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Early Childhood Education: Health, Equity, and Economics

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Abstract

Many low-income and minority children in the United States and globally are at risk of poor educational trajectories and, consequently, diminished life courses, because their households and neighborhoods lack resources to adequately support learning and development prior to formal schooling. This review summarizes evidence on center-based early childhood education (ECE) for three- and four-year-olds as a means of assuring school readiness in cognitive and socioemotional skills. While the details of ECE programs merit further research, it is clear that ECE can benefit children, especially those most disadvantaged, with additional societal benefits and positive long-run economic returns. Universal ECE is not a cure-all, and its success requires ongoing alignment with subsequent education and attention to child household and community conditions. Because resource deprivation is concentrated in low-income and minority communities, publicly funded universal ECE can also be a powerful instrument for the promotion of social equity.

1. INTRODUCTION

Associations between education and health are well established (52). While health conditions also affect education, for example, when a child is chronically ill or hungry, analyses that control for family background, including health, indicate that education remains a powerful determinant of long-term health (27). A wide range of evidence, including experiments, suggests a causal connection through pathways, including the development of problem-solving abilities; socioemotional capacities; positive health behaviors; and improved employment opportunities, income, and other resources for health (11, 97).

Educational opportunities begin at birth (105). Early learning provides the foundation for lifelong learning and its benefits (114). Child development is an incremental process of "self-productivity" (25). The development of the human child is rooted both in the anatomy and physiology and in its environment. Healthy growth requires physical inputs, such as nutrition and protection from injury, and social inputs, including affection and cognitive stimulation (10, 79).

The growth of the child allows both opportunities (when needs are met) and harms (when needs are not met). Children deprived of opportunities may suffer long-term consequences (79). At the extreme, abusive or neglectful experiences can have persistent deleterious consequences for brain, cognitive, and socioemotional functioning (104). Socioemotional capacities also play a fundamental role in human development and mental health (45).

In the United States and globally, resources for optimal child growth are unequally distributed among households and communities at different levels of wealth, often associated with minority racial identity (36, 57, 88). In their first year of life, the mental capacities of Black and White infants do not differ (43). By age two, gaps in learning emerge, and at kindergarten entry, Black and Hispanic children are behind their White classmates in reading and math (see **Supplemental Figure 1**) (80). Ability gaps are associated with levels of parental education and, relatedly, parental income (39, 56, 80, 83, 84) (see **Supplemental Figures 2 and 3**). Adjusting racial differences for socioeconomic characteristics decreases but does not eliminate the gaps (44). Persistent racism contributes to and exacerbates inequities in wealth that restrict the opportunities and resources available for children to grow up educated and healthy (113). Thus, low-income and some minority children may have a greater need for programs that might compensate for the resource gaps that they experience early in life (74, 82).

Supplemental Material >

This review summarizes evidence on the effects of center-based early childhood education (ECE) as an intervention to address gaps in early learning and development and to assure that low-income and minority children have the intellectual, socioemotional, and interactional abilities needed to effectively engage with kindergarten through twelfth-grade education and to pursue a healthy life. For the purposes of this review, ECE is defined as a center-based program designed to improve the cognitive and social development of three- and four-year-old children prior to kindergarten. ECE programs typically address the following learning objectives: language, literacy, numeracy, and cognitive (including executive functions), socioemotional, and physical development. ECE programs often include recreation, meals, health care, parental engagement and support, and social services (51). In addition, a common goal of ECE programs is to facilitate parental employment (58).

2. REVIEW APPROACH

This article is not a systematic review of ECE. Rather, we address several basic topics, indicating the predominant evidence on each: (*a*) the effectiveness of ECE for health-related outcomes, (*b*) the economics of ECE, and (*c*) the potential contributions of ECE to health equity.

Because studies use different measures and thus may not be directly comparable, we use the standardized mean difference (SMD) to report effect sizes. Given the large number of comparisons made in many studies, we do not report findings with statistical significance levels larger than $p = 0.05$. We review evidence of effect modification because program effects vary with ECE program characteristics, participants, and environments. Potential effect modifiers may also be interconnected. We focus on programs in the United States and summarize the state of ECE in other nations.

We rely principally on findings from three meta-analyses of ECE conducted in the last 15 years: Two (14, 59) report all findings in one publication each, and the third is a series of meta-analyses using a shared database (3, 9, 48, 64, 70, 73, 77, 99, 103). Because the three meta-analyses include some of the same studies, the results we report are not entirely independent.

In all this research, it is essential to attend to study comparators (19). When an intervention is compared with a comparator intervention or with no deliberate intervention, the effectiveness assessed is relative effectiveness (109). The effects of ECE compared with other, possibly effective interventions are likely to be smaller than ECE compared with no deliberate intervention (38, 103). A small or null relative effect does not necessarily mean no effect, but no greater (or smaller) effect than that of the comparator.

3. WHAT ARE THE EFFECTS OF ECE ON HEALTH AND HEALTH-RELATED OUTCOMES? WHAT ARE MAJOR EFFECT MODIFIERS?

3.1. Effects on Health and Health-Related Outcomes

Specific health outcomes, e.g., physical and mental morbidity and mortality, are among the outcomes reviewed here. However, most if not all the other outcomes assessed—e.g., educational attainment, grade retention, and economic outcomes—are social determinants of health, which are upstream social events and conditions with recognized health consequences. Thus, even if health outcomes were not specifically assessed, there would be substantial evidence of likely health benefits associated with these determinants (50).

3.1.1. Health and health risk. With the exception of research on the High/Scope Perry Preschool Project ("Perry"), the Carolina Abecedarian Project ("Abecedarian"), and Head Start (a comprehensive federal child development program with an explicit focus on health), few ECE studies have focused on morbidity, mortality, and injury as primary outcomes. In addition, because health outcomes of ECE may take time to manifest themselves and because few long-term studies are available, there is less evidence on health-specific outcomes than on educational outcomes.

Nevertheless, health outcomes of ECE can be expected through both direct and indirect means (8, 41). Directly, ECE programs may require immunizations, provide nutritional supports, conduct health screening, and refer children for health services. They may also remove children from environments where they are exposed to environmental toxins (air and water pollution, secondhand smoke, etc.). ECE programs typically include physical activity. ECE may teach children healthy behaviors, such as handwashing and teeth brushing, and promote healthy eating and exercise habits. Indirectly, ECE programs may also promote strong adult–child attachments and teach socioemotional skills that improve mental health and educational, social, and economic success. ECE can help children develop a wide range of cognitive skills, including language, problem-solving, and executive functions, which also have long-term outcomes. And ECE programs may provide parental education that promotes improved child health, perhaps reducing abuse, neglect, and injury (41). ECE may also be associated with harms through increased exposure to infectious diseases, negative peer interactions, and potential loss of parental attention.

The most recent US-based meta-analysis (59) provides evidence of several long-term health benefits of ECE: reductions in rates of depression (SMD −0.19, $p = 0.002$), the use of alcohol (SMD −0.211, $p = 0.002$), and the use of tobacco (SMD −0.131, $p = 0.070$) by middle-school age. In a regression discontinuity study that exploits the federal assistance in the Head Start application process provided to communities below the poverty level in 1965, Ludwig & Miller (71) found a reduction in the mortality of Head Start participants between the ages of five and nine from causes regarded as affected by Head Start participation, but not from other causes.

The dated but informative Abecedarian project initially randomized healthy at-risk infants in a mostly Black, disadvantaged community to an intensive five-year ECE program and, at ECE program completion, again randomized study subjects to an intensive three-year early schooling program (15). Whereas the post-ECE schooling did not demonstrate long-term health effects, the ECE component did have long-term health benefits. Risk factors for cardiovascular and metabolic diseases were substantially reduced among male ECE participants, and effects were generally positive for females though not statistically significant (15).

Another study comparing representative samples of US children attending Head Start and non–Head Start ECE, which controlled for child and family background, found that Head Start attendees had improved diets and increased screening for and detection of hearing and vision problems; non–Head Start ECE attendees showed reduced obesity, while Head Start attendees did not; no benefit was found for overall health (8). It may be that, with the availability of public child health programs such as SCHIP and Medicaid, the provision of health care in ECE programs has become duplicative and costly and a distraction from educational objectives. While Yoshikawa et al. (114) recommend including health services along with ECE, Camilli et al. (14) find that services not part of a typical educational program are associated with lower educational outcomes.

ECE programs have been found to improve the socioemotional outcomes of participants. Even programs without an explicit socioemotional focus, e.g., literacy-focused curricula, have small socioemotional benefits (64). However, focused socioemotional training may be particularly important because evidence indicates that more time in nonmaternal care, such as ECE, is associated with a greater likelihood of externalizing behavior and conflict (33). Programs that supplement ECE with fully developed parenting education report substantial benefits for child socioemotional outcomes (64).

3.1.2. Learning: cognition, math, reading, and language. Researchers consistently find that ECE produces substantial benefits for cognition, including executive function, and achievement in math, reading, and language (14, 59). Cognition is regarded as a foundation of subsequent benefits in terms of long-term learning, social and economic advancement, and health (93). Regarding executive function, one meta-analysis finds a significant benefit (59), and another study finds no effect (44). Benefits are similar for boys and girls (73). Effect sizes are often found to be lower for Head Start (e.g., SMD 0.129, $p = 0.000$) than for state programs—both targeted low-income programs (e.g., SMD 0.293, $p = 0.000$) and universal programs (e.g., SMD 0.470, $p = 0.000$) (59). Evidence generally finds greater benefit for children in low-income households than for children in higher-income households, implying that universal programs are likely to promote equity (13).

The recent study by Gray-Lobe et al. (47) is the only randomized study of a large-scale ECE program with long-term educational follow-up. Boston Public Schools operate a universal ECE program that requires teachers to have a bachelor's degree. Lack of funding for all eligible students allowed researchers to use the lottery selection system to follow more than 4,000 4-year-olds enrolled and not enrolled in the program. ECE attendance was associated with a 6% increase in high-school graduation, an 18% increase in on-time college attendance, and a 5.5% increase in attendance of a four-year college (47). Benefits were greater for boys than for girls, and differences

among racial groups were minimal. While the study showed reductions in behavioral issues such as school disciplinary actions, no apparent educational benefits were noted during elementary, middle, and high school in the few achievement measures assessed.

Researchers have examined the effects of facets of the ECE classroom process: Meta-analyses (e.g., 64) have found that focused attention on specific outcomes increases benefits for those outcomes. This concept has been interpreted by some as indicating that skill-specific curricula are more effective than "global, whole child" curricula (62, 72). However, whether these specific gains come at the cost of losses in skills not included is unclear (102). Another meta-analysis found intentional teaching one-on-one and in small groups to be associated with larger effects on learning (14).

Parental engagement in the child's learning, e.g., reading, is an important contributor to the child's progress (84). Some evidence indicates that, compared with middle-class parents, working-class parents may underestimate this potential contribution and minimize their own agency (24, 69). Two meta-analyses from the same database (48, 64) examine the child cognitive, preacademic, and socioemotional outcome effects of adding parental education to ECE programs. One (48) finds that parent programs improve cognitive and preacademic outcomes only with home visitation by program educators once a month or more. An analysis of 28 developed-nation ECE programs suggests that engaged parenting and effective ECE have similar benefits (21), indicating that, to some extent, ECE may act as a compensatory "equalizer" for less-effective parenting associated with lower levels of parental education (30).

One meta-analysis (77) finds substantial benefits of ECE for other academic outcomes (i.e., grade retention, assignment to special education, and high-school graduation); reduction in grade retention is confirmed in another meta-analysis (59). Grade retention and assignment to special education are costly consequences of a lack of educational progress.

3.1.3. Social and economic outcomes. The assessment of outcomes for ECE participants when they reach adulthood requires long-term follow-up, resulting in few qualified studies. For example, the three early studies found reductions in rates of crime for program participants (1, 44, 100). They also found improved employment and income for participants as adults (1, 100).

3.2. Effect Modifiers

The effects of ECE on health and determinants of health differ by various facets of program timing and program quality. These factors are likely to be critical in ECE program design.

3.2.1. Time: ECE initiation and dosage. It has been difficult to sort out the dimensions of timing in relation to the benefits of ECE. One meta-analysis (70) finds that programs begun at earlier ages, e.g., 2–3 years of age, are more effective than those initiated at ages 3 or 4; that shorter programs have larger but less enduring effects; and that cognitive and achievement effects decline geometrically following program completion and level out at still-beneficial levels. Two (overlapping-source) meta-analyses concur that starting at age three and having two years of ECE adds little, if any, benefit over one year at age four (14, 70). None of the meta-analysis findings regarding starting age and duration have been confirmed in randomized trials, and they are difficult to reconcile with within-study findings showing that longer duration is associated with larger long-term effects (1, 6, 13). A randomized trial finds that full-day ECE yields substantially greater educational effects than does half-day ECE (95).

The latest studies included in the meta-analyses were published in 2007. More recent rigorous large-scale studies examining the effects of duration have added to the evidence and indicate that more time in early childhood programs is associated with larger short- and long-term gains

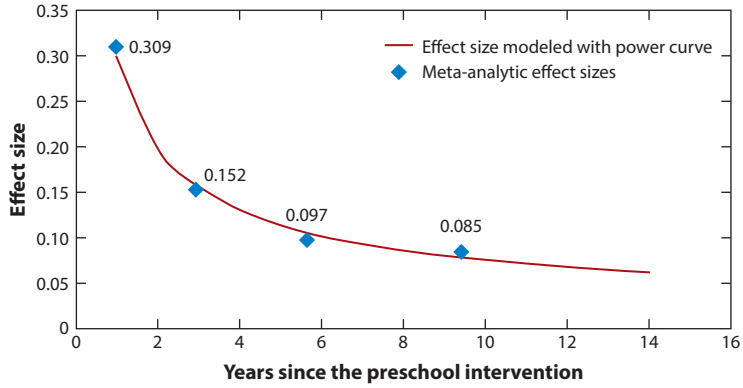

Figure 1

Academic ability and performance fade-out (combining achievement and cognitive ability), Washington State Institute for Public Policy (WSIPP) meta-analysis, 2014; standardized mean difference (59 data points). Figure adapted with permission from Reference 66.

(1, 6, 13, 53, 112). This evidence also suggests that the advantages of a longer duration (e.g., two years over one) vary with the population served, program quality, context, and specific outcomes.

3.2.2. Time: Fade-out/persistence/catch-up. There are two other critical facets of ECE and time. Duncan & Magnuson (31) observed that ECE effect sizes have declined over decades—a secular trend. Plausible explanations are the large effects of intensive early model research programs such as Perry and Abecedarian, the increasing participation by children in comparator populations in ECE and other supports for learning and development (for example, home visitation and parenting programs), and improved home environments (31). The latter two explanations do not indicate a diminution of ECE efficacy per se.

A major concern regarding ECE is that benefits diminish following program completion in a geometric function (see **Figure 1**)—referred to as fade-out, persistence, and, because non-ECE participants may eventually acquire the skills of their ECE classmates, catch-up. The sources used in **Figure 1** are the early studies of ECE in which participants were generally exposed to two years of the program and control subjects were less likely to receive another form of ECE than they are today; study subjects today are more likely to have parents with greater levels of education than the parents in the source studies. In part because of lower participation by control subjects in ECE-like programs, **Figure 1** likely makes a useful representation of the magnitude of program effects over time.

Though noting a lack of extensive evidence, Bailey and colleagues (3) provide a complex but logical framework of ECE persistence, arguing that three components of a persistent program are necessary: First, the skills imparted by the ECE program must be both malleable and fundamental to long-term success. In addition, perhaps tautologically, for the ECE intervention to be beneficial in the long term, its benefits must have been unlikely to have occurred in its absence. Academic skills—basic literacy and numeracy—are malleable and fundamental but commonly achieved in the absence of ECE. General intelligence is fundamental but appears to be less malleable. Bailey et al. (3) find few components of ECE that meet all three criteria; exceptions may be intensive math and reading skills and positive attitudes toward one's learning capacity. Second, some long-term benefits can be achieved through one-time foot-in-the-door interventions that achieve outcomes, such as the reduction in grade retention, but may not in themselves have

enduring benefits. Third, specific environmental conditions are likely to sustain the benefits of ECE, while other environments are not.

A small portion of fade-out has been attributable to a statistical phenomenon, i.e., the increasing variance of cognitive scores as children age, thus lowering SMDs regardless of ECE effectiveness (20). Some researchers have proposed sleeper or reemergence effects in which a benefit from ECE disappears during an interval, then reemerges at a later time (3, 88). ECE benefits may take time to mature and manifest their effects on the measures typically assessed (88).

What must happen subsequent to ECE to maintain initial benefits? Along with the roles of family and community, an obvious factor is subsequent schooling. The deliberate coordination of ECE and subsequent education is referred to as alignment, and misalignment is seen as a source of fade-out (62, 111). Because children from low-income households attending ECE are likely to live in low-income neighborhoods, they are also likely to attend schools where the benefits of ECE may not be supported (26, 63). However, the question of effectiveness is not whether the benefits of ECE fade in these circumstances (26), but whether ECE participants, compared with children who were not exposed, are protected by their ECE experience in school environments that provide less-effective supports for further learning (17, 63, 91).

Some evidence (62) indicates that teachers in kindergarten and subsequent grades may repeat what ECE participants have learned previously, or that they may pay more attention to children who did not attend ECE and may need more help, such that those who benefited from ECE may be relatively ignored and progress at a slower rate. Studies (23, 62) find that enriched rather than repeated instruction in kindergarten and first grade can maintain students' learning, whether or not students have participated in ECE. Given the substantial benefits of ECE at program completion and the common finding of effect fade-out, the issue of persistence merits more attention.

The doubly randomized Abecedarian study (16) examined the separate and combined effects of the Abecedarian ECE and an enhanced schooling follow-on supplement on outcomes at age 8 and age 15. Essentially, children exposed to both ECE and the early schooling intervention did best in terms of IQ, reading, math, and reduced grade retention and assignment to special education. Next best were the children exposed to ECE, but not the subsequent schooling, followed by those who were exposed only to the schooling, and last were those exposed to neither intervention (16). These findings are confirmed by other research (63, 91).

3.2.3. ECE program quality. ECE program quality is widely reported to be critical for ECE benefits (40, 114). Standard measures of quality (42, 54, 55, 85) address several of the effect modifiers considered above, and dose–response relationship and minimum thresholds of quality have been assessed (42, 115). Two domains of quality measures are distinguished. Structure measures address the organization and administration of ECE programs and include staff training and compensation, program management, quality assessment and improvement, and also classroom organization (size, student–teacher ratios). Process measures address what happens in the classroom and include curriculum, form of instruction, and characteristics and qualities of teacher–student interaction. Parent engagement could also be considered an aspect of process quality. A recent cohort study indicates that high-quality programs can substantially reduce gaps in rates of college graduation and income at age 26 between ECE participants from low-income and higher-income households (13; see also 115). Most ECE programs in the United States are rated as being of moderate quality whether for process or for structure (28). In 2020, only 10 states met the 10 benchmarks for minimum state preschool quality standards by a rating system intended to review the minimum policy provisions for effective ECE; 13 states met fewer than half of the standards (42).

Commonly used quality measures are found to be only moderately predictive of cognitive and socioemotional outcomes (60, 76), which suggests that the measures may not be measuring key factors causing ECE benefit or that the factors are not measured well (12). Perhaps quality factors must act in concert and thus be assessed in combination. Burchinal (12) recommends theory-based measures that better assess in-depth learning and the emotional quality of teacher–participant interaction.

4. THE HEAD START EXPERIMENT

We highlight evidence from the Head Start experiment (61, 86, 87), which was a large, randomized controlled study of the principal national ECE program focused on children from low-income households. This program remains controversial and has yielded remarkable and disappointing results. We focus on the effects of Head Start on participants' cognition, socioemotional capacities, and health at the end of third grade.

The federal Head Start ECE program was launched in 1965 as a means of interrupting the cycle of poverty by providing low-income children with educational and other services and preparing them for successful schooling. With several exceptions, 3- and 4-year-olds qualify for Head Start if their family income is at or below the federal poverty level. In 2020, approximately 558,000 children participated—36% of eligible 3- and 4-year-olds in the United States (42). Almost three times as many 3- and 4-year-olds in the United States (1.6 million) participated in state-run ECE programs (42).

In the Head Start experiment, beginning in 2002, almost 4,500 3- and 4-year-olds were recruited and randomized to Head Start or a non–Head Start form of care, either another form of ECE or home care. Because the 3-year-olds were randomized only to one year of Head Start and might or might not have participated in a second year, the study can evaluate only the effect of beginning Head Start at age 3 but not their participation in two years of Head Start.

Despite study guidance, 14.9% of 3-year-olds and 20.2% of 4-year-olds assigned to the Head Start treatment did not actually participate in Head Start. Also, almost 60% of the children assigned to the control condition participated in a form of ECE, with 13.9% of 4-year-olds and 17.3% of 3-year-olds participating in Head Start, contrary to study guidance. Overall, one-third of study subjects participated in the intervention opposite the one assigned.

Study participants were examined at the completion of their assigned intervention, after kindergarten, and after the completion of each grade through third grade. Analyses examined results for all randomized study participants (*a*) regardless of whether they actually participated in the assigned intervention, i.e., intention to treat (ITT), and also (*b*) according to the intervention in which they actually participated, regardless of assignment, i.e., treatment of the treated (TOT). We focus on the findings adjusted for multiple comparisons and child background characteristics.

The most remarkable finding of the Head Start randomized trial is that while participants demonstrated some benefits at Head Start program completion that contributed to kindergarten preparedness (principally in reading and language), by the end of third grade, compared with control subjects, essentially no remaining benefits of Head Start were noted, in terms of multiple aspects of cognition, diverse aspects of socioemotional development, or parenting attitudes and behavior (87). Even for health outcomes, the study showed no long-term effects, despite the greater provision of health care services for participants. Findings were similar, whether the analysis was ITT or TOT (87). The only differences found in TOT analyses were among 4-year-olds: a decrease in negative emotional symptoms and a substantial increase in the time parents spent with their children. Dual language learners and those with lowest baseline skills benefited

more than others (78), an important finding for health equity. Also surprising was that no greater benefit was associated with higher-quality programming, as systematically rated in terms of classroom resources, interactions with teachers, and exposure to different facets of learning (61).

Note, the Head Start randomized trial is a comparative study, and readers should not take these results as indicating the failure of Head Start (78, 103). Sixty percent of the control participants received some form of ECE, while the remainder received a form of home care. Comparison of features of Head Start and comparator ECE programs found substantial differences only in the greater amount of services provided by Head Start. A national survey conducted in 2005–2006 (106)—around the time of the Head Start experiment—used a standardized rating system to assess the quality of Head Start, other forms of ECE, and home-based care in the United States. Forty percent of Head Start centers were of high quality, compared with 32.8% of other ECE settings and only 9.5% of home-based care (106). The Head Start experiment essentially found Head Start to be no better (or worse) than a statistically weighted combination of these other forms of care. Some analysts have reanalyzed the Head Start experiment and found more positive outcomes (38, 68).

5. HOW DOES ECE WORK?

Having reviewed evidence for components and outcomes of ECE programs, here we examine how the effects of the program elements and outcomes examined above work as part of a system. We describe a path analysis (93), which combines the findings of three foundational research studies of ECE: Perry, 1962–1967 (101), Abecedarian, 1972–1977 (89), and the Child-Parent Center (CPC) program, 1983–1985 and ongoing (92, 93). While the details of these projects differed substantially, they all had an educational focus, evaluated possible program mediators, and assessed educational attainment at age 21.

Reynolds and colleagues (93, pp. 418–20) examine pathways linking five principal notions about how ECE works:

1. Cognitive advantage, described as "the enhancement of cognitive skills broadly defined";
2. Motivational advantage, described as "children's self-system attributes such as achievement motivation, school commitment, perceived competence, or educational expectations";
3. Social adjustment, described as "noncognitive skills";
4. Family support behavior, described as "parental investments in children's development, such as greater parental involvement in education, increased parenting skills"; and
5. School support behavior, described as "postprogram school experiences."

In this model, the principal consequence of ECE is the strengthening of cognitive skills (8) (see **Figure 2**). These skills lead to academic motivation and socioemotional adjustment in grades 1–3, which, in turn, lead to reduced grade retention and assignment to special education. These outcomes then lead to improved academic achievement by ages 14–15 and educational attainment by age 21. Another consequence of ECE is increased parental involvement, which leads to child educational attainment (see also 25, 34) and a reduction in the incidence of a child changing schools one or more times—a risk factor for school failure and juvenile arrests.

Reynolds's study was extended to examine health and health risk behaviors associated with ECE and potential mediators of this association (37). Of 15 outcomes examined, only 2 were statistically significant ($p < 0.05$): reductions in heavy drug use and combinations of ≥ 2 harmful behaviors. Prominent mediators were educational attainment at age 21, child motivation, and delinquent behavior.

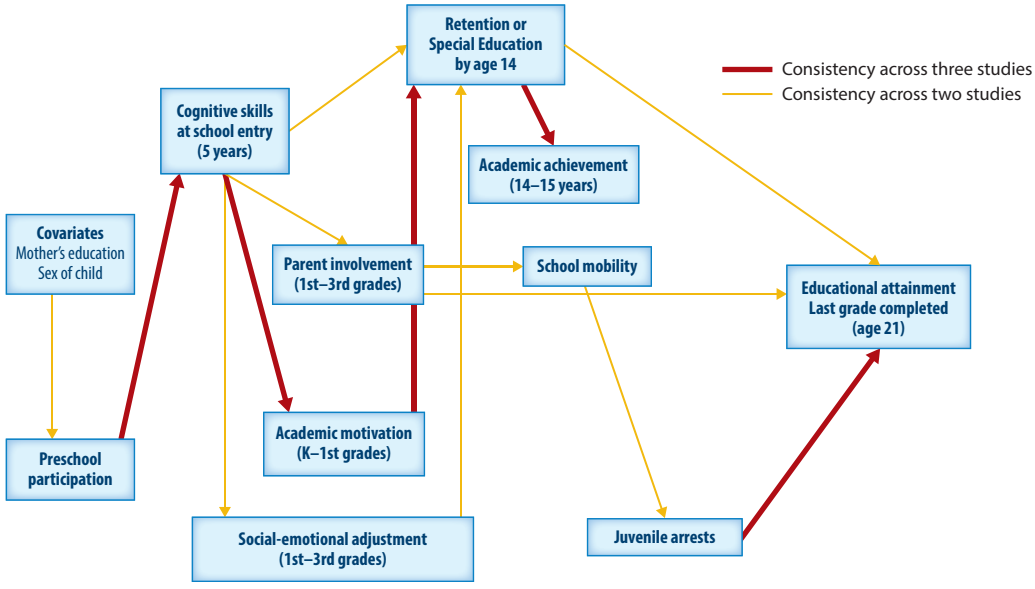

Figure 2

Path analysis for educational attainment outcomes in early adulthood common paths across the three studies. Thicker lines indicate consistency across studies; other lines indicate consistency in two studies. Figure adapted with permission from Reference 93.

6. IS ECE COST BENEFICIAL? WHAT ARE THE RELATIVE BENEFITS OF TARGETED VERSUS UNIVERSAL ECE?

Supplemental Material >

Economist James Heckman (57) has hypothesized that intervention early in a child's life has a higher rate of return in the promotion of equity than does later intervention, represented by the Heckman curve (see **Supplemental Figure 4**). The hypothesis may rest on assumptions, e.g., that children's ability formation is more malleable in earlier than in later years, that child development is incremental and cumulative so that later compensation for missed earlier development becomes increasingly difficult, and that intervention costs do not vary greatly by age. A review of Danish (welfare state) interventions confirm Heckman's hypothesis (96). However, a systematic study examining 339 interventions does not confirm the hypothesis (90).

Given the wide range of effect modification reported above—e.g., full-day programs versus part day, with and without health services, one year or two—a single benefit–cost ratio (BCR) for the range of ECE programs is unlikely. BCRs are likely to vary with program characteristics, participant characteristics and needs, and environmental and historical circumstances. In particular, program quality, as established by systematically evaluated criteria that recognize critical effect modifiers, is an important determinant of BCR (5, 42).

Karoly (65) reviews a range of high-quality benefit–cost studies of ECE programs, including the early research studies, Head Start, and state programs. She notes the variability of economic components included in studies and focuses on costs and benefits related to participating children, but not their parents (e.g., parental employment). Present discounted value annual costs (in 2014 dollars) ranged from $5,170 for the Tulsa universal part-day program to between $18,329 and $24,192 for the two-year, targeted Perry program. BCRs ranged from 2.63 for Head Start, to 4.20 for state and district programs, and to one estimate of 17.07 for the Perry program (with longer-term outcomes). The Tulsa universal program BCRs did not differ systematically by participant poverty level.

Findings from the Perry and CPC evaluations indicated that BCRs increased as participants aged, most likely because of greater impact in terms of wages, taxes, reductions in crime, and dependence on public welfare. Several BCR estimates from Perry studies are higher than those of the scaled-up programs such as the Tulsa program, Head Start, and state programs. However, the latter are also evaluated at younger participant ages; do not include measures of income, taxes, or reductions in welfare; and were evaluated more recently, when control participants had greater access to other forms of early childhood care (and relative effect sizes are thus likely smaller).

Karoly also examines the relative costs and BCRs of ECE programs targeted to low-income children versus universally,[1] i.e., regardless of family income level (65). Based on effectiveness findings of the CPC, Karoly estimates BCRs in six states with universal programs. The societal perspective includes costs and benefits to all parties: the children and families who participate in a public program, the general public or taxpayers who finance the program, and others in society. The government BCR encompasses only the costs to the government and the benefits to the government (primarily program expenditures, reduced costs for government programs, and increased tax revenues). From the societal perspective, BCRs range from 2:1–4:1 in California to 3.4:1 in Texas, which are close to the BCRs for the universal Tulsa program. Even examining the BCRs for the government sector alone, ratios range from 1.2:1 to 1.9:1 in Arkansas, Massachusetts, Ohio, and Wisconsin; ratios are slightly lower than that for Head Start but still beneficial.

Several rationales indicate the overall societal benefit of universal rather than targeted ECE programs.

1. Universal programs may increase the coverage of children from low-income households. Despite its existence for almost 60 years, Head Start enrolls less than half of eligible children from low-income households. One problem is that the Head Start poverty entry criterion is not a constant characteristic of many households (35), so a family whose child is eligible at one time period may not be eligible several months later, perhaps because Head Start has allowed his mother time to work. Universal programs would thus reach more children whose households fluctuate around the poverty cutoff.
2. Because programs including children from higher-income households may be more closely monitored by higher-income parents, universal programs may increase overall program quality and thus effectiveness. A study (18) comparing universal and targeted state ECE programs finds greater effectiveness for children from low-income households in universal programs, similar costs per child, and a greater BCR as compared with targeted programs.
3. Children from lower-income households are likely to benefit from the peer influence of classmates from higher-income households; stronger educational foundations have been associated with greater household resources (75).
4. Educational tracking by means testing may promote harmful self-perceptions of inferiority and superiority (22), and universal programs may eliminate the stigma associated with participation in programs for lower-income populations.

[1]The term "universal" in reference to ECE is not used consistently; sometimes it refers to all children (of specified ages) regardless of socioeconomic status (SES) (58) and at other times it refers to all children (of specified ages) and of a specified low SES. Programs called "universal" may also be said to be available to a specified population but not actually provided to all eligible children (46, 47). For example, Georgia's lottery-funded pre-K program for 4-year-olds is described as "universal," but the program website notes that "there may not be enough spaces in every community for all four year olds who wish to participate" (**http://www.decal.ga.gov/prek/About.aspx**). Clear usage of the term requires specification of (*a*) target population enrollment criteria and (*b*) indication of whether the program is actually provided to this population or is limited by available funding.

5. ECE has been shown to reduce school dropout and grade retention (59). Most of the children who are retained in a grade or who do not complete high school are not from the lowest family income quintile, but from middle- and upper-income households (4).

7. ECE IN OTHER NATIONS

Supplemental Material >

As of 2018, the United Nations Educational, Scientific, and Cultural Organization (UNESCO) reported substantial variability among nations in preprimary education enrollment (including kindergarten). Rates have increased worldwide in recent decades (see **Supplemental Figure 5**). In sub-Saharan Africa and South and West Asia, enrollment rates were low (10–15% of age-eligible children) in 1999 but had doubled by 2018. Enrollment was moderately high in Asia and highest in Europe and the Americas. The proportion of 3–5-year-olds in ECE and kindergarten in the United States in 2018 was 64.0% (29), substantially lower than the 88% average reported by UNESCO for North America overall and Western Europe (see also 19).

In Europe, most ECE programs are universal (107). A growing number of nations have made ECE compulsory and available for all children of specific ages younger than 5 (81). In more than half of the 42 Organisation for Economic Co-operation and Development (OECD) and partner countries, the enrollment of 3–5-year-old children is at least 90%. Among OECD nations, the equitable distribution of quality ECE is a major challenge and prominent concern (108, 110).

In developing nations, an estimated ~200 million children younger than age 5 are at risk of poor physical and educational development because of inadequate nutrition, increased exposure to disease and violence, and limited educational opportunities (36). Analyses of programs evaluated in some developing nations indicate that ECE programs, including those with nutritional and health components, have the potential to increase participants' education and income levels and to reduce poverty and inequity (36).

8. ECE AND EQUITY

In 2018, 38.0% of 3-year-olds, 60.1% of 4-year-olds, and 16.9% of 5-year-olds in the United States were enrolled in ECE (29). Enrollment differed by race: 42.9% of White 3–5-year-olds were enrolled, 34.4% of Hispanics, 37.9% of Blacks, and 35.9% of Asians. Higher enrollment was associated with greater parental educational attainment: Approximately 70% of the children of parents who had not completed high school and more than 50% among children whose parents had a graduate or professional degree were not participating in ECE (29). The COVID-19 pandemic has exacerbated the educational gap in ECE participation (42). Given that children with less-educated parents are also likely to come from households with lower incomes, this gradation is contrary to what would benefit the children of lower-income parents.

Evidence for the effectiveness of ECE indicates that while details remain uncertain, ECE overall can be a powerful tool for the redress of inequity in the United States and is highly cost beneficial. Even the more costly, intensive, high-quality programs assessed by randomized trials demonstrate long-term benefits and substantial BCRs for minority children from low-income households (94). Benefits, including positive BCRs, were also found in a recent assessment of 5,000 US school district public ECE programs; while typical programs have no benefits, high-quality programs and programs in majority-Black school districts show substantial benefit (7). Universal high-quality ECE for at least one year merits attention as a central societal policy.

If an intervention, such as ECE, is determined to be effective overall, and to be more effective among populations who suffer the deprivations of inequity, this intervention can be deployed in two basic ways to advance equity: targeted and universal approaches. The intervention can be

targeted to populations of children ages 3 or 4 who suffer inequity, and, because it is especially effective among these populations, the intervention will promote equity by reducing gaps. Many current programs, including Head Start, are means-tested and thus promote health equity. The intervention can also be directed to all children ages 3 or 4, and, because it is more effective among populations who suffer inequity, it will still promote equity but at a slower rate. Decisions about strategy will depend on a balance of societal values, including the need to redress historic inequities. There are substantial societal benefits to universal programs.

Although ECE is a powerful intervention for promoting the education and health of low-income populations, it is not a "silver bullet" (67). Equity in health requires not only that the populations that suffer inequity reach parity in outcomes, but also that parity be achieved in the social determinants of those outcomes (49). It is implausible that parity in an outcome such as educational attainment or health can be sustained if the causes of that outcome are not also equitably distributed and sustained. Increased resources for low-income families, including a living minimum wage, housing and tax benefits, and health care, are likely to be critical in achieving the full benefits of ECE (2, 44, 67, 98).

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