ECE Impacts on Child Outcomes

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Early Education
Effectiveness

Introduction

This chapter covers the short-, medium-, and long-term effects of United States-based early childhood education (ECE) interventions on children's development, education, and well-being. It highlights how impacts can vary (or not) by developmental domain/skill. It also covers impacts on key subgroups such as dual language learners, children from families with low incomes, children with developmental differences, and racially minoritized children.

For this review, we are operationalizing ECE to mean services offered through center-based ECE models. Home-based or informal care settings also serve essential functions in ECE (e.g., offering care after-hours, weekends, and overnight); however, less is known about the impacts of such care settings on children's development. We focus on the preschool-aged (3–5-year-old) subpopulation comprising most research on scaled-up ECE, and thus use ECE and preschool interchangeably. We devote a section to the causally informative work examining ECE effects during the infant and toddler period (ages 0-2.9 years), although there are fewer studies in this age group, and more infants and toddlers are served in home-based than center-based settings. Even after narrowing the focus to center-based ECE programs serving preschool-aged children, our review still includes a wide range of programs with different goals, funding streams, and characteristics, and we remind readers that these diverse programs should not be viewed as a monolith.

In our review, we consider evidence from modern-day programs, from 1990 to the most recent findings, but do briefly review historical ECE findings from key "proof of concept" demonstration programs. We prioritize high-quality evaluations that randomized the offer or availability of preschool and quasi-experimental evaluations (i.e., use some source of variation outside of a family's control) that establish baseline equivalence on children's developmental skills. We exclude most propensity score matching or simple correlational studies, but do turn to them where few rigorous studies are available.

Key Findings

Key Finding #1: *Preschool improves children's academic readiness for kindergarten.*

Children who attend preschool improve in academic and cognitive domains such as early language, literacy, and math relative to children who were either at home with their family or in another form of non-parental care. Less consistent and robust evidence exists for ECE providing benefits to socioemotional skills.

Key Finding #2: *The impacts of preschool participation on academic readiness are getting smaller over time.*

Preschool treatment-comparison impacts (or "effects") on academic readiness have become smaller over the past 50 years within which such effects have been documented. This is perhaps due to changes in ECE availability and access, social safety net spending, and improvements in the home environment.

Key Finding #3: *Medium and long-term ECE effects are a mix of positive, negative, and null findings*

We have some compelling causal evidence that ECE can have large and lasting effects. However, this is not always true. A body of studies show that benefits seen at kindergarten entry are no longer detectable early in the elementary grades as children who did not attend preschool catch up with those who did. One recent experimental study showing fadeout found benefits re-emerge later in adulthood. Fadeout of the initial boost is occurring at a faster rate for programs implemented in 2000 or later compared with earlier programs.

Key Finding #4: *Children facing structural and economic challenges and with developmental differences may differentially benefit from ECE.*

Some groups of children—including children from low-SES backgrounds, dual language learners, children from minoritized backgrounds, and children with special needs—benefit more from ECE across a host of short, medium, and long-term child development outcomes, including cognitive, language, motor, and some executive function skills. In this way, ECE supports educational equity.

Key Finding #5: *There is a paucity of high-quality research examining the impacts of infant and toddler care on children's academic and socioemotional outcomes.*

Relatively fewer children from this age group attend center-based ECE. The publicly-funded supply of infant and toddler care is very low. Although many infants and toddlers use non-parental care we have very little evidence on the impact of this care.

The Evolution of Modern ECE Policy

The story of modern ECE policy evaluation in the United States begins with two classic demonstration studies. Results from experimental evaluations of Perry Preschool and Abecedarian programs provide convincing evidence that preschool programs can produce immediate boosts to children's academic skills followed by lasting benefits by improving educational attainment, income, and health through adolescence and into adulthood.[1] Perry Preschool (n = 123) provided half-day center care and home visiting to 3- and 4-year-olds for low-income Black families in the 1960s in Ypsilanti, Michigan at a cost of approximately $43,500[2] per child. Abecedarian (n = 111) provided full-time preschool to low-income, predominantly Black children from infancy through entry into kindergarten during the 1970s in Chapel Hill, North Carolina, costing approximately $120,000[3] per child. Seventy-three percent of the control group attended alternative center-based care.[4]

Modern-day publicly funded preschool programs serve substantially more children. Head Start served over 800,000 children with an operating budget of more than 10 billion dollars in 2022.[5] State preschool programs operating in 44 states served over 1.7 million children for 13.6 billion dollars in the 2023-24 school year.[6] Block grants to states for child care subsidies similarly serve many children from birth through age 12 (approximately 1.3 million a month) at the cost of nearly 10 billion.[7] Emerging in the public preschool landscape is transitional kindergarten (TK), a form of preschool offered in public elementary schools for children who miss kindergarten age cutoffs, operating alongside state preK, federal Head Start, and subsidized childcare programs.[8]

The massive scale of modern public programs is clearly different from the demonstration programs. State and local programs require layers of administrative oversight, recruitment and training of many educators, working across programs with varying organizational practices and goals, and dispersed accountability and checks for implementation fidelity.[9,10] Scale-up typically entails reducing per-child costs to fit government budgets. Current costs of high-quality, full-day preK are in the range of approximately $15,000-16,500 (in 2023$)—substantially less than the demonstration programs.[11] Although it's clear that quality can and should be improved across all sectors of ECE to better support children's development, such scaled-up improvements are onerous and often slow moving; this is due to meager economic investment, workforce shortages, teacher turnover, and overlaid monitoring requirements from each ECE funding source.[12,13]

Given all these differences between demonstration programs and scaled-up preschool programs, it is reasonable to expect that impacts would differ as well. A large body of research has aimed to evaluate the impact of scaled-up preschool programs and understand why effects may differ over time (as we describe more below). One challenge in interpreting this literature is that expansions over time in the publicly funded opportunities for ECE and the increasing number of children attending center-based ECE.[14] Researchers must always keep in mind the "counterfactual" of their study, or in other words, to what conditions are treated children being compared.

Evidence

Key Finding #1: Preschool improves children's academic readiness for kindergarten

Wide support exists from a variety of studies that ECE participation results in an initial boost to children's cognitive and academic outcomes, specifically benefitting math, literacy, and language skills.[15,16,17] Indeed, a consensus statement released from ECE research experts in 2017 highlights that positive end-of-treatment impacts on academic skills (i.e., treatment-control group differences) are robust across studies.[18] Effect sizes across individual studies range from moderate to large, depending on context, program, evaluation design, and counterfactual care setting; however, findings are near ubiquitous in terms of positive end-of-program cognitive and academic effects for preschool participants. For example, the Head Start Impact Study (HSIS) a nationally representative randomized evaluation of the Head Start program that began in school year 2002-03, demonstrated positive impacts in the 4-year-old cohort at the end of preschool year on language and literacy outcomes, such as vocabulary development and letter-word identification when compared with children in the control group, about half of whom attended another form of non-parental care.[19] Math impacts were positive but not statistically significant for 4-year-olds in the study, but were statistically significant when combining the 3- and 4-year-old cohorts (due to improved statistical power).[20] Similarly, a state-wide evaluation of Tennessee's voluntary pre-kindergarten program found a range of positive academic achievement outcomes in the year immediately following the preK year for those assigned to the treatment condition.[21]

Evaluations of recent state- or city-wide pre-kindergarten programs using regression discontinuity (RD) designs demonstrate similar positive impacts on children's language, early literacy, and math outcomes at the end of the program.[22,23,24,25] These quasi-experimental studies take advantage of the birthdate eligibility cutoffs in these programs – i.e., comparing children that are eligible to attend the program in a given year with those that miss the cutoff and need to wait an additional year to participate. In a seminal paper using the method to estimate preK effects in five states, Wong and colleagues[26] found that program participation had a positive impact on receptive vocabulary, print awareness, and emergent math skills in a few of the five states included. Similarly, an RD evaluation of the Boston PreK program, widely known for its high-quality curricula and professional development supports, yielded similar results but with larger effect sizes, with program participation resulting in moderate size impacts on children's language, literacy, and math skills.[27]

More limited evidence is available on the effectiveness of ECE participation on socioemotional skills at the end of the program,[28,29] although questions remain about how to adequately assess these skills in the early childhood years.[30] The HSIS found no significant difference in 4-year old Head Start children's end of program social skills or problem behavior, as reported by parents, while two statistically significant differences emerged for the 3-year old Head Start cohort—reduction in problem and hyperactive behavior.[31] Humphries et al[32] also find no significant effects of randomly offered public preK on any socioemotional outcomes assessed at kindergarten entry. Some evidence does exist that preschool programs can positively impact behavioral outcomes, like emotion recognition;[33] however, the evidence is not robust or consistent across ECE programs.[34] This is a clear area for further research, in addition to testing other less commonly assessed outcomes, such as executive function, as some have found positive impacts in this domain.[35]

Although the evidence on TK is still emerging, early evaluations of short-run effects demonstrate results consistent with preschool evaluations. Two RD evaluations of the California TK program revealed positive impacts on children's cognitive and academic skills, including vocabulary, early literacy, math and engagement at the end of the year.[36,37] Another evaluation of California's TK program suggests participation results in earlier identification of special education needs.[38] Following the state funded preK and Head Start preschool literature, no consistent evidence emerged for TK participation effects in social skills or reductions in problem behaviors.[39] As TK continues to expand, the field will benefit from rigorous evaluations of programs.

While most preschool research has examined a single program, policymakers and researchers are perennially interested in understanding whether providing ECE to children from families with low incomes only or offering the program to all age-eligible children is most beneficial. Combining staggered rollout with birthdate eligibility differences across states and within cohorts of children, Cascio[40] finds larger positive benefits for lower-income children attending universal preK programs on end of preK achievement assessments (math and literacy combined) compared with those attending income-targeted programs. While the benefits of ECE programs tend to be larger among families with lower income, some scholars have raised concerns about the effects of economically segregated programs, and it is an emerging area of work for the field.[41]

Key Finding #2: *The impacts of preschool participation on academic readiness are getting smaller over time.*

Although clear evidence exists that ECE participation provides an initial boost in children's academic achievement at kindergarten entry, the magnitude of short-term effect sizes has been declining over time. In a meta-analysis of ECE effects from experimental or quasi-experimental evaluations from the 1960s to 2010, researchers found that the end of ECE program effects on short-term academic and cognitive outcomes declined by approximately 50% (effect size of .33 to .16) for programs that started after 1980 compared with those that began before that time.[42] Similarly, a separate meta-analysis of effects from only randomized control trials of early educational interventions shows declining initial impact.[43] Specifically, researchers found that evaluations of programs that began in 2000 or after had over a 50% reduction in effect size (effect size of .47 to .21) on end of program outcomes compared with programs that began prior to 2000. The scale-up of programs to serve more children, which requires more dispersed oversight, variations in implementation, and differing goals across program sites, certainly contributes to the smaller sized impacts;[44] however, other explanations also contribute to the weakening of effects.

Researchers have discussed several factors that likely contribute to these declining short-term effect sizes in ECE evaluations.[45,46] Primary among them is the change in counterfactual conditions experienced by children and families. Better societal conditions exist now than 50 years ago when demonstration programs were evaluated. Many aspects of the home environment have improved particularly for families in the bottom income quintile, such as increased maternal education and employment,[47] and time spent engaging with children.[48,49] Additionally, there are more social programs (e.g., Medicaid, Special Supplemental Nutrition Program for Women, Infants, and Children) available and designed to support children's health and well-being, and additional funding to support families with low incomes like Temporary Aid for Needy Families.[50] Indeed, the more widespread availability of social services for children and families, a core component of early demonstration ECE programs, may contribute to smaller effects today. Combined, these home and societal changes likely result in more

enriching and higher-quality environments than what was available to low-income children, on average, in the 1960s.

Another reason for diminishing effect sizes could be the greater supply and demand for ECE compared with the 1960s and 70s. As more women have entered the workforce, more children from birth to age 5 are experiencing care outside of the home.[51] For instance, fewer than 20% of 4-year-olds were in child care or preK in 1970, compared with nearly 60% in 2018. Public options for ECE have greatly expanded since the 1960s, such as child care subsidies (Child Care and Development Block Grant) and state preK programs; opportunities have increased even more rapidly over the past 25 years. In 2001, 38 states had preK programs, serving approximately 700,000 children, whereas in 2023, 45 states had programs serving over 1.7 million children.[52] These expansions in the availability of preschool experiences have changed the counterfactual care conditions of children, thereby reducing the preschool treatment-control contrast estimated in modern evaluation studies. Research suggests that ECE benefits are more pronounced when comparing children who attended center-based care with children who would have otherwise stayed home with their parents.[53,54]

Key Finding #3: *Medium- and long-term effects are a mix of null, negative, and positive findings*

Fewer studies have followed preschool participants into K-12 and beyond to understand whether there are longer-term impacts of attending ECE programs. Broadly summarized, the literature shows that academic advantages between preschool attenders and non-attenders decrease substantially and often fade to zero in the medium term (i.e., during primary and secondary school), with some studies finding benefits of preschool emerging in young adulthood, and some demonstrating negative middle-childhood impacts, compared with a broad set of counterfactual conditions.[55,56] Important exceptions to the fadeout phenomenon do exist for Dual Language Learners (see section 4 below).

Quasi-experimental work examining programs from the 1960s-70s found consistent evidence of benefits of preschool attendance in the medium- and long-term. For instance, evidence from the initial years of Head Start in the 1960s-70s suggest a negative effect on mortality rates of children[57] and a positive effect on educational attainment in adulthood.[58] Importantly, Bailey and colleagues.[59] find that Head Start impacts on self-sufficiency were smaller when there was greater availability and access to social services, suggesting that Head Start in the early years provided a critical role in serving families in ways not met by other community or governmental services. One of the first and most widely cited studies of Head Start participation during the 1980s came from Deming,[60] who found persistent impacts on high school graduation and educational attainment using sibling fixed effect analyses—comparing younger siblings to an older sibling for whom Head Start was not available—in the National Longitudinal Study of Youth.

Evaluations of more recent programs have found a mixed pattern, with some demonstrating lasting benefits in the K-12 years and beyond, and other studies with null or even negative findings in these years. The most rigorous, positive evidence of the persistence of preschool impacts comes from Gray-Lobe and colleagues,[61] who examined Boston's preK as implemented from 1998-2003, using a ranked-choice lottery design. Their analysis revealed null effects of participation during middle and high school on academic achievement compared with attending private or Head Start preschool, but positive effects emerged on graduating high school and enrolling in college, and in reducing disciplinary outcomes (e.g., suspension, juvenile incarceration).

Other studies have taken advantage of quasi-experimental variation in the staggered roll out of state preK programs to evaluate medium-term effects of preK scale-up. Cascio and Schanzenbach[62] show that Oklahoma and Georgia's universal preK program expansions increased the population-level achievement of low-income children in these states in 4th grade by 3.1 points on the NAEP, which faded to 2.2 points but remained positive in 8th grade. Berne[63] examines long-run impacts of the Georgia program, finding that UPK access raised high school graduation rates by 1.5 percentage points, reduced adult SNAP benefit receipt by 1.9pp, and reduced teen births by 1.7pp, compared with children who were attending privately funded preschool. Similarly, using the variation in timing from NC's funding allocations for the preK program expansion, a set of papers finds population-level impacts of preK funding on reading and math achievement at third grade,[64] through fifth grade,[65] and treatment on the treated impacts for enrolled children in fifth grade.[66] The counterfactual condition in NC was no preschool or private-paid preschool.

Yet several other rigorous studies find no impacts of preschool attendance during the k-12 years. The Head Start Impact Study's impacts on early learning skills (i.e., math, language, literacy, socioemotional) were largely no longer detectable by the spring of kindergarten for both 3- and 4-year-old cohorts.[67] Findings did not re-emerge by third grade across the full study sample;[68] however one study finds that treatment effects on a vocabulary measure persisted through first grade when treatment is compared only with children who would have spent the preschool year at home.[69] Weiland and colleagues[70] evaluated an expanded, quality-improved version of Boston's program for the 2007-2010 cohorts using a lottery design (comprising relatively more economically advantaged children than the full set of preK applicants), with a majority of control group children attending alternate center-based care. They found null effects on academic skill outcomes, special education identification, and grade retention by third grade, but greater likelihood of enrollment in Boston Public Schools in K-3 grades. A correlational study of Boston's lottery applicants suggests that initial program impacts faded largely during the kindergarten year, following several other studies.[71] Another lottery study of preK in New Haven, CT finds null effects on achievement and retention outcomes through grades K-8, where the comparison group largely attended other center-based programs.[72] A re-analysis of the NLSY data from Deming's[73] seminal study using additional waves of data and a complementary sample of younger youth attending Head Start in later years were not as favorable; the authors found no longer-run impacts on Deming's original outcomes, nor the additional economic self-sufficiency outcomes available in the newer data collection;[74] some negative impacts were also revealed in the complementary sample.

Most surprising to the field were the findings from a random assignment lottery study of Tennessee's Voluntary Pre-K program (TN VPK). Lipsey and colleagues[15] found robust positive impacts of TN VPK at the end of preschool compared with children who attended center-based preschool or stayed at home. Impacts became null in third grade, with some negatively trending findings for behavioral outcomes not reaching statistical significance. In their 6th grade follow-up study, TN VPK participants were performing significantly worse on achievement and behavioral outcomes.[75]

Much like the mixed long-term findings regarding academic achievement, there exists similar findings regarding special education placement. In the Boston randomized lottery, researchers find no effects of attending Boston preK on special education placement in kindergarten through 3rd grade compared with children who had access to other forms of preschool.[76] Yet, an evaluation of DC's preschool program using a lottery design finds increased special education placement in kindergarten, likely as a result of earlier identification, but then no significant differences in first or second

grade.[77] These findings contrast with results from the TN VPK randomized evaluation where they found increases in special education placement through 6th grade.[78] This is an area for further research as our strongest studies do not concur regarding how preschool attendance may impact special education placement in elementary school.

There is also mixed evidence emerging about the persistence of effects from newly created state TK programs, compared with a broad set of conditions. Findings from the first study of California's TK program faded to null on all academic and socioemotional outcomes, except for one assessment of early literacy, by the end of kindergarten.[79] Lafortune and Hill[80] use administrative data from several CA school districts and find null effects of attending CA TK on achievement by third grade. Berne and colleagues[81] show impacts on third grade math achievement of Michigan's TK program with a subset of relatively more advantaged districts using an RD design; results are positive and robust in magnitude across specifications but not statistically significant in most specifications.

Many scholars have sought to understand if features of kindergarten and early grades environments may play a role in the persistence of preschool's academic boosts.

Key Finding #4: *Children facing structural and economic challenges and with developmental differences may differentially benefit from ECE*

Understanding heterogeneous effects of ECE programs has long been a goal of researchers to better understand who to target or recruit for program participation. Of primary focus has been children from families with low incomes, racially minoritized children, and children with developmental differences. Indeed, many programs are specifically geared towards children from lower-income households or who may have developmental differences. For instance, the longest-running public ECE intervention, Head Start, borne from the War on Poverty, was created to provide comprehensive educational and nutritional services for young children from economically disadvantaged families. A Head Start program is required to reserve at least 10% of its enrollment for children that qualify for services from the Individuals with Disabilities Education Act.[82] In addition to Head Start, many state preK programs are "targeted", meaning children must meet an economic criterion (i.e., below the poverty line) to be eligible, and historically derive the greatest benefit from public preschool investments.[83]

In line with the aims of these major policy initiatives, analyses of modern-day ECE and state preK programs demonstrate a larger, more positive boost to cognitive, motor, and language scores[84] and math, inhibitory control and attention shifting for low-income children.[85] Additionally, children whose mothers have less than a high school education show greater gains in cognitive skills or academic achievement scores compared with children who have mothers with more education.[86'87]

Furthermore, ECE investments promote greater equity in opportunity for children facing structural disadvantages stemming from systemic racism. Several studies find that children of color, specifically Black and Hispanic students, can benefit more either socioemotionally or academically from participating in preschool than their peers.[88'89'90'91'92]. For instance, Black children in the Head Start Impact Study, specifically the 4-year old cohort, had positive impacts on socioemotional skills in kindergarten, in terms of reduced peer problem interactions and more positive teacher interactions.[93] Further, in a quasi-experimental evaluation of North Carolina preK, researchers found that Hispanic preK attenders had larger impacts on late elementary school achievement compared with White preK attenders.[94] This finding is aligned with research from Boston's PreK program that demonstrates Hispanic

children had higher end-of-program language, early literacy, math, executive function and socioemotional skills compared with White preK attenders.[95]

There are also larger academic achievement impacts for Spanish-speaking dual-language learners across more recent preK and Head Start studies.[96,97] Evidence further demonstrates greater persistence in language effects into early elementary school for Spanish-speaking dual language learners.[98] Yet some emerging findings from CA's TK program reveals some troubling trends in negative impacts on socioemotional learning for dual language learners.[99]

A core theory of intervention behind ECE is that earlier is better, particularly when children may be experiencing developmental challenges or delays.[100] A study on Boston's preK program finds children with special needs demonstrated greater gains than typically developing children on measures of inhibitory control and attention at the end of preschool.[101] Encouragingly, both the Boston study and a study of the Tulsa preK program revealed that children with disabilities benefit similarly as their typically-developing peers who also attended the program with respect to language, literacy, and math outcomes[102,103] This is important given challenges parents face in accessing inclusive and supportive care for their children with developmental needs.[104]

Key Finding #5: *Lack of research on infant and toddler ECE impacts*

In this section we cover the causal research on infant and toddler programs. More information on publicly-funded programs is available in the chapter of ECE Access and Affordability if this Handbook.

In the United States, not only are there relatively fewer ECE programs serving infant and toddlers, but also fewer high-quality evaluations of such programs. One reason is that infants and toddlers tend to be in more informal care environments, not in a specific ECE intervention program, such as Head Start for preschoolers.[105] Results from other countries that have examined the impact of child care on infant and toddler development, while not a perfect comparison, may shed light on potential outcomes. One such example comes from Quebec Canada, where the universal expansion of child care access, that included infant and toddlers, was studied to understand child-level effects.[106,107] Results indicate negative outcomes for children's cognitive, health, and emotional development,[108,109] with significant results concentrated among those that likely took up the care because of the policy change.[110] Quality of the program has been extensively debated, and initial evidence suggests programs part of the initial expansion were lower in quality.[111]

A notable exception in the United States is the national evaluation of the federal Early Head Start (EHS) program using a randomized design of oversubscribed sites. The evaluation began in 1996 and included home-based, center-based, and mixed approach program models.[112] Results indicated positive effects on children's cognitive, language, and socioemotional development, along with improved parenting practices, including more cognitive stimulation provided in the home, when children were three years of age. By age 5, the language skill boost had faded, but EHS children were still outperforming control group peers on some measures of socioemotional development.[113] Follow-up assessments at grade 5 indicated no significant differences on child-level (cognitive, academic achievement, social-emotional) or family-level (discipline, family involvement, home environment) outcomes.[114]

Another notable example in the infant and toddler ECE evaluation literature is the Educare program. Educare is a birth to 5 center-based program for low-income

children and families that operates using Head Start and EHS standards and additional requirements. In the 2022-23 school year, 25 Educare schools were serving 4,000 children.[115] In 2010, a randomized evaluation of about 200 infants and toddlers into five Educare programs began in Tulsa, Omaha, Chicago, and Milwaukee.[116] Results after one year of participation revealed significant positive effects on children's vocabulary, which were maintained when children were 3 years of age, revealing positive, statistically significant effects on children's language, math, and behavioral outcomes.[117]

Future directions.. As states expand preschool programs to serve greater numbers of children, many questions remain, particularly about the impact of preschool participation on on children's development in the medium- and long-run has become less clear. Future research should continue to rigorously evaluate program impacts, as well as their implementation, to understand why results are mixed for longer-term outcomes, the mechanisms underlying sustained impacts, and how policymakers can ensure preschool is effective at scale. Methodologically strong evaluation studies of TK and infant and toddler programs and incorporating more measures of other developmental domains such as social, emotional, and executive function skills, are important for future work as well.

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