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Schools' Neighborhoods and Characteristics: Implications for Standardized Academic Achievement in Passaic, NJ's Elementary, Middle and High Schools

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Abstract
Schools in urban neighborhoods receive less funding, have less programming, and have poorer infrastructure. Such disparities may impede academic outcomes among youth. This study used publicly available data to examine the association between school characteristics and surrounding neighborhood environment on educational outcomes across three academic years among 132 schools in Passaic County, New Jersey. Further, we assessed how schools' socioeconomic status could buffer the effects of a school's neighborhood disadvantage on academic outcomes. Results supported compound deprivation theory highlighting that lower-performing schools were located in lower-resourced neighborhoods. Further, school characteristics and neighborhood resource deprivation were associated with lower math, English, and science academic performance. Additionally, we found that associations between neighborhood resources and math and science academic outcomes were strongest in schools with greater economic support. We provide implications for research and practice by identifying multi-faceted approaches to challenge educational disparities addressing school and neighborhood-level disadvantages to improve educational outcomes for youth.

Keywords Urban schools · Neighborhoods · Resources · Academic outcomes

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Aside from the family environment, schools and their neighborhoods are considered among the most important contextual influences on students' academic outcomes (Carlson & Cowen, 2015; Chetty et al., 2016; Ruiz et al., 2018; Schwartz et al., 2020). Understanding the role of school neighborhood characteristics on academic outcomes is a critical line of research as rising income inequality and growing residential segregation can have dire implications for urban schools and educational outcomes (Duncan & Murnane, 2011, 2016; Kalil, 2016; Martorell et al., 2016;). There is a large body of evidence to suggest the role of school characteristics on students' academic achievement, such as school size, student-teacher ratio, percentage of (Black, Hispanic, Asian) and school's socioeconomic status (Clayton, 2011; Kweon et al., 2017; Mayer, 2002; Rumberger & Palardy, 2005; Wu et al., 2021). For instance, results from a large, randomized study across 79 elementary schools in Tennessee revealed that as a result of being assigned to a smaller classroom of 13–17 students instead of a classroom size of 22–25, students' achievement in math and reading standardized tests significantly improved (Shin, 2012). In a separate study, using subgroup analyses, Black students and students from lower-income families had the highest gains, suggesting that reducing class size might be an effective strategy to reduce the achievement gap (Koc & Celik, 2015; Wu et al., 2021). Additional results from quasi-experiments (Hoxby, 2000; Molnar et al., 1999) and studies examining statewide class-size-reduction policies (Unlu, 2005) have shown that smaller class sizes positively affect children's academic outcomes. Furthermore, research has shown that higher SES (i.e., lower number of students receiving free/reduced-price lunches) is positively associated with academic performance, regardless of their own individual SES (Perry & McConney, 2010), while schools with greater percentages of racial/ethnic students of color are associated with lower standardized performance (Duncan & Murnane, 2011; Rumberger & Palardy, 2005).

School Neighborhood Context on Academic Outcomes

In addition to school-level characteristics, there is growing recognition and research highlighting the role of neighborhood-level indicators on children's academic development (Carlson & Cowen, 2015). Morrissey and Vinopal (2018) found that as neighborhood poverty increased, children's achievement decreased after controlling for child and family characteristics (e.g., parental education). Similarly, other studies have found that higher rates of neighborhood poverty have been associated with low levels of school readiness (Brooks-Gunn et al., 1997; Hanson et al., 2011; Jeon et al., 2014; Kohen et al., 2008; Ryan et al., 2013) and lower standardized test scores (Burdick-Will et al., 2011; Leventhal et al., 2005). One study assessing school-level data across 21 schools in Flint, Michigan, found that school's neighborhood physical disorder was significantly negatively associated with mathematics but not English scores (Smart et al., 2021). Furthermore, emerging research suggests that other school environmental factors such as air pollution and exposure to toxic waste sites are associated with decreased academic performance among youth (Berman et al., 2018; Gilliland et al., 2001; Mohai et al., 2011). Additionally, research has shown that the violent crime rate in school neighborhoods is associated with academic achievement (Ruiz et al., 2018). Further, previous research has focused on specific indicators of neighborhood disadvantage (i.e., crime, pollution, poverty).

Guiding Theoretical Frameworks

Socio-ecological theories posit the role of the social context within the scope of child development. Most notably, Bronfenbrenner's social-ecological theory of development (1977) asserted that microsystem (i.e., most proximal factors including home environment), mesosystem (i.e., school environment), exosystem (i.e., neighborhood environment) and macrosystem (i.e., most distal factors including policies, cultural beliefs, and values) factors influence a child's academic achievement. The compound disadvantage theory further argues that the experience of deprivation in one social context exacerbates the harmful consequences of deprivation in other contexts (Jencks & Mayer, 1990; Wodtke et al., 2016), suggesting, for example, that living in a disadvantaged neighborhood exacerbates the harmful effects of attending a lower quality school. Ecological and compound disadvantage theories position the critical influence of disadvantageous conditions across social contexts and the subsequent impact on child academic outcomes (Jeon et al., 2014; Ruiz et al., 2018). Drawing on ecological theory and compound disadvantage theory and building upon the extant research, the present study sought to examine the direct role of school characteristics (i.e., population size, number of teachers, percentage of students of color, socioeconomic status) and the availability of resources within the surrounding school neighborhood on school-level academic performance.

Community Context

Passaic County is one of the most populous counties in New Jersey. Although Passaic County is overall diverse, Passaic (city within the larger Passaic County, herein, Passaic city) and Paterson has the highest concentration of individuals from racially/ethnically diverse backgrounds (Flaxman et al., 2013). Thus, the overall racial/ethnic diversity of Passaic County is driven by towns such as Passaic and Paterson cities. These cities are among the most economically disadvantaged due to structural and historical disenfranchisement. Paterson has a poverty rate that is 19% above the state's average. Approximately 25.5% of residents living in Passaic city have a poverty rate of 21.1%, which is about 1.5 times the rate in Passaic County (13%) and more than double the rate in New Jersey (10%). While both cities have significant educational disparities, no study has examined academic outcomes within this county that would bring to light the disparities that both cities are experiencing due to neighborhood resource segregation in a recent report, *"New Jersey's Segregated Schools Trends and Paths Forward,"* Orfield and colleagues (2017) highlight these disparities in academic achievement among public schools, including differences in socioeconomic, racial, and neighborhood-level disparities. Thus, this study aims to highlight these disparities to influence future research, practice, and policy development to reduce the growing educational gap among urban, lower-income and predominantly racial/ethnic communities of color.

The Present Study

The present study is a part of a larger project that seeks to understand neighborhoods impact on youth developmental outcomes in Paterson, New Jersey (Opara et al., 2021). The current study examined resources at the school level and expands upon previous literature by investigating more comprehensive indicators of school context (student population, teacher ratio, percentage of students of color, and economic disadvantage) and neighborhood resources (indicated by a composite measure assessing educational, health/environmental, and social/economic disparities in a given community). Using publicly available data, the present study used geospatial analyses to highlight inequities in academic achievement based on more considerable geographical disadvantages. Further, we used multilevel growth modeling to examine the association between school and neighborhood contexts on school-level educational outcomes across three academic school years in Passaic County, New Jersey. Further, we assessed the extent to which schools' socioeconomic status could buffer the effects of neighborhood disadvantage on students' academic outcomes. We hypothesize that:

(H1) Schools that have a lower student population, greater amounts of teachers, percentage of students of color (i.e., students identifying as non-Hispanic White), and lower economic disadvantage (i.e., students receiving free/reduced-price lunch) will have greater academic outcomes (i.e., higher scores on math, science, and English standardized assessment).
(H2) Schools with greater school neighborhood resources (i.e., higher educational, health/environmental, and socioeconomic opportunities) will have greater academic outcomes (i.e., higher scores on math, science, and English standardized assessment).

Methods

Schools

Publicly available data were used to assess school-level academic performance from public elementary, middle, and high schools in Passaic County, New Jersey (n = 132). Each school represents a single unit of analysis. Data were represented across all 19 cities and towns in Passaic County. Schools varied in their percentage of students of color ranging from 0–99%, with higher percentages indicative of a greater racial/ethnic underrepresented student population (M = 59.79, SD = 36.86) and socioeconomic status (i.e., percentage of students receiving free or reduced-price lunch), ranging from 2.1–100% (M = 51.55, SD = 32.70). Schools were clustered in 79 census tracts that ranged in size from 1 to 4 schools. It is important to note that given that data were not acquired or available at the individual student level, we cannot be sure that students in the school are from that specific neighborhood/district. While the Paterson school district does not allow students to attend schools that are not within their designated district unless they qualify for special education services that the district does not have, only two towns within Passaic County qualified for students to attend schools outside of their district, indicating that most schools in the present study were more likely to enroll students from within their district.

Measures

Neighborhood Opportunity

The *child opportunity index (COI)* measures resources and conditions for children to develop healthily in their neighborhoods (Acevedo-Garcia et al., 2020). The Child Opportunity Index (COI) was created as a publicly available and readily accessible index that includes a range of measures enumerating relative opportunity in educational, health and environmental, and social and economic domains across all United States neighborhoods (Acevedo-Garcia et al., 2020; Noelke et al., 2019). The opportunities in each neighborhood are then compared to the level of opportunities in the average neighborhood of other children across the United States in a single metric. This provides an assessment and visualization of disparities within access to opportunities.

The COI consists of three latent predictors of opportunity: educational opportunity, health, and environmental opportunity, and the social and economic *opportunity* indices. The child opportunity index (COI) is a measure of disparities and resources in each neighborhood (operationalized as census tracts) relative to the state's average (Noelke et al., 2020). The COI consists of three latent predictors of opportunity: educational opportunity, health, environmental opportunity, and social and economic opportunity. *The educational opportunity index* includes the following eight indicators: Adult educational attainment rate (college and above), school poverty rate, reading proficiency rate, math proficiency rate, preschool/nursery school attendance rate, high school graduation rate, proximity to accredited early education centers, and proximity to early childhood education centers of any type. *The health and environmental opportunity index* includes the following five indicators: proximity to healthy food retailers, proximity to toxic release waste sites, the volume of toxic release in nearby areas, proximity to parks and open spaces, and housing vacancy rates. Finally, *the social and economic opportunity index* includes the following five indicators: neighborhood foreclosure rate, poverty rate, unemployment rate, public assistance rate, and proximity to employment.

The overall COI measure was used in this study (Acevedo-Garcia et al., 2014). Indicators were constructed using data collected from large-scale, nationally representative surveys (e.g., U.S. Census Bureau American Community Survey, U.S. Environmental Protection Agency Toxic Release Inventory. In the present study, the range of overall COI scores was 2–95 (M=37.06, SD=30.35). The 2015 COI was used to prospectively assess the effects of neighborhood resources on academic performance between 2016 and 2019.

Academic Outcomes

School educational outcomes were obtained from the New Jersey Department of Education for all public schools within Passaic County. Academic results were operationalized in the study as school-level performance on yearly standardized statewide assessments for English, mathematics, and science. School-level performance was operationalized as the Proficiency Rate for Federal Accountability or the percentage of students who scored at either Level 4 or 5 on the New Jersey Student Learning Assessment (NJSLA) or Level 3 or 4 on the Dynamic Learning Assessment (DLM). Notably, the 2018-19 results are from the NJSLA, and the 2016-17 and 2017-18 data are from the Partnership for Assessment of College and Careers (PARCC) assessment. The NJSLA measures the same content as the PARCC assessment but with a shorter testing time. Nearly identical procedures were implemented in administration, scoring, and reporting systems, and similar scale scores and performance levels were used for both assessments. Further, a policy change began with the 2018-19 school year that no longer required students in grade 11 to take statewide assessments in ELA and mathematics. These results include students in grades 3 through 10 and exclude students who have not attended the same school for at least half a year.

School Characteristics

Economic Disadvantage rates for each school were defined as the percentage of low-income students eligible for free or reduced lunch. The number of students was operationalized as the total enrollment, including all students across all grades served by that school. Student-Teacher Ratio was operationalized as the total end-of-year enrollment for the school and dividing by the number of teachers. Diversity of the Student Body represented the percentage of students in the school identifying as a race/ethnicity group that does not include White non-Hispanic students. Racial/ethnic students are students of color, including the following student groups: American Indian or Alaska Native, Asian, Black, or African American, Hispanic/Latino, Native Hawaiian or Other Pacific Islander, and two or more races. Supplemental Fig. 1). Preliminary analyses were conducted to visualize spatial relationships among neighborhood resources (*i.e.*, child opportunity indices) and academic outcomes (*i.e.*, math, English, and science standardized assessment scores) in ArcMap 10.3 (ESRI). See Supplemental Fig. 1, for example.

Preliminary analyses consisted of running bivariate correlations to assess the relationship between neighborhood opportunities, school-level characteristics, and academic outcomes. Next, independent samples t-tests were conducted to examine significant differences in study variables with Paterson and Passaic cities compared to other towns in Passaic County, NJ.

Primary analyses include multilevel modeling in SAS (version 9.4) using a nested design that provides for multiple academic assessment outcomes (i.e., Math and English standardized scores) within each school across three academic school years

(2016–2017, 2017–2018, 2018–2019). Hierarchical linear modeling (Raudenbush & Bryk, 2002) was used as the conceptual and analytic framework for specifying three-level models that examined the association between school-level academic outcomes (end-of-year math and English achievement test scores) across three academic years, school-level characteristics, and neighborhood-level opportunity. Two separate models were estimated with math as the outcome in the first model and English as the outcome in the second model. For ease of interpretation, the variables were group mean-centered before estimating the models. The Akaike information criterion (AIC) was used to test the goodness-of-fit of each model, with a lower value representing a closer model fit (Christensen, 2018). Assumptions of linearity, normality, homoscedasticity, and independence of observation were evaluated for multilevel models. PROC Mixed in SAS using restricted maximum likelihood estimation was used.

Finally, moderation analyses were conducted in SAS (version 9.4) to determine the moderating role of the school's economic disadvantage on the relationship between the school's neighborhood opportunity and math, English, and science academic outcomes. Follow-up simple slope analyses were conducted to determine how the strength of the association between neighborhood opportunity and educational outcomes varied at different levels of the school's economic disadvantage controlling for the school district. Scores below the mean indicated schools that were lower on economic disadvantage and thus higher resourced. Scores that were above the mean were indicative of schools that were higher on economic disadvantage and, therefore, lower resourced. Assumptions of linearity, normality, homoscedasticity, multicollinearity, and independence of observation were evaluated for regression models. Bonferroni adjustments were made for the following analyses such that statistical significance was accepted when $p < .02$ (Olejnik et al., 1997).

Results

Missing Data Analyses

There were no missing data for indicators of neighborhood opportunity. The missingness for school characteristics variables were as follows: Student population: 0, Teacher Ratio: 1, Percentage of students of color:16, and Economic Disadvantage:11. Missingness for academic outcomes were as follows: Math 2018–2019: 20, Math 2017–2018: 23; Math 2016–2017: 21, English 2018–2019: 6, English 2017–2018: 12; English 2016–2017: 14, and Science 2018–2019: 19. Little missing completely at random (MCAR) test suggested that values were not missing at random ($p < .05$). Analyses revealed that Paterson and Passaic cities (0-32.8% missingness) had significantly greater missingness than schools in other Passaic towns (0-9.2% missingness). Little MCAR analyses were repeated and conducted separately for schools in Paterson and Passaic cities versus other towns in Passaic County. Results suggested that values were MCAR for Paterson and Passaic cities ($p > .05$) but not schools from other towns in Passaic County ($p = .045$). Missing data are presented below in Tables 3 and 4 for each model. The sample size in each model represents the value out of 396, which is the total amount of repeated assessments (132 schools x 3 waves).

Table 1 Mean, standard deviation, and ranges for the study variables.

	Complete Sample			Paterson and Passaic Cities			Other Towns in Passaic County			Difference Test
	N	Mean *(SD)*	Range	N	Mean *(SD)*	Range	N	Mean *(SD)*	Range	(t)
Neighborhood Opportunity										
1) Overall COI	132	37.06 (30.35)	2–95	66	11.15 (8.35)	2–36	66	62.97 (20.58)	19–95	(18.95)**
2) Educational	132	32.45 (27.31)	1–90	66	10.11 (5.19)	1–20	66	54.79 (21.51)	20–90	(16.41)**
3) Health/ Environmental	132	43.89 (29.11)	2–98	66	20.85 (9.72)	2–40	66	66.94 (23.14)	14–98	(14.92)**
4) Social/Economic	132	39.67 (32.10)	1–97	66	12.76 (11.52)	1–47	66	66.59 (21.74)	19–97	(17.78)**
School Academic Outcomes										
5) Math 2019	112	40.92 (19.61)	10.7–99.1	48	25.71 (15.95)	10.7–99.1	64	52.32 (13.40)	18.0-86.4	(9.35)**
6) Math 2018	109	41.87 (19.35)	10.5–97.3	45	27.60 (15.64)	10.5–97.3	64	51.90 (14.95)	17.4–95.6	(8.13)**
7) Math 2017	111	39.69 (19.20)	10-95.7	46	26.95 (15.74)	10-95.7	65	48.70 (16.14)	10.4–84.8	(7.10)**
8) English 2019	126	47.81 (20.03)	10-99.1	60	34.30 (17.75)	10-99.1	66	60.09 (12.82)	20.8–81.4	(9.41)**
9) English 2018	120	48.16 (18.96)	10.9–96.4	55	35.11 (17.61)	10.9–96.4	65	59.21 (11.69)	33.4–81.8	(8.95)**
10) English 2017	118	47.29 (20.40)	10-96.2	52	32.78 (17.22)	10.7–96.2	66	58.72 (14.69)	10-93.3	(8.66)**
11) Science 2019	113	17.12 (15.99)	0–69	54	6.31 (10.83)	0–69	59	20.02 (13.35)	0–68	(9.00)**
School Characteristics										
12) Student Population	132	598.61 (487.71)	42-3684	66	636.32 (379.98)	101–2477	66	560.89 (576.28)	42-3684	(-0.89)
13) Student Teacher Ratio	131	12.24 (2.75)	5–24	65	13.46 (2.96)	7–24	66	11.03 (1.87)	5–16	(-5.62)**
14) Students of color	116	59.79 (36.86)	0–99	51	92.06 (17.13)	1–99	65	34.48 (27.05)	0–91	(-13.25)**
15) Economic Disadvantage	121	51.55 (29.34)	2.1–100	55	77.18 (10.87)	57.5–100	66	30.19 (21.71)	2.1–80.5	(-14.59)**

Note. Significant negative t-values indicate that Paterson has higher rates than other towns in Paterson, NJ, and significant positive t-values indicate that Paterson has lower rates than other towns in Paterson, NJ

Preliminary Analyses

Means and standard deviations for all primary variables of interest in the study are reported in Table 1. Descriptive statistics are provided for the complete sample, Paterson and Passaic cities and the remaining towns in Passaic County, NJ. Given the focus on intervening and strengthening diverse urban cities within Passaic County, we specifically focused on differences in Paterson and Passaic cities and other towns in Passaic County. The independent samples t-test revealed significant differences between neighborhood opportunity indicators, school academic performance, and school-level characteristics. Bivariate correlations are presented in Table 2. Results of the bivariate association suggest that greater educational, health/environmental, and social/economic opportunities are associated with greater academic outcomes across three academic years. Specific school-level characteristics, such as a higher student-to-teacher ratio, greater representation of students of color and greater economic disadvantage, were significantly associated with lower educational outcomes (2017–2019 school years). A larger school size was associated with lower math outcomes across all three academic years, but not English.

Primary Analyses

For ease of interpretation, the variables were group mean-centered before estimating the models. Test of assumptions revealed normality (as evidenced by the Residual P-P plots of math and English outcomes across all academic years) in outcome variables. Homoscedasticity was assessed using visualization of a standardized residual plot; there was no obvious pattern, as points were equally distributed above and below zero on the X-axis and to the left and right of zero on the Y-axis. Linearity between all outcome variables was assessed using a scatter plot matrix. Given that all assumptions were met, we proceeded with the multilevel models using maximum likelihood estimations to account for missing data.

Math Outcomes

To conduct multilevel growth models, we first estimated an empty model consisting of only the school and neighborhood and no predictor variables (Model 1).

Initial analyses revealed that 74% of the variation in school-level math achievement exists between schools and 20% between neighborhoods, leaving 6% of the variance in math achievement existing within schools (across the 2016–2017 to 2018–2019 academic years). Thus, a practically meaningful proportion of the variance in math achievement exists at the school and neighborhood levels, providing support for using a three-level analytical model. Further, the intercept variance in the unconditional model is statistically significant, suggesting that math achievement in the 2016–2017 academic year varied by school and neighborhood. Time was added to the model (Model 2) as a Level 1 predictor of the school's math achievement scores. The fixed effect of time was 0.633 ($p <. 05$), suggesting that with every one-year time that passes, schools increased 0.63 points in their math achievement score on average. To understand if the average growth in reading achievement varied across schools and neighborhoods, we estimated a model where our centered time variable (academic year) was added to our random line (Model 3). The results of random effects model suggested that the average growth in math achievement scores significantly varied across schools ($B=5.11$, $p<.05$) and neighborhoods ($B=2.98$, $p<.01$).

Next, student population, student-teacher ratio, percentage of students of color, and economic disadvantage were added to the model as school-level characteristics (Level 2; Model 4). The results suggested that only the number of students ($B = -0.01$,

Table 2 Bivariate correlations among study variables

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Neighborhood Opportunity														
1) Overall COI														
2) Educational	.95**													
3) Health/Environmental	.90**	.91**												
4) Social/Economic	.97**	.87**	.83**											
School Academic Outcomes														
5) Math 2019	.72**	.72**	.72**	.69**										
6) Math 2018	.66**	.67**	.67**	.62**	.96**									
7) Math 2017	.64**	.65**	.65**	.60**	.92**	.95**								
8) English 2019	.70**	.71**	.70**	.66**	.88**	.84**	.82**							
9) English 2018	.65**	.67**	.67**	.62**	.86**	.85**	.83**	.96**						
10) English 2017	.68**	.69**	.68**	.65**	.88**	.88**	.91**	.92**	.95**					
11) Science 2019	.75**	.76**	.74**	.70**	.84**	.80**	.73**	.68**	.69**	.72**				
School Characteristics														
12) Student Population	-0.06	-0.03	-0.04	-0.09	−.29**	−.30**	−.29**	-0.19	-0.15	-0.18	−.19*			
13) Student Teacher Ratio	−.41**	−.44**	−.45**	−.39**	−.49**	−.37**	−.33**	−.38**	−.40**	−.37**	−.39**	.28**		
14) Students of Color	−.82**	−.79**	−.76**	−.79**	−.57**	−.53**	−.55**	−.66**	−.59**	−.61**	−.53**	0.14	.40**	
15) Economic Disadvantage	−.91**	−.89**	−.87**	−.86**	−.67**	−.63**	−.64**	−.66**	−.66**	−.68**	−.72**	0.15	.43**	.84**

Note. ** Correlation is significant at the 0.01 level (2-tailed). *Correlation is significant at the 0.05 level (2-tailed)

$p < .05$) and economic disadvantage (B = -0.38, $p < .01$) were significant predictors of math achievement. Specifically, more populated schools and those with greater economic disadvantage had significantly lower math achievement outcomes. Finally, neighborhood opportunity was added to the model as a level 3 predictor (Model 5). Results of the model suggested that neighborhood opportunity was a significant predictor of math achievement (B = 0.31, $p < .01$), such that schools in neighborhoods with greater opportunities have significantly higher math achievement.

As shown in Table 3, as the models became more complex, the AIC and BIC values decreased, thus indicating better model fit throughout the progression of models. Although the change between Model 4 and 5 is a 5.3 decrease $\chi^2(2) = 5.3$, $p = .07$), a chi-square difference test suggests favoring the more parsimonious model (i.e., Model 4; O'Connell & McCoach, 2008; Raftery, 1995)

English achievement outcomes

Multilevel growth models explained above were repeated, examining the effects of school and neighborhood-level characteristics on school's English achievement outcomes over three academic years. Initial analyses revealed that 77% of the variation in school-level math achievement exists between schools and 17% between neighborhoods, leaving 6% of the variance in English achievement existing within schools (across the 2016–2017 to 2018–2019 academic years). The intercept variance in the unconditional model is statistically significant, suggesting that English achievement in the 2016–2017 academic year varied by school and neighborhood. Time was added to the model (Model 2) as a Level 1 predictor of a school's English achievement scores. The fixed effect of time was 0.748 ($p <. 05$), suggesting that with every one-year period that passes, schools increased 0.748 points in English achievement scores on average. The results of random effects model (Model 3) suggested that the average growth in English achievement scores significantly varied across schools (B = 3.79, $p < .05$), but not by neighborhoods (B = 3.78, $p > .05$). The results of Model 4 with school-level characteristics suggested that only school economic disadvantage predicted English achievement scores (B =-0.28, $p < .01$). Specifically, greater economic disadvantage is associated with significantly lower English achievement outcomes. Model 5, incorporating neighborhood opportunity, suggested that the child opportunity index was not a significant level 3 predictor of English achievement scores ($p = .06$). Chi-square analyses [$\chi^2(2) = 1$, $p = .61$)] revealed that Model 4 is the best fitting model compared to Model 5, suggesting that the more parsimonious model is more acceptable than the complex one (O'Connell & McCoach, 2008; Raftery, 1995)

The Moderating Role of School Economic Disadvantages

Regression coefficients for the models and standard errors can be found in Table 4. First, a multiple regression was run to predict math achievement scores in the 2019 academic year from overall neighborhood opportunity, school economic disadvantage, and their interaction term, controlling for the location of schools (e.g., Paterson/Passaic or other towns in Passaic, NJ).

Table 3 Estimates from 3 level Hierarchical growth model examining growth in math achievement over three academic years

	Model 1 Estimate *(SE)*	Model 2 Estimate *(SE)*	Model 3 Estimate *(SE)*	Model 4 Estimate *(SE)*	Model 5 Estimate *(SE)*
Fixed Effects					
(Intercept)	-1.46 (1.79)	-2.10 (1.82)	-2.05 (1.80)	-1.92 (1.54)	-3.00 (1.56)
Academic Year		0.633 (0.32)*	0.620 (0.37)	1.10 (0.37) *	1.11 (0.37)
Student Population				-0.01 (0.00)*	-0.01 (0.00)*
Student Teacher Ratio				-0.486(0.82)	-0.59 (0.80)
Students of Color				-0.014 (0.07)	0.01 (0.07)
Economic Disadvantage				-0.38 (0.09)*	-0.10 (0.15)
Economic Disadvantage * Time				-0.00 (0.01)	–
Neighborhood Opportunity					0.314 (0.13)*
Neighborhood Opportunity * Time					0.02 (0.01)
Random Effects					
Intercept (school)	292.08 (50.34)*	291.09 (50.41)*	260.38 (51.89)	138.69 (33.05)*	134.46(31.64)*
Slope (school)	–	–	5.11 (2.57)*	2.96 (2.47)	2.71 (2.49)
Intercept (neighborhood)	78.24 (7.57)*	79.73 (7.73)*	106.51 (14.93)*	62.74 (9.57)*	55.67 (8.73)*
Slope (neighborhood)	–	–	2.98 (0.42)*	2.96 (0.45)*	2.71 (0.42)*
Residual	22.00 (2.13)*	21.70 (2.10)*	13.77 (1.93)*	14.16 (2.16)*	14.54 (2.28)*
-2 Residual Log Likelihood	2418.70	2415.20	2400	1989.01	1983.70
AIC	2424.70	2421.20	2410.01	1999.01	1993.70
BIC	2433.30	2429.01	2424.50	2012.50	2007.10
N	332	332	332	283	283

Math achievement outcomes

The multiple regression model significantly predicted math achievement (2019), $F(4, 111) = 34.33$, $p < .001$, adj. $R^2 = .55$. All variables added statistically significantly to the prediction, $p < .01$, except economic disadvantage. Further, there was a significant interaction effect of school economic disadvantage and neighborhood opportunity on math achievement, such that at low levels of economic disadvantage, the association between neighborhood opportunity and math achievement outcomes was positive (B = 13.03, SE = 3.26, $p < .001$, see Fig. 1a).

English achievement outcomes

The multiple regression model significantly predicted English achievement (2019), $F(4, 125) = 30.92$, $p < .001$, adj. $R^2 = .49$. Only neighborhood opportunity significantly added to the overall model. There were no significant interaction effects. See Fig. 1b.

Table 4 Estimates from 3 level Hierarchical growth model examining growth in English achievement over three academic years

	Model 1 Estimate *(SE)*	Model 2 Estimate *(SE)*	Model 3 Estimate *(SE)*	Model 4 Estimate *(SE)*	Model 5 Estimate *(SE)*
Fixed Effects					
(Intercept)	-0.82 (1.76)	-1.60 (1.79)	-1.56 (1.79)	-0.53 (1.42)	-1.26 (1.46)
Academic Year		0.75 (0.31)*	0.72 (0.35)	0.67 (0.38)	0.66 (0.38)
Student Population				-0.00 (0.00)	0.00 (0.00)
Student Teacher Ratio				-1.43 (0.74)	-1.53 (0.73)*
Students of Color				-0.11 (0.07)	0.09 (0.07)
Economic Disadvantage				-0.28 (0.09)*	-0.07 (0.14)
Economic Disadvantage*Time				-0.00 (0.01)	–
Neighborhood Opportunity					0.23 (0.12)*
Neighborhood Opportunity*Time					0.00 (0.01)
Random Effects					
Intercept (school)	313.06 (50.08)*	311.30 (50.23)*	272.17 (53.77)	132.87 (30.0)*	130.65 (31.64)*
Slope (school)	–	–	3.79 (2.43)	3.95 (2.73)	3.76 (2.68)
Intercept (neighborhood)	71.06 (6.53)*	73.84 (6/80)*	119.06 (15.88)*	55.35 (8.18)*	55.67 (8.73)*
Slope (neighborhood)	–	–	3.79 (0.50)*	3.95 (0.58)*	3.76 (0.56)*
Residual	22.57 (2.08)*	22.08 (2.03)*	14.35 (1.91)*	14.03 (2.07)*	14.12 (2.10)*
-2 Residual Log Likelihood	2657.10	2651.70	2637.10	2154.60	2153.60
AIC	2663.10	2657.70	2647.10	2168.43	2167.20
BIC	2671.70	2666.31	2661.51	2181.80	2180.71
N	364	364	364	306	306

Science achievement outcomes

The multiple regression model statistically significantly predicted science achievement (2019), $F(4, 112) = 39.11$, $p < .001$, adj. $R^2 = .57$. All variables added statistically significantly to the prediction, $p < .01$, except the location of the school (Paterson/Passaic or other towns in Passaic, NJ). Further, there was a significant interaction effect of school economic disadvantage and neighborhood opportunity on science achievement, such that at low levels of economic disadvantage, the association between neighborhood opportunity and science achievement outcomes was positive (B = 15.00, SE = 2.53, $p < .001$, see Fig. 1c).

Summary of Findings

In sum, results suggested that both school-level characteristics and features of the school's surrounding neighborhood have important implications for students' educational achievement. In bivariate correlations, greater educational, health/environmental, and social/economic opportunities were associated with greater academic

Table 5 Regression estimates for the three models.

		Estimate	SE	t	*Sig.*
Math Outcomes	*(Intercept)*	-10.22	6.15	-1.66	.09
	Neighborhood Opportunity	0.351*	0.08	4.00	<.001
	Economic Disadvantage	10.70	5.14	2.08	.04
	Interaction Term	-0.41*	0.15	-2.72	.01
	School District	-13.52*	5.31	-2.54	.01
Test of Simple Slopes	Low Economic Disadvantage	13.03*	3.25	4.00	<.001
	High Economic Disadvantage	-2.16	6.41	-0.34	.74
English Outcomes	*(Intercept)*	-8.66	6.30	-1.37	.172
	Neighborhood Opportunity	0.35*	0.09	3.83	<.001
	Economic Disadvantage	4.48	5.36	0.84	.40
	Interaction Term	-0.24	0.15	-1.55	.12
	School District	-10.14	5.19	-1.95	.05
Science Outcomes	*(Intercept)*	-15.16*	4.75	-3.19	.002
	Neighborhood Opportunity	0.40*	0.07	5.94	<.001
	Economic Disadvantage	10.89*	4.10	2.66	.01
	Interaction Term	-0.34*	0.11	-2.95	.004
	School District	-5.85	3.93	-1.50	0.14
Test of Simple Slopes	Low Economic Disadvantage	15.00*	2.53	5.94	<.001
	High Economic Disadvantage	2.47	4.71	0.52	.60

Note. Interaction term = represents the product of neighborhood opportunity and school economic disadvantage. Investigation of simple slope effects suggested that the slope of low economic disadvantage was significant, meaning that higher-income schools in higher opportunity neighborhoods have higher math and science achievement score. The School district represents schools in Paterson or Passaic city (1) and schools in another town in Passaic County (0)

outcomes across three academic years. Specific school-level characteristics, such as a higher student-to-teacher ratio, greater representation of students of color, and greater economic disadvantage, were significantly associated with lower math, science, and English educational outcomes across all academic years. Larger school size was associated with lower math and science educational outcomes across all three academic years, but not English. Independent samples t-test assessing differences in resources allocation and educational performance results suggested that Patterson and Passaic cities had lower neighborhood-level resources, larger school sizes, fewer teachers, a higher percentage of students of color, a greater percentage of students receiving free/reduced-price lunches, and lower math, science, and English performance. In nested multilevel, results suggested that more populated schools and those with greater economic disadvantage had significantly lower math achievement outcomes. In contrast,

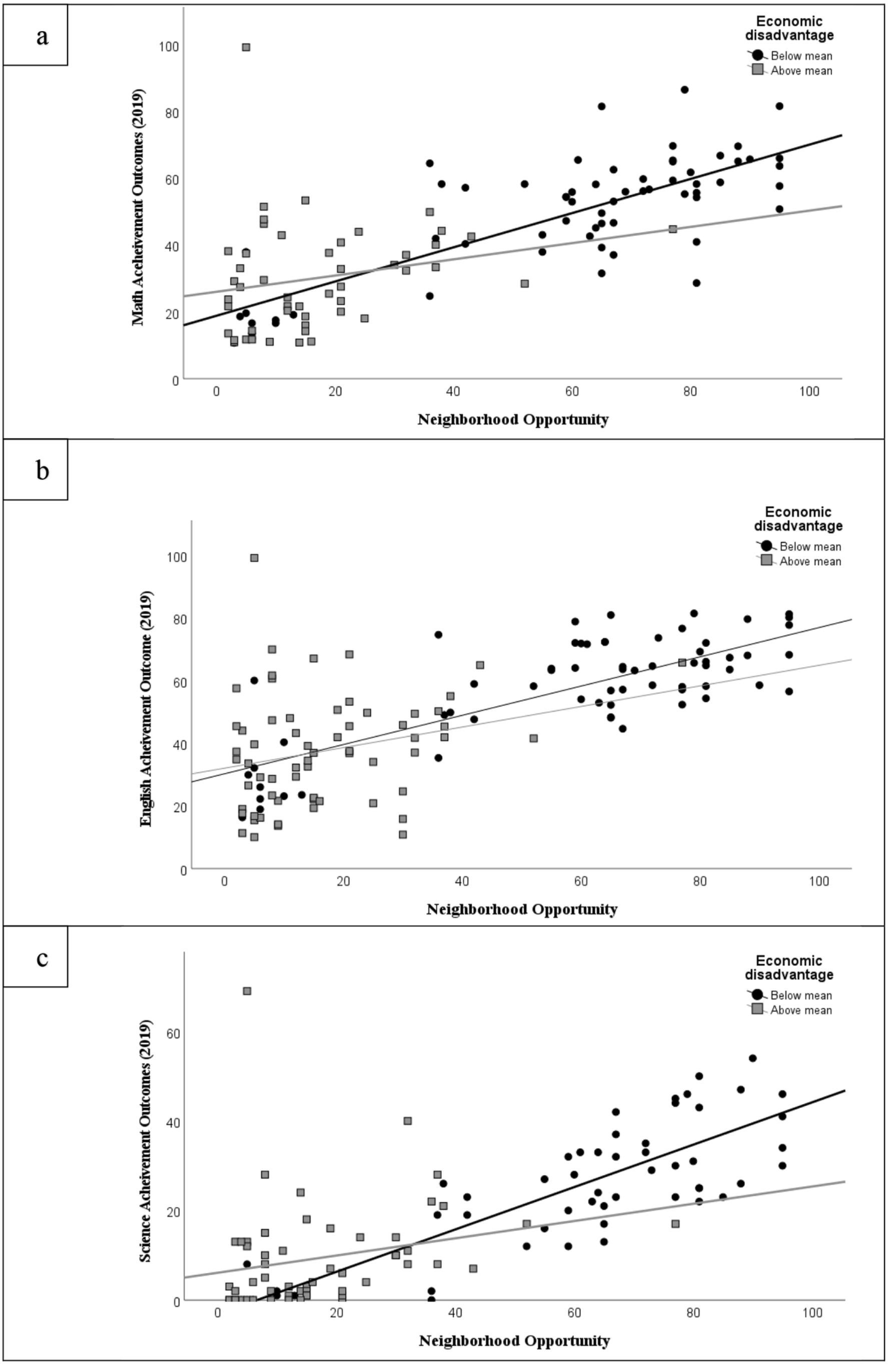

Fig. 1 Figure 1 Graph of the associations between neighborhood opportunity and Math, English, and Science academic achievement performance.

greater economic disadvantage predicted poorer English achievement outcomes. Finally, moderation analyses suggested that students' math and science achievement outcomes were highest when both schools and the surrounding neighborhood had greater economic capital.

Discussion

The present study examined the association between comprehensive indicators of school context (population, teacher ratio, percentage of students of color, and economic disadvantage) and schools' neighborhood resources (indicated by a composite measure assessing educational, health/environmental, and social/economic disparities in a given community) and academic outcomes across three academic school years in multilevel growth models. The findings are consistent with extant literature supporting the role of school characteristics such as student population and teacher ratio on educational outcomes. Results support that school performance in cities that have higher neighborhood resources had greater academic effects across multiple domains of academic achievements (e.g., English, Math, and Science)

Consistent with current literature, the multilevel model suggests that school economic disadvantage was a significant predictor of math and English outcomes (Perry & McConney, 2010). Specifically, schools with a higher proportion of students receiving free or reduced-priced meals score significantly lower on the 2016–2017 math and English proficiency exams. In other studies, higher middle school socioeconomic status is associated with better student outcomes even when controlling for individual student SES (Perry & McConney, 2010; Reardon, 2016; Rumberger & Palardy, 2005). Of note, in bivariate correlations, school economic disadvantage was significantly associated with English and math assessments across all three academic years; however, in growth models, school economic disadvantage did not predict change in academic scores over time.

In the multilevel growth models, student population and teacher ratio were significant predictors, suggesting that larger schools with greater student-teacher ratios had lower performance. Interestingly, these results were only for math, not English scores. This may indicate that different resources are necessary for optimal performance across academic domains (e.g., math and English). Specifically, given that math involves a more "hands-on" approach, smaller class sizes may be better for students to get the opportunity to engage in activities to help their learning and receive one-on-one assistance from teachers (Sirin, 2005). In a follow-up study of the STAR experiment, teachers reported using various strategies to promote learning that only a small classroom afforded, such as closely monitoring students' progress and re-teaching materials using alternative methods.

On the other hand, larger classrooms may create an additional burden on teachers affecting their ability to effectively deliver the curriculum (García & Weiss, 2019; Webster & Fisher, 2003). Although some of the present findings are consistent with previous research, we provide novel evidence that different aspects of the school environment may differentially impact academic outcomes. Thus, interventions to increase achievement scores should consider nuanced factors that may be important for learning various subjects (Beghetto, 2017).

The results of the present study also suggested the role of neighborhood resources on academic outcomes. In bivariate analyses, greater educational opportunities were associated with better performance across math, science, and English assessments across all academic years. While these are consistent with studies assessing the role of neighborhood poverty (Dyson et al., 2003) and exposure to pollutants (Mohai et al., 2011) on academic outcomes, this study is among the first to utilize the Child Opportunity Index as a broad measure of neighborhood opportunity to assess its association with academic outcomes. Importantly, the findings across educational, health/environmental, and social/economic opportunity highlight that a broad range of neighborhood-level factors contribute to academic performance. In multilevel growth models, neighborhood opportunity was a significant predictor of math and English outcomes, indicating that greater neighborhood opportunity predicted better academic performance. Previous studies using the Child Opportunity Index have found evidence for its association with physical development and physiological regulation (Aris et al., 2021; Beck et al., 2017; Roubinov et al., 2018; Thorpe & Klein, 2022). These findings extend current literature by highlighting the role of schools' neighborhood-level resources in predicting school academic outcomes. In growth models, neighborhood opportunity only predicted the intercept of educational outcomes, suggesting evidence for a cross-sectional but not a longitudinal effect. Importantly, these associations may have been obscured by the high association between neighborhood resources and the school's economic disadvantage.

We also found a significant moderation of the school's economic disadvantage, neighborhood resources, and math and science, but not English academic outcomes in the most recent 2018–2019 academic year. Specifically, higher-income schools buffered the association between neighborhood resources and educational outcomes, suggesting that students perform better when schools are more resourced. This is in line with previous research. For example, Owens (2010) found that living in an advantaged neighborhood amplified the positive effects of attending a school with more advantaged students on high school graduation and college attendance. Higher-resourced schools can provide additional support and programs that students need to succeed (Durlak et al., 2010; Mahoney et al., 2005). As seen in Fig. 1a-c, low-resourced schools (grey squares) were more likely to aggregate in lower-resourced neighborhoods and perform lower academically. Higher-resourced schools (black circles) were more likely to aggregate in higher-resourced areas and perform better academically. Results of the independent samples t-test comparing Paterson and Passaic city schools to other schools across Passaic County also suggested that resource and deprivation tend to collate in specific geographic areas. Notably, Paterson and Passaic cities – two of the most diverse and economically disadvantaged cities – have lower neighborhood opportunities, larger schools, fewer teachers, more diverse students, higher disadvantages, and lower academic achievement scores. These findings are consistent with the compound deprivation theory (Jencks & Mayer, 1990; Wodtke et al., 2016). These findings further highlight the need for policies to address residential segregation and rising achievement gaps among more and less-resourced neighborhoods.

Strengths and Limitations

This study has several strengths that contribute significantly to the literature. First, few studies have examined the influence of neighborhood resources through the Child Opportunity Index (COI) and school context (student population, teacher ratio, percentage students of color, and economic disadvantage) on students' academic outcomes (e.g., math and English scores). This study addresses current gaps in the literature by investigating comprehensive measures of school characteristics and schools' neighborhood resources on school-level academic outcomes using publicly available data. Second, the study provides the use of spatial analysis to visualize disparities in neighborhoods, specifically those comprised of predominantly low-income residents in New Jersey. Study findings have the potential to be disseminated to policymakers and community leaders to inform educational policy reform.

Despite its strengths, this study had a few limitations that may guide directions for future research. Given that the data were collected and assessed at the school level, it did not allow for an examination of individual-level or family-level variables that may buffer against the effects of disadvantaged neighborhoods and schools on academic outcomes. Additionally, given the use of public data, the authors could not control or account for the rigor of the data collection. Consequently, there were missing data across some study variables, although preliminary analyses suggested values were missing completely at random. Furthermore, schools' operationalization of their diversity precludes examination of how these factors may differentially impact students from different racial/ethnic backgrounds. Specifically, schools reported the percentage of their student body identifying as a race/ethnicity other than non-Hispanic White. However, research has shown that experiences of neighborhood resource deprivation and school environment have similar but unique effects on students of different racial/ethnic backgrounds (Reardon et al., 2008; Wisman, 2020). Given the study limitations, findings significantly contribute to the literature on urban education research and lay the foundation for future work in this area. Although the present study found significant effects in the hypothesized directions, the magnitude of association was small, suggesting that studies with larger sample sizes and power are warranted to further support our findings.

Conclusions and Implications

Overall, findings from this study indicate that school neighborhoods and their characteristics can influence academic achievement. As a central nexus point in the community, schools can represent an important location for learning, connection, and resource identification and utilization. Yet, change is necessary at the systemic level because schools with low academic achievement are located in lower-income communities with lower-resourced families. Policymakers need to reassess long-standing policies regarding allocating school funding based on property taxes, which creates more significant disparities in school resources between high-income and low-income urban communities (Kelly, 2020); students in lower-income urban schools are continuously at the losing end in this scenario. Moreover, as schools become older and more dilapidated in low-income urban communities, students are forced to endure classrooms with expanding student-to-teacher ratios, or where students vastly outnumber the teacher, as well as classrooms that may not have been designed to accommodate the number of students present in that learning space (Taines, 2011). This is not just a safety concern but influences the quality of learning, with the onus of responsibility placed directly on students' inability to learn, as opposed to considering the context of that learning (Lardier et al., 2019; Taines, 2011).

Drawing on interventions that highlight neighborhood context within schools could help create more opportunities for social connection between and among students and empower students to act toward school and community-level change. This type of intervention may help youth identify their voice in transforming social structures and making systemic policy level changes (at various levels of government). For instance, Kornbluh et al. (2015) has noted the importance of involving youth in changing school structures and co-creating educational spaces alongside adult allies that are resource-wealthy and allow for individual and collective growth. Lardier et al. (2019) also discussed that it might be helpful to position these youth outside the typical school structure and within after-school programs to cultivate engagement in activism. However, this would require school districts, school staff, and adult allies to rethink how they engage and visualize youth – i.e., not as problems to be solved but as savvy actors who can engage in activism toward systemic change. It is important to note that the sole onus of responsibility cannot be on the youth and residents of the community. Policymakers at the federal, state, and city levels need to examine the ways that neighborhood context affects children's educational outcomes and take a multi-faceted approach to address environmental conditions that confer disadvantages spanning education, health, environment, and the economy — as these have important implications for the educational outcomes and long-term well-being of youth.

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Data Availability Data will be made available through the Open Science Framework (OSF) page

Code Availability Analytic code will be made available through the OSF page

Declarations

Materials Availability Additional materials will be made available through the OSF page

Conflicts of Interests The authors report no conflict of interests

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