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A Path to Equity: From Expanded Pre-kindergarten Access to Success in Elementary School

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Introduction

In 2013-14, Chicago Public Schools (CPS), the nation's third-largest school district, implemented several changes to the policies governing its pre-kindergarten (pre-k) application and enrollment process. Two policy changes that were central to the school district's strategy focused on increasing access to full-day pre-k for high-priority student groups:[1]

- increasing the overall number of full-day pre-k classrooms within school buildings,[2] and
- intentionally placing those full-day pre-k classrooms in neighborhoods with a large proportion of age-eligible, high-priority children and historically low rates of enrollment in CPS pre-k.

Our research examines whether and how **access**—defined as the distance to the closest school with full-day school-based pre-k and the number of full-day pre-k classrooms near potential students' homes—was related to pre-k enrollment and ongoing learning outcomes in early elementary school. In other words, we ask: Does the geographic placement of full-day pre-k classrooms within a school district matter? In prior work, we found that after these policy changes in Chicago, there were more equitable patterns of pre-k access and enrollment (see Box). **This brief presents new findings: Geographic placement of full-day pre-k matters not only for more equitable pre-k access and enrollment, but also for academic outcomes in early elementary school.** Students—especially in high-priority student groups—who were eligible to enroll in pre-k *after* the policy changes had higher math scores and grades in early elementary school than did students eligible for pre-k *before* the policy changes. These benefits are partly explained by the fact that Black students and those living in lowest-income neighborhoods lived closer to full-day school-based pre-k options post-policy, which in turn was related to increased enrollment in full-day pre-k, higher kindergarten entry skills, and ultimately better 2nd grade academic outcomes.

[1] The school district defined high-priority student groups to include students of color, students speaking a language other than English, and students living in neighborhoods with lower income and higher employment.
[2] Some of these full-day pre-k classrooms were new to the school building in which it was placed, while others were converted from an existing half-day classroom to a full-day classroom.

Background

High-quality, pre-k programs within school settings provide many important supports to young children and families—especially those who have access to the fewest resources.[4] In light of a wealth of encouraging research on the benefits of pre-k, 4-year-olds' access to public pre-k has expanded over the past two decades. In 2020, 34% of 4-year-olds in the U.S. were enrolled in state-funded pre-k, which is largely school-based.[5] Unfortunately, access to pre-k is not equitable; in many locales, students of color and those living in low-income neighborhoods have the least access to high-quality pre-k.[6] Although we know that inequities in access exist, we know less about what this means for who actually enrolls in pre-k and how those disparities may contribute to early academic achievement.

The good news is that school districts have a great deal of control over who has access to pre-k. Nationwide, many districts are trying to figure out how to better oversee and coordinate pre-k enrollment processes in order to shape and improve families' experiences in a more systematic way. When districts exercise this

Prior Research Findings Regarding Full-Day Pre-k Access & Enrollment

In prior work, we studied how these early education policies were related to changes in access to and enrollment in school-based pre-k within CPS.[3] When comparing three cohorts of students before these policy changes took place in 2013-14 to three cohorts of students after, we found that:

1. **Access to full-day, school-based pre-k increased, especially for high-priority student groups** (students of color, students speaking a language other than English, and students living in neighborhoods with lower income and higher employment),
   - The portion of elementary schools offering full-day pre-k quadrupled, from 10% to 41%.
   - Nearly all student groups saw an increase in the average number of full-day pre-k classrooms near their home, and increases were largest for high-priority groups (e.g., an average of 0.4 to 1.7 for students in the lowest-income group).
   - Overall, students lived an average of 0.6 miles closer to a school with at least one full-day pre-k classroom; improvements in proximity were even greater for high-priority student groups.
2. **Enrollment in full-day pre-k also increased for high-priority student groups**
   - Pre-policy, the students most likely to enroll in full-day pre-k were White students, students living in highest-income neighborhoods, and students living in mostly-White neighborhoods.
   - Post-policy, the students most likely to enroll in full-day pre-k were Black students, students living in lowest-income neighborhoods, and students living in mostly-Black neighborhoods. These student groups were up to three times more likely to enroll in full-day pre-k post-policy compared to before the policy changes.
   - Latinx students and students living in mostly-Latinx neighborhoods were also notably more likely to enroll in full-day pre-k. However, the post-policy Latinx student enrollment rate of 2.6% remained much lower than the city average of 7.2% (three-year averages, pre- and post-policy).
3. **There was a persistent link between access to and enrollment in full-day school-based pre-k**, both overall and within student groups, before and after Chicago's policy changes.

[3] See Ehrlich et al. (2020) for full description of policy changes and prior research findings.
[4] This refers to both economic and social resources. (e.g., Bassok, Fitzpatrick, Greenberg, & Loeb, 2016; Weiland & Yoshikawa, 2013; Winsler at al., 2008)
[5] Friedman-Krauss et al. (2021)
[6] Bassok (2012); Fuller & Liang (1996)

kind of centralized control, the policy decisions they make are likely to influence which students enroll in pre-k, where they enroll, and ultimately their academic achievement. This phase of our study explores possible changes in elementary school academic outcomes between 2013 and 2019 in CPS. The six cohorts of students in the study sample were eligible for pre-k just before and after 2013-14, the year when the district began implementing a set of policy changes focused on pre-k availability, including intentional expansion and placement of full-day pre-k options in communities that served more students of color and had fewer resources. While these policies were a part of a larger effort across the entire City of Chicago to increase access to high-quality early education in a variety of settings, this study focuses specifically on CPS-based pre-k.

Method

To address our research questions, we used two types of statistical analyses. First, we tested whether pre-k policy changes were associated with changes in 2nd grade outcomes for different student groups using Hierarchical Linear Modeling (HLM; see Technical Details below). Second, we tested the pathways through which the policy changes operated using Structural Equation Modeling (SEM). The SEM models explored pathways from the policy changes to 2nd grade academic outcomes through (a) access to full-day pre-k, (b) enrollment in full-day pre-k, (c) kindergarten entry skills, and (d) enrollment in highly-rated elementary schools[7] (see Appendix for more details).

In both sets of models, we predicted three student outcomes:

- **NWEA Reading scores** in spring of 2nd grade
- **NWEA Math scores** in spring of 2nd grade
- **Academic grades** in 2nd grade[8]

We defined **access to full-day pre-k** in two ways:

- Distance to closest school with full-day pre-k (in miles)
- Number of full-day pre-k classrooms within a 0.5-mile radius of the students' home

Technical Details. Each model included the following student-level control variables: age at kindergarten entry; gender; an indicator for whether they were enrolled in school-based (CPS) pre-k as a 3-year-old; an indicator for special education status; an indicator for English Language Learner status; a measure of census block-level income and employment (a combination of the percent of families with income above the poverty level and the percent of males employed at the census block level); and a measure of census block-level education and occupation (the combination of percent of people employed as professionals or in management positions and the mean level of education at the census block level).

Income for each student was calculated as a combination of the percent of families with income below the federal poverty line and the percent of males unemployed at the census block level. Students with a standard deviation of >1 were considered to be lowest-income and those with a standard deviation <-1 were considered to be highest-income. To identify and describe CPS pre-k students' neighborhoods, we combined 12 tract-level census variables from the 2012 American Community Survey 5-year estimates that measure race/ethnicity, language, place of birth, and financial and socioeconomic characteristics. We have simplified the names of the neighborhood groups in this research snapshot to the defining racial characteristics, as race was the strongest census variable for differentiating across neighborhood groups. See Easton et al. under "Publication Information" for full details on the methodology, rationale, and outcomes of our neighborhood analyses. Data for Asian, Asian/Pacific Islander, Multiracial, Native American/Alaskan Native, and Pacific Islander/Hawaiian students are represented in the *Additional Race Categories* group. All race/ethnicity categories used for student characteristics here come from CPS data files.

[7] A highly-rated school was one that received a 1 or 1+ on Chicago Public School's School Quality Rating Policy (SQRP).
[8] Academic grades were calculated by coding teacher-assigned A-F letter grades on a scale from 0 to 4. Grades were averaged across four subjects: reading, math, writing, and speaking.

Research Findings

Were Chicago's pre-k policy changes related to academic outcomes in early elementary school?

Yes. For most student groups, the pre-k policy changes were related to more favorable early elementary math test scores AND academic grades.

Students in the first three cohorts eligible to enroll in pre-k after the pre-k policy changes demonstrated significantly higher NWEA math scores and overall academic grades than age-eligible students in the three cohorts before the policy changes.

- All students had significantly higher 2nd grade math scores post-policy, with post-policy students scoring 0.05 standard deviations (SD) higher than pre-policy students, on average.
- Almost all student groups had significantly higher academic grades post-policy than pre-policy. The exceptions were White students and those living in mostly-White neighborhoods.
- Differences in academic grades from pre-policy students were 0.07 higher for Black students, 0.08 for those in the lowest-income group, and 0.10 for those living in racially-diverse neighborhoods where about half of the population was Black. For Black students, this corresponds to an improvement of 0.10 on 4-point grading scale.

For Black students and students in the lowest-income group, the pre-k policy changes were also associated with higher reading test scores in 2nd grade.

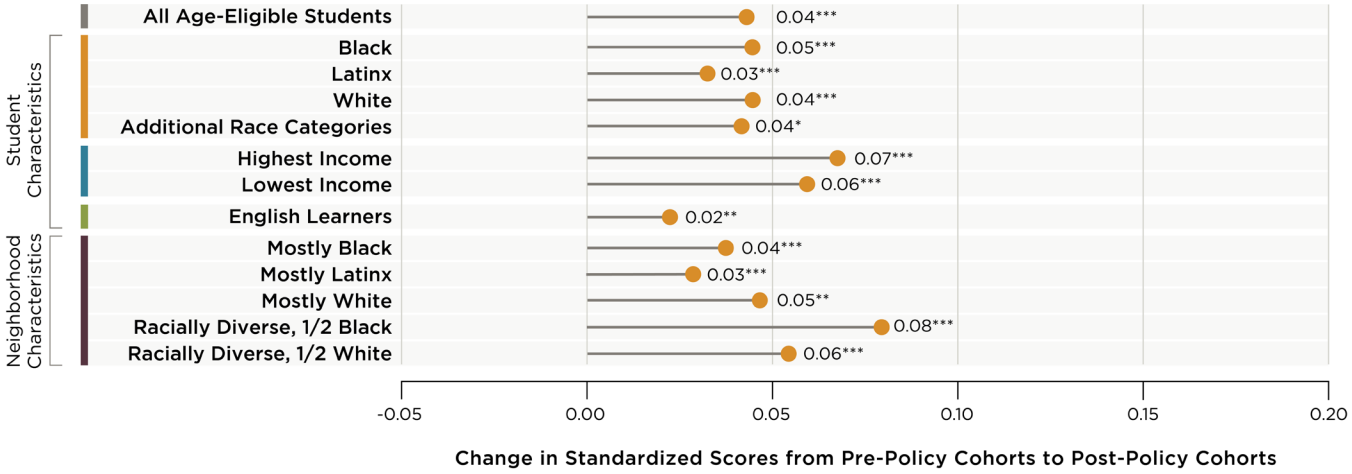
For some high-priority student groups (Black students, students in the lowest-income group, and those who lived in neighborhoods that were racially-diverse where about half of residents are Black), 2nd grade NWEA reading scores were significantly higher for students eligible for pre-k after the policy changes than for students eligible for pre-k before the policy changes. For instance:

- Among students in the lowest-income group, post-policy students scored an average of 0.04 SD higher in reading than pre-policy students.
- In contrast, among students in the highest-income group, pre- and post-policy students' reading scores were not statistically significantly different from one another.

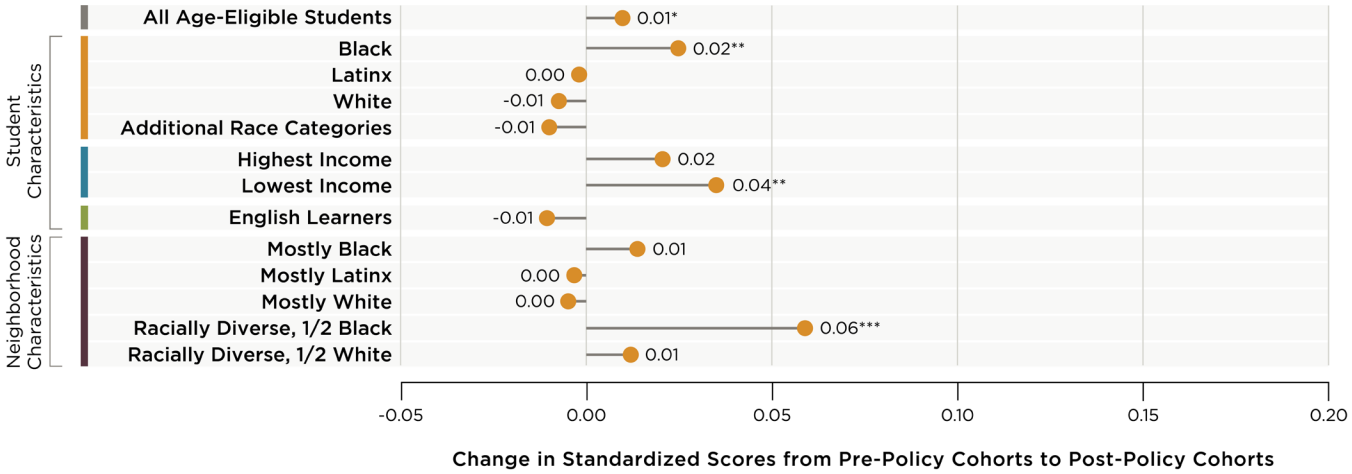
> **Average 2nd grade math and reading test scores and academic grades increased the most for Black students, students in the lowest-income group, and those living in neighborhoods where at least half of the population is Black.**

Figure 1. Most student groups eligible for pre-k in post-policy years had significantly higher 2nd grade math scores and academic grades than those eligible for pre-k in pre-policy years, while some high-priority student groups also had significantly higher 2nd grade reading scores in the post-policy years.

2nd grade NWEA math scores



2nd grade NWEA reading scores



2nd grade academic grades

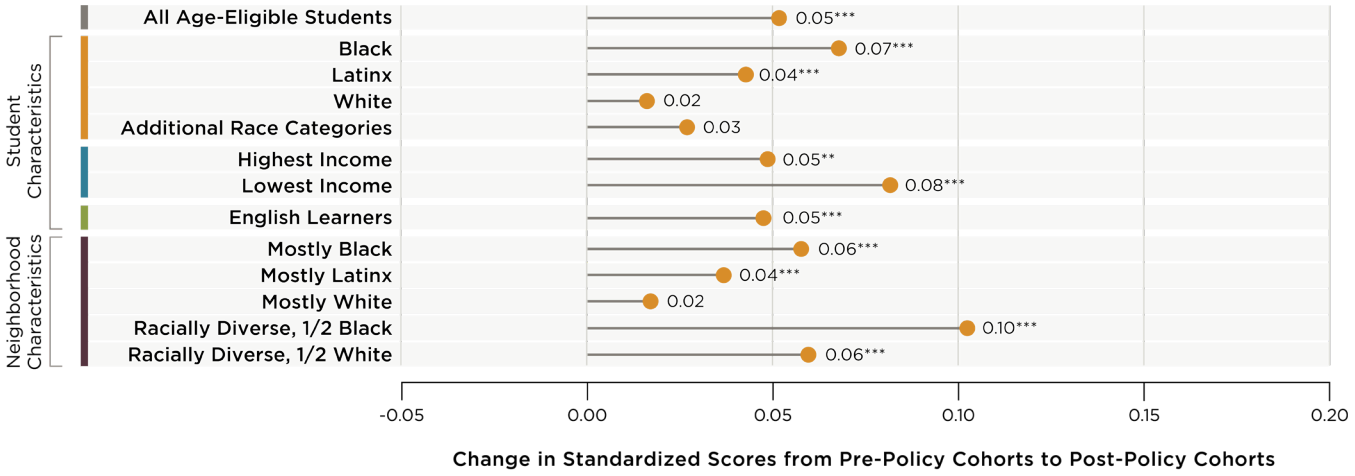


Figure Notes: *N* = 170,031. * p < .05; ** p < .01; *** p < .001

How were pre-k policy changes related to 2nd grade outcomes?

Given that there were higher 2nd grade outcomes after Chicago's pre-k policy changes were enacted—especially for high-priority student groups—we also explored the *pathways* through which the policy changes may have enabled those better outcomes. Specifically, we examined the role the following factors may have played in the connection between pre-k policy changes and 2nd grade outcomes:

- access to full-day pre-k
- enrollment in full-day pre-k
- kindergarten entry skills
- attending a highly-rated elementary school in the years between kindergarten and 2nd grade

Across all student groups, improved 2nd grade outcomes were related to pre-k policy changes through greater access to full-day pre-k, and subsequently improved kindergarten entry skills.

For all student groups, changes in the pre-k policy were related to living closer to a school with full-day pre-k, meaning that on average students lived closer to a school with full-day pre-k in post-policy years. As described in our previous findings, access to pre-k predicted enrollment in full-day pre-k, and this was particularly the case for high-priority student groups.[9]

As shown in the "indirect pathway" illustrated in Figure 2, students who enrolled in full-day pre-k were more likely to have entered kindergarten with higher kindergarten entry scores. In turn, this was related to better 2nd grade outcomes.

In addition, students with higher kindergarten entry scores were very slightly more likely to attend a highly rated elementary school, which also helped contribute to higher 2nd grade outcomes. But overall, our analyses did not draw a clear link between enrollment in full-day pre-k and enrollment in highly rated elementary schools.

[9] Ehrlich et al. (2020)

Figure 2. Policy changes were associated with better 2nd grade academic outcomes *through* greater access to and enrollment in full-day pre-k and subsequently better kindergarten entry skills.

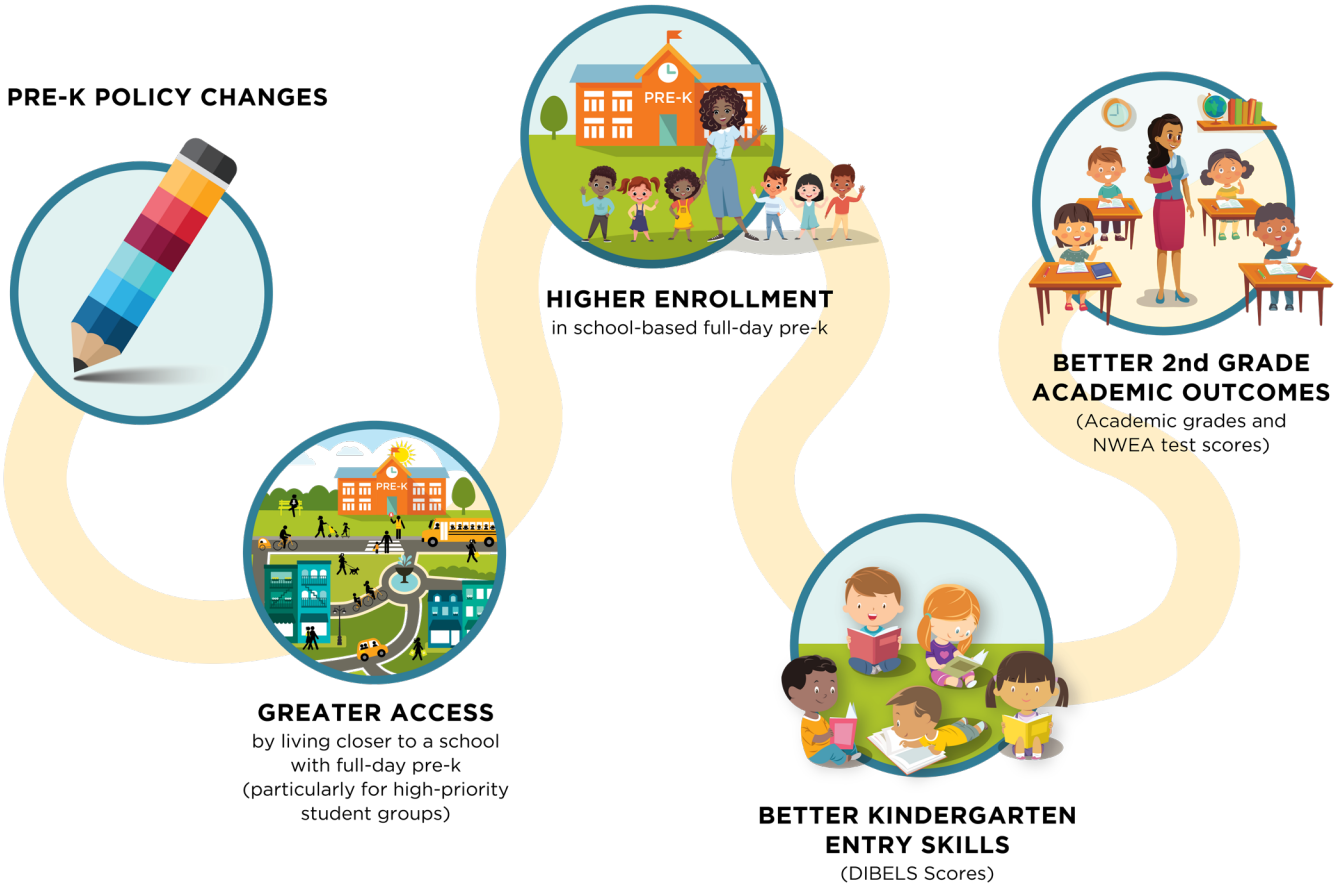


Figure Notes: *N* = 170,545. See Appendix for more details about the full structural equation model that tested this indirect effect.

This pathway explained more of the association between pre-k policy changes and 2nd grade academic outcomes for high-priority student groups than for others.

Figure 1 showed us that following the pre-k policy changes, 2nd grade academic outcomes improved the most for high-priority student groups—namely Black students, those in the lowest-income group, and those living in mostly-Black neighborhoods. Figure 2 shows a key pathway through which the policy changes were linked to academic outcomes via access. In fact, the pathway shown in Figure 2 better explained the changes we found in 2nd grade outcomes for these high-priority student groups than it did for other student groups (Figure 3).

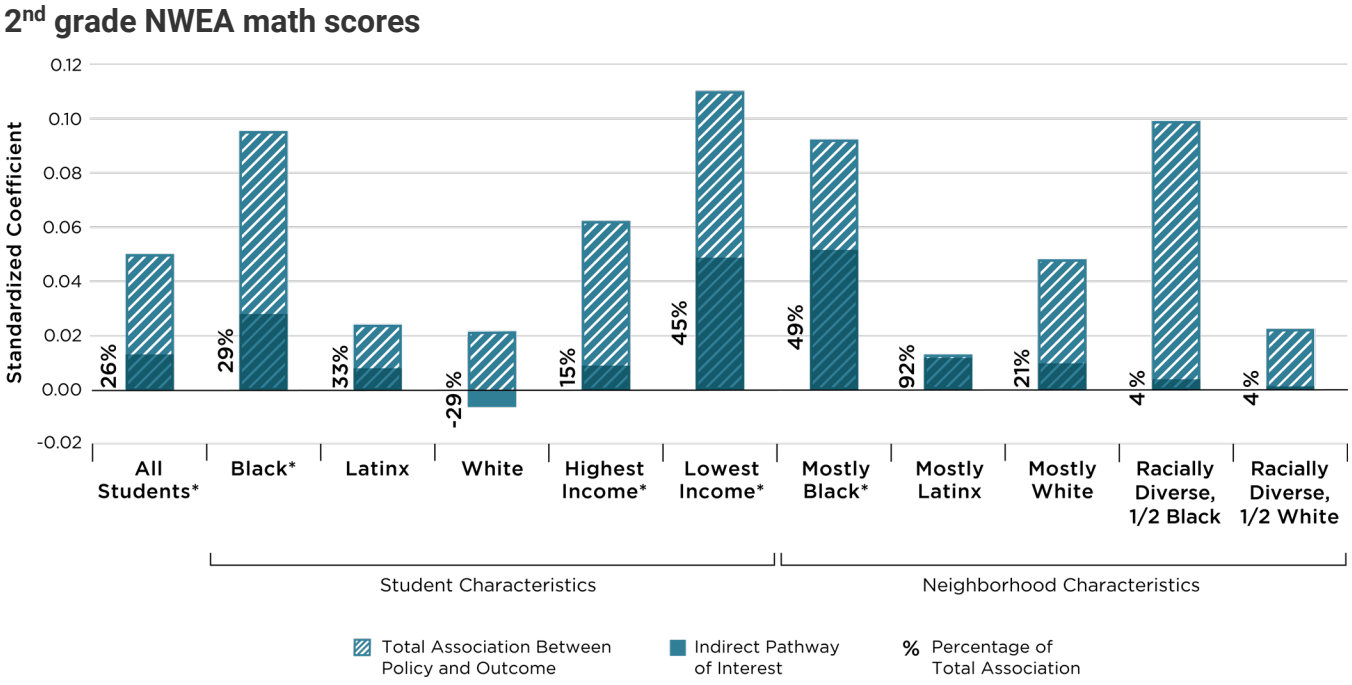
That is, Figure 3 shows that:

- For Black students, the indirect pathway illustrated in Figure 2 accounted for nearly one-third of the total association between the policy changes and 2nd grade math scores (29%) and roughly one-half of the association between the policy changes and 2nd grade reading scores and academic grades (46% and 56%, respectively). This pathway explained even greater proportions of these associations for students living in mostly-Black neighborhoods.

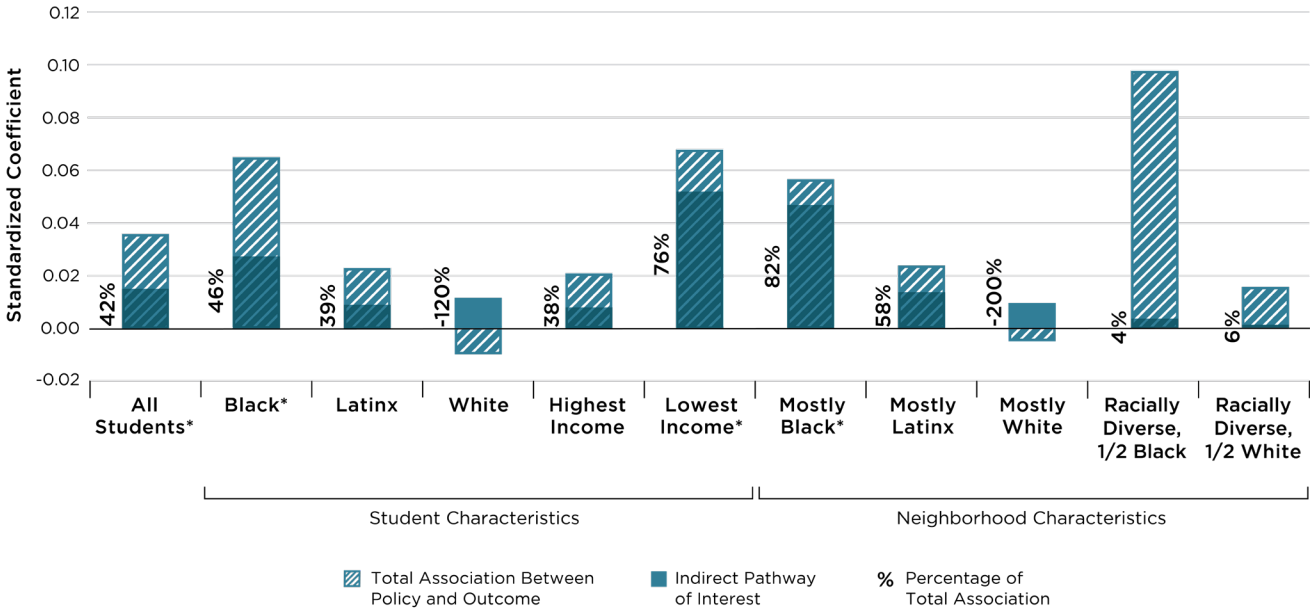
- For students in the lowest-income group, the same indirect pathway explained almost half (45%) of the total association between the pre-k policy changes and higher 2nd grade math scores, three-quarters (76%) of the association with 2nd grade reading scores, and nearly all (98%) of the association with 2nd grade academic grades.
- In contrast, the same indirect pathway explained far less of the policy changes' association with 2nd grade outcomes for students in the highest-income group (between 15-38%) and did not explain the association for White students or those living in racially diverse neighborhoods.

This study cannot explain the entire association between policy changes and 2nd grade outcomes beyond what is shown in Figure 2. We do not know precisely what these other factors are, but they may include aspects of the pre-k policy changes that were not measured. These could include changes in the application and prioritization processes and formal and informal recruitment efforts. There were also other changes occurring in the district at the same time, such as an intensive effort to improve the quality of instruction district-wide.

Figure 3. The proportion of the total association between pre-k policy and 2nd grade outcomes explained by greater access to pre-k, pre-k enrollment, and higher kindergarten entry skills was especially large for high-priority student groups.



2nd grade NWEA reading scores



2nd grade academic grades

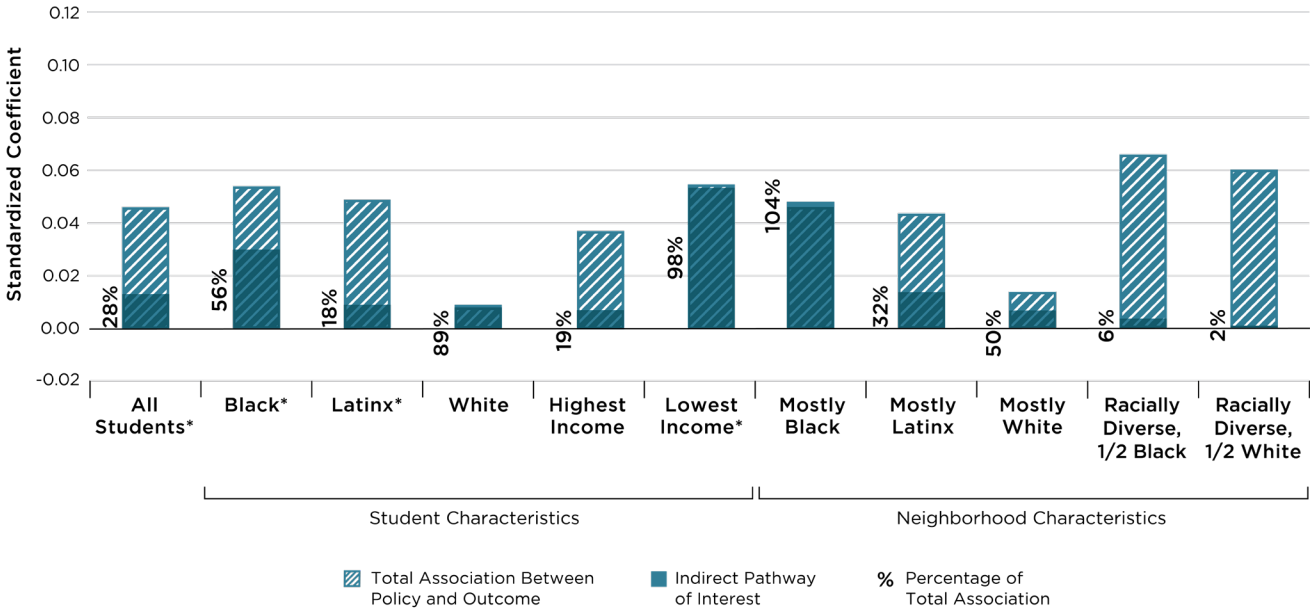


Figure Notes: *N* = 170,545. The standardized coefficients presented in this figure came from a set of structural equation models (SEMs). The lighter portion of this graph shows the standardized coefficients for the total association between policy changes and 2nd grade student outcomes. The darker portion of this graph shows the standardized coefficients for the indirect pathway of interest illustrated in Figure 2. The percentages indicate the proportion of the total association explained by the indirect pathway of interest. A table with full details on SEM results can be found in the Appendix.

* Both the total association and indirect pathway of interest are statistically significant at $p < .05$.

Access to full-day pre-k is a critical policy lever that districts can use as they work to achieve greater equity in their system.

Putting these Findings in Context

Overall, this study provides evidence that the geographic placement of school-based full-day pre-k classrooms is an important mechanism for advancing equity in pre-k access and enrollment as a means to improving academic achievement in early elementary school, especially for high-priority student groups.

To put these findings in context, we end by returning to the original purpose of these policy changes. Early racial/ethnic- and income-based differences in academic achievement were a primary motivation behind Chicago's intentional expansion of full-day pre-k. For example, in the years before the policy changes, there were large differences in 2nd grade NWEA math scores in Chicago between students in the highest- and lowest-income groups (0.69 SD), White and Black students (0.93 SD), and White and Latinx students (0.75 SD) that favored highest-income and White students. Our study found evidence that Black students, Latinx students, and students in the lowest-income group scored higher post-policy than they had before, but the total benefit to 2nd grade math scores for these groups was small—between 0.02 and 0.11 SD. These patterns were very similar for 2nd grade NWEA reading scores and academic grades. Therefore, the increases in outcomes found in this study account for only a small portion (3-16%) of the differences in achievement that the policy aimed to mitigate. In other words, more equitable access to, and even enrollment in, pre-k cannot alone undo long-standing systemic inequities and associated academic achievement differences.

In addition, this study examines only *public school-based* pre-k, not early education options within Chicago more broadly. Therefore, we cannot draw conclusions about the role of access to early education overall. Instead, **we conclude that access to school-based full-day pre-k is *one* critical policy lever that districts can use in their work to achieve greater equity in their system.**

Implications

Policies that focus on addressing and advancing more equitable access and enrollment in pre-k have the potential for downstream academic benefits in the elementary years, particularly for high-priority student groups. Therefore, findings from this study offer relevant insights to district leaders nationwide as they work to expand pre-k, make decisions about where to locate pre-k classrooms, and develop and implement policies related to pre-k access and enrollment. Specifically, district leaders can:

- Prioritize policies and funding that provide more full-day pre-k classrooms close to where historically underserved students live.
- Implement targeted strategies to **improve families' awareness of pre-k options and motivation to enroll their child in pre-k** to help ensure that more high-priority students are able to benefit from the pre-k opportunities available to them.
- **Monitor patterns in data and engage in research partnerships** to continuously examine changes in pre-k access and enrollment and in elementary school outcomes for different student groups. Focus on changes that occur as new policies are being implemented in order to assess whether they are achieving intended goals.
- **Consider other key policies beyond access to pre-k,** such as those that support preschool-to-3rd grade instructional alignment,[10] restorative or inclusive school discipline policies,[11] and reduction of poverty[12] and violence,[13] in efforts to address the inequities in students' early academic achievement.

[10] Reynolds, Magnuson, & Ou (2010)
[11] Anyon et al. (2014)
[12] Duncan, Magnuson, & Votruba-Drzal (2017)
[13] McCoy, Raver, & Sharkey (2015); McCoy, Roy & Sirkman (2013)

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Appendix

Here, we provide detailed information about the structural equation model (SEM) analyses conducted for this study to estimate the direct and indirect associations between the pre-k policy changes and 2nd grade academic outcomes. This project conducts a specific case of SEM, a path analysis, where all of the variables are observed and only the structural relationships between the observed variables are modeled. The aim of this path analysis is to produce non-causal estimates of the magnitude and significance of hypothesized connections between an indicator for membership in a post-policy cohort and each of our 2nd grade academic outcomes (NWEA math scores, NWEA reading scores, and academic grades), allowing us to determine which hypothesized relationships are best supported by the data.

We conducted a set of SEMs that included the following **key student-level mediators:**

- distance to the nearest school with full-day pre-k;
- the number of school-based full-day pre-k classrooms within 0.5 miles of a student's home;
- an indicator of enrollment in full-day school-based pre-k;
- standardized beginning-of-kindergarten early literacy assessment (DIBELS) score;
- number of years attending a highly-rated elementary school (using Chicago Public Schools School Quality Rating Policy (SQRP) ratings of 1 or 1+).

As presented in Table A1, we ran separate models for each student group (race/ethnicity, lowest- or highest-income, and neighborhood type) and each 2nd grade academic outcome (NWEA math scores, NWEA reading scores, and academic grades).

Each model included the following **student-level control variables:**

- age at kindergarten entry;
- gender;
- race/ethnicity;
- an indicator for whether they were enrolled in school-based (CPS) pre-k as a 3-year-old;
- an indicator for special education status;
- a measure of census block-level income and employment (a combination of the percent of families with income above the poverty level and the percent of males employed at the census block level);
- a measure of census block-level education and occupation (the combination of percent of people employed as professionals or in management positions and the mean level of education at the census block level);
- an indicator for English Language Learner status;
- competition for a pre-k slot (the number of students who were age-eligible for pre-k living within 0.5 miles of each sample student's home);
- neighborhood type the student lived in;
- school mobility (the number of CPS schools attended from pre-k through 2nd grade).

We first ran the most complex SEM model in the full sample using weighted least square mean and variance adjusted (WSLMV); we chose to use this estimator based on its straightforward fit indicators and support for a clear model selection process. Next, we ran a series of models using a backward elimination process, in which theoretically-indicated path(s) were sequentially removed from the most complex model one at a time or in sets, and a chi-square difference test assessed whether the more or less complex model fit the data better. Paths from the most complex model were either kept or eliminated before moving onto the next test until we found a final model that was both parsimonious and fit the data well.

Following the selection of a final specified model for all students, we ran multi-group analyses to examine whether the path models differed by student race/ethnicity, students' income group based on the census block on which they lived, and neighborhood type in which they lived. This process involved running models in which the policy effects were either constrained to be the same across student characteristics or left unconstrained and allowed to differ. We selected the better-fitting model in which the policy effects were unconstrained based on a chi-square difference test. Key results from these analyses, including the indirect pathway illustrated in Figure 2, are presented in Table A1.

Table A1. Total and key indirect effects from SEM analyses by student groups (in standard deviation units).

	ALL STUDENTS	White	Black	Latinx	Highest Income	Lowest Income	Mostly White	Mostly Black	Mostly Latinx	Racially Diverse, half Black	Racially Diverse, half White
2nd grade NWEA math scores											
Total association	.050***	0.021	.095***	0.024	.062*	.110***	.048†	.092***	0.013	.099**	0.023
Indirect pathway of interest	.013***	-0.006	.028***	.008***	.009*	.049***	.010**	.045***	.012***	0.004	0.001
2nd grade NWEA reading scores											
Total association	0.036***	-0.01	0.065***	0.023	0.021	0.068**	-0.005	0.057**	0.024	0.098**	0.016
Indirect pathway of interest	0.015***	0.012***	0.030***	0.009***	0.008*	0.052***	0.010**	0.047***	0.014***	0.004	0.001
2nd grade academic grades											
Total association	.046***	0.009	.054*	.049**	0.037	.054*	0.014	0.046†	0.044†	0.066†	0.060**
Indirect pathway of interest	.013***	.008***	.030***	.009***	.007**	.053***	0.007**	0.048***	0.014***	0.004	0.001

* $p < .05$; ** $p < .01$; *** $p < .001$

About Our Organizations

ABOUT NORC

NORC at the University of Chicago is an independent research organization headquartered in downtown Chicago with additional offices on the University of Chicago's campus, the DC Metro area, Atlanta, Boston, and San Francisco. NORC also supports a nationwide field staff as well as international research operations. With clients throughout the world, NORC collaborates with government agencies, foundations, educational institutions, nonprofit organizations, and businesses to provide data and analysis that support informed decision-making in key areas, including health care, education, economics, crime, justice, and energy. NORC's decades of leadership and experience in data collection, analysis, and dissemination—coupled with deep subject matter expertise—provide the foundation for effective solutions.

ABOUT START EARLY

Start Early (formerly known as the Ounce of Prevention) is a nonprofit public-private partnership advancing quality early learning and care for families with children, before birth through their earliest years, to help close the opportunity gap. For nearly 40 years, Start Early has delivered best-in-class doula, home visiting and Early Head Start and Head Start programs. Bringing expertise in program delivery, research and evaluation, professional development and policy and advocacy, Start Early works in partnership with communities and other experts to drive systemic change so that millions more children, families and educators can thrive. Learn more at www.StartEarly.org.

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The University of Chicago Consortium on School Research conducts research of high technical quality that informs and assesses policy and practice in Chicago Public Schools. We seek to expand communication among researchers, policymakers, and practitioners as we support the search for solutions to the challenge of transforming schools. The UChicago Consortium encourages the use of research in policy action and improvement of practice but does not advocate for particular policies or programs. Rather, we help to build capacity for school improvement by identifying what matters most for student success, creating critical indicators to chart progress, and conducting theory-driven evaluation to identify how programs and policies are working. The UChicago Consortium is a unit of the Urban Education Institute at the Crown Family School of Social Work, Policy, and Practice.