

Multi-Site Expansion of an Early Childhood Intervention and School Readiness

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abstract

OBJECTIVES: To evaluate the impacts of the expansion of an evidence-based full- and part-day early childhood development program on multiple indicators of school readiness, attendance, and parental involvement for a large cohort of low-income children.

METHODS: This study involved the end-of-preschool follow-up of a nonrandomized, matched-group cohort of 2630 predominantly low-income, ethnic minority children who enrolled in the Midwest Child-Parent Centers (CPC) or alternative preschools in the fall of 2012 in 31 schools in Chicago, Illinois. The program provides comprehensive education, family support, and health services. In the preschool component assessed in this study, 1724 children aged 3 to 4 years in all 16 Chicago centers enrolled in the program. The comparison group included 906 children of the same age who participated in the usual preschool services in 14 matched schools.

RESULTS: Relative to the comparison group who enrolled in the usual preschool services and adjusted for covariates, CPC participants had higher mean scores on all performance-based assessments of literacy (59.4 vs 52.4; $P = .001$), socioemotional development (57.0 vs 51.8; $P = .001$), and physical health (34.5 vs 32.1; $P = .001$). They also had higher ratings of parental involvement in school (5.3 vs 4.0; $P = .04$). Group differences also translated into higher rates of meeting national assessment norms. Program estimates were similar for children attending new and established CPCs and according to age, race/ethnicity, and family income status.

CONCLUSIONS: The findings show that expansion of the program to new schools and more diverse populations is feasible and effective in promoting school readiness skills and parental involvement.



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Dr Reynolds conceptualized and designed the study, directed the data analysis, and drafted the manuscript; Mr Richardson conducted the data analysis and revised parts of the manuscript; Dr Hayakawa helped design the data collection instruments and reviewed the manuscript; Dr Englund conducted the study's data analysis and reviewed the manuscript; Dr Ou helped conceptualize the study and critically reviewed the manuscript; and all authors approved the manuscript as submitted.

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WHAT'S KNOWN ON THIS SUBJECT: Although the benefits of early intervention are well documented, relatively few children are enrolled in high-quality publicly funded programs, especially the most vulnerable. Most previous evidence relies on efficacy trials rather than on routine programs at the population level.

WHAT THIS STUDY ADDS: This study provides the first findings of the contemporary scale-up of one of the most evidence-based early childhood programs. Findings illustrate the feasibility and benefits of scaling effective preventive interventions to reduce achievement gaps and later health disparities.

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The behavioral sources of achievement and health disparities begin early in life. Economic disparities of at least 10 percentage points are evident in prenatal care quality, which increase in magnitude during childhood as measured according to school readiness, reading proficiency, household food insecurity, delinquency, and high school graduation.¹⁻⁴ These factors predict economic well-being, mental health, and health behavior.^{5,6}

In recognition of the major role that social determinants play in well-being, Healthy People 2020 includes early and middle childhood as a key context for policy and programming.⁷ This approach reflects the inherent connection between the school achievement gap and health disparities. Because of their demonstrated impact on well-being, early childhood interventions are at the forefront of prevention for improving educational success and health. Life-course studies indicate that participation in high-quality center-based programs at age 3 and 4 years links to higher levels of school readiness and achievement, as well as higher rates of educational attainment and socioeconomic status as adults, and lower rates of crime, substance use, and mental health problems.⁸⁻¹¹

Although publicly funded preschool programs such as Head Start and state pre-kindergarten serve an estimated 42% of US 4-year-olds, most provide only part-day services and only 15% of 3-year-olds are enrolled.¹² These rates plus differences in quality, intensity, and comprehensiveness may account for the finding that only about one-half of children entering kindergarten have mastered the cognitive skills needed for school success.^{13,14} Large differences are also found among economic groups.

CHILD-PARENT CENTER PROGRAM AND SCALE UP

The Child-Parent Center (CPC) Education Program is a school-based public program with strong evidence of benefits for children and families.¹⁵ Routinely implemented in the Chicago Public School District since 1967, the program provides comprehensive educational and family support services to children ages 3 to 4 years in high-poverty neighborhoods with continuing services up to third grade. In a series of reports in the CLS (Chicago Longitudinal Study), an economically disadvantaged cohort of 1500 program and control group children born in 1980 has been followed up to age 30 years. Participation beginning in preschool was found to eliminate the achievement gap in school readiness and early performance, reduce rates of child maltreatment and school remedial education, reduce rates of felony arrest and substance abuse, and increase rates of high school graduation.¹⁵⁻¹⁹ Economic benefits were found to exceed costs by a ratio of 7-to-1 or higher.²⁰⁻²² Although these findings provide a foundation for expansion, the contemporary context of early childhood programs are different than in the 1980s.

A scale-up of the CPC program was begun in 2012 under an Investing in Innovation Grant from the US Department of Education. Based on a matched-group design similar to earlier studies, we assessed effects in more diverse communities and school contexts. The program model was revised to optimally address the learning needs of children and families, including the opening of full-day preschool classrooms at Chicago sites and implementing a comprehensive set of educational and family supports.²³

Three major questions were addressed: (1) Is participation in the CPC expansion preschool intervention associated with higher

school readiness skills, attendance, and parental involvement at the end of the year? (2) Do the effects of CPC vary between established sites and new sites beginning to implement the program? and (3) Do the effects of CPC participation vary according to age, race/ethnicity, and low-income status?

METHODS

The Midwest Expansion of the Child-Parent Center Education Program, Preschool to Third Grade (Midwest CPC) is an intervention project of the Human Capital Research Collaborative at the University of Minnesota and 8 school districts and educational partners. Midwest CPC was implemented for a 2012 preschool cohort of 2364 to be followed up to third grade and beyond. The goals of the project are to implement the program with high levels of fidelity; assess impacts on child and family well-being; and facilitate expansion and sustainability. Institutional review board approval and informed consent were obtained through the University of Minnesota and participating school districts. The focus of the present report is on 1724 children in 16 Chicago public school sites, which is the largest district and the location of the largest preschool expansion (Supplemental Information).

SAMPLE AND DESIGN

The original sample included 1006 children aged 3 to 4 years in all 10 existing CPCs and 718 children in 6 new CPCs in underrepresented areas of the city. Although all schools serve high proportions of low-income families, the new centers were more diverse in economic status and ethnicity, including a larger concentration of Latino families. The control group included 906 children of the same age who enrolled in preschool programs in 14 non-CPC

schools that matched the CPC schools as closely as possible. Due to poor matches and insufficient records, two additional control schools were excluded (Supplemental Information). Similar to reports in the CLS, all children in the control group participated in the usual early childhood services available in the Chicago school district for part of the day (Supplemental Information).²⁴

We assessed the impact of 2 measures of CPC participation. For any preschool, children enrolled in the program at age 3 or 4 years in 2012–2013 were compared with children who did not participate but who enrolled in the usual preschool program in the control sites (either Head Start or state-funded pre-kindergarten). Thus, the added value of CPC preschool above and beyond the typically implemented program was assessed rather than the impact of preschool compared with no preschool. This approach may provide a conservative bias. Given our focus on the effects of participation, children in both groups attended preschool for at least 3 months and began no later than January 2013.

As a dosage measure, full-day preschool compared children enrolled in the CPC program for the entire school day of 7 hours and children in a part-day CPC program for 3 hours per day or in the usual preschool program in control sites. Table 1 shows the pattern of participation and data collection in the study.

Midwest CPC Intervention

The CPC intervention in the expansion project is designed to enhance early childhood development in multiple domains of health and well-being. Located within or near elementary schools, the program provides educational and family support services between the ages of 3 and 9 years (preschool to third grade). Within a structure of

TABLE 1 Patterns of Participation in the Midwest CPC Expansion, Chicago

Study Category	CPC Preschool Group ^a	Comparison Group ^a
Participants' characteristics at start of study ^b		
Original sample	1938	945
No. of cases with preschool participation	1724	906
No. of cases with CPC full-day preschool	409	0
No. of cases with CPC part-day preschool overall	1315	0
No. of cases with usual Head Start preschool	0	450
No. of cases with usual state-funded preschool	0	456
No. of cases in the original CPC sites	1006	0
No. of cases in the CPC expansion sites	718	0
Total participants in CPC expansion sites, %	41.7	0
No. of 4-y-olds by September 1 enrolled in program	1027	548
No. of 3-y-olds by September 1 enrolled in program	697	358
Participants who are 4-y-olds, %	59.6	60.5
Total full-day participants who are 4-y-olds, %	85.8	0
Total full-day participants in CPC expansion sites, %	30.3	0
No. of cases residing in low-income families (<185% FPL)	1473	754
No. of cases residing in families >185% FPL	251	152
Total participants in low-income families, %	85.4	83.2
No. of study participants with data ^c		
Attendance and chronic absence	1724	906
At least 1 measure of school readiness	1289	591
Parental involvement (teacher ratings)	1724	820

^a Program group enrolled in the CPC program in 2012–2013 as 3- or 4-year-olds; comparison group enrolled in the usual preschool programs in schools that were matched with the CPC schools on propensity scores. Original sample includes the number of cases with any record of attendance based on school records.

^b Participants include all children in the 16 CPCs and from preschool classrooms in the 14 comparison schools who enrolled in Head Start or state-funded preschool. Children attended at least 3 months and to be included were enrolled no later than January. Low income is \leq 185% of the Federal Poverty Line (FPL).

^c Attendance data are from school administrative records; school readiness is from the TS assessment; and parental involvement are teacher ratings at the end of the preschool year. For TS, multiple imputation was used to increase sample size.

comprehensive services (education, family, health, and social services), 6 major components are included^{23,25}: (1) collaborative leadership team led by the head teacher; (2) effective learning experiences (eg, small classes, a literacy-rich instruction); (3) parental involvement and engagement; (4) aligned curriculum across grades; (5) continuity and stability; and (6) a professional development system of teacher coaching and site support.^{15,20} The preschool program is 3 (part-day) or 7 hours per day, 5 days a week during the school year (Supplemental Information).

Outcome Measures

School Readiness

Seven indicators were assessed at the end of the preschool year by using the Teaching Strategies GOLD Assessment System (TS).²⁶ TS is

a performance-based assessment designed for children from birth through kindergarten and comprises 66 items measuring mastery on 38 objectives in 9 domains of child development. We reported outcomes for 6 of the domains assessed with 49 items: literacy (12 items), oral language (6), math (7), cognitive development (10), socioemotional (9), and physical health (5). Each item (indicator) is rated by teachers from 0 (not yet meeting objective) to 9 (full mastery of objective) denoting the level of mastery observed for the objective (Supplemental Table 6). The mean of the scale is set at \sim 36 months of age. The raw scores summed across items for the 6 subscales plus the total score for all domains were analyzed. Dichotomous scores measuring performance at or above the national average were also assessed. As a widely used assessment in early

childhood settings, TS has shown strong reliability and validity in measuring school readiness that is predictive of school achievement and performance.^{26–28}

Teachers were blinded to intervention conditions, and the assessment, being routinely administered by schools, avoided the reactivity of measurement that is common with new assessments used just for research purposes. A significant advantage is that teachers observe children's behavior over a period of 4 to 6 weeks before recording their assessments. This method enhances the ecological validity of the scores.^{24,29}

Attendance

The study used 3 indicators of attendance in the preschool program from official school administrative records. Average daily attendance was the percentage of total available days of enrollment that a child was in attendance. Chronic absence was a dichotomous indicator of whether a child missed 10% or 20% of the total possible school days or more. Absences are not only an indicator of whether the child (and family) are meeting basic school requirements but reflect health problems, illness, and adverse experiences in the family that prevent regular attendance. Economic factors related to transportation and employment instability also correlate with chronic absence. There is extensive literature that attendance and chronic absence predict not only academic achievement but social and emotional adjustment as well as health behavior.^{30,31} Attendance in preschool is also highly correlated with elementary school attendance.³⁰

Parental Involvement

The study used 3 indicators of parental involvement in children's education. For parental involvement in school or the center, classroom teachers rated on a 10-point scale the

“percent of parents who participated in school events and activities from January to the end of the year.” A rating of 1 designated that <10% of families in the classroom participated and a rating of 10 designated that ≥90% of families in the classroom participated in school events and activities (range, 1–10; mean ± SD, 5 ± 2.2). The rating for each class was assigned to each individual child, which reduces response bias and “halo” effects found in ratings of individual children. A dichotomous indicator at or above the mean of 6 was also assessed. The third indicator was parent ratings of their own involvement in the school. A mid-year survey item asked “So far this year, about how often have you participated in school or center activities?” Categorical responses were coded as follows: 0 = never, 1 = less than once a month, 2 = once a month, 3 = two or three times per month, 4 = once a week, and 5 = more than once a week (range, 0–5; mean, 2.19 ± 1.56). Previous studies show that parental involvement ratings by teachers are valid indicators of parenting practices and are a mechanism of long-term effects of early intervention.^{16,18}

Statistical Analysis

Data were analyzed by using generalized estimating equations in SPSS (IBM SPSS Statistics, IBM Corporation, Armonk, NY).³² This model accounts for the multilevel, nested design of children clustered within schools.³³ It also provides robust estimates of marginal means under deviations from multivariate normality and misspecification of the correlated data structure.³⁴ Findings are reported as adjusted means or percentages and group differences controlling for the influence of the following factors: child's gender, race/ethnicity, subsidized lunch status, age in months, special education, school size, and fall scores (school readiness

or attendance). These covariates were measured at preschool entry from school administrative records and parent surveys. Continuous variables were analyzed with the generalized linear model via maximum likelihood (average attendance, TS subscales, and parental involvement). Dichotomous variables were analyzed with probit regression (chronic absences, TS at/above national norms). All estimates account for clustering or nesting of observations according to site. The generalized estimating equation model provides consistent estimates of marginal means under a wide variety of modeling assumptions (distribution of error terms, correlated structure, and clustering).^{34,35} SEs and significance tests were adjusted for variation among sites by using the Huber-White/sandwich correction.^{32,33}

As observed in previous studies,^{16–21} coefficients were robust to alternative covariates and model specifications. Given the relatively high levels of fidelity of program implementation, site-to-site variation in outcomes was modest. School-level achievement, site differences, and new versus established CPC status, however, were accounted for in the models. Multiple imputation of missing data TS subscales was based on the expectation-maximization algorithm after determining that scores were missing at random.³⁶ Findings were consistent across a range of analyses and for different sample sizes. Adjusted group differences at the 0.05 probability level were emphasized. To test subgroup effects, program interaction terms included age, race/ethnicity, and family income status. Within the program group, the effect of established and newly opened sites was also assessed. The statistical significance of subgroup effects was set at 0.05, emphasizing those with overall effects. Standardized mean differences were reported to show

TABLE 2 Characteristics of CPC and Comparison Groups at Baseline

Child/Family Characteristic ^a	Study Sample (<i>N</i> = 2630) ^b		<i>P</i>	Standardized Mean Difference
	CPC Group (<i>n</i> = 1724)	Comparison Group (<i>n</i> = 906)		
Female child, %	51.6	50.2	.512	0.05
Black, %	64.1	45.6	<.001	0.38
Hispanic, %	34.1	53.8	<.001	-0.41
Special education status (IEP), % ^c	9.6	9.2	.696	0.02
Age in months on September 1, 2012 (mean)	48.4	48.6	.595	-0.02
Enrolled as 3-y-olds on September 1, 2012, %	40.4	39.5	.680	0.01
Mother completed high school, %	73.8	63.4	.008	0.28
Child eligible for fully subsidized meals, % ^d	85.4	83.2	.136	0.04
Single parent family status, %	48.8	46.7	.525	0.04
Mother employed full- or part-time, %	71.1	74.1	.300	-0.08
School-level proficiency on state tests (grades 3–8; %)	62.4	60.8	.280	0.05
Attended a school with a high percentage of students meeting state reading norms, %	47.4	40.7	.010	0.15
Fall baseline literacy subscale, mean ± SD	34.2 ± 16.5	31.2 ± 14.2	<.001	0.19
Fall baseline language subscale, mean (SD)	28.5 (8.5)	28.4 (7.3)	.695	0.01
Fall baseline math subscale, mean ± SD	22.9 ± 9.3	23.2 ± 7.9	.564	-0.03
Fall baseline socioemotional development, mean ± SD	40.7 ± 14.0	40.4 ± 10.6	.600	0.01
Fall baseline physical health subscale, mean (SD)	25.8 (6.6)	25.3 (5.8)	.111	0.079
Fall baseline cognitive development, mean (SD)	41.6 (13.0)	42.4 (11.1)	.222	-0.064
Fall baseline total scale, mean ± SD	193.7 ± 67.4	190.8 ± 51.8	.320	0.05
Fall baseline assessed after October, %	51.3	36.7	<.001	0.35

^a Data on child and family characteristics were collected from school administrative records with the exception of low-income status (which was a combination of administrative records and parent reports), parent education, single parent family status, and employment (from parent surveys). *N* for parent survey is 1455.

^b Sample included participants who enrolled in the CPC program or in comparison sites. Comparison children participated in the usual preschool (state pre-kindergarten or Head Start). *P* values show the significance of mean (or percentage) group differences. Fall baseline scores were adjusted for age. Fully imputed fall baseline total scale mean and SD for the respective groups were as follows: 192.2 (58.8) and 190.2 (49.1). The percentage of each group at/above national norms on 3 or more subscales was 10.6% vs. 4.8%, respectively. The threshold for state reading norms was ≥70%. Sample had valid values for ≥1 outcome indicator. Standardized mean difference indicates the difference between groups (SDs) with probit transformations for dichotomous indicators.

^c Children who have an Individual Education Plan (IEP) under the Individuals with Disabilities Education Act.

^d Eligibility defined at ≤185% of the Federal Poverty Line.

the relative magnitude of changes across outcomes.

RESULTS

Sample Characteristics

In the fall of 2012, total enrollment in Chicago sites was 2630, with 1724 in the CPC program and 906 children in the matched comparison schools. Nearly 60% of each group was 4 years old; the remainder were 3 years of age. One-quarter of CPC participants attended full-day classes. The sample is more heterogeneous in both ethnic composition and geography than in previous years. Compared with the existing CPCs, the new CPCs (expansion sites) have a large percentage of Hispanic families.

The characteristics of the program and comparison groups are shown in Table 2. Children were well matched

on school-level characteristics, including the percentage of children scoring proficient on state tests and the probability of program enrollment. Groups were also equivalent in age, gender, low-income status, and receipt of special education services. The major difference between groups was in race and ethnicity. This outcome was due to a few control schools with large Hispanic populations. These differences were taken into account, and program impacts according to race/ethnicity were also estimated. Fall assessment performance was also generally similar between groups, including for the total scale.

Implementation Fidelity

Through monitoring, observations, and staff interviews, we evaluated the extent to which the sites

implemented the program requirements and with high levels of fidelity. Overall, the 16 sites successfully implemented the program requirements, including establishing the leadership teams, maintaining small class sizes, and providing comprehensive child development and family services (Supplemental Information). The average number of hours of instruction for the year was 552 with the majority of time being devoted to literacy and math. There was nearly an equal split between teacher-directed and child-initiated activities (Supplemental Table 7).

Overall Effects of CPC Participation

Table 3 shows the group differences and *P* values for program and comparison groups on the outcomes after adjustment for the covariates.

TABLE 3 CPC Preschool Intervention and Comparison Groups: Marginal Means

Outcome	Program Group (<i>n</i> = 1724)	Comparison Group (<i>n</i> = 906)	Difference (95% CI)	<i>P</i>	Standardized Mean Difference
School readiness skills					
Literacy	59.4	52.4	7.0 (4.4 to 9.7)	.001	0.40
At/above the national norm, %	78.0	57.2	20.8 (9.6 to 31.9)	.001	0.59
Language	38.4	36.0	2.4 (1.1 to 3.6)	.001	0.31
At/above the national norm, %	70.8	63.6	7.2 (−7.0 to 21.4)	.320	0.19
Math	37.6	33.5	4.1 (3.0 to 5.3)	.001	0.43
At/above the national norm, %	73.9	59.7	14.2 (5.0 to 23.5)	.003	0.39
Cognitive development	59.4	53.5	5.9 (3.4 to 8.3)	.001	0.48
At/above the national norm, %	67.7	49.3	18.4 (1.1 to 35.7)	.037	0.50
Socioemotional development	57.0	51.8	5.2 (3.0 to 7.5)	.001	0.44
At/above the national norm, %	66.7	45.6	21.1 (3.0 to 39.2)	.022	0.54
Physical health	34.5	32.1	2.4 (1.1 to 3.8)	.001	0.41
At/above the national norm, %	75.6	59.3	16.3 (1.8 to 30.7)	.028	0.48
Total score (6 subscales)	286.3	259.3	27.0 (17.5 to 36.4)	.001	0.44
At/above the national norm on 4+ subscales, %	69.6	52.2	17.4 (1.4 to 33.3)	.033	0.47
Attendance/parental involvement					
Average daily attendance, %	84.5	86.6	−2.1 (−0.4 to 4.6)	.104	−0.17
Chronic absences, % (10% level)	60.2	47.9	12.3 (0.6 to 24.0)	.040	0.30
Chronic absences, % (20% level)	25.8	20.7	5.1 (−1.0 to 11.2)	.100	0.17
Parental involvement in school (teacher rating)					
High involvement (score of ≥6), %	58.6	19.5	39.1 (1.9 to 76.4)	.039	1.00
Parental involvement (parent rating, spring cases)	2.3	1.8	0.5 (0.05 to 0.9)	.029	0.29

Sample size is 2630. Coefficients are from linear or probit regression analysis (generalized linear models via maximum likelihood) transformed to marginal means, and they are adjusted for child gender, race/ethnicity, age (months), subsidized lunch status, special education, school-level achievement, and fall baseline performance (school readiness or attendance). For school readiness, a dichotomous indicator for a later fall assessment was also included. The *P* value is the probability level of the adjusted mean or percent difference. SEs, and thus *P* values, are adjusted for variation among program sites by using the Huber-White/sandwich correction. Sample sizes for school readiness were 1289 (CPC) and 591 (comparison). Standardized mean difference is in SDs with probit transformation for dichotomous outcomes.

School Readiness

Relative to the comparison group participating in the usual preschool programs, CPC participants had significantly higher mean scores at the end of the preschool year for all 6 domains and the total score. The largest of these differences were for literacy (59.4 vs 52.4; *P* = .001), cognitive development (59.4 vs 53.5; *P* = .001), math (37.6 vs 33.5; *P* = .001), and socioemotional development (57.0 vs 51.8; *P* = .001). CPC participants were also more likely to perform at or above the national average for literacy (78.0% vs 57.2%), math (73.9% vs 59.7%), cognitive development (67.7% vs 49.3%), and physical health (75.6% vs 59.3%). For the total score across all 6 domains, preschool participants had a mean score that was 27 points higher (286.3 vs 259.3; *P* = .001). The standardized mean differences are shown in Fig 1. Their rate of meeting the national norm was also higher (69.6% vs 52.2%; *P* = .033).

The latter finding corresponds to a group difference of 0.47 SD. Findings based on full imputation of TS scores showed similar benefits (Supplemental Table 8).

Attendance

In contrast to school readiness, CPC participants had statistically equivalent rates of daily attendance and chronic absences (missing 20% of days) but significantly higher rates of chronic absences defined as missing ≥10% of school days (60.2% vs 47.9%; *P* = .040). This outcome was reported with or without fall absences taken into account and may reflect the greater economic disadvantages of the CPC schools. The high rates of chronic absence for both groups reflect, in part, that preschool attendance is not mandatory whereas school-age attendance is mandatory.

Parental Involvement

CPC participants had higher rates of parental involvement in school as rated by teachers (5.3 vs 4.0; *P* <

.001). The percentage of CPC parents with high involvement in school was also significantly greater (58.6% vs 19.5%; *P* < .001). This finding was corroborated for the parent ratings, which were based on a smaller sample.

Full- and Part-Day Preschool Versus the Comparison Group

School Readiness and Attendance

Table 4 shows that CPC full-day and part-day groups had higher mean scores and rates of proficiency than the comparison group across all subscales. This finding indicates that the impact of CPC is not due to just the full-day group. As illustrated in Fig 1, standardized mean differences were larger for the full-day group. For attendance, no consistent differences were found, although the CPC full-day group had higher rates of attendance and lower chronic absences than the part-day group.

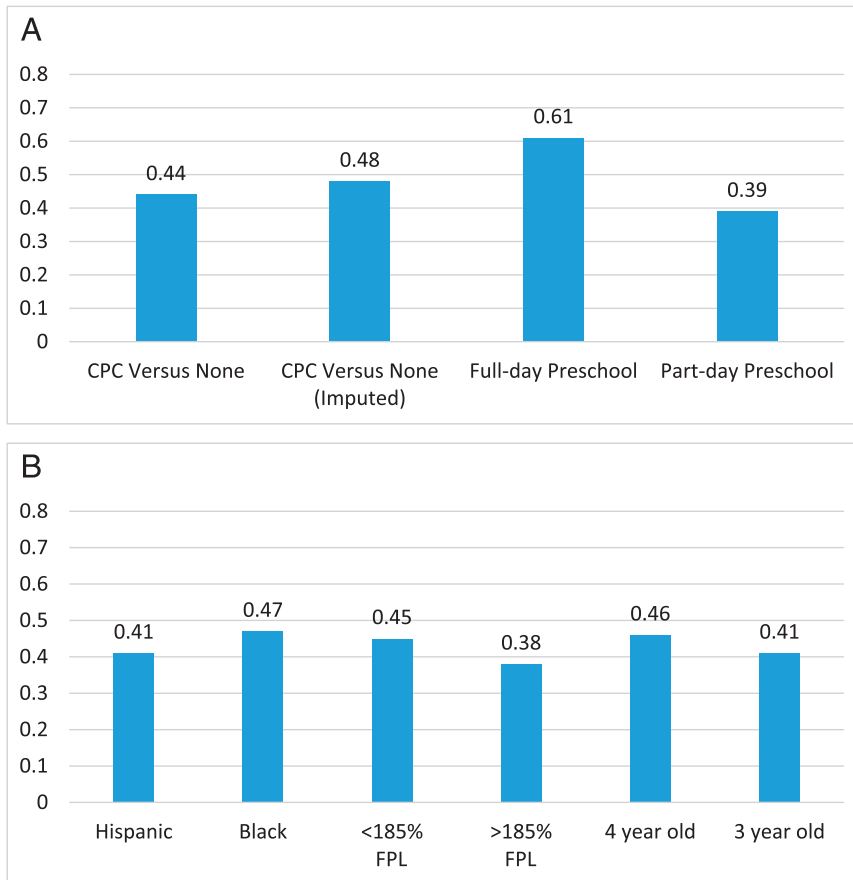


FIGURE 1

Standardized mean differences (effect sizes) in total school readiness associated with CPC preschool participation. (A) Differences for the overall program groups at the end of the preschool year (May 2013) on TS scores. The comparison condition is participation in the usual preschool program in the district. (B) Differences for select subgroups at the end of the preschool year in which the comparison condition is the participation in the usual preschool program for the matched subgroup (eg, established CPC versus comparison for the established CPCs, new CPC versus comparison for the new CPCs). Values are the adjusted marginal mean difference between groups divided by the pooled SD for the total school readiness score including all 6 subscales. The covariates for the adjusted marginal means were fall baseline performance, gender, race/ethnicity, age in months, subsidized lunch status, special education, timing of fall assessment, and school-level achievement. Values are corrected for clustering at the site level based on the Huber-White/sandwich method. The standardized mean difference of 0.40 is equivalent to an improvement of about two-fifths of a school year (4 months), 0.50 is equivalent to an improvement of about one-half of a school year (5 months), and 0.60 is equivalent to an improvement of two-thirds of a school year (6 months). A similar pattern of differences was found for the subscales of the TS assessment. FPL, federal poverty line.

Parental Involvement

Both CPC groups had higher levels of teacher-rated parental involvement than the comparison group. The CPC full-day group had a higher mean rating than the part-day group only for the parent-rated measure (2.5 vs 2.2; $P = .015$).

Subgroup Differences

We assessed whether program effects for particular subgroups differed

from other subgroups of participants (difference-in-differences).

New and Established Sites

As shown in Table 5, no pattern of differences was found in estimated effects between newly opened and established CPCs. Standardized mean differences were similar for the total school readiness scale (Fig 1). The only differences were that impacts on the percent meeting national

norms on total school readiness were greater for children in newly opened sites. Standardized mean differences on parental involvement also favored the new CPC sites.

Child and Family Characteristics

No differential effects of the program were found for ethnicity or race, low-income status, and child age (Supplemental Tables 9 and 10). As shown in Fig 1, the relatively large standardized mean differences were similar for Hispanic and black subjects, according to family income status, and for 4- and 3-year-olds.

DISCUSSION

This study reports the largest expansion of the CPCs. Although the intervention has gone through distinct phases over the course of >4 decades, the present study's findings illustrate the positive impacts of a scaled-up program for a contemporary and more heterogeneous cohort of families. Compared with routinely implemented preschool, CPC participation was linked to greater school readiness skills and parental involvement.

The standardized mean difference for the total score of approximately one-half a SD is relatively large and is equivalent to a >0.5-year gain in proficiency skills and a 33% increase over the comparison group in meeting the national norm. Increases in parental involvement in school were even larger in magnitude. Full-day preschool provided added school readiness benefits beyond part-day services, but both CPC groups showed greater performance than the comparison group. The program in the new sites, which served higher proportions of Latino families, exhibited the same pattern of effects as those in the established sites. Program benefits were also similar according to age, race and ethnicity, and family income.

TABLE 4 CPC Full- and Part-Day Preschool Groups and Comparison Group: Marginal Means

Outcome	Full-Day Group (n = 409)	Difference CPC Full-Day-Control (95% CI)	P	Part-Day Group (n = 1315)	Difference CPC Part-Day-Control (95% CI)	P	Control (n = 906)
School readiness skills							
Literacy (raw score; 12 items)	62.8	10.5 (5.9 to 15.2)	.000	58.4	6.1 (3.2 to 9.0)	.000	52.3
At/above the national norm, %	79.0	21.8 (0.1 to 0.3)	.001	77.7	20.5 (0.08 to 0.3)	.001	57.2
Language (6 items)	39.8	3.8 (2.1 to 5.5)	.000	37.9	1.9 (0.6 to 3.3)	.005	36.0
At/above the national norm, %	76.4	13 (-0.01 to 0.3)	.069	68.9	5.6 (-0.1 to 0.2)	.495	63.3
Math (7 items)	39.7	6.3 (4.0 to 8.6)	.000	37.0	3.5 (2.3 to 4.8)	.000	33.4
At/above the national norm, %	78.8	19.4 (0.05 to 0.1)	.000	72.3	12.8 (0.03 to 0.2)	.012	59.4
Cognitive development (10 items)	60.1	6.7 (3.0 to 10.3)	.000	59.1	5.7 (3.1 to 8.2)	.000	53.5
At/above the national norm, %	65.5	16.1 (-0.05 to 0.37)	.135	68.4	19.0 (0.01 to 0.4)	.044	49.4
Socioemotional (9 items)	58.7	7.0 (3.8 to 10.3)	.000	56.5	4.8 (2.4 to 7.2)	.000	51.7
At/above the national norm, %	69.3	23.8 (0.02 to 0.46)	.034	65.9	20.4 (0.01 to 0.4)	.035	45.5
Physical health (5 items)	35.4	3.3 (1.7 to 4.9)	.000	34.3	2.2 (0.7 to 3.6)	.003	32.1
At/above the national norm, %	78.5	19.2 (0.04 to 0.3)	.011	74.6	15.4 (-0.01 to 0.3)	.054	59.2
Total Score (49 items, all subscales)	296.6	37.8 (22.1 to 53.4)	.000	282.9	24.1 (14.0 to 34.1)	.000	258.9
At/above the national norm, %	75.4	23.5 (0.07 to 0.4)	.005	67.7	15.7 (-0.02 to 0.3)	.084	52.0
Attendance							
Average daily attendance, %	86.8	-0.3 (-4.0 to 3.3)	.856	83.4	-3.8 (-6.8 to -0.8)	.014	87.2
Chronic absences ($\geq 10\%$ of days), %	51.7	5.4 (-8.6 to 19.4)	.449	63.9	17.5 (4.6 to 30.5)	.008	47.3
Chronic absences ($\geq 20\%$ of days), %	17.2	-1.9 (-11.7 to 7.9)	.705	29.7	10.6 (2.8 to 18.3)	.008	19.1
Parental involvement							
Parental involvement in school (teacher ratings)	4.8	0.8 (-0.7 to 2.4)	.284	5.5	1.5 (0.2 to 2.8)	.022	4.0
High involvement (score of ≥ 6), %	44.6	24.4 (-14.2 to 63.1)	.215	63.4	43.2 (5.5 to 80.9)	.025	20.2
Parental involvement (parent report, spring cases)	2.5	0.7 (0.1-0.1.2)	.015	2.2	0.4 (0.01 to 0.9)	.046	1.8

Coefficients are from linear or probit regression analysis (generalized linear models via maximum likelihood) transformed to marginal means, and they are adjusted for child gender, race/ethnicity, age (months), subsidized lunch status, special education, school size, control group participation, and fall score (school readiness or attendance). For attendance, whether a school was under a proposed school action for closure or consolidation was also included. The *P* value is the probability level of the adjusted mean or percent difference. SEs, and thus *P* values, are adjusted for variation among program sites by using the Huber-White/sandwich correction.

TABLE 5 Adjusted Marginal Means for Established and New CPC Sites

Outcome	Established Prog-Comp (n = 1006)	New Sites Prog-Comp (n = 718)	Difference-in-Differences (95% CI)	P	Standardized Mean Difference (Established, New)
School readiness skills					
Literacy (raw score; 12 items)	7.5	6.4	1.1 (-4.4 to 2.5)	.597	0.43, 0.37
Language (6 items)	2.3	2.5	-0.2 (-1.3 to 1.6)	.843	0.30, 0.32
Math (7 items)	4.1	4.3	-0.2 (-1.3 to 1.6)	.800	0.43, 0.45
Cognitive development (10 items)	5.4	6.5	-1.1 (-1.8 to 3.9)	.468	0.44, 0.53
Socioemotional development (9 items)	4.4	6.2	-1.8 (-0.7 to 4.4)	.156	0.37, 0.53
Physical health (5 items)	1.9	3.0	-1.1 (-0.4 to 2.6)	.159	0.33, 0.52
Total score (49 items, 6 subscales)	26.0	28.4	-2.4 (-9.3 to 14.0)	.694	0.42, 0.46
At/above the national norm on 4+ subscales, %	12.0	34.9	-22.9 (4.8 to 40.9)	.013	0.36, 0.91
Attendance					
Average daily attendance, %	-1.6	-4.5	2.9 (-9.1 to 3.0)	.295	-0.13, -0.36
Chronic absences ($\geq 20\%$ of days), %	4.8	11.0	-6.2 (-8.0 to 2.1)	.377	0.17, 0.34
Parental involvement					
Parental involvement in school (teacher ratings)	0.625	1.064	-0.439 (-1.33 to 2.31)	.627	0.29, 0.50
High involvement (score of ≥ 6), %	-0.02	0.186	-18.8 (-15.6 to 53.1)	.285	0.0, 0.38

Sample is fully imputed. To optimize power, continuous outcomes are emphasized. Difference-in-Differences is the mean difference of the difference between each respective subgroup. Coefficients are from linear or probit regression (generalized linear models via maximum likelihood) transformed to marginal means, and they are adjusted for child gender, race/ethnicity, age (months), subsidized lunch status, special education, school-level achievement, and fall baseline performance (school readiness or attendance). For school readiness, a dichotomous indicator for a later fall assessment was also included. The *P* value is the probability level of the adjusted mean or percent difference. SEs, and thus *P* values, are adjusted for variation among program sites by using the Huber-White/sandwich correction.

Although there is a growing literature that state pre-kindergarten and other publicly funded programs improve school readiness,^{8,12} the present study illustrates the feasibility and demonstrated effects of scaling up one of the most evidence-based programs. Because CPC provides more intensive and comprehensive services than most other programs, larger and more sustained effects have been found on educational, economic, and social well-being.^{16–20} In contrast to efficacy trials, CPC also implements a system of services for broader populations that are cost-efficient and replicable. The Midwest CPC expansion is designed to increase access to high-quality early childhood programs and provide a continuous learning experience through the early school grades.

Our findings show that the CPC program can help achieve the Healthy People 2020 early childhood goal to “increase the proportion of children who are ready for school in all five domains of healthy development: physical development, socio-emotional development, approaches to learning, language and cognitive development.”⁷ This goal suggests that implementation at the population level can promote positive effects. Achieving these gains requires high levels of quality. In the CPCs, not only are class sizes small and family services extensive, but there is a curriculum focus on child engagement in all domains of learning. Staff professional development activities further support the quality of implementation. Early childhood investments that prioritize these elements are more likely to promote healthy development. Enhancing school readiness skills initiates a process of cumulative advantage that leads to better health and well-being in adulthood.^{11,15,18}

The findings of the Midwest CPC expansion provide support for increasing access to effective

preschool as a strategy for closing the achievement gap and addressing health disparities. As the present study illustrates, preschool participation seems to be a particularly effective approach for strengthening school readiness. By promoting consistent improvements in readiness skills and in parental involvement, the transition to kindergarten may be smoother and more successful. These presage continuing effects into the early grades. The size and breadth of impacts go beyond previous studies.¹⁴ The positive effects of full-day preschool over part-day also suggest that increasing access to early childhood programs should consider the optimal dosage of services. In addition to educational benefits, full-day preschool benefits parents by freeing time to pursue career and educational opportunities.

As shown in previous studies,^{37–39} improvements in early cognitive, literacy, and numeracy skills are a primary mechanism through which early childhood intervention promotes long-term effects on health and well-being; these improvements include reducing the need for remediation and treatment services and promoting educational attainment and economic self-sufficiency.^{19–21} For example, in the adult follow-up of the CLS, school readiness skills accounted for up to one-third of the direct effect on educational attainment, substance abuse, and crime prevention.^{18,38} Similarly, parental involvement in school (an indicator of the family support hypothesis) explained one-quarter of these long-term effects.

The interpretation of the positive effects should be viewed in the context of major changes in the intervention from that previously evaluated. The Midwest CPC program emphasizes 6 major elements: effective learning experiences, collaborative leadership, parental involvement and engagement,

aligned curriculum, continuity and stability, and professional development. The previous model emphasized only the first 3 elements and with a lower degree of intensity. For example, enhanced elements of effective learning experiences include a curriculum balance of teacher-directed and child-initiated activities, full-day preschool, and progress monitoring of instruction.^{23,25}

The estimated effects in the present study measure the added value above and beyond that of the usual preschool services. Because all comparison group participants enrolled in Head Start or state pre-kindergarten, the effects in this study would have been larger if a no-preschool group was included (as was typical of earlier studies).^{8,22} Thus, relative to conventional comparisons, the present findings are likely to be conservative. Although only 15% of the comparison group in the earlier CPC study attended other preschool programs, the entire group attended full-day kindergarten, whereas only 60% of the CPC group did.^{22,39} Nevertheless, we interpret the pattern of findings in both sets of studies as indicative of large effects on early childhood development outcomes.

We found no effect of the overall program on attendance, which may be attributed to the challenges of an initial start-up. CPCs are located in the most disadvantaged areas of the city and enroll 3 to 5 times more children than comparison sites. The latter had higher rates of attendance at the beginning of the year. Monitoring efforts take time to be established. We found that attendance rates improved as parental involvement and outreach staff increased their time engaging families. Overall parental involvement and engagement was substantially strengthened in the program, which also expands on previous studies.^{15,18,19}

The study has 3 limitations. First, the measures assessed program outcomes rated by teachers and parents. Although not purely objective measures of school readiness skills, TS scores are a performance-based assessment of mastery. They have the further advantage of being aligned with district and state learning standards. Direct cognitive assessments would be complementary indicators, but they were unavailable at the end of preschool. Performance-based and direct assessments correlate highly with each other, however.^{40–42} These factors and related indicators such as peer relations, task orientation, and executive functioning will be assessed in follow-up periods.

The second limitation was that even with the history of previous program implementation, the Midwest CPC

expansion was being implemented for the first time. Delays and changes in staffing, as well as extra time for establishing the structure of operations, were unavoidable. This situation suggests that the positive findings may be conservative compared with implementation after the start-up period. Moreover, the findings address only the preschool component of the program. Continuing kindergarten and school-age services are now being evaluated. Fidelity of implementation to the program, however, has been relatively high.

Finally, the findings have limited generalizability beyond urban contexts. Despite the expansion to new underrepresented areas, most families were low-income and ethnic minority. The fact that the new sites were found to have the same impact as established sites, as well as other

parallel findings, suggests a moderate degree of external validity.

CONCLUSIONS

We found that a contemporary expansion of the CPC program provided significant benefits in school readiness skills and parenting practices. The magnitude and consistency of the impacts are predictive of sustained effects on well-being and school success. The comprehensive and intensive approach of the program to promoting early childhood development provides a strong foundation for improved achievement and health.

ABBREVIATIONS

CPC: Child–Parent Centers
TS: Teaching Strategies GOLD Assessment System

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