



HHS Public Access

Author manuscript

JAMA. Author manuscript; available in PMC 2015 November 26.

Published in final edited form as:

JAMA. 2014 November 26; 312(20): 2126–2134. doi:10.1001/jama.2014.15376.

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

Arthur J. Reynolds, PhD, Brandt A. Richardson, BA, C. Momoko Hayakawa, PhD, Erin M. Lease, MA, Mallory Warner-Richter, MPP, Michelle M. Englund, PhD, Suh-Ruu Ou, PhD, and Molly Sullivan, MPP

Institute of Child Development, University of Minnesota (Reynolds, PhD; Englund, PhD; Ou, PhD; Lease, MA; Warner-Richter, MPP); Human Capital Research Collaborative, University of Minnesota (All authors); Humphrey School of Public Affairs, University of Minnesota (Sullivan, MPP; Hayakawa, PhD); Department of Applied Economics, University of Minnesota (Richardson, BA)

Abstract

Importance—Early childhood interventions have demonstrated many positive effects on well-being. Whether attending for the full day vs part day improves outcomes is unknown.

Objective—To evaluate the association between a school-based full- and part-day early childhood development program and multiple indicators of school readiness, attendance, and parent involvement for a large cohort of low-income children.

Design, Setting, and Participants—End-of-preschool follow-up of a nonrandomized, matched-group cohort of predominantly low-income, ethnic minority children who enrolled in the Child-Parent Centers for the full school day (7 hours; n = 409) or part of the day (3 hours on average; n = 573) in the fall of 2012 in 11 schools in Chicago, Ill.

Interventions—The Midwest Child-Parent Center Education Program provides comprehensive education, family-support, and health services from preschool to third grade in high-poverty

Corresponding Author: Arthur Reynolds, Institute of Child Development & Human Capital Research Collaborative, University of Minnesota, 51 East River Road, Minneapolis, MN 55455, Ph: 612-625-4321, ajr@umn.edu.

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

Study concept and design: Reynolds, Richardson, Warner-Richter

Acquisition, analysis, or interpretation of data: Reynolds, Warner-Richter, Lease, Sullivan, Englund

Analysis and Interpretation of data: Reynolds, Richardson

Drafting of the manuscript: Reynolds, Hayakawa, Lease, Richardson

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

Statistical analysis: Richardson, Reynolds, Englund

Obtained funding: Reynolds, Ou, Sullivan

Administrative, technical, or material support: Warner-Richter, Lease, Ou, Englund

Study supervision: Reynolds, Ou, Englund

Conflict of Interest Disclosures: All authors have completed and submitted the ICMJE Form for Disclosure of Potential Conflict of Interest. No conflicts of interest were reported.

Disclaimer: The views expressed in this article are those of the authors and do not necessarily represent the views of the sponsors and funders of this project.

neighborhoods. In the preschool component assessed in this study, 3- and 4-year-olds in enrolled in the program for full- or part-day.

Main Outcomes and Measures—School readiness skills in 6 domains and on a total score at the end of the year, attendance and chronic absences, and parental involvement. Mean raw scores and the number of items for readiness domains were as follows: literacy (57.1, 12 items), language (37.8, 6), math (36.3, 7), cognitive (57.6, 10), socioemotional (55.4, 9), physical health (33.8, 5), and the total (278.0; 49).

Results—Full-day preschool participants had higher scores than part-day peers in the same schools on socioemotional development (58.6 vs. 54.5; diff. = 4.1; $P = .025$; 95% CI = 0.5, 7.6), language (39.9 vs. 37.3; diff = 2.6; $P = .010$; 95% CI = 0.6, 4.6), math (40.0 vs. 36.4; diff. = 3.6; $P = .022$; 95% CI = 0.5, 6.7), and physical health (35.5 vs. 33.6; diff. = 1.9; $P = .006$; 95% CI = 0.5, 3.2) but not parent involvement in school (3.95 vs. 4.65; diff. = -0.70; $P = .170$; 95% CI = -1.7, 3.0). The full-day group also had a higher mean total score (298.1 vs. 278.2; diff. = 19.9; $P = .037$; 95% CI = 1.2, 38.4) compared with the part-day group. For literacy, language, math, socioemotional development, and the total score, full-day participants met national assessment norms at rates that were 11 to 22 points higher (percentage change of 17-38%) than those in part-day classes. Standardized mean differences ranged from 0.16 (cognitive development score) to 0.65 (at/above national norm on 4 of 6 subscales). They also had significantly higher levels of attendance (85.9% vs. 80.4%; diff. = 5.5; $P = .001$; 95% CI = 2.6, 8.4) and lower rates of chronic absences measured at 10% (53.0% vs. 71.6%; diff. = -18.6; $P = .001$; 95% CI = -28.5, -8.7) and 20% or more of days missed (21.2% vs. 38.8%; diff. = -17.6; $P < .001$; 95% CI = -25.6, -9.7).

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

Early childhood interventions have been shown to improve educational success, health, social functioning, and economic well-being.^{1, 2} Life-course studies indicate that 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 as adults, and lower rates of crime, substance use, and mental health problems.³⁻⁶

Although publicly funded preschool programs 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 are enrolled.⁷ These rates plus differences in quality may account for the finding that only about half of entering kindergartners have mastered the cognitive skills needed for school success.^{8, 9}

One approach for enhancing effectiveness is increasing from a part-day to a full-day schedule. In addition to substantially increasing the amount of learning time for educational enrichment, full-day preschool can increase continuity in learning as a consequence of children avoiding multiple care and education placements during the day; reduce stress on the family by increasing the available time for parents to pursue work, education, and vocational interests; and promote long-term effects on well-being. Although evidence from

prior studies of different programs is promising but meager,¹⁰⁻¹² 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 for children and families.¹³ 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, an economically disadvantaged cohort of 1,500 program and control-group children born in 1979-1980 has been followed 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 remedial education, reduce rates of felony arrest and substance abuse, and increase rates of high school graduation, health insurance coverage, and economic self-sufficiency.¹⁴⁻¹⁸ Economic benefits were found to exceed costs by a ratio of 7 to 1 or higher and larger benefits accrued to the most vulnerable families.¹⁹⁻²⁰ However, the preschool day was limited to 3 hours.

A scale up of the CPC program was begun in 2012 in more diverse communities. The program model was revised to incorporate advances in teaching practices and family services and included the opening of full-day preschool classrooms in some sites.²¹

In this study, we investigated whether full-day preschool would yield higher levels of school readiness, attendance, and parent involvement compared with part-day participation. We also examined whether outcomes varied by child and program characteristics.

Methods

The Midwest Expansion of the CPC is a contemporary expansion of the original program in more diverse communities implemented for a 2012 preschool cohort to be followed 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 of the program. 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 3- and 4-year-olds in these 11 schools, and represents 57% of the original sample of 1,724 children who enrolled in fall 2012 (A description of the larger Midwest CPC Expansion is in eAppendix A). Three of the schools with full-day classes were new CPCs in underrepresented areas of the city while 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. There was no evidence the schools implementing full-day preschool differed from the 5 schools offering only part-day services in commitment to school improvement.

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 noncompliance and school resistance. Three general criteria were used by principals in consultation with the project team to assign children to the full-day program: children who were 4 years of age rather than 3 years; 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 their children. Children in both groups attended preschool 5 days a week for at least 3 months and began no later than January 2013.

Intervention

The CPC intervention in the expansion project 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 included:²¹ (a) collaborative leadership team led by ahead teacher and 2 family coordinators; (b) effective learning experiences (e.g., small classes, state-certified teacher and aide, and literacy-rich instruction); (c) parent involvement and engagement; (d) aligned curriculum across grades; (e) continuity and stability; and (f) 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, science, 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 receiving parenting education, volunteering in the classroom, attending school events and field trips, furthering educational attainment, and receiving home visits; and health and nutrition services, including screening and diagnostics, meal services, and referrals by program nurses. Professional development includes on-line 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.²² Teaching Strategies is a performance-based assessment designed for children from birth through kindergarten comprised of 66 items measuring mastery on 38 objectives in 9 domains of child 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 (see eAppendix B).²³⁻²⁶ Scores reflect functional performance in the social context of the classroom that is not directly measured by tests of cognitive skills, yet they are moderately to highly correlated with direct assessments.^{23, 26} The assessment is also aligned with state early learning and development standards (eAppendix B).

We reported outcomes for 6 of the domains assessed with 49 items as administered by the Chicago Public School District: literacy (12 items), oral language (6), math (7), cognitive development (10), socio-emotional (9), and physical health (5). Each item is rated from 0 (not yet meeting objective) to 9 (full mastery of objective) as observed by the classroom teacher (see eTable 1 for item descriptions). The mean of the scale is set at the midpoint of the distribution, which is the expected score for age 36 months. We analyzed the raw scores summed across items for the 6 subscales adjusted for age plus the total score for all domains. Measurements were conducted 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.²³ Meeting the national norm on 4 or more subscales was the threshold for the total score.

Attendance—We 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. 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 social and emotional adjustment and health behavior.²⁷⁻²⁹

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 designated less than 10% of families in the classroom participated and a rating of 10 designated 90% or more of families participated (range, 2 – 10, $M = 6$, $SD = 2.2$). 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 also was assessed. Previous studies show that parent involvement ratings by teachers are valid indicators of parenting practices and are a mechanism of long-term effects of early intervention.^{16, 30} 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).³¹ 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, 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 (GEE) approach, which is an extension of the Generalized Linear Model appropriate for correlated/clustered data.³² 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.^{33, 34}

Multiple imputation of missing data on the Teaching Strategies subscales was based on the Expectation-Maximization algorithm after determining that scores were consistent with the assumption of missing at random.³⁵ 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 (standard deviations) were also reported with values of .20 or higher in the range of clinical or practical significance. To assess subgroups, program interaction terms included child age, race/ethnicity, and income status. 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 enrolled children in full-day classes and 573 in part-day. The pattern of participation and data collection for these groups are shown in Table 1. The characteristics of the full-day and part-day preschool 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; diff. = 3.0; $P = .46$; dichotomous, 14.2% vs. 16.1%; diff. = -1.9; $P = .49$). Groups were also equivalent on many child and family background characteristics. These included sex, ethnicity, low-income status, parent education, employment status, and receipt of special education services. The major difference between groups was age, as full-day was more likely for 4-year-olds. This difference was taken into account by including age as a covariate in the main analysis.

Implementation Adherence and Fidelity

Overall, the sites successfully implemented the requirements including establishing the leadership teams, maintaining small class sizes, and providing comprehensive child development and family services. Four sites experienced delays in opening full-day classrooms but these were fully operating by January.

The overall average rating of implementation fidelity for the year across the 6 program elements was 3.9 or moderately high (min. score = 1, max. score = 5). Parent involvement was moderately high (3.9). Mean classes sizes were 17.8 in full-day and 15.1 in part-day classes. Although no differences in student engagement were detected between full-day and part-day classrooms, the total amount of core instruction time for the year was more than double in full-day classes (984 vs. 417 hours; eTable 2). There was no evidence of crossover effects between the sites.

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 levels and gains in skill than part-day participants. These included language (39.9 vs. 37.3; diff. = 2.6; P = .01; 95% CI = 0.6-4.6), math (40.0 vs. 36.4; diff. = 3.6; P = .022; 95% CI = 0.5-6.7), socioemotional development (58.6 vs. 54.5; diff. = 4.1; P = .025; 95% CI = 0.5-7.6), and physical health (35.5 vs. 33.6; diff. = 1.9; P = .006; 95% CI = 0.5-3.2). For rates of mastery at or above the national average, 4 of the 6 subscales showed differences by dosage. Full-day participants had higher rates of performance for literacy (85.5% vs. 74.6%; diff. = 10.9; P = .034; 95% CI = 1.5-19.4), math (84.4% vs. 72.3%; diff. = 12.1; P = .001; 95% CI = 5.3-18.9), socioemotional (73.4% vs. 56.0%; diff. = 17.4; P = .053; 95% CI = 0-35.0), and language development (81.2% vs. 61.7%; diff. = 19.5; P = .011; 95% CI = 4.5-35.6). Standardized mean differences ranged from .16 (cognitive development) to .57 (language), which are in the range of practical and clinical significance.

In addition, the full-day group demonstrated a significantly higher rate of mastery on the total readiness metric as 80.9% were at or above the national average on 4 or more subscales compared with 58.7% for the part-day group (diff. = 22.2; P = .008; 95% CI = 5.8-38.5). The standardized mean difference of .65 was relatively large. Mean differences also were significant (298.1 vs. 278.2; diff. = 19.9; P = .037; 95% CI = 1.2-38.4; standardized mean difference = .33).

As shown in Figure 1, these findings translate to percentage change differences associated with full-day preschool of 16.7% (at/above norm in math) to 37.6% (total score).

Attendance—Compared with part-day, full-day participation was associated with a higher rate of average daily attendance (85.9% vs. 80.4%; diff. = 5.4; P = .001; 95% CI = 2.6-8.4) and lower rate of chronic absences (53.0% vs. 71.6%; diff. = -18.6; P = .001; 95% CI = -28.5- -8.7) as well as chronic absences defined at 20% of more days missed (21.2% vs. 38.8%; diff. = -17.6; P < .001; 95% CI = -25.6- -9.7). Standardized mean differences were around -.50. This corresponds to percentage reductions in chronic absences associated with full-day preschool of 26.0%-45.4% (see Figure 1).

Parental involvement—No significant differences were detected for teacher (3.95 vs. 4.65; diff. = -0.7; P = .170; 95% CI = -1.7-3.0) and parent ratings of school involvement (2.54 vs. 2.51; diff. = 0.03; P = .916; 95% CI = -0.54-0.61).

Sensitivity Analysis

The pattern of findings for full-day versus part-day preschool was found with or without multiple imputation of Teaching Strategies (see eTables 3 and 4). With fully imputed scores, full-day preschool in the same schools was positively associated with the total score (296.7 vs. 277.7; diff. = 19.0; P = .018; 95% CI = .2-34.8; stand. mean diff. = .31) and 5 of the 6 subscales, including literacy (64.1 vs. 58.3; diff. = 5.8; P = .038; 95% CI = .3-11.2; stand.

mean diff. = .33), math (39.8 vs. 36.3; diff. = 3.5; $P = .008$; 95% CI = .9-6.1; stand. mean diff. = .37), and physical health (35.3 vs. 33.6; diff. = 1.7; $P = .003$; 95% CI = .6-2.8; stand. mean diff. = .29; eTable 3). Moreover, alternative specifications of GEE and related approaches also showed a similar pattern of findings.

Subgroup Differences

We found few differences in estimates of CPC full-day preschool on the 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 outcomes to optimize power. Notably, differences in mean attendance (14.4 percentage points) and chronic absences (22.1 percentage points) significantly favored children in new sites (P s < .001; 95% CIs = 11.6-17.2, -33.9, -10.3, respectively). TS-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 full-day in established sites had significantly higher parent-reported involvement than in new sites ($P = .005$, 95% CI = -2.2, -0.38).

Comment

The current study shows that full-day preschool in the CPC program was associated with greater readiness skills, increased attendance, and reduced chronic absences by 26-45% over part-day services. The higher dosage of preschool was associated with 17-38% increases in the meeting national norms in school readiness. Full-day preschool appears to be a particularly effective approach for strengthening school readiness. By promoting a more consistent pattern of attendance, rates of mastery in several domains increased by nearly half. The size and breadth of associations go beyond previous studies.¹⁰⁻¹² The positive association of full-day preschool over part-day 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 a continuous enrichment environment throughout the day thus freeing 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.^{36, 37}

The relation between full-day preschool and school readiness found in this report is consistent with prior dosage studies examining early language, reading, and math achievement.^{10-12, 38} 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.¹⁰ No differences were found for social behavior, however, and the findings from the observational study were consistent across a range of analyses. In a randomized control trial of Head Start programs in Chicago, full-day preschool at ages 3 and/or 4 years was associated with nearly double the gains in school readiness compared with part-day preschool.¹² Our 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 CLS and other interventions showing both immediate and long-term associations of preschool intensity measured in total days or years of attendance.³⁹⁻⁴²

The current study is the first to assess full-day CPC preschool. The positive association between full-day preschool should be seen in the context of changes in the intervention from that evaluated previously. First, the program emphasizes 6 major elements: 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 school principals. These elements are likely to have contributed to the findings.

The study has 5 limitations. First, the measures assessed a limited range of outcomes at the end of preschool. 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.^{25, 26, 43} 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 significant training on the assessment to increase accuracy and help reduce ratings bias. 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, mean 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 to minimize this threat to validity.

The third limitation was that even with the history of prior program implementation, full-day preschool in the Midwest CPC intervention 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 to 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 can more easily rule out potential confounding variables or those that are difficult to measure (e.g., motivation or attitudes). The inclusion of the most relevant covariates identified in prior studies of the program reduces this threat however. The fact that the fall baseline assessment

occurred 1-2 months into the year also mitigates against the influence of unmeasured factors.

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.

Conclusion

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

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

Funding/Support: Preparation of this report was supported by the U.S. Department of Education's Investing in Innovation Fund (Grant No. U411B110098) and the following contributors: J. B. and M. K. Pritzker Family Foundation, McCormick Foundation, Boeing Corporation, Evanston Community Foundation, Finnegan Family Foundation, Lewis-Sebring Family Foundation, Foundation65, Northwestern University, Elizabeth Beidler Tisdahl Foundation, Target Corporation, W. K. Kellogg Foundation, Doris Duke Charitable Trust, Foundation for Child Development, McKnight Foundation, Greater Twin Cities United Way, Saint Paul Foundation, Minneapolis Foundation, and the Joyce Foundation. Support also was provided by the National Institute of Child Health and Human Development (Grant No. R01HD034294). We thank the Office of Early Childhood Education in the Chicago Public School District and 17 CPC schools (one begins in kindergarten) for their extensive collaboration in the Midwest CPC Expansion Project. Special thanks go to Elizabeth Mascitti-Miller, Chief Officer of the Office of Early Childhood Education; Christopher Rosean, Executive Director of the Office of Early Childhood Education; Jaclyn Vasquez, CPC Manager; and Serah Fatani, Research Manager. We also thank our project partners, including the Erikson Institute, Center of the Study of Education Policy, Illinois State University, and SRI International, for their contributions to the project.

Role of Sponsors/Funders: The sponsors and funders had no role in the design and conduct of the study; management, collection, analysis and interpretation of the data or findings; review or approval of the manuscript; and decision to submit the manuscript for publication.

References

1. Braveman P, Gottlieb L. The social determinants of health: It's time to consider the causes of the causes. *Public Health Reports*. 2014; 129(Suppl. 2):19–31. [PubMed: 24385661]
2. Power C, Kuh D, Morton S. From developmental origins of adult disease to life course research on adult disease and aging: Insights from birth cohort studies. *Annual Review of Public Health*. 2013; 34:7–28.
3. Karoly, L.A.; Kilburn, M.R.; Cannon, J.S. *Early Childhood Intervention: Proven Results, Future Promise*. Santa Monica, CA: RAND Corp; 2005.
4. Reynolds AJ, Ou S. Paths of effects from preschool to adult well-being: A confirmatory analysis of the Child-Parent Center Program. *Child Dev*. 2011; 82(2):555–582. [PubMed: 21410923]
5. Campbell FA, Ramey CT, Pungello E, Sparling J, Miller-Johnson S. Early childhood education: young adult outcomes from the Abecedarian project. *Appl Dev Sci*. 2002; 6(1):42–57.

6. Schweinhart, L.J.; Montie, J.; Xiang, Z.; Barnett, W.S.; Belfield, C.R.; Nores, M. Lifetime Effects: The High/Scope Perry Preschool Study Through Age 40. Ypsilanti, MI: High/Scope Educational Research Foundation; 2005.
7. Barnett, W.S.; Carolan, M.E.; Fitzgerald, J.; Squires, J.H. The state of preschool 2012: State preschool yearbook. New Brunswick, NJ: National Institute for Early Education Research; 2012.
8. U.S. Department of Education, National Center for Education Statistics. Conditions of Education: Kindergarten entry status: On-time, delayed-entry, and repeating kindergartners. Vol. Ch 2. Washington, DC: 2013. https://nces.ed.gov/programs/coe/pdf/coe_tea.pdf
9. Heckman J.J. Skill formation and the economics of investing in disadvantaged children. *Science*. 2006; 312(5782):1900–1902. [PubMed: 16809525]
10. Loeb S, Bridges M, Bassok D, Fuller B, Rumberger RW. How much is too much? The influence of preschool centers on children's social and cognitive development. *Economics of Education Review*. 2007; 26(1):52–66.
11. Valenti JE, Tracey DH. Full-day, half-day, and no preschool effects on urban children's first-grade reading achievement. *Education and Urban Society*. 2009; 41(6):695–711.
12. Robin, K.B.; Frede, E.C.; Barnett, W.S. Is more better? The effects of full-day vs half-day preschool on early school achievement. NIEER Working Paper. 2006. Retrieved at <http://nieer.org/resources/research/IsMoreBetter.pdf>
13. Reynolds, A.J. Success in Early Intervention: The Chicago Child-Parent Centers Program and Youth Through Age 15. Lincoln: University of Nebraska Press; 2000.
14. Reynolds AJ, Temple JA, Robertson DL, Mann EA. Long-term effects of an early childhood intervention on educational achievement and juvenile arrest: a 15-year follow-up of low-income children in public schools. *JAMA*. 2001; 285(18):2339–2346. [PubMed: 11343481]
15. Reynolds AJ, Temple JA, Ou S, Robertson DL, Mersky JP, Topitzes JW, Niles MD. Effects of a school-based, early childhood intervention on adult health and well being: A 19-Year follow-up of low-income families. *Archives of Pediatrics & Adolescent Medicine*. 2007; 161(8):730–739. [PubMed: 17679653]
16. Reynolds AJ, Temple JA, Ou S, Arteaga I, White BAB. School-based early childhood education and age-28 well-being: Effects by timing, dosage, and subgroups. *Science*. 2011; 333:360–364. [PubMed: 21659565]
17. Reynolds AJ, Robertson DL. School-based early intervention and later child maltreatment in the Chicago Longitudinal Study. *Child Dev*. 2003; 74(1):3–26. [PubMed: 12625433]
18. Reynolds AJ, Temple JA, White BA, Ou S, Robertson DL. Age-26 cost-benefit analysis of the Child-Parent Center education program. *Child Development*. 2011; 82:782–804.
19. Reynolds AJ, Temple JA, Robertson DL, Mann EA. Age 21 cost-benefit analysis of the Title I Chicago Child-Parent Centers. *Educ Eval Policy Anal*. 2002; 24(4):267–303.
20. Temple JA, Reynolds AJ. Benefits and costs of investments in preschool education: Evidence from the Child-Parent Centers and related programs. *Econ of Educ Rev*. 2007; 26(1):126–144.
21. Human Capital Research Collaborative. Program requirement and guidelines, Midwest Expansion of the Child-Parent Center Program, Preschool to Third Grade. Minneapolis: Human Capital Research Collaborative; 2012. <http://humancapitalrc.org/midwestcpc>
22. Teaching Strategies, Inc. Teaching Strategies GOLD Assessment System: Technical summary Summary. Findings of a Study Conducted by the Center for Educational Measurement & Evaluation, University of North Carolina; Charlotte: 2011.
23. Lambert, R.; Kim, D.; Burts, D. Technical manual for the Teaching Strategies Gold Assessment System. 2nd. CEME Technical Report Center for Educational Measurement & Evaluation, Charlotte: University of North Carolina; 2013.
24. Joseph, G.E.; McCutchen, D., et al. Inter-rater Reliability and Concurrent Validity Study of the Washington Kindergarten Inventory of Developing Skills (WaKIDS). Center for Research and Professional Development, University of Washington; Seattle, WA: <http://depts.washington.edu/cqel/IRCV.php>
25. Lambert, R.; Kim, D.; Burts, D. Evidence for the association between scores from the Teaching Strategies Gold Assessment System and Information from direct assessments of child progress.

CEME Technical Report. Center for Educational Measurement & Evaluation, Charlotte: University of North Carolina; 2013.

26. Lambert RG, Kim D, Burts DC. Using Teacher Ratings to Track the Growth and Development of Young Children using the Teaching Strategies GOLD Assessment System. *Journal of Psychoeducational Assessment*. 2014; 32(1):27–39.
27. Balfanz, R.; Byrnes, RV. *Chronic absenteeism: Summarizing what we know from nationally available data*. Baltimore, MD: Center for Social Organization of Schools, Johns Hopkins University; 2012.
28. Ou S, Mersky JP, Reynolds AJ, K M. Alterable predictors of educational attainment, income, and crime: Findings from an inner-city cohort. *Soc Serv Rev*. Mar.2007 :85–128.
29. Ou S, Reynolds AJ. Predictors of educational attainment in the Chicago Longitudinal Study. *School Psychology Quarterly*. 2008; 23(2):199–229.
30. Reynolds AJ, Ou S, Topitzes J. Paths of effects of early childhood intervention on educational attainment and juvenile arrest: a confirmatory analysis of the Chicago Child-Parent Centers. *Child Dev*. 2004; 75(5):1299–1328. [PubMed: 15369516]
31. SPSS Inc. *Advanced Statistics*. Vol. 22. New York: IBM; 2013.
32. Hoffman, JP. *Generalized Linear models: An Applied Approach*. New York: Pearson; 2003.
33. Diggle, P.; Heagerty, P.; Liang, K.; Zegler, S. *Analysis of Longitudinal Data*. 2ne. New York: Oxford; 2002.
34. Hubbard AE, Ahern J, Fleischer NL, et al. To GEE or not to GEE: Comparing population average and mixed models for estimating the associations between neighborhood risk factors and health. *Epidemiology*. 2010; 21:467–474. [PubMed: 20220526]
35. Little, RJ.; Rubin, DB. *Statistical Analysis with Missing Data*. New York: Wiley; 1987.
36. Koh HK, Blakey CR, Roper AY. *Healthy People 2020: A report card on the health of the nation*. JAMA. 2014; 6446:E1–E2.
37. Halfon N. Socioeconomic influences on child health: Building new ladders of social opportunity. JAMA. 2014; 311(9):915–917. [PubMed: 24595774]
38. Yves H, Maltais C, Thompson K. Effects of a full-day preschool program on 4-year-old children. *Early Ch Res & Pract*. 2007; 9(2):1–20.
39. Reynolds AJ. One year of preschool intervention or two: Does it matter? *Early Ch Res Quart*. 1995; 10(1):1–31.
40. Arteaga I, Humpage S, Reynolds AJ, Temple JA. One year of preschool or two: Is it important for adult outcomes? *Econ of Ed Rev*. 2014; 40:221–237.
41. Ramey CT, Bryant DM, Wasik BH, Sparling JJ, Fendt KH, et al. Infant Health and Development Program for low birth weight, premature infants: Program elements, family participation, and child intelligence. *Pediatrics*. 1992; 89(3):454–465. [PubMed: 1371341]
42. Hill J, Brooks-Gunn J, Waldfogel J. Sustained effects of high participation in an early intervention for low-birth-weight premature infants. *Dev Psych*. 2003; 39(4):730–744.
43. Reynolds, AJ.; Englund, MM.; Hayakawa, C.; Hendricks, M.; Ou, S., et al. *Assessing the validity of the Minnesota school readiness indicators*. Saint Paul, Minnesota: Minnesota Department of Education; 2011.

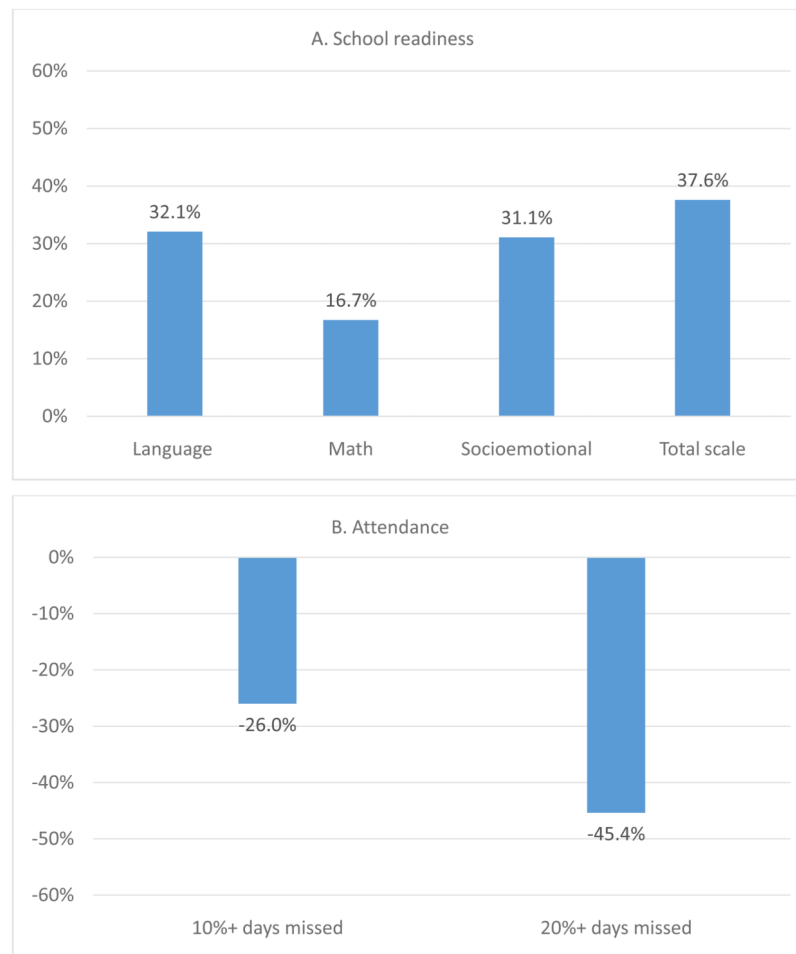


Figure 1.

Percentage for Child-Parent Center Full-Day Preschool Participation over Part-Day Preschool Participation.

Percentage Change Relative to Part-Day Preschool Associated with Full-Day Preschool Participation. Section A shows select subscale percentage changes and the total score for Teaching Strategies Gold at the end of the preschool year. Section B shows chronic absences for official school records. Values are the ratio of the mean group difference divided by the adjusted mean of the part-day group. Mean differences used in the percentage change metric were significant at the 95% level (two-tailed). The covariates for the adjusted means were fall baseline performance, gender, race/ethnicity, age in months, subsidized lunch status, special education, and school-level achievement. For school readiness the timing of the fall assessment is also taken into account. Values are corrected for clustering based on the Huber/White/sandwich method.

Table 1
**Patterns of Participation of Full-Day and Part-Day Preschool Groups in 11 Schools,
 Midwest CPC Expansion**

Study Category	Full-Day Group	Part-Day Group
Participants' Characteristics at Start of Study*		
Original Sample	409	573
No. of cases with CPC preschool	409	573
No. of classrooms (sessions per class)	23 (1)	19 (2)
No. of cases in the original sites	285	529
No. of cases in the expansion sites	124	44
No. of 4-year-olds at program entry	351	215
No. of 3-year-olds at program entry	58	358
No. of Study Participants with Data**		
Attendance and Chronic Absence	409	573
At least 1 measure of School Readiness	337	471
Parent involvement (teacher ratings)	409	573

Note.

* Program group enrolled in the CPC program in 2012-13 as 3-or 4-year-olds in 11 schools offering full-day preschool classes. Children attended at least three months and to be included were enrolled no later than January.

** 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.

Table 2
Characteristics of Same-School CPC Full-Day and Part-Day Groups at Fall Baseline, 2012-2013

Child/Family Characteristics**	CPC sample*		
	Full-Day Preschool (N=409)	Part-Day Preschool (N=573)	Full-Day/Part-Day P-value
Female child, %	52.8	51.2	.55
Black, %	88.8	93.0	.02
Hispanic, %	7.6	7.0	.80
Special education status (IEP), % ^a	4.6	3.8	.63
Age in months on Sept. 1, 2012 (mean)	51.6	45.8	<.01
Mother completed high school, %	79.9	78.1	.61
Child eligible for fully subsidized meals, ^b %	89.7	92.3	.17
Single parent family status, %	65.1	65.7	.93
Mother employed full- or part-time, %	53.7	48.0	.19
Attended a school with a high percentage of students meeting state reading norms, %	15.4	28.9	<.01
Fall Baseline Literacy subscale, mean (SD)	35.3 (16.3)	33.9 (16.4)	.20
Fall Baseline Math subscale, mean (SD)	23.5 (8.9)	22.6 (9.2)	.16
Fall Baseline Socioemot. devel., mean (SD)	40.2 (11.8)	39.2 (14.7)	.26
Fall Baseline Total scale (SD)	193.2 (57.4)	190.2 (64.7)	.46
At/above national norm on 4+ subscales, %	14.2	16.1	.49
Fall Baseline assessed after October, %	53.4	58.0	.20

Notes.

* 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) group differences. Values for the nonCPC comparison group are shown in eTable 2. Fall baseline scores were adjusted for age. The threshold for state reading norms was 70% or higher. Sample had valid values for one or more outcome indicators.

** 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). Sample size for parent survey was 566-604.

^a Children who have an Individual Education Plan under IDEA. N for single parent family status is 1,455 (parent survey).

^b Eligibility defined at 130% of the Federal Poverty Line (FPL) or lower.

Table 3
Child-Parent Center Same-School Full-Day Versus Part-Day Preschool: Adjusted Marginal Means

Outcome	Full-Day Group (N = 409)	Part-Day Group (N = 573)	Difference (95% CI)	P-value	Standard. Mean Diff.
School Readiness Skills					
Literacy (Raw score; 12 items)	64.5	58.6	5.9 (-0.7-12.4)	.081	.33
At/above the national norm (%)	85.1	74.6	10.5 (1.5-19.4)	.034	.37
Language (6 items)	39.9	37.3	2.6 (0.6-4.6)	.010	.34
At/above the national norm (%)	81.2	61.7	19.5 (4.5-34.6)	.011	.57
Math (7 items)	40.0	36.4	3.6 (0.5-6.7)	.022	.38
At/above the national norm (%)	84.4	72.3	12.1 (5.3-18.9)	.001	.41
Cognitive development (10 items)	59.7	57.7	2.0 (-2.4-6.3)	.381	.16
At/above the national norm (%)	70.3	64.0	6.3 (-16.2-28.8)	.986	.22
Socioemotional development (9 items)	58.6	54.5	4.1 (0.5-7.6)	.025	.34
At/above the national norm (%)	73.4	56.0	17.4 (0-35.0)	.053	.46
Physical health (5 items)	35.5	33.6	1.9 (0.5-3.2)	.006	.32
At/above the national norm (%)	82.2	68.6	13.5 (-1.0-28.1)	.068	.42
Total Score (49 items, 6 subscales)	298.1	278.2	19.9 (1.2-38.4)	.037	.33
At/above the national norm on 4+ subscales (%)	80.9	58.7	22.1 (5.8-38.5)	.008	.65
Attendance					
Average daily attendance, %	85.9	80.4	5.5 (2.6-8.4)	.001	-.41
Chronic absences (10% or more of days, %)	53.0	71.6	-18.6 (-28.5- -8.7)	.001	-.50
Chronic absences (20% or more of days, %)	21.2	38.8	-17.6 (-25.6- -9.7)	<.001	-.53
Parental Participation					
Parent involvement in school (teacher ratings)	3.95	4.65	-.70 (-1.7-3.0)	.170	-.38
High involvement (score of 6 or higher, %)	30.3	44.3	-14.0 (-38.3-10.3)	.225	-.37
Parent involvement (parent report, spring cases)	2.54	2.51	.03 (-0.54-0.61)	.916	.02

Notes: Sample includes 982 CPC 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 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. CI is for 95% level. Standard errors, and, thus, P-values, are adjusted for variation among program sites by the Huber/White/sandwich correction. Sample sizes for school readiness were 337 (CPC full-day) and 471 (CPC part-day). The number of items for the language subscale was reduced from 8 to 6 because of substantial missing data.

Table 4
Adjusted Mean Differences Between Same-School Full-Day and Part-Day Preschool for New and Established Sites and By Age

Outcome	New Sites Fday-Pday (N = 168)	Established Fday- Pday (N = 814)	Difference in Difference (95% CI)	P-value	4-year-olds Fday-Pday (N = 566)	3-year-olds Fday-Pday (N = 416)	Difference in Difference (95% CI)	P-value
School Readiness Skills								
Literacy (Raw score; 12 items)	6.5	5.8	-0.7 (-6.8-8.2)	.816	4.7	10.1	5.4 (1.4-9.3)	.007
Language (6 items)	2.1	2.7	0.6 (-2.7-1.5)	.599	1.7	1.1	-0.6 (-2.6-1.4)	.568
Math (7 items)	3.7	3.5	-0.2 (-3.2-3.7)	.903	2.6	3.5	0.9 (-0.5-2.2)	.211
Cognitive development (10 items)	1.6	2.2	0.6 (-4.9-3.7)	.793	3.1	1.0	-2.1 (-5.3-1.0)	.188
Socioemotional development (9 items)	2.9	3.8	0.9 (-4.6-2.9)	.653	2.1	3.0	0.9 (-4.5-6.2)	.750
Physical health (5 items)	0.9	2.0	1.1 (-2.8-.6)	.187	2.9	2.5	-0.4 (-1.9-1.0)	.553
Total Score (49 items, 6 subscales)	17.6	19.9	2.3 (-23.1-19.2)	.378	12.5	31.3	18.8 (-4.5-42.1)	.113
At/above the national norm on 4+ subscales, %								
	2.6	16.6	14.0 (-34.4-6.3)	.193	13.2	30.3	17.1 (-4.7-29.9)	.105
Attendance								
Average daily attendance, %	17.3	2.9	14.4 (11.6-17.2)	<.001	5.6	4.1	-1.5 (-4.2-1.1)	.264
Chronic absences (20% or more of days, %)	-35.6	-13.5	-22.1 (-33.9- -10.3)	<.001	16.0	18.6	2.6 (-11.8-6.6)	.583
Parental Participation								
Parent involvement in school (teacher ratings)	0.2	-0.4	0.6 (-1.0-2.1)	.464	-0.4	-1.8	-1.4 (-3.2-0.4)	.122
High involvement (score of 6 or higher), %	-7.2	-6.2	-1.0 (-35.5- 33.9)	.964	-10.1	-33.1	-23.1 (-23.0-68.0)	.402

Notes. Sample is fully imputed and includes 982 CPC children from 11 sites offering full-day preschool. 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. CI is for 95% level. Standard errors, and, thus, *p*-values, are adjusted for variation among program sites by the Huber/White/sandwich correction.