

Original Investigation

Association of a Full-Day vs Part-Day Preschool Intervention With School Readiness, Attendance, and Parent Involvement

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IMPORTANCE Early childhood interventions have demonstrated positive effects on well-being. Whether full-day vs part-day attendance improves outcomes is unknown.

OBJECTIVE To evaluate the association between a full- vs part-day early childhood program and school readiness, attendance, and parent involvement.

DESIGN, SETTING, AND PARTICIPANTS End-of-preschool follow-up of a nonrandomized, matched-group cohort of predominantly low-income, ethnic minority children enrolled in the Child-Parent Centers (CPC) for the full day (7 hours; n = 409) or part day (3 hours on average; n = 573) in the 2012-2013 school year in 11 schools in Chicago, Illinois.

INTERVENTION The Midwest CPC Education Program provides comprehensive instruction, family-support, and health services from preschool to third grade.

MAIN OUTCOMES AND MEASURES School readiness skills at the end of preschool, attendance and chronic absences, and parental involvement. The readiness domains in the Teaching Strategies GOLD Assessment System include a total of 49 items with a score range of 105-418. The specific domains are socioemotional with 9 items (score range, 20-81), language with 6 items (score range, 15-54), literacy with 12 items (score range, 9-104), math with 7 items (score, 8-60), physical health with 5 items (score range, 14-45), and cognitive development with 10 items (score range, 18-90).

RESULTS Full-day preschool participants had higher scores than part-day peers on socioemotional development (58.6 vs 54.5; difference, 4.1; 95% CI, 0.5-7.6; $P = .03$), language (39.9 vs 37.3; difference, 2.6; 95% CI, 0.6-4.6; $P = .01$), math (40.0 vs 36.4; difference, 3.6; 95% CI, 0.5-6.7; $P = .02$), physical health (35.5 vs 33.6; difference, 1.9; 95% CI, 0.5-3.2; $P = .006$), and the total score (298.1 vs 278.2; difference, 19.9; 95% CI, 1.2-38.4; $P = .04$). Literacy (64.5 vs 58.6; difference, 5.9; 95% CI, -0.07 to 12.4; $P = .08$) and cognitive development (59.7 vs 57.7; difference, 2.0; 95% CI, -2.4 to 6.3; $P = .38$) were not significant. Full-day preschool graduates also had higher rates of attendance (85.9% vs 80.4%; difference, 5.5; 95% CI, 2.6-8.4; $P = .001$) and lower rates of chronic absences ($\geq 10\%$ days missed; 53.0% vs 71.6%; difference, -18.6; 95% CI, -28.5 to -8.7; $P = .001$; $\geq 20\%$ days missed; 21.2% vs 38.8%; difference -17.6%; 95% CI, -25.6 to -9.7; $P < .001$) but no differences in parental involvement.

CONCLUSIONS AND RELEVANCE In an expansion of the CPCs in Chicago, a full-day preschool intervention was associated with increased school readiness skills in 4 of 6 domains, attendance, and reduced chronic absences compared with a part-day program. These findings should be replicated in other programs and contexts.

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Early childhood interventions improve educational success and well-being.^{1,2} Participation in high-quality center-based programs at ages 3 and 4 years is associated with greater school readiness and achievement, higher rates of educational attainment and socioeconomic status, and lower rates of crime.³⁻⁵

Although publicly funded preschool such as Head Start and state prekindergarten serve an estimated 42% of US 4-year-olds, most provide only part-day services, and only 15% of 3-year-olds enroll.⁶ These rates plus differences in quality may account for only about half of entering kindergartners having mastered skills needed for school success.^{7,8}

One approach for enhancing effectiveness is increasing from a part-day to a full-day schedule. In addition to increasing the amount of learning time, full-day preschool can increase continuity in learning as children avoid multiple education placements during the day; reduce family stress by increasing time for parents to pursue employment and education; and promote long-term effects on well-being. Although evidence from prior studies is meager,⁹⁻¹¹ implementation of full-day preschool within a high-quality, evidenced-based model may be particularly cost-effective, especially for children exposed to early adversity.

The Child-Parent Center Education Program (CPC) is a school-based public program with strong evidence of benefits.¹² Implemented in the Chicago Public Schools since 1967, the program provides comprehensive education and family services beginning in preschool. Cohort studies have found that participation has helped eliminate the achievement gap in school readiness and performance; reduced rates of child maltreatment, remedial education, and crime; and increased rates of high school graduation and economic well-being.¹³⁻¹⁵ Benefits exceed costs by a ratio of 7 to 1.¹⁵ However, the preschool day was limited to 3 hours.

A scale-up of the CPC program began in 2012 in more diverse communities. The model was revised to incorporate advances in teaching practices and family services and included the opening of full-day preschool classrooms in some sites.

We investigated whether full-day preschool was associated with higher levels of school readiness, attendance, and parent involvement compared with part-day participation. We also examined variation by age and program attributes.

Methods

The Midwest Expansion of the CPC is a contemporary expansion of the original program implemented for a 2012 preschool cohort to be followed up to third grade. Five school districts of various sizes serving a broad spectrum of predominantly low-income families in Illinois and Minnesota agreed to implement CPC and follow the guidelines and requirements. Approval for the project was granted by institutional review boards at the University of Minnesota and participating institutions, including written informed consent.

In 11 of 16 Chicago sites, both full- and part-day programs were conducted in the same schools. This report compares outcomes of children in these programs at the end of preschool.

Sample and Design

The study included 982 three- and four-year-olds in these 11 schools. (A description of the larger Midwest CPC Expansion is in eAppendix A in the Supplement.) Three of the schools with full-day classes were new CPCs in underrepresented areas; the others were established prior to 1980.

Schools offered full-day preschool primarily because they had space, slots were available, and there was a perceived demand. This was not the case in other schools as they all lacked space and had little demand. There was no evidence the schools implementing full-day differed from the 5 schools offering only part-day services in commitment to school improvement. All showed evidence of effective implementation of services,¹⁶ and one was undergoing a reform initiative.

For full-day preschool, children enrolled at age 3 or 4 years for the entire school day (7 hours) were compared with children in the same schools who participated for part of the day (between 2.75 and 3 hours). Children were not randomly assigned to full- or part-day, due to the high likelihood of non-adherence by parents and school resistance. Three criteria were used by principals in consultation with the project team to assign children to the full-day program: children who were 4 years rather than 3 years of age; parental preference due to employment or education, transportation barriers, or the lack of available care for the other part of the day; and children with greater educational needs. In some cases, existing part-day classrooms were converted to full-day and families participated who would not have otherwise enrolled. Children in both groups attended preschool 5 days a week for at least 3 months and began no later than January 2013.

Intervention

The Midwest CPC intervention was 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 preschool and third grade. Within a structure of comprehensive services (education, family, health, and social services), 6 major components are included¹⁷: (1) collaborative leadership team led by a head teacher and 2 family coordinators; (2) effective learning experiences (eg, small classes, certified teachers, and literacy-rich instruction); (3) parent involvement and engagement; (4) aligned curriculum across grades; (5) continuity and stability; and (6) professional development system of teacher coaching and site support.

In the effective learning component, the emphasis is on the acquisition of basic skills in language and literacy, math, and socioemotional development through relatively structured but diverse learning experiences that include teacher-directed, whole-class instruction, small-group and individualized activities, field trips, and child-initiated learning. The parent component is an intensive menu-based approach that includes parenting education, volunteering in the classroom, attending school events and field trips, furthering education, and receiving home visits and health and nutrition services, including screening and diagnostics, meal services, and referrals. Professional development includes online teaching modules.

Outcome Measures

School Readiness

We assessed 7 indicators of school readiness at the end of the preschool year using the Teaching Strategies GOLD Assessment System.¹⁸ Teaching Strategies is a performance-based assessment designed for children from birth through kindergarten composed of 66 items measuring mastery on 38 objectives in 9 domains of development. As a widely used assessment in early childhood settings, Teaching Strategies has shown strong reliability and validity in measuring school readiness that is predictive of school achievement and performance (eAppendix B in the Supplement).¹⁹⁻²² Scores reflect functional performance in the classroom context that is not directly measured by tests of cognitive skills, yet they are highly correlated with direct assessments.^{19,22} The assessment is also aligned with state early learning standards (eAppendix B in the Supplement).

We reported outcomes for 6 domains assessed with 49 items as administered by the Chicago Public School District: literacy with 12, oral language with 6, math with 7, cognitive development with 10, socioemotional with 9, and physical health with 5 items. Social studies, science, and art were not assessed in most sites. Each item is rated from 0, not yet meeting objective, to 9, full mastery of objective, as observed by the classroom teacher (eTable 1 in the Supplement provides item descriptions). The mean of the scale is set at the distribution midpoint, which is the expected score for age 36 months. We analyzed raw scores summed across items for the subscales adjusted for age plus the total score for all domains. Measurements were taken at the fall baseline (October to November 2012) and mid-May 2013. Dichotomous scores measuring performance at or above the national norm also were assessed.¹⁹ Meeting the national norm on 4 or more subscales was the set threshold.

Attendance

We used 3 indicators 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 possible school days or more. Average attendance and chronic absence were based on the total number of school days a child was enrolled during the year. Attendance and absences reflect health problems, illness, adverse experiences in the family, and economic factors and predict not only academic achievement but socioemotional adjustment and health.²³⁻²⁵

Parental Involvement

We used 3 indicators of participation in children's education. For parent involvement, 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 indicated that less than 10% of families in the classroom participated and a rating of 10 indicated that 90% or more of families participated (range, 2-10; median [SD], 6 [2.2]). The rating for each class was assigned to each individual child, which reduces response bias and halo effects found in individual rat-

ings. A dichotomous indicator at or above the mean of 6 also was assessed. Previous studies show that ratings by teachers are valid indicators of parenting practices and are a mechanism of long-term effects of early intervention.^{14,26} As a secondary measure, parents rated mid-year their own frequency of participation: "So far this year, about how often have you participated in school or center activities?" (range, 0-5 number of activities).

Statistical Analysis

Data were analyzed in SPSS (version 22).²⁷ Findings are reported as marginal means and group differences controlling for the influence of the following: child's sex, race/ethnicity, eligibility for subsidized lunches (based on family income), age in months, special education, school-level achievement (attended a school in which 70% or more of third graders met state reading norms), fall baseline performance (school readiness or attendance), and a dichotomous indicator of the timing of the baseline assessment. These covariates were measured at preschool entry from school administrative records and parent surveys. Continuous and dichotomous outcomes were analyzed as linear or probit regressions in the generalized estimating equations (GEEs) approach, which is an extension of the generalized linear model appropriate for correlated or clustered data.²⁸ Using maximum likelihood techniques, estimates account for clustering of observations by school through the Huber-White-sandwich correction. The GEE approach provides robust estimates of standard errors and accommodates non-normal data.^{29,30}

Multiple imputation of missing data on Teaching Strategies was based on the expectation-maximization algorithm after determining that scores were consistent with the assumption of missing at random.³¹ A sensitivity analysis was conducted using imputation. Adjusted group differences at the .05 probability level for a 2-tailed test were emphasized. Standardized mean differences (SDs) were also reported with values of 0.20 or higher in the range of clinical or practical significance.³² Raw score differences equivalent to one-fifth of a year of growth (2-3 months) in school readiness were considered of practical significance.¹⁹ These ranged from 1.5 (physical health) to 4.0 points (literacy). To assess subgroups, program interaction terms included child age, race/ethnicity, and whether the site was a new CPC. Differences for existing and new sites also were tested. The significance of subgroups was set at .05.

Results

Sample Characteristics

Among the 11 sites, 409 children enrolled in full-day classes and 573 in part-day classes. The pattern of participation and data collection for these groups are shown in Table 1. They represent 57% of the original sample of 1724 children who enrolled in fall 2012. Excluded children attended part-day programs in the 5 other schools not offering full-day. They had similar characteristics as the study sample of age, sex of child,

low-income status, and fall baseline performance. The excluded group had a higher concentration of Latino families.

The characteristics of the full-day and part-day groups in the same school are shown in **Table 2**. Children were well-matched on fall baseline school readiness, including the mean total score across the 6 subscales (193.2 vs 190.2; difference, 3.0; $P = .46$; dichotomous, 14.2% vs 16.1%; difference, -1.9 ; $P = .49$). Groups were also equivalent on many child and family background characteristics. These included sex of child, race/ethnicity, low-income status, parent educational achievement, employment status, and special education. The major difference between groups was age because full-day participation was more likely for 4-year-olds. This difference was taken into account by including age as a covariate in the main analysis as well as baseline performance. Also taken into account was that proportionally fewer full-day participants attended high-performing schools (Table 2).

Implementation Adherence and Fidelity

Overall, the sites successfully implemented the program requirements including establishing the leadership teams, maintaining small class sizes, and providing comprehensive child development and family services.^{16,17} All sites met these and related requirements, and 75% of observed classrooms were rated moderately high to high in task orientation (a key program focus). Four sites experienced delays in opening full-day classrooms but these were fully operating by January.

The overall average rating of implementation fidelity across the 6 elements was 3.9 or moderately high (minimum score, 1, maximum score, 5).¹⁶ The highest was continuity and stability at 4.3 and the lowest aligned curriculum at 3.3. The collaborative leadership score of 4.0 and parent involvement score of 3.9 were also moderately high. Mean classes sizes were 17.8 in full-day and 15.1 in part-day. Although no differences in classroom ratings of student engagement (eg, task orientation and responsiveness) were detected, a greater percentage of math instruction in full-day classrooms was child-initiated compared with part-day classrooms (eTable 2 in the Supplement). A similar pattern occurred for language and literacy.

The total amount of instruction time for the year was 2.2 times greater in full-day classes (936 vs 418 hours; $P < .001$; eTable 2 in the Supplement). The median duration of participation for each group was 165 days (8 months; range, 3-9 months) with 91% in the full-day and 84% in the part-day groups enrolled for at least 6.5 months. Patterns of enrollment showed no evidence of crossovers.

Outcomes of CPC Full-Day and Part-Day Participation

Table 3 shows the group differences, P values and 95% confidence intervals for the same-school full- and part-day groups after adjustment for the covariates.

School Readiness

For 4 of the 6 subscales, full-day participants demonstrated higher mean skill mastery than part-day participants. These included language (39.9 vs 37.3; difference, 2.6; 95% CI, 0.6-4.6; $P = .01$), math (40.0 vs 36.4; difference, 3.6; 95% CI, 0.5-

Table 1. Patterns of Participation of Full-Day and Part-Day Preschool Groups in 11 Schools, Midwest Child-Parent Center Expansion

Study Category	No. of Children	
	Full-Day	Part-Day
Characteristics at start of study, No. ^a		
CPC preschool	409	573
Classrooms, No. (sessions/classes)	23 (1)	19 (2)
Original sites, No.	285	529
Expansion sites, No.	124	44
4-y-olds at program entry	351	215
3-y-olds at program entry	58	358
Study participants with data ^b		
Attendance and chronic absence	409	573
≥1 measure of school readiness	337	471
Parent involvement (teacher ratings)	409	573

Abbreviation: CPC, Child-Parent Centers.

^a Program group enrolled in the CPC program in 2012-2013 as 3- or 4-year-olds in 11 schools offering full-day preschool classes. Children attended at least 3 months and were enrolled no later than January. Part-day classes had 2 sessions per day (morning and afternoon).

^b Attendance data are from school administrative records; school readiness is from the Teaching Strategies GOLD Assessment; and parent involvement is from teacher ratings at the end of the preschool year. Parent ratings of involvement was a supplemental measure in which 272 and 332 full-day and part-day participants, respectively, provided data by early spring 2013.

6.7; $P = .02$), socioemotional development (58.6 vs 54.5; difference, 4.1; 95% CI, 0.5-7.6; $P = .03$), and physical health (35.5 vs 33.6; difference, 1.9; 95% CI, 0.5-3.2; $P = .006$). Results for literacy (64.5 vs 58.6; difference, 5.9; 95% CI, -0.07 to 12.4; $P = .08$), and cognitive development (59.7 vs 57.7; difference, 2.0; 95% CI, -2.4 to 6.3; $P = .38$) were not statistically significant.

For rates of mastery at or above the national average, 4 of the 6 subscales showed differences. Full-day participants had higher rates of literacy (85.1% vs 74.6%; difference, 10.5; 95% CI, 1.5-19.4; $P = .03$), math (84.4% vs 72.3%; difference 12.1; 95% CI, 5.3-18.9; $P = .001$), socioemotional (73.4% vs 56.0%; difference, 17.4; 95% CI, 0-35.0; $P = .05$), and language development (81.2% vs 61.7%; difference, 19.5; 95% CI, 4.5-34.6; $P = .01$). Although literacy showed a positive association for mastery at the national average, findings for physical health were limited to mean differences. Standardized mean differences were 0.57 for language, 0.46 for socioemotional, 0.42 for physical health, 0.41 for math, 0.37 for literacy, and 0.16 for cognitive development.

In addition, the full-day group had a significantly higher rate of mastery on the total readiness metric, for 80.9% were at or above the national average on 4 or more subscales compared with 58.7% of the part-day group (difference, 22.2; 95% CI, 5.8-38.5; $P = .008$). The standardized mean difference of 0.65 was relatively large. Mean differences also were significant (298.1 vs 278.2; difference, 19.9; 95% CI, 1.2-38.4; $P = .04$; standard mean difference, 0.33).

These findings translate to percentage change differences associated with full-day preschool of 16.7% (at or above norm in math) to 37.6% (total score; eFigure in the Supplement). Converting the observed raw score differences to

Table 2. Characteristics of Same-School Child-Parent Center Full-Day and Part-Day Groups at Fall Baseline, 2012-2013

Characteristics ^b	Child-Parent Center Sample, No. (%) ^a		
	Preschool		P Value for Full-Day vs Part-Day
	Full-Day (n = 409)	Part-Day (n = 573)	
Demographics, No. (%)			
Girl	216 (52.8)	295 (51.2)	.55
Black	363 (88.8)	523 (93.0)	.02
Hispanic	31 (7.6)	40 (7.0)	.80
Special education status ^c	19 (4.6)	22 (3.8)	.63
Age on September 1, 2012, mean (SD), mo	51.6 (5.4)	45.8 (6.5)	<.001
Parent survey ^d			
Mother completed high school	215 (79.9)	253 (78.1)	.61
Eligible for fully subsidized meals ^e	367 (89.7)	529 (92.3)	.17
Single-parent family status ^f	177 (65.1)	218 (65.7)	.93
Mother employed full- or part-time ^f	186 (53.7)	231 (48.0)	.19
Attended a school with a high percentage of students meeting state reading norms	80 (15.4)	188 (28.9)	<.008
Fall baseline, mean (SD), score			
Literacy subscale	35.3 (16.3)	33.9 (16.4)	.20
Math subscale	23.5 (8.9)	22.6 (9.2)	.16
Socioemotional development	40.2 (11.8)	39.2 (14.7)	.26
Total scale	193.2 (57.4)	190.2 (64.7)	.46
≥National norm on >4 subscales	48 (14.2)	76 (16.1)	.49
Fall baseline assessed after October	201 (53.4)	266 (58.0)	.20

^a The sample included participants who enrolled in full-day or part-day preschool in the same 11 sites. P values show the significance of mean or percentage for group differences. Fall baseline scores were adjusted for age. The threshold for grade 3 state reading norms was 70% or higher on the Illinois State Achievement Test. The sample had valid values for 1 or more outcome indicators.

^b 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.

^c Children who have an individual education plan under Individuals with Disabilities Education Act (IDEA).

^d Parent education, single-parent family status, and employment were garnered from parent surveys. Sample size for parent survey was 272 in the full-day group and 332 in the half-day group. The sample sizes for the fall baseline assessments were 337 for the full-day group and 471 for the half-day group.

^e Eligibility was defined at 130% of the federal poverty line or lower.

^f There were 272 parents whose children were in the full-day group and 332 in the half-day group.

months of expected improvement during the year, full-day preschool was associated with about a third of a year (3-4 months) of improvement in all domains except cognitive development (1-1.5 months).

Attendance

Compared with part-day, full-day participation was associated with a higher rate of average daily attendance (85.9% vs 80.4%; difference, 5.5; 95% CI, 2.6-8.4; P = .001) and a lower rate of chronic absences (53.0% vs 71.6%; difference, -18.6; 95% CI, -28.5 to -8.7; P = .001) as well as absences defined at 20% or more days missed (21.2% vs 38.8%; difference, -17.6; 95% CI, -25.6 to -9.7; P < .001). Standardized mean differences were around -0.50. This corresponds to percentage reductions in chronic absences associated with full-day preschool of 26.0% to 45.4%.

Parental Involvement

No significant differences were detected for teacher (3.95 vs 4.65; difference, -0.7; 95% CI, -1.7-3.0; P = .17) and parent ratings of school involvement (2.54 vs 2.51; difference, 0.03; 95% CI, -0.54-0.61; P = .92).

Sensitivity Analysis

The pattern of findings for full-day vs part-day preschool was found with or without multiple imputation of Teaching Strategies (see eTables 4 and 5 in the Supplement). With fully imputed scores (17.7% imputed for spring scores), full-day in the same schools was positively associated with the total score (296.7 vs 277.7; difference, 19.0; 95% CI, 0.2-34.8; P = .02; standard mean difference, 0.31) and 5 of the 6 subscales, including literacy (64.1 vs 58.3; differences, 5.8; 95% CI, 0.3-11.2; P = .04; standard mean difference, 0.33), math (39.8 vs 36.3; difference, 3.5; 95% CI, 0.9-6.1; P = .008; standard mean difference, 0.37), and physical health (35.3 vs 33.6; difference, 1.7; 95% CI, 0.6-2.8; P = .003; standard mean difference, 0.29; eTable 4 in the Supplement). Moreover, alternative specifications of GEE and related approaches showed a similar pattern of findings.

Subgroup Differences

We found few differences in estimates of CPC full-day preschool on outcomes by race/ethnicity, age, and CPC status (new vs established). Table 4 shows the results for select continuous outcomes. We used the fully imputed and continuous out-

Table 3. Child-Parent Center Same-School Full-Day vs Part-Day Preschool: Adjusted Marginal Means^a

Outcome	Group, No. (%)		Difference (95% CI)	P Value	Standard Mean Difference
	Full-Day Preschool (n = 409)	Part-Day Preschool (n = 573)			
School readiness skills					
Literacy, raw score, 12 items	64.5	58.6	5.9 (−0.7 to 12.4)	.08	0.33
≥National norm	287 (85.1)	351 (74.6)	10.5 (1.5 to 19.4)	.03	0.37
Language, 6 items	39.9	37.3	2.6 (0.6 to 4.6)	.01	0.34
≥National norm	274 (81.2)	291 (61.7)	19.5 (4.5 to 34.6)	.01	0.57
Math, 7 items	40.0	36.4	3.6 (0.5 to 6.7)	.02	0.38
≥National norm	284 (84.4)	341 (72.3)	12.1 (5.3 to 18.9)	.001	0.41
Cognitive development, 10 items	59.7	57.7	2.0 (−2.4 to 6.3)	.38	0.16
≥National norm	237 (70.3)	301 (64.0)	6.3 (−16.2 to 28.8)	.99	0.22
Socioemotional development, 9 items	58.6	54.5	4.1 (0.5 to 7.6)	.03	0.34
≥National norm	247 (73.4)	264 (56.0)	17.4 (0 to 35.0)	.05	0.46
Physical health, 5 items	35.5	33.6	1.9 (0.5 to 3.2)	.006	0.32
≥National norm	277 (82.2)	323 (68.6)	13.5 (−1.0 to 28.1)	.07	0.42
Total score, 49 items with 6 subscales	298.1	278.2	19.9 (1.2 to 38.4)	.04	0.33
≥National norm on >4 subscales	273 (80.9)	276 (58.7)	22.1 (5.8 to 38.5)	.008	0.65
Attendance					
Average daily, %	85.9	80.4	5.5 (2.6 to 8.4)	.001	0.41
≥10% Absences, d	217 (53.0)	410 (71.6)	−18.6 (−28.5 to −8.7)	.001	−0.50
≥20% Absences, d	87 (21.2)	222 (38.8)	−17.6 (−25.6 to −9.7)	<.001	−0.53
Parental participation score					
Teacher ratings	3.95	4.65	−0.70 (−1.7 to 3.0)	.17	−0.38
High involvement, ≥6	124 (30.3)	254 (44.3)	−14.0 (−38.3 to 10.3)	.23	−0.37
Parent report, spring cases	2.54	2.51	0.03 (−0.54 to 0.61)	.92	0.02

^a The sample includes 808-982 children from 11 sites offering full-day preschool. Coefficients are from linear or probit regression analysis (generalized linear models via maximum likelihood) transformed to marginal effects, and they are adjusted for child sex, 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 also was included. The *P* value is the probability level of the adjusted mean or percentage difference. Standard errors, and thus *P* values, are adjusted for variation among program sites by the Huber-White-sandwich correction. Three hundred thirty-seven children were in the full-day and 471 in the part-day Child-Parent Center. The possible (not actual) ranges for continuous outcomes were literacy (0-108), language (0-54), math (0-63), cognitive development (0-90), socioemotional development (0-81), physical health (0-45), total score (0-441), average daily attendance (1%-100%), parent involvement in school (teacher, 1-10), and parent involvement (parent, 0-5).

comes to optimize power. Notably, differences in mean attendance (14.4 percentage points) significantly favored children in new sites (95% CI, 11.6-17.2) as did chronic absences at 22.1 percentage points (95% CI, −33.9 to −10.3; *P* < .001 for both measures). Teaching Strategies GOLD scores were similar by site status and age, although the pattern of findings favored 3-year-olds. The only difference for parent involvement was that compared with part-day, full-day in established sites had significantly higher parent-reported involvement than in new sites (0.3 vs −1.10; difference in difference, −1.3; 95% CI, −2.2 to −0.38; *P* = .005).

Discussion

The current study shows that full-day preschool in the Midwest CPC program was associated with higher scores in 4 of 6 domains of school readiness skills—language, math, socioemotional development, and physical health—increased attendance, and reduced chronic absences by 26% to 45% over part-day services. The greater amount of time spent in preschool was associated with 17% to 38% increases in children meeting national norms on 4 of 6 subscales—language, math,

socioemotional development, and literacy—and gains in school readiness of 3 to 4 months. Only for cognitive development were there no group differences detected. Full-day preschool appears to be a promising strategy for school readiness. The size and breadth of associations go beyond previous studies.⁹⁻¹¹ The positive association of full-day preschool also suggests that increasing access to early childhood programs should consider the optimal dosage of services. In addition to increased educational enrichment, full-day preschool benefits parents by providing children with a continually enriched environment throughout the day, thereby freeing parental time to pursue career and educational opportunities. By offering another service option, full-day preschool also can increase access for families who may not otherwise enroll. These findings also support the prevention goals of Healthy People 2020.³³

The relation between full-day preschool and school readiness found in this report is consistent with prior dosage studies examining early reading and math achievement.^{9-11,34} For example, a report of the federally sponsored Early Childhood Longitudinal Study found that length of day in center-based preschool was positively associated with reading and math skills at kindergarten entry, especially for low-income children.⁹ No differences were found for social behavior, however, and

Table 4. Adjusted Mean Differences at the End of Preschool Between Same-School Full-Day and Part-Day Preschool for New and Established Sites and by Age^a

Outcome	Full-Day and Part-Day Preschool		Difference in Difference (95% CI)	P Value	Full-Day and Part-Day Preschool		Difference, Difference (95% CI)	P Value
	New Sites (n = 168)	Established (n = 814)			4-Year-Olds (n = 566)	3-Year-Olds (n = 416)		
School readiness skills								
Literacy, raw score, 12 items	6.5	5.8	-0.7 (-6.8 to 8.2)	.82	4.7	10.1	5.4 (1.4 to 9.3)	.01
Language, 6 items	2.1	2.7	0.6 (-2.7 to 1.5)	.60	1.7	1.1	-0.6 (-2.6 to 1.4)	.57
Math, 7 items	3.7	3.5	-0.2 (-3.2 to 3.7)	.90	2.6	3.5	0.9 (-0.5 to 2.2)	.21
Cognitive development, 10 items	1.6	2.2	0.6 (-4.9 to 3.7)	.79	3.1	1.0	-2.1 (-5.3 to 1.0)	.19
Socioemotional development, 9 items	2.9	3.8	0.9 (-4.6 to 2.9)	.65	2.1	3.0	0.9 (-4.5 to 6.2)	.75
Physical health, 5 items	0.9	2.0	1.1 (-2.8 to .6)	.19	2.9	2.5	-0.4 (-1.9 to 1.0)	.55
Total score, 49 items, 6 subscales	17.6	19.9	2.3 (-23.1 to 19.2)	.38	12.5	31.3	18.8 (-4.5 to 42.1)	.11
At or above the national norm on ≥4 subscales, %	2.6	16.6	14.0 (-34.4 to 6.3)	.19	13.2	30.3	17.1 (-4.7 to 29.9)	.11
Attendance								
Average daily attendance, %	17.3	2.9	14.4 (11.6 to 17.2)	<.001	5.6	4.1	-1.5 (-4.2 to 1.1)	.26
Chronic absences, ≥20% days, %	-35.6	-13.5	-22.1 (-33.9 to -10.3)	<.001	16.0	18.6	2.6 (-11.8 to 6.6)	.58
Parental participation								
Parent involvement in school (teacher ratings)	0.2	-0.4	0.6 (-1.0 to 2.1)	.46	-0.4	-1.8	-1.4 (-3.2 to 0.4)	.12
High involvement (≥6 score), %	-7.2	-6.2	-1.0 (-35.5 to 33.9)	.96	-10.1	-33.1	-23.1 (-23.0 to 68.0)	.40

^a The sample is fully imputed and includes 982 children from 11 sites offering full-day preschool. The Difference in Difference is the mean difference of the difference between each respective subgroup. Coefficients are from linear or probit regression analysis (generalized linear models via maximum likelihood) transformed to marginal effects, 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 also was included. The *P* value is the probability level of the adjusted mean or percentage difference. Standard errors, and, thus, *P* values, are adjusted for variation among program sites by the Huber-White sandwich correction.

results of the observational study were consistent across a range of analyses. In a randomized controlled trial of Head Start programs in Chicago, full-day preschool at ages 3 years, 4 years, or both was associated with nearly double the gains in school readiness compared with part-day preschool.¹¹

To our knowledge, this study is the first to extend the outcomes of full-day preschool to higher attendance and lower chronic absences. Unlike previous studies, we also documented relatively large associations with socioemotional development and physical health. As a comprehensive evidence-based program, CPC's demonstrated quality is higher than most other interventions. These findings are also consistent with those in the Chicago Longitudinal Study and other projects showing both immediate and long-term associations of preschool intensity measured in total days or years of attendance.³⁵⁻³⁸

Although the program was associated with significant gains in 5 of the 6 domains for raw scores or rates of mastery at or above the national average, not all scores were improved. The large percentage of each group that was absent 10% to 20% or more of days enrolled as well as the limits of measuring a comprehensive set of outcomes may have contributed. No differences were detected for either indicator of cognitive development. This may be due to the instructional focus of the program on specific skills in language, numeracy, and behavior rather

than general cognition (eg, thinks symbolically). Moreover, the subscale may not reflect the wide range of skills and approaches to learning that encompass the broad concept of cognitive development. Although literacy readiness scores were not different between groups, differences favoring full-day preschool were detected for the dichotomous indicator of meeting the national norm and in the fully imputed model of means. These estimates translate to educationally meaningful differences (standard mean difference, 0.37 or a 4-month gain). Physical health showed mean differences but no differences in the rate at or above the national average. Results were also educationally meaningful (standard mean difference, 0.42 or a 3-4 month gain.)

The current study is the first to assess full-day CPC preschool. The positive association between full-day and school readiness should be seen in the context of changes in the intervention from that evaluated previously. First, 6 elements are emphasized: effective learning experiences, collaborative leadership, parent involvement and engagement, aligned curriculum, continuity and stability, and professional development. The previous model emphasized only the first 3 and with a lower degree of intensity. The Midwest expansion also introduced a professional development system of coaching, provided program support by site mentors, and implemented curriculum alignment and parent involvement plans

in collaboration with principals. These elements inform the interpretation of results and provide a documented framework for replication and expansion. For example, the City of Chicago has announced plans to implement this model to serve an additional 2600 children using Pay-for-Success financing.

The study has at least 5 limitations. First, the measures assessed a limited range of outcomes. Although not a purely objective measure of school readiness skills, Teaching Strategies is a performance-based assessment of mastery. Further advantages are that the assessment is aligned to state standards, it includes all domains of learning key to school readiness, results are used to improve instruction, and it has evidence of predictive validity. Moreover, performance-based and direct assessments correlate highly with each other.^{21,22,39} The major disadvantage is the possibility of bias in ratings since teachers were not blind to children's intervention status. Two factors counteract this limitation. First, teachers receive training on the assessment to increase accuracy and help reduce ratings bias. Teaching Strategies is routinely administered by schools and was not specific to this study. Second, if the lack of blinding about intervention status introduced bias in favor of children in full-day classrooms, it would have been expected to be observed at the baseline assessment, 2 months into the year. However, group differences on the assessment were equivalent.

Second, a significant amount of data for Teaching Strategies were missing, which may have affected the reliability and stability of estimates. That findings were similar across a range of imputations minimizes this threat to validity.

The third limitation was that even with the history of prior program implementation, full-day preschool in the CPCs was being implemented for the first time. Delays in staffing and the extra time needed to establish the full-day structure of operations were unavoidable. This suggests that the findings may be conservative compared with implementation after the start-up period.

Fourth, although groups were similar at baseline and analyses accounted for many school, child, and family attributes, it is possible that unmeasured factors contributed to findings. Consequently, results should be interpreted cautiously. Random assignment, although not possible in our study, can more easily rule out potential confounding variables or those that are difficult to measure (eg, motivation or attitudes). The inclusion of the most relevant covariates identified in prior studies reduces this threat however.^{14,35,36} That the full-day group had a higher concentration of 4-year-olds was accounted for by the inclusion of age and baseline performance as covariates. To the extent that this compositional difference was not fully adjusted in the model, findings may be conservative because the pattern of associations favored younger children and they had a lower rate of participation in full-day preschool. The fact that the fall baseline assessment occurred 1 to 2 months into the year after the program began implementation also mitigates against the influence of unmeasured factors. Findings of prior CPC studies support this interpretation.^{35,36,40}

Finally, the findings may have limited generalizability beyond urban contexts and to programs different than CPC. Despite the expansion to new underrepresented areas, most families were low-income and ethnic minority. That the associations in new sites were largely equivalent to those in established sites suggests a moderate degree of external validity.

Conclusions

In an expansion of the CPC program in low-income Chicago communities, a full-day preschool intervention was associated with increased school readiness skills in 4 of 6 domains, attendance, and reduced chronic absences compared with a part-day program. These findings need to be replicated in other programs and contexts.

ARTICLE INFORMATION

Author Contributions: Dr Reynolds had full access to all of the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.

Study concept and design: Reynolds, Hayakawa, Warner-Richter.

Acquisition, analysis, or interpretation of data: All authors.

Drafting of the manuscript: Reynolds, Hayakawa, Lease, Ou, Sullivan.

Critical revision of the manuscript for important intellectual content: Richardson, Hayakawa, Warner-Richter, Englund.

Statistical analysis: Reynolds, Richardson, Hayakawa, Englund.

Obtained funding: Reynolds.

Administrative, technical, or material support: Reynolds, Hayakawa, Lease, Warner-Richter, Englund, Ou, Sullivan.

Study supervision: Reynolds, Englund.

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