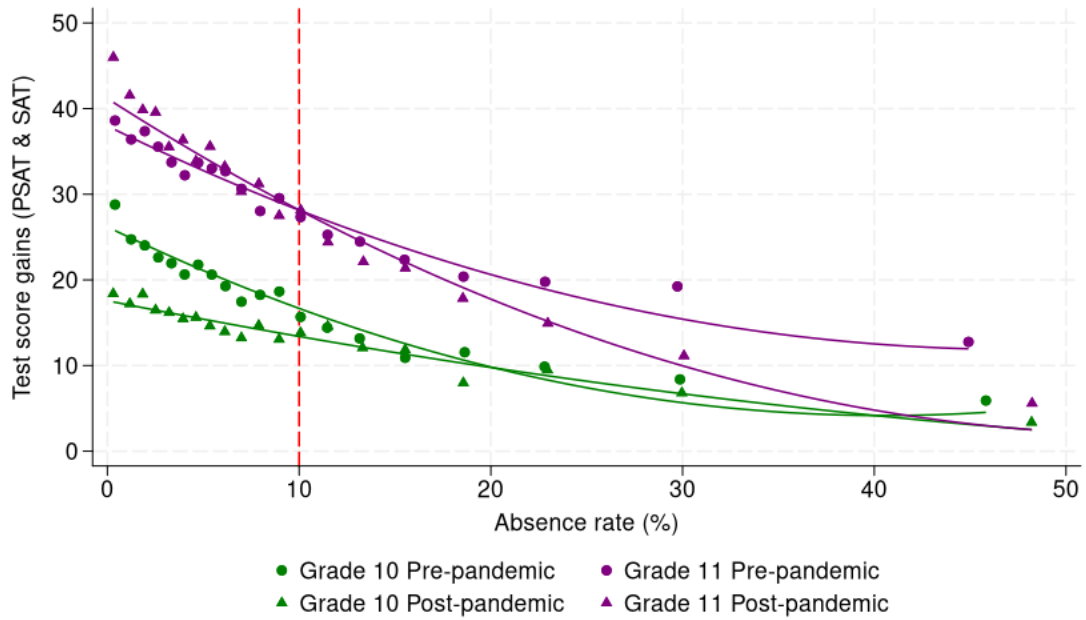
## Relationships of absences with gains on standardized tests

In addition to the figures shown in the report, we also examined the relationship of absences with students' gains on standardized assessments (shown in Figure A.3). A student's test gains are computed as the difference between their current score and their score in the prior grade. For eleventh grade, we take the difference between SAT and PSAT because they are vertically aligned. For tenth grade, we take the difference between their PSAT scores. For sixth, seventh, and eighth grade, we take the difference between their PARCC scores (pre-pandemic) or IAR scores (post-pandemic). However, in 2019, when IAR was introduced, we take the difference between IAR and prior grade PARCC, both of which had the same scale.

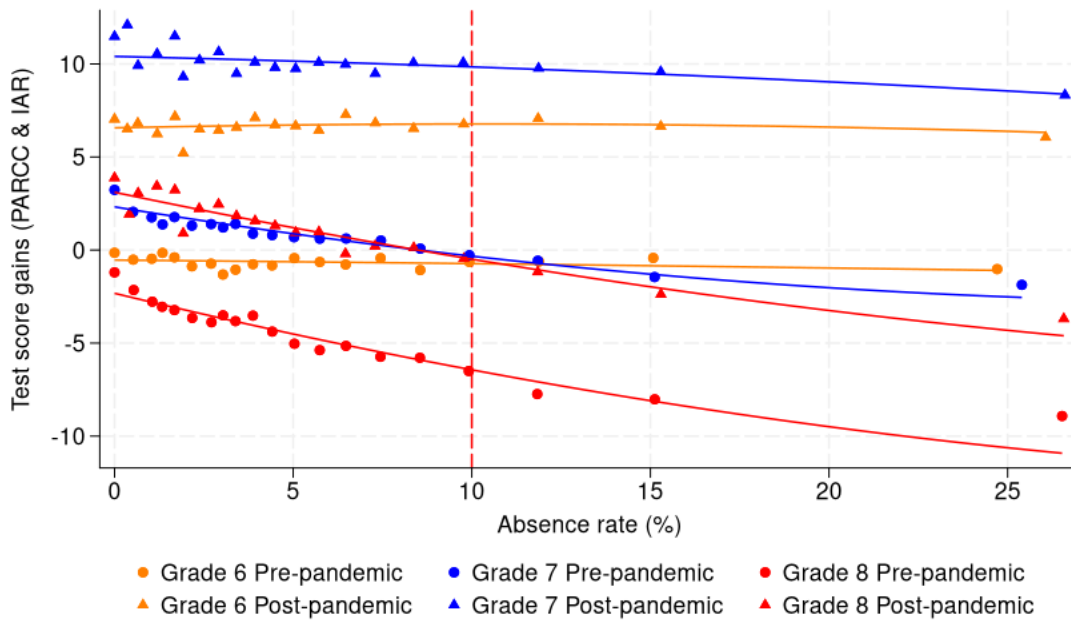
There were negative relationships between students' absences and their gains from ninth to tenth grade on the PSAT and from tenth to eleventh grade on the PSAT to SAT in both pre- and post-pandemic years. There were also negative relationships for eight-graders in both pre- and post-pandemic years, but these relationships were flatter for sixth- and seventh-graders. While the slopes are similar, the size of the gains were higher in post-pandemic years in the middle grades; students had larger gains in post-pandemic years than students with similar absences in pre-pandemic years.

**Figure A.3. Students with higher absence rates had lower test gains in all grades**

*PSAT and SAT test score gains and absences for high school students*



*PARCC and IAR test score gains and absences for middle grade students*



## Additional information on Key Finding 3

School absence rates varied considerably, even when comparing schools serving similar students from similar neighborhoods.

The main report displays scatterplots of average absence rates with students grouped by the school they attended (for Figure 4) and provides analysis that tracks the school variation after taking into account the variation at the neighborhood where students lived, and then also controls for a series of student characteristics (Table 1 in the main report).

We run hierarchical linear models (HLM) that predicted students' absence rates, nesting student observations within their school and then school and the neighborhood where they lived (cross-nested model) to estimate the variation at the school-level and census-tract level. In addition, we control for student characteristics in the cross-nested model to adjust for variation in absence rates between schools that is due to schools serving different student populations. The covariates included are:

- Baseline average absences in grades 3-5 (when predicting absences in the middle grades) or grades 6-8 (when predicting absences in high school)
- Standardized test scores in grades 3-5 (when predicting absences in the middle grades) or grades 6-8 (when predicting absences in high school).
- Demographic characteristics:
  - Race and ethnicity
  - Gender
  - Specific IEP designation
  - Whether they were an English Learner
- Whether they were attending their neighborhood school
- Whether they were in temporary living situations
- Grade level
- Indicators of income and social status in their residential census block group:
  - Percent of families under the poverty line
  - Male unemployment rates
  - Median family income
  - Average education level of adults over age 25

There were 475 schools serving the middle grades and 798 census tracts in which students lived in our analysis before the pandemic and 470 schools and 792 census tracts after the pandemic. In our analysis of grades 9-11 there were 139 schools and 800 census tracts before the pandemic and 131 schools and 793 census tracts after the pandemic.

Table A.4 shows the estimated school standard deviation from the hierarchical models. We used these estimated standard deviations to calculate how different absence rates were for schools and neighborhoods with high absence rates (at the 75th percentile, or 0.6745 standard deviations

above the mean) relative to those with low absence rates (at the 25th percentile or 0.6745 standard deviations below the mean), in both pre-pandemic and post-pandemic years, as shown in Table 1 in the main report. The estimated school standard deviations show that variation was larger in post-pandemic years than in pre-pandemic years, and larger across high schools than across schools serving grades 6-8. When we took into account the variation that comes from the neighborhood students live in, the variation across schools remained largely the same, declining by 2-6%. When we took into account student characteristics, the variation across schools dropped further by almost one-third, except for schools serving middle grades before the pandemic. There was still substantial variation at the school level even when comparing schools serving similar students.

**Table A.4. Estimated school-level standard deviation from hierarchical linear models**

		<b>HLM: Observations nested in schools No controls</b>	<b>Cross-nested HLM: Observations nested in school and neighborhood No controls</b>	<b>Cross-nested HLM: Observations nested in school and neighborhood With Covariates</b>
<b>Grades 6-8</b>	Pre-Pandemic	1.37	1.35	1.13
	Post-Pandemic	2.37	2.23	1.35
<b>Grades 9-11</b>	Pre-Pandemic	5.63	5.42	3.82
	Post-Pandemic	6.85	6.42	4.39

**Note:** Pre-pandemic years include 2017–19, while post-pandemic years are 2022–24.

## Additional information on Key Finding 4

School climate was even more strongly related to school absence after the pandemic than before.

For this part of the analysis, we took the school-level residuals from the cross-nested HLM model with student controls, which are empirical Bayes estimates adjusted for student covariates, and used them to estimate how different school-level measures were related to absence rates among different schools (after we took into account differences in the students they serve, including their students’ absence rates in prior years). School-level measures were the average in the three years before the pandemic and the three years after the pandemic. School climate measures came from school average responses on annual surveys of students and teachers in CPS, which had response rates ranging from 71% to 82% among students and 72% to 81% among teachers from 2017 to 2024

(excluding pandemic years). A few schools were not part of these analyses when the measures were not available due to low response rate. For example, instead of 475 middle grade schools in our sample in the pre-pandemic years, we had 470 or 471 schools for these analyses (in the post-pandemic years, 12 middle grade schools lacked two of the measures). For high schools, two or three schools at the most did not have enough answers to calculate a particular measure.

Table A.5 shows the details of the individual school-level measures (*5Essential* school climate) and survey items used for this analysis. Using the school residuals as the dependent variable, we ran regression models with one school-level measure at the time to avoid collinearity among them. The estimated coefficients from these regression equations were transformed to calculate the differences between schools that were in the 25th percentile and the 75th percentile in a measure, based on the fact that a school in the 25th percentile is 0.6745 standard deviation below the mean and one in the 75th percentile is 0.6745 standard deviations above the mean. This is shown in Figure 6.

**Table A.5. Measures of school climate from the 2024–25 *5Essentials* Survey**

Measure	Description	Survey Items	Respondent	Reliability
<b>Safety in/around the school</b>	Students feel safe both in and around the school building, and while they travel to and from home.	<i>How safe do you feel</i> 1. In the hallways of the school? 2. In the bathrooms of the school? 3. Outside around the school? 4. In your classes?	Student	0.77
<b>Safety from bullying/teasing</b>	Students feels safe from threats, crime or bullying at school.	<i>How much do you disagree or agree with the following statements?</i> 1. I worry about crime and violence in this school. 2. Students at this school are often teased or picked on. 3. Students at this school are often threatened or bullied.	Student	0.80
<b>Student peer relationships</b>	Students respect and learn from each other.	<i>Most students in my school</i> 1. Like to put others down. 2. Help each other learn. 3. Don't get along together very well. 4. Treat each other with respect.	Student	0.72
<b>School connectedness</b>	Students feel connected and included in the school.	<i>How much do you disagree or agree with the following statements?</i> 1. I feel like a real part of my school.	Student	0.82

		<ol style="list-style-type: none"> <li>2. People here notice when I'm good at something.</li> <li>3. Other students in my school take my opinion.</li> <li>4. People at this school are friendly to me.</li> <li>5. I'm included in lots of activities at school.</li> <li>6. I'm excited to go to school everyday.</li> </ol>		
<b>Student-Teacher Trust</b>	Students and teachers share a high level of mutual trust and respect.	<p><i>How much do you disagree or agree with the following statements?</i></p> <ol style="list-style-type: none"> <li>1. I feel safe with my teachers at this school</li> <li>2. I feel comfortable with my teachers at this school.</li> <li>3. My teachers always keep their promises.</li> <li>4. My teachers always listen to students' ideas.</li> <li>5. My teachers treat me with respect.</li> </ol>	Student	0.81
<b>Peer Support for Academic Work</b>	Students demonstrate behaviors that lead to academic achievement.	<p><i>How many students in your Target class</i></p> <ol style="list-style-type: none"> <li>1. Feel it is important to attend school everyday?</li> <li>2. Feel it is important to pay attention in class?</li> <li>3. Think doing homework is important?</li> <li>4. Try hard to get good grades?</li> </ol>	Student	0.82
<b>Academic Personalism</b>	Teachers connect with students in the classroom and support them in achieving academic goals.	<p><i>In my class, my teacher</i></p> <ol style="list-style-type: none"> <li>1. Notices if I have trouble learning something</li> <li>2. Explains things in a different way if I don't understand something in class.</li> <li>3. Gives me specific suggestions about how I can improve my work in this class.</li> <li>4. Helps catch up if I am behind.</li> </ol>	Student	0.78

		5. Is willing to give extra help on schoolwork if I need it.		
<b>Academic engagement</b>	Students look forward to class, try do their best and find it interesting	<p><i>How much do you disagree or agree with the following statements about your Target class?</i></p> <ol style="list-style-type: none"> <li>1. I usually look forward to this class.</li> <li>2. I work hard to do my best at this class.</li> <li>3. Sometimes I get so interested in my work I don't want to stop.</li> <li>4. The topics we are studying are interesting and challenging.</li> </ol>	Student	0.79
<b>Academic Press</b>	Teachers expect students to do their best and to meet academic demands.	<p><i>How much do you disagree or agree with the following statements about your Target class?</i></p> <ol style="list-style-type: none"> <li>1. This class really makes me think.</li> <li>2. I'm really learning a lot in this class.</li> <li>3. Expects everyone to work hard.</li> <li>4. Expects me to do my best all the time.</li> <li>5. Wants us to become better thinkers, not just memorize things.</li> </ol> <p><i>In your target class, how often</i></p> <ol style="list-style-type: none"> <li>1. Are you challenged?</li> <li>2. Do you have to work hard to do well?</li> <li>3. Does the teacher ask difficult questions on tests?</li> <li>4. Does the teacher ask difficult questions in class?</li> </ol>	Student	0.75
<b>Teacher-Parent Trust</b>	Teachers and parents are partners in improving student learning.	<ol style="list-style-type: none"> <li>1. <i>How many teachers at this school feel good about parents'/guardians' support for their work?</i></li> </ol> <p><i>For the students you teach this year, how many of their parents/guardians.</i></p> <ol style="list-style-type: none"> <li>2. Support your teaching efforts?</li> </ol>	Teacher	0.87

		<p>3. Do their best to help their children learn?</p> <p>4. <i>To what extent do you feel respected by the parents/guardians of your students?</i></p> <p><i>Please indicate the extent to which you disagree or agree with the following:</i></p> <p>5. Teachers and parents/guardians at this school think of each other as partners in educating children.</p> <p>6. Staff at this school work hard to build trusting relationships with parents/guardians.</p>		
<b>Parent Involvement in School</b>	Parents are active participants in their child's schooling.	<p><i>For the students you teach this year, how many of their parents/guardians</i></p> <p>1. Attended parent-teacher conferences when you requested them?</p> <p>2. Volunteered time to support the school (e.g., volunteer in classrooms, help with school-wide events, etc.)?</p> <p>3. Contacted you about their child's performance?</p> <p>4. Responded to your suggestions for helping their child?</p>	Teacher	0.88
<b>Parent Influence on Decision Making in Schools</b>	The school has created opportunities for parents to participate in developing academic programs and influencing school curricula.	<p><i>To what extent does this school</i></p> <p>1. Involve parents/guardians in the development of programs aimed at improving students' academic outcomes?</p> <p>2. Involve parents/guardians in commenting on school curricula?</p> <p>3. Include parent leaders from all backgrounds in school improvement efforts?</p> <p>4. Develop formal networks to link all families with each other</p>	Teacher	0.86

		<p>(e.g., sharing parent directories, providing a website for parents/guardians to connect with one another, etc.)?</p> <p>5. Encourage more involved parents/guardians to reach out to less involved parents/guardians?</p>		
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Note: Reliability is derived from a Rasch model using student-level data and ranges from a value of zero (not at all reliable) to 1.0 (perfect reliability).