

## EARLY CHILDHOOD EDUCATION: PATHWAYS TO BETTER HEALTH

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Early childhood education programs can have significant impacts on the health of participants beginning in early childhood and persisting through adulthood. There are multiple pathways, both direct and indirect, through which early childhood education programs can contribute to better health, in both the short and long term. For example, children attending high-quality early education programs make cognitive and social-emotional gains that are associated with improved adult health. Preschool participants are also more likely to go to a doctor, receive appropriate screenings and immunizations, and receive dental care, laying an early foundation for better health. Additionally, preschoolers and their parents often learn about health and nutrition, which can result in lifestyle changes that address issues such as obesity and malnutrition. Finally, children who participate in high-quality early education or parenting support programs may experience less abuse, neglect, and injury in the home.

Yet these health benefits of early childhood programs have not been fully recognized in program evaluations.<sup>1</sup> A broad definition of good health includes cognitive ability, a low likelihood of engaging in risky behaviors, mental stability, and positive social-emotional development in addition to a lack of illness. Healthy individuals, in this broad sense, are less likely to engage in crime and violence or other behaviors that risk serious injury or even death to themselves or others. They are less likely to be obese or malnourished, or experience prolonged periods of elevated stress, and are more apt to acquire habits, skills, and dispositions that lead to a positive outlook on life.



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The potential health benefits of early childhood education programs are quite large, especially for children living in poverty. In the United States, violence is the leading cause of death for African American males between the ages of 15 and 34. Indeed during these ages between 33 and 50 percent of African American male deaths are caused by homicide.<sup>2</sup> Other risky behaviors such as suicide, smoking, drug use, and teen pregnancy are serious health problems. Weight gain and obesity now impose high costs, beginning at relatively early ages for some children. Many of these same health problems are evident globally, though the extent of each varies from country to country. In developing nations malnutrition among children continues to be a major health problem.

Given the potential magnitude, understanding the health impacts of early childhood education in the United States and abroad is critical. This report sets out the evidence regarding the health benefits to children from early childhood education programs, identifies the features of high-quality programs that produce health benefits, and offers policy recommendations to improve the contributions of such programs to health.

### What We Know

- Health care costs in the United States reached \$2.6 trillion in 2010, consuming 18 percent of Gross Domestic Product up from the 9 percent in 1980.<sup>3</sup> Chronic disease treatment may account for over 75 percent of these costs. Prevention of chronic disease, including disease related to increasing rates of overweight and obesity, has the potential to produce significant cost savings.
- Children living in poverty are more likely to experience highly stressful home environments and be exposed to violence, both of which are associated with negative health and developmental outcomes.
- Childhood obesity is a problem in developed nations where children consume more calories than they burn during physical activity, which can lead to serious health problems that begin in childhood and last into adulthood.
- Childhood malnutrition is a significant problem in developing nations, often resulting in impaired neurological development which can impair school readiness skills.
- Early care and education can improve children's health both directly in the short-term and indirectly through long-term effects of education on health, health related behavior, and access to health care.
- Early education programs reach about three quarters of 4-year-olds and about half of 3-year-olds in the United States.<sup>4</sup> While they have the potential to positively impact short- and long-term health, many do not live up to that promise.
- Early education programs can improve access to health services including vaccinations, health and dental screenings, and social workers/psychologists as well as provide nutritional meals.
- Programs focused on parenting can significantly benefit children's physical and mental health as well as their overall development.
- Head Start requires health screenings and referrals and the provision of meals that have between one- and two-thirds of the child's nutritional needs.<sup>5</sup> However, not all early childhood development programs provide meals or screenings and referrals.
- In developing nations, the provision of health and nutrition services in early childhood development programs has been associated with gains in development. However, in the United States, preschool program provision of health and nutrition services has not always translated into impacts on cognitive or social-emotional development.
- Although most children in the United States participate in some type of out of home care before entering kindergarten, few attend a high-quality early learning program. Access to high quality is poor for children from all socio-economic backgrounds.
- Globally, access to early care and education has been increasing, but provision of high quality is limited in most countries. Obviously, lower-income countries have more difficulty providing high quality, but even in higher-income countries quality is an issue that must be attended to if long-term benefits, including health benefits, are to be obtained.

## Policy Recommendations

- All children in the United States should have access to high-quality preschool programs, and parenting education should begin early in pregnancy with the degree of support based on risk of poor health and developmental outcomes.
- Early education programs should provide screenings and referrals for health, dental, mental health, developmental, vision, and hearing, or facilitate access to these through other programs.
- Every nation should prioritize high-quality early learning opportunities and other supports for early childhood development. International support to lower income countries for investment in early childhood development should increase.
- Because health habits are formed at an early age, early education programs should be required to provide health, nutrition, and exercise education.
- To combat and prevent obesity, programs should consider policies prescribing desirable meals, snacks, and exercise. Programs also can help families implement healthy changes at home.
- In developing nations and low-income areas, early childhood programs should offer nutrition supplementation to prevent malnutrition.
- Access to health and nutrition services should be based on the needs of the child and family. Some may need extensive assistance while others may need limited services.
- Preschool curriculum should include an emphasis on supporting children's social-emotional development, including self-regulation skills.
- More health-related early education research is needed. Health outcomes should be included in evaluations of impacts of early childhood programs as well as benefit-cost analyses.

## Introduction

The positive association between schooling and better health has been well-established.<sup>6</sup> Schools are an important and effective vehicle for promoting health and providing health education because they reach most children for a long period of time.<sup>7</sup> However, the direct and indirect effects of early childhood education programs on health, broadly defined, have yet to be determined. What we do know is that health during adulthood and old age is influenced by experiences during early childhood.<sup>8</sup> That said, high-quality early education programs can be expected to have substantial impacts on health that extend into adulthood<sup>9</sup> through both direct and indirect mechanisms. Direct pathways include the provision of health services and indirect pathways include cognitive and social-emotional or self-regulation gains that are associated with improved mental health and greater academic achievement, both of which can lead to improved long-term health.

The potential for early care and education programs to improve health depends on access to programs that provide high-quality services, as we discuss later. The Early Childhood Longitudinal Study–Birth Cohort provides informative data on the participation of American children in preschool programs at ages 2 and 4. Although these data are from some time ago, annual data from the Current Population survey suggest that any changes in participation since then have been modest.<sup>10</sup> Half of all children have regular non-parental care at age 2 and 80 percent at age 4.<sup>11</sup> For younger children these arrangements are primarily in homes; only about 15 percent attend centers. At age 4, over 60 percent enroll in a classroom. The National Institute for Early Education Research (NIEER) estimates that the percentage of children enrolled in a classroom the year prior to kindergarten entry—a somewhat different measure—is even higher.

Unfortunately, few of these arrangements are of high quality.<sup>12</sup> At age 4 only 35 percent of those in centers receive a high-quality early education as measured by direct observation with the Early Childhood Environment Rating Scale. Children from some groups have less access to quality preschool education than others. African-American children attend centers at higher rates, but have lower access to quality than other ethnic groups as only 25 percent of their classrooms are of high quality. The lack of quality is a concern because only high-quality programs produce substantial improvements in children's learning and development that produce the health benefits discussed in this brief.<sup>13</sup>

Access to high-quality early learning programs is also a global concern across the full range of economic development.<sup>14</sup> Many European and some Asian countries have universal or near universal participation in preschool education and some have high rates of participation in early care and education for children under age 3.<sup>15</sup> High rates of access also are seen in some Latin American and Caribbean nations. Higher income countries have relatively well-funded systems of early care and education, but how to best provide high quality remains an issue in all countries.<sup>16</sup> Lower income countries vary considerably in both access and capacity to produce high quality, and yet the potential benefits are particularly high given the large numbers of children who have less than optimal environments for their early development.<sup>17</sup>

### **Health Problems in the United States and Abroad**

Efforts to promote health through early education programs could not come sooner. In the United States and throughout the world children, especially children living in poverty, face a variety of serious health risks. Poor health can place limits on individuals' freedoms to pursue their life goals, preventing them from developing to their full potential, and perpetuating disparities.<sup>18</sup> The health risks and problems faced by young children are serious

and diverse: obesity, malnutrition, stunting, lack of access to health care, mental health care, or dental care, exposure to violence in and outside of the home, and toxic stress.

In the United States and other developed countries, obesity is a growing problem. Importantly, malnutrition is frequently associated with obesity. A combination of eating high-calorie, low-nutrient foods, and spending less time engaged in active physical play and more time in front of the computer or television has contributed to this alarming trend.<sup>19</sup> Over the last three decades, in the United States, rates of overweight and obesity have increased from 5.0 percent to 13.9 percent among 2- to 5-year-olds, from 6.5 percent to 18.8 percent among 6- to 11-year-olds, from 5.0 percent to 17.4 percent among 12- to 19-year-olds, and from 15.0 percent to 32.9 percent among 20- to 72-year-olds.<sup>20</sup> In addition to the almost 15 percent who are obese, approximately one-quarter of all preschoolers in the United States is overweight or at-risk of becoming overweight. Obesity is also a problem globally: In 2010 more than 40 million children under the age of 5 world-wide were overweight.<sup>21</sup>

Malnutrition is also a serious problem throughout the world, especially in developing nations and impoverished areas of developed nations, regions where hunger is a problem. In these areas, stunting of physical and cognitive development is a grave concern. The World Health Organization estimates that 162 million children in developing countries under the age of 5 have stunted growth, and 200 million preschool age children in developing countries are malnourished.<sup>22</sup>

Access to health care is another serious problem faced by many young children around the world. According to the National Health Interview Survey, 8.0 percent of children in the United States under age 17 did not have health insurance in 2009 and 5.0 percent of them had no usual place to go for health care. Doctors can screen for chronic illnesses such as asthma, developmental disabilities and mental health problems, administer vaccinations,

and assess children's body-mass index (BMI). Although most school-age children have received their vaccinations because they are required for school entry, fewer younger children have been vaccinated because they are not required to do so or may not have access to vaccinations. Children who do not receive vaccinations are at increased risks for preventable diseases including measles.<sup>23</sup> Dental screenings are also centrally important for a child's health, yet dental care is one of the most unmet health needs, especially among children in poverty. In 2003-2004, 27 percent of children had untreated dental caries.<sup>24</sup>

Exposure to violence, in both the community and the home, is another serious problem that threatens the health of many children in the United States and throughout the world, especially among the poor and in urban areas.<sup>25</sup> In the United States, approximately 2.7 million children are abused or neglected each year.<sup>26</sup> Exposure to violence may be traumatic and influence children's long-term mental health, including emotional and behavior problems.<sup>27</sup> In addition to the direct effects of violence (i.e. injury or death), violence exerts many indirect effects on children's health that are less frequently measured.<sup>28</sup> One study found that exposure to violent crime in their neighborhood was associated with lower executive function abilities among elementary school children.<sup>29</sup> Children who are exposed to domestic violence and or victims of child abuse are also more likely to suffer from psychopathology and internalizing and externalizing behavior problems.<sup>30</sup> In many regions of the world, children are exposed to violence from wars and political instability, with many children becoming political refugees. In addition to threatening their basic human rights, causing trauma, displacement, and orphaning, war is also associated with a decrease in the availability of food, further threatening children's health. Exposure to this type of violent conflict can also lead to increased aggression and behavior problems in children.<sup>31</sup>

Exposure to violence contributes to the high levels of stress, or toxic stress, experienced due to living in poverty. Toxic stress, defined by the National Scientific Council on the Developing Child as "experiences of severe, uncontrollable, and chronic adversity,"<sup>32</sup> is another health problem. Chronic exposure to stress is associated with prolonged increases in cortisol, a hormone released during stressful experiences.<sup>33</sup> This chronicity has been shown, in animal models, to alter brain structure, genes, and physiological responses to stress.<sup>34</sup> That is, chronic exposure to stress, especially during developmental sensitive periods, can alter or reset the resting point of the stress response system to a level that is either too high or too low. This shift, or allostatic load, is associated with a decreased ability to regulate stress as well as risk for developing self-regulation and behavior problems, and is one way in which toxic stress "gets under the skin" and negatively influences children's health.<sup>35</sup> Indeed, exposure to stress is associated with an abundance of negative health outcomes including heart disease, cancer, depression, obesity, mental health problems, smoking, and alcoholism.<sup>36</sup>

Children, especially those living in poverty, in the United States and abroad, in developed and developing countries, are at-risk for many health problems. Throughout the world, early childhood is a period of rapid brain development; a period during which experiences, including stress, education, and nutrition, are highly influential,<sup>37</sup> highlighting the important role of early childhood programs. Just as the health problems vary by country, the solutions to these health problems will need to be different. That is, in developing interventions and prevention strategies, the ecological context of each country or region must be considered. In poor, developing countries where nutrient rich food is scarce, the first step for any early childhood development program may be nutrition supplementation. In poor urban areas in the United States, a more pressing need may be parenting training to help stressed parents interact with their children.

Thus, although there is some overlap, this paper will address the needs of children and families in developed and developing nations separately.

### Pathways to Health

We propose three theoretical models to explain how early childhood development programs can have both short and long term, direct and indirect effects on health, broadly defined. These models are general such that they can be applied to children and families in both developed and developing nations. Figure 1 outlines how early education programs can directly impact children's health, which translates into greater school attendance and achievement, which in turn is associated with greater adult health. Another mechanism for the association between early childhood programs and long-term health is through its impact on children's cognitive, social-emotional, and self-regulation development. According to the American Academy of Pediatrics, "High quality early education and child care for young children improves their health and promotes their development and learning."<sup>38</sup> Children who are healthy are more likely to be ready for school and ready to learn. They are less likely to be absent and more likely to pay attention and learn while in school.<sup>39</sup> Thus early education programs can improve both the health and the academic achievement of children, which translate into long term improvements in health during adulthood.<sup>40</sup>

Figure 2 outlines how parenting interventions, one type of early childhood program, influence children's short and long-term health through improving access to health care, reductions in neglect, abuse, injury, and violence in the home, as well as improvements in child cognitive, social-emotional, and self-regulation skills. Reductions in household violence are likely to lead to decreases in stress, thus possibly preventing toxic stress from "getting under the skin" and leading to better health outcomes.

Figure 3 focuses on longer-term and indirect health impacts of early childhood education and development programs. These longer-term health impacts are mediated

by shorter-term impacts on cognitive and social-emotional development. Improvements in cognitive abilities are associated with greater academic achievement and attainment which translates into better jobs and greater earnings, both of which are associated with better adult health. Improvements in social-emotional, including self-regulation, skills are associated with decreased stress, risk-taking behaviors, and abuse and neglect, all of which in turn are related to improvement in health (both directly and indirectly).

In sum, both center based early childhood programs and in home parenting intervention programs are associated with short and long-term improvements in children's health. Programs vary in that some early childhood programs focus solely on providing education or parenting training while others also include specific health components. The remainder of this paper offers empirical evidence, from early childhood and parenting programs in the United States and abroad, to support the mechanisms proposed in Figures 1, 2, and 3.

### Impacts of Early Childhood Programs on Children's Health

#### ***Research in the United States***

*Physical Health.* Physical health is broadly defined to include health screenings, doctor visits, health insurance, obesity and nutrition, as well as general well-being and lack of illness. Despite concerns that children enrolled in center-based early childhood programs get sick more due to the spread of germs between children, early childhood programs can positively impact children's short- and long-term health. While children in out-of-home care do get sick more frequently research suggests that young children in out-of-home care experience fewer illnesses later in life. Exposure to germs at an early age may serve as a protective factor against illness such as asthma and allergies later in life.<sup>41</sup> Child care centers can and should be managed to minimize the spread of infection, without being sterile, by teaching children

about hygiene, especially hand washing, and by disinfecting toys.<sup>42</sup>

Indeed, early education programs can impact short-term child health outcomes through two main pathways: increased access to health care and improved health behaviors (see Figure 1). For example, Head Start programs are required to offer a variety of health screenings and referrals and to provide nutritious meals and thus should be expected to improve health through both pathways. However, the results of small and large scale evaluations of Head Start have not always found positive impacts on child health. For example, one small scale study found that children enrolled in Head Start were significantly more likely than children on the waitlist or middle class children to receive a variety of health care screenings.<sup>43</sup> Another small scale study found that 100 percent of children randomly assigned to Head Start compared to only 8 percent of children on the waitlist received a well-care doctor visit/check-up during the previous year. Head Start participants were more likely to receive a variety of health screenings, be up-to-date on immunizations, and to have visited the dentist. However, the most recent Head Start Impact study found few health effects. For example, improvements to Head Start children's health, compared to control group, were either very small (.11-.13) or not significant. Impacts on having health insurance were also not maintained into first grade.<sup>44</sup> Additionally, data from the National Longitudinal Study of Youth 1997, suggest that despite Head Start's focus on nutrition, program participation was not associated with improvements in height-for-age, an indicator of nutrition.<sup>45</sup> And an evaluation of the Early Head Start program failed to find an impact on children's health status.<sup>46</sup>

There is limited research on the health impacts of non-Head Start early childhood programs. However, an evaluation of North Carolina's Smart Start program found mixed evidence of impacts on children's health: Smart Start participants were significantly more likely to have a regular source of health care and to have received the

DPT vaccination. However, there were no significant impacts on receipt of other vaccinations or health screenings.<sup>47</sup> The Infant Health and Development Program, found that low birth weight children enrolled in an educational intervention from birth through age three, were significantly taller and had significantly greater head circumference at age 8. Impacts on weight were only found for the lowest birth weight infants.<sup>48</sup>

A recent review of studies examining the impacts of preschool programs on children's health outcomes found 1) some evidence of increased health among preschool participants, including decreases in obesity, greater mental health and social emotional competence and 2) a lack of rigorous research evaluating the impacts of preschool on health.<sup>49</sup> More recently, using data from the Early Childhood Longitudinal Study–Birth Cohort and more rigorous statistical methods to control for selection bias, Belfield and Kelly found that children enrolled in center-based care including Head Start were less likely to be obese, more likely to be physically active, and more likely to consume a nutritious diet during preschool. Head Start and center-based programs also appeared to have protective effects against allergies and respiratory problems, including asthma. Children who participated in Head Start were also more likely to receive health screenings during preschool. And children in both center-based programs and Head Start were more likely to receive screenings for ADHD.<sup>50</sup>

Early childhood education programs also offer an opportunity for the provision of specific health interventions. Two such promising interventions are Healthy Start,<sup>51</sup> which aims to get children to eat healthy foods, and Hip Hop to Health Jr.,<sup>52</sup> which aims to increase children's physical activity. Both programs emphasize the importance of forming good health, nutrition, and exercise habits at an early age to prevent health problems later in life, and have demonstrated some significant impacts on child health. For example, Healthy Start found significant reductions in consumption of calories from fat and saturated fat and also reductions in high cholesterol for

the most at-risk group. However, they did not find significant impacts on healthy eating habits outside of school, one goal of the program.<sup>53</sup> Random assignment to participate in the Hip Hop to Health Jr. program was associated with smaller increases in body mass index (BMI) after 1 and 2 years of the program.

*Dental Health.* Early childhood education programs can also help ensure that young children receive dental care by providing or facilitating access to dental care and educating parents about the importance of dental care.

When dental care is available through the school system, children are much more likely to visit the dentist. An analysis by Barnett & Brown<sup>54</sup> found that all Head



Start children received dental exams and 94 percent of those who needed dental treatment received it. Several other small scale studies comparing children randomly assigned to Head Start versus a weight list also found that children enrolled in Head Start were significantly more likely to receive dental screenings and care.<sup>55</sup> Data from the National Household Education Survey showed that 77 percent of 3-year-olds and 78 percent of 4-year-olds in Head Start received dental care, compared to 33 percent of 3-year-olds and 48 percent of 4-year-olds not in Head Start.<sup>56</sup> A study in a low-income urban setting in New Jersey revealed that only 42 percent of 3-year-olds and 55 percent of 4-year-olds had seen the dentist in the past year. However, older children and children who attended Head Start were more likely to visit the dentist.<sup>57</sup> Finally, a study of more than 5,000 children under the age of 5 in Arizona revealed that 3- and 4-year-old children in Head Start were significantly more likely to receive treatment for cavities than children not in Head Start.<sup>58</sup> However, although the recent

nationally representative Head Start Impact Study found a significant 0.31 intent to treat effect size on access to dental care during Head Start, these impacts did not carry over to kindergarten or first grade.<sup>59</sup>

*Abuse, Neglect, Injury, and Violence.* High-quality early childhood programs include parenting interventions and home visiting programs that teach parenting skills, treat parents' mental health or substance abuse problems, or in some way reduce parent stress can have important impacts on children's likelihood of experiencing abuse, neglect, injury or violence.<sup>60</sup> These potential impacts are important as children who are abused or neglected are more likely than other children to develop mental health problems throughout their lives. Moreover, abuse and neglect can lead to injury which can impair health in the short-term term. Medical bills from children who are abused or neglected are also costly, exceeding \$80 billion per year.<sup>61</sup> Thus, investing in early childhood education programs, including home visiting and parenting interventions can be an effective and cost-saving way to prevent child abuse, neglect, injury, and violence. Early Head Start, the Nurse Home Visiting Program, Healthy Families America, and the Chicago Child Parent Center are all programs that focused on parenting skills that had positive outcomes for children and their mothers.

The Nurse Home Visiting Program, first implemented in Elmira, NY in 1978, provided home visits by a nurse for mothers during pregnancy or during their pregnancy and the first two years of their child's life. Participation in the Nurse Home Visiting program was associated with a reduction in the number and severity of children's incidents of abuse and neglect. Children also experienced fewer injuries, fewer injuries that required hospitalization, fewer accidental ingestions, and fewer instances of domestic violence.<sup>62</sup> Fifteen years after the intervention, children still had experienced fewer incidences of maltreatment involving their mothers, a reduction that occurred between ages 4 and 15, rather than immediately following the intervention. At follow-up, children also were less likely to report arrests, convictions, probation violations,



involvement in crime, or running away and also reported to have fewer sexual partners, smoke fewer cigarettes per day, and drink alcohol on fewer days. The program also had positive effects on mothers: they were less likely to have problems with drugs or alcohol, had fewer arrests and convictions.<sup>63</sup> However, these positive impacts of the Nurse Home Visiting Program have not always replicated.<sup>64</sup> Additionally, an adaption of the Nurse Home Visiting Program, Health Families American has found mixed evidence of impacts on child abuse and neglect.<sup>65</sup>

The Chicago Child Parent Center (CPC) is an early education program that included preschool education, home visiting, and parenting training aimed to help parents be more involved with their children's education. The program had significant impacts on reducing child abuse and neglect: When children were 17, those who had participated in CPC were less likely to have been abused or neglected. This effect was greatest for children who participated in CPC for a longer period of time and for those children who were at the greatest risk and/or from the highest poverty communities. Statistical analyses revealed that the increases in parent involvement in the child's schooling was a mechanism for the reduction in abuse and neglect.<sup>66</sup> Child and parent participation in CPS was also associated with fewer incidences of out-of-home placements,<sup>67</sup> juvenile arrests, multiple arrests, or arrests for violent crimes.<sup>68</sup>

Early Head Start, a federal program which provides center-based programs and home-visiting to low-income children from birth to age 3, has also demonstrated robust impacts on parenting behaviors thought to be related to a lower likelihood of child abuse, neglect or injury. In a nationally representative sample, children randomized to receive Early Head Start services were significantly more likely to have parents engaged with them during play and parents who read to them daily, and significantly less likely to have parents who spanked them.<sup>69</sup> The Infant Health and Development found a significant positive impact of program participation on maternal mental health for the very low birth weight group and the quality

of the home environment.<sup>70</sup> Currently there are ongoing new parenting interventions aimed at preventing the negative effects of toxic stress on low-income parents and children. Evaluations of these interventions are underway.<sup>71</sup>

### ***Research from Other Nations***

Early childhood interventions outside of the United States have also demonstrated important impacts on children's health (as well as cognitive development).<sup>72</sup> The focus of the interventions often varies based on the needs of the children and families. For example, in developing countries where malnutrition is prevalent, early childhood interventions may focus on providing access to health care and nutrients, in addition to educational programs. Conditional cash transfer programs, which provide families with cash in exchange for meeting pre-established goals, are increasingly popular in developing nations.<sup>73</sup> A recent meta-analysis of studies of 30 early childhood interventions in 23 developed and developing countries conducted by the National Institute for Early Education Research found that children in the programs received substantial cognitive, behavioral, health and schooling benefits that were sustained over time. Across these studies, the mean effect size on health outcomes was 0.31 SD but these varied by type of program (Nutrition: 0.38 SD, Cash Transfer: 0.38 SD, Mixed (including educational, nutrition, care, stimulation): 0.23 SD). Of the 14 studies that measured health outcomes, all but two had positive impacts on child health and the dosage of the intervention was a significant predictor of health outcomes.

Highlighting only a few of the studies that have found impacts of early childhood interventions on children's health, Mexico's Oportunidades, formally the Program for Education, Health, and Nutrition (PROGRESA), is a randomized control trial of a conditional cash transfer program that aimed to increase educational attainment, job attainment, and quality of life during adulthood for low income children by investing in their nutrition (providing

micronutrient-fortified foods and money to purchase food), education (cash incentives for attending school that compensate for potential wages), and health (cash incentives for attending health care appointments and receiving immunizations). Children who received the interventions showed more physical growth and were less likely to suffer from iron deficiency anemia, diarrhea, stunting, being overweight, and respiratory infections. These effects were largest for the poorest children. However, there was no impact on the number of days sick in the month prior to the completing the survey for the study.<sup>74</sup>

A center-based program in Cali, Columbia that combined education with a health and nutrition intervention, also found significant positive impacts on the health of children randomly assigned to receive the intervention. Low-income, malnourished children who were randomly assigned to receive a health, nutrition, and education intervention, demonstrated significant improvements in weight for age and height for age. Gains were largest for the children who began the intervention at the youngest age, and consequently received the intervention for the longest period of time. Unfortunately, upon completion of the intervention, children's growth was still stunted compared to non-malnourished children and children from middle- and high-income families.<sup>75</sup>

Malnourished children in Jamaica who were randomly assigned to received zinc supplementation and psychosocial stimulation were less likely to suffer from diarrhea and had improved hand-eye coordination. Although there were health impacts for children who received only zinc supplementation *or* stimulation, the impacts were greatest for the children who received both interventions.<sup>76</sup>

A study in rural Vietnam showed that stunted and non-stunted children who received nutrition supplementation and participated in preschool activities had decreases in stunting and when stunting improved, so did cognitive abilities.<sup>77</sup> Taken together, these studies suggest that a combination of nutrition supplementation, early education, and social stimulation can have a positive impact on

overall development and child health.

### Impacts of Early Childhood Programs on Adult Health

The benefits of high-quality early childhood interventions extend beyond the first few years of life and last into adulthood. These long-term positive impacts include cognitive, educational, social-emotional, health, and economic benefits.<sup>78</sup> High-quality early childhood programs that begin early, and last throughout early childhood, are more likely to produce these positive effects.<sup>79</sup> Higher educational attainment, a common benefit of high-quality early education,<sup>80</sup> is associated with better health,<sup>81</sup> due in part to the greater investment in human capital represented by additional years of schooling.<sup>82</sup> Better health and higher educational attainment are in turn associated with increased earning power.<sup>83</sup> There are three pathways through which early childhood programs impact adult health: improvements to child health, cognitive development, and social-emotional skills (See Figure 3).

The first, direct, pathway through which early education improves adult health is by improving child health. As discussed previously, preschool participants are more likely to go to the doctor, receive appropriate screenings and immunizations, and receive dental care,<sup>84</sup> all of which contribute to improvements in childhood health. Preschoolers and their parents also often learn about health and nutrition, which can result in healthy lifestyle changes. Adult health is dependent on child health; healthier children become healthier adults.<sup>85</sup>

A second pathway through which early education programs improve adult health is by increasing cognitive abilities, educational attainment, knowledge, and use of knowledge.<sup>86</sup> There is a large evidence base indicating that participation in early childhood education programs is indeed associated with significant gains in cognitive development, including math and language/literacy skills.<sup>87</sup> More intelligent, knowledgeable, and educated individuals not only know more about health issues, but

are also more likely to trust scientific health information,<sup>88</sup> and are better able to use that knowledge to make health decisions and healthy life style changes.<sup>89</sup> These same individuals are more adept at seeking and complying with medical treatment.<sup>90</sup> According to economic theory, education is an investment in one's future because it raises the value of staying alive. More highly educated individuals therefore have more incentives to stay alive and healthy and therefore tend to make better health decisions.<sup>91</sup> Numerous research studies provide evidence that these individuals also:<sup>92</sup>

- have lower mortality rates;
- have fewer chronic diseases including heart disease, cancer, diabetes, high cholesterol and depression;
- are more likely to use their seatbelts;
- are more likely to exercise regularly;
- are more likely to eat healthily;
- are more likely to eat breakfast;
- are more likely to own a smoke detector;
- are more likely to have mammograms, pap smears, colonoscopies, and vaccinations;
- are less likely to have ever smoked;
- are less likely to drink heavily or drive while intoxicated; and
- are less likely to be obese or overweight.

These long-term improvements in health and health behaviors can be produced by early education programs to the extent that they increase educational achievement and attainment.

The third pathway suggests that the long-term impacts of early childhood education programs on adult health are mediated by improvements in social emotional skills, including reductions in behavior problems and stress, and increases in self-regulation. In light of the fade out of cognitive impacts, it has been suggested that many of the long-term impacts (non-cognitive) found in longitudinal evaluations of early childhood interventions such as Perry Preschool Program, Abecedarian, and the Chicago Child Parent Centers are due to improvements in self-regulation.<sup>93</sup> Although most evaluations of early childhood interventions have focused on cognitive rather than

social-emotional impacts, there is some evidence that early childhood education program positively impact children's social-emotional development, including mental health, behavior problems, and self-regulation skills. For example, children who were randomly assigned to participate in Early Head Start showed significantly lower levels of aggressive behaviors and greater sustained attention during play, an indicator of greater self-regulation skills.<sup>94</sup> Random assignment to Head Start also lead to significant decrease in hyperactivity and behavior problems for 3-year-olds.<sup>95</sup> NIEER's meta-analysis of the impacts of early childhood programs around the world also found that many program did have positive impacts on children's behavior (although some programs also demonstrated negative impacts).<sup>96</sup> Importantly, although enrollment in child care programs have been associated with increases in behavior problems, this association was mediated by the quality of the program. That is, increased behavior problems were associated with participation in low-quality child care,<sup>97</sup> highlighting the importance of high-quality early childhood programs.

As the importance of social-emotional skills for school readiness and school success has become increasingly more salient, several interventions have been implemented within the context of broader early childhood programs that aim to improve children's social-emotional skills.

*Tools of the Mind* is a preschool curriculum that is designed to improve children's executive function skills. Indeed, a randomized trial of the *Tools of the Mind* curriculum found significant impacts on children's executive function skills, especially on the most difficult executive function tasks.<sup>98</sup> The Chicago School Readiness Project is a cluster-randomized trial of a classroom-based intervention aimed at reducing behavior problems among preschoolers in Head Start. At the end of the school year, children in intervention classrooms had significant reductions in both externalizing and internalizing behaviors<sup>99</sup> and improvements in self-regulation skills.<sup>100</sup> The importance of these impacts is highlighted by recent findings from a large-scale longitudinal study that self-

regulation during childhood was associated with smoking, substance abuse, dropping out of school, becoming a teen parent, criminal activities, and poor health.<sup>101</sup>

Impacts of early childhood programs on both cognitive and social-emotional development can improve adults' job opportunities, salaries and earning potential, and benefits, all of which are associated with greater health. That is, individuals with more desirable and profitable jobs are more likely to value their health and therefore make healthier decisions and seek health care because they want to maintain their employment and continue to increase their earning power.<sup>102</sup> Their increased economic prosperity due to higher earnings raises the value of staying alive and the cost of poor health, because they have more to lose by dying or being too sick to work. Thus, early childhood interventions can be expected to significantly reduce smoking, obesity, mental health problems, and dementia, and improve general health, nutrition, and physical activity.

### General Health

Greater educational attainment, one long term impact of participation in early childhood interventions, is associated with greater health and longevity. For example, data from the National Health Interview Survey indicated that

individuals with more years of education reported lower morbidity from heart disease, stroke, hypertension, high cholesterol, diabetes, emphysema, asthma, and ulcers. Longitudinal evaluations of the Chicago Child Parent Centers and the Perry Preschool program have shown improved health outcomes for participants. Individuals who attended the CPC preschool were more likely to have health insurance at age 24.<sup>103</sup> Through age 40, Perry Preschool participants were less likely to miss work due to an illness and were more likely to be knowledgeable about health information and to have health insurance.<sup>104</sup>

### Smoking

Better-educated individuals are less likely to smoke and are also more likely to quit smoking.<sup>105</sup> Evaluations of Head Start, the Chicago Child Parent Centers, Perry Preschool, and Abecedarian (described in Table 1) all indicated that participants were less likely to smoke than members of the control group, though in smaller studies the estimated effects were not statistically significant. Nevertheless, these studies add to the evidence base. When we pool data from the Perry and Abecedarian studies, the estimated reduction in smoking across both studies is statistically significant.

**Table 1: Impacts of Early Childhood Education Programs on Smoking**

Program	Evaluation	Comparison Group	Results
Head Start	Anderson, Foster, & Frisvold, 2008 <sup>106</sup>	Siblings of Head Start Attendees	1. Head Start attendees 12.4% ( $p < .10$ ) less likely to smoke 2. Duration of Head Start enrollment inversely proportional to likelihood of smoking
Chicago CPC	Reynolds et al., 2007 <sup>107</sup>	Nonrandomized alternative intervention matched group	1. CPC preschool participants less likely to smoke (17.9% vs. 22.1%, n.s.)
Perry Preschool	Schweinhart et al., 2005 <sup>108</sup>	Randomized control group	1. At age 40, Perry Preschool participants were less likely to smoke (42% vs. 55%, n.s.) 2. At age 40, Perry Preschool participants were less likely to use drugs
Abecedarian	Campbell et al., 2002 <sup>109</sup>	Randomized control group	1. At age 21, Abecedarian participants were less likely to smoke (39% vs. 55%, $p < .20$ )

## **Obesity, Nutrition, Exercise**

There is an inverse relationship between overweight/obesity and educational attainment (which is also associated with participation in high-quality early childhood programs). Individuals with higher educational attainments are more likely to exercise and eat fruits or vegetables, and less likely to be overweight or obese.<sup>110</sup> These relationships may also be explained by an investment in human capital.<sup>111</sup> However, currently, there are no evaluations of early childhood interventions that demonstrate a relationship between attending preschool and nutrition, weight, and/or exercise during adulthood.

## **Mental Health**

Longitudinal follow-up of individuals who participated in Perry Preschool, Abecedarian, Chicago CPC, and the Mauritius Early Childhood Development program have shown positive impacts on participants' mental health and other risk factors during adulthood, suggesting a central role of improvements to self-regulation. Participation in the Perry Preschool Program resulted in reduced likelihood of being arrested and abusing marijuana, cocaine, hallucinogens, and heroin. However, participation was not indicative of lower rates of alcohol consumption.<sup>112</sup> Individuals who attended the Abecedarian preschool were less likely to be convicted of a felony or misdemeanor, to be incarcerated, to use marijuana,<sup>113</sup> or to report symptoms of depression.<sup>114</sup> Chicago CPC preschool participants were also less likely to be found guilty of a felony, to be incarcerated, to have symptoms of depression,<sup>115</sup> or to smoke daily.<sup>116</sup>

The Mauritius Early Childhood Development program was an enrichment program for 3-5 year olds that provided education and an emphasis on nutrition, health care, hygiene, and physical activity. Children who were randomly chosen to participate in the program reported fewer behavior problems and fewer symptoms of schizotypal personality and disorganization as adults. They were also less likely to report criminal activity,<sup>117</sup> another indication of the role of self-regulation.

## **Dementia**

Studies around the world have shown an association between low educational attainment and higher rates of dementia. A study in the U.S. found that more highly educated elderly individuals did not show a decline in mental status over the six years of the study. These findings may be explained if individuals with more education have increased synaptic density in areas of the brain associated with memory and learning. Increased synaptic density could delay the onset of dementia because more deterioration would have to occur before the threshold for dementia is reached.<sup>118</sup> Education that occurs during a sensitive period of development, such as preschool education, may have a stronger impact on brain development and synaptogenesis than education that occurs later in life. Individuals who are deprived during these sensitive periods can often not catch up later in life.<sup>119</sup> Individuals with higher educational attainments are also more likely to have cognitively challenging occupations, another protective factor against dementia. Preschool education, by improving brain development and increasing educational and occupational attainment, may have the effect of reducing the risk of/delaying the onset of dementia.<sup>120</sup> Gene expression is also influenced by early experiences, such as early education and early nutrition, and can determine the connectivity of neurons and overall development.<sup>121</sup> Thus early experiences that influence brain development can have an important protective influence during late adulthood.

## **Policy Recommendations**

Health care is expensive for individuals, employers, and the government. Poor health is even more costly. Investing in preventative programs and improving young children's health can result in large monetary savings and improvements in the quality of life.<sup>122</sup> As discussed, there are many pathways, both direct and indirect, through which investments in early childhood interventions lead to improved child and subsequently adult health. Although relatively few studies have rigorously evaluated the short

and long-term health benefits of early education programs, the evidence that has been obtained indicates that such benefits are highly important. Thus, the following policy recommendations are offered based on these findings.

*1. All children in the United States should have access to high-quality preschool programs, and parenting education should begin early in pregnancy with the degree of support based on risk of poor health and developmental outcomes.*

Although most American preschoolers participate in out of home care, few attend high-quality centers even at age 4. Just 20 percent attended a high-quality program in 2005 with the expansion of pre-K for 4-year-olds a priority.<sup>123</sup> Although states have expanded access to pre-K since then, increased enrollment has been accompanied by declining expenditure per child which limits the provision of high-quality services.<sup>124</sup> There is extremely high variability among the states in standards that support quality. Yet, without high educational quality such programs will not provide the learning and developmental gains that lead to later improvements in health behaviors, health care, and health.

As participation in high-quality preschool does not exceed 30 percent for even children of the best educated American parents, the public sector should support access to high-quality preschool for all children. Forty states already have public pre-K systems that serve some four-year-olds, and the expansion of these programs to serve all children is a sensible first step. In addition, access to high-quality preschool and other programs should be expanded to more children at the highest risk of poor health and development at earlier ages. These efforts should include improving the quality of Head Start which should shift its focus from ensuring the direct provision of health care to improving children's health directly and indirectly through education. Parenting support through home visiting should begin early in pregnancy. The degree of support provided should depend on a

comprehensive assessment of risks rather on simple designation based on demographic characteristics such as income or education level.<sup>125</sup> Research to develop and identify the most effective approaches is an important priority.

*2. Early education programs should provide screenings and referrals for health, dental, mental health, developmental, vision, and hearing, or facilitate access to these through other programs.*

The American Academy of Pediatrics and Bright Futures have published "Recommendations for Preventive Pediatric Health Care" which outlines their suggestions, by age, for health care services that typically developing children should receive. Their recommendations for preschool-age children include the following: a medical history, height and weight, BMI, blood pressure, vision, hearing, developmental surveillance, psychosocial/behavioral assessment, physical examination, immunizations, hematocrit, lead screenings, tuberculosis test, dyslipidemia screening and oral health.<sup>126</sup> While Head Start does currently require all children to receive a variety of health screenings, not all state-funded preschool programs or child care programs have these same requirements. In 2011-2012, only 37 state-funded preschool programs met NIEER's quality standard of requiring vision, hearing, and health screenings.<sup>127</sup> Considering that many preschool age children are enrolled in other early child education programs or none at all, many children, especially those living in poverty, are still in need of access to health screenings. It has been estimated that 10 percent of children lack health insurance.<sup>128</sup> Early childhood programs can play a pivotal role in helping children access health screenings and health care.

Additionally, trained staff members can encourage parents to seek preventive health care for their children by explaining the importance of such care and helping parents to find doctors and clinics in their communities who accept their insurance. Teachers can also reassure chil-

dren who might be afraid of the doctor through activities in the classroom including setting up a doctor office in dramatic play and encouraging role playing about the doctor's office, reading books about going to the doctor, or taking a field trip to a doctor's office in the local community.

As children's health is essential to creating a healthy, productive workforce, and policy makers must create new policies to ensure that it becomes a national priority. Importantly Belfield & Kelly found that children's health at 24 months was a significant predictor of their health in kindergarten,<sup>129</sup> highlighting the importance of early access to health screenings and care. Thus policies that require early childhood programs to ensure children receive health screenings and referrals (as outlined by Bright Futures and AAP) or at a minimum facilitate access to care, can successfully improve the health of millions of children in the United States and abroad.

*3. Every nation should prioritize high-quality early learning opportunities and other supports for early childhood development. International support to lower income countries for investment in early childhood development should increase.*

Regardless of the current level of economic development, high-quality early care and education programs have the potential to contribute to improvements in health and development. In some nations access to programs is universal or nearly so and the focus is entirely on ensuring that they provide high-quality services. In others, both access and quality require attention. When access is limited, most often those who lack access are the children with the greatest needs and who can benefit the most.<sup>130</sup> In low- and middle-income countries around the world some 200 million children under the age of five live in conditions that impair their healthy development. Investments in high-quality child development programs including early care and education can significantly improve their health and long-term development. Increasing participation rates in low- and middle-income nations sub-

stantially is estimated to produce high benefit-cost ratios based on increased adult earnings alone without even quantifying the direct benefits on health and health care costs or the indirect benefits because, for example, improved health leads to increased adult productivity.<sup>131</sup> Each nation should prioritize the expansion of high-quality early learning opportunities and other effective supports for early childhood development based on current availability, need, and national capacity to support such efforts. Increased international support to lower income countries for investment in effective early childhood development programs should be a high priority.

*4. Because health habits are formed at an early age, early education programs should offer health, nutrition, and exercise education.*

In 2000, the total costs of overweight and obesity in this country amounted to \$117 billion. Treating childhood obesity costs almost \$1,400 per child but obesity prevention programs can cost as little as \$1.21 per child.<sup>132</sup>

Early childhood programs can be used as a vehicle to provide obesity prevention programs. In 2010-2011, approximately 75 percent of all 4-year-olds were enrolled in some type of center-based preschool program including state preschool, Head Start, special education, and other child care.<sup>133</sup> Many, but not all, early education programs do emphasize health and nutrition. When children learn about health and healthy habits at an early age, they can learn early on about the importance of being healthy and how to stay healthy. Research on such programs as Hip Hop to Health, Jr. and Healthy Start has



shown that it is possible to effect health improvements in preschoolers through health education. Because center based preschool is so wide-spread, it can be a useful mechanism for educating young children and their parents about health, nutrition, and physical activity. However, in order to accomplish this task, teachers and other staff members must first receive training on these topics. Policy makers can help by supporting early childhood policies that prioritize health, nutrition, and exercise education in early childhood programs. Grants should be readily available to programs who want to implement health, nutrition, and/or physical activity programs.

To help with health, nutrition, and physical activity education, early childhood programs should have access to a health consultant. This individual can be a doctor, nurse, medical or nursing student, nutritionist, or health teacher. Teachers and parents should not only learn about how to model healthy behaviors for their students/children, but also how to teach young children about health. Children can be taught about hygiene and how frequent hand-washing can prevent the spread of germs and reduce their chances of getting sick. They can also learn about how the body works so that they can understand why it is important to stay healthy, and what happens to an unhealthy body. While these are complicated topics, they can be taught on a developmentally appropriate and engaging level, especially through the use of hands-on activities. Sesame Workshop's "The Body" exhibit was successful in teaching young children about how the body works and how to keep the body healthy. Inviting doctors, nurses, or other health care workers from the community to talk to preschoolers can also be a helpful way to encourage children to be healthy.

First Lady Michelle Obama's Let's Move Campaign recognizes that children need to be physically active and eat healthy foods in order to fight child obesity. The LetsMove.gov website offers strategies for schools to promote health and healthy behaviors among their staff and students. It also suggests that schools include

nutrition education and physical education in the curriculum. Children and schools can take the Let's Move Pledge and agree to eat better foods and become more active. The Let's Move Campaign could adapt a focus on early childhood by adding information targeted specifically to children birth through 5 years old.

*5. To combat obesity, programs should consider policies prescribing desirable meals, snacks, and exercise. Programs also can help families implement these changes in their homes.*

While obesity has both genetic and environmental underpinnings, it often can be prevented, especially if children develop healthy eating habits at an early age. Preschool programs can provide a vehicle through which to institute changes to eating and exercise habits. Rates of obesity and malnutrition are often high in low-income neighborhoods, the same neighborhoods where Head Start programs and targeted preschool programs operate. Head Start Program Standards state that "All children in a part-day program will receive at least 1/3 of the child's daily nutritional needs and all children in a full-day program will receive 1/2 to 2/3 of the child's daily nutritional needs. Meal patterns will follow USDA guidelines."<sup>134</sup> While Head Start is required to serve high-nutrient, low-fat, low-calorie meals, other center-based preschool and child care programs are not required to provide healthy meals, and in these centers children may be found eating chips and drinking high-calorie, nutrient-empty beverages. Many programs, but not all, participate in the Child and Adult Care Food Program, which provides nutritious meals to low-income individuals.<sup>135</sup> All programs serving young children should be strongly encouraged to provide healthy nutritious meals to all children. In 2011-2012, 24 state-funded preschool initiatives required programs to offer at least one meal daily.<sup>136</sup> Other programs required only a snack, or required a meal in a full-day program but only a snack in a half-day program. Programs serving economically disadvantaged children in particular should be encouraged to offer at least one nutritious meal.



The Child Nutrition Act, encompasses the National School Lunch Program, the School Breakfast Program, the Summer Food Service Program, and the Child and Adult Care Food Program. Currently, the National School Lunch Program, and the School Breakfast Program are not specifically aimed at preschool-age children. The Healthy, Hunger-Free Child Kids Act of 2010 added incentives as well as requirements for schools to improve the nutritional value of all food served in schools.<sup>137</sup> Thus, it would be beneficial to implement these programs not just in preschool programs in public schools, but also in private programs. The United States Department of Agriculture currently has a program called Healthier US School Challenge that recognizes schools that offer nutritious meals and adequate physical activity. Schools can apply for awards of distinction, which as a result of the Lets Move Campaign, are now accompanied by a monetary reward. While this program is currently only offered in K-12 schools, it should be expanded to include all types of preschool programs and can act as an additional incentive for preschool programs to emphasize healthy meals and physical activity.<sup>138</sup>

Preschoolers can take an active role in planning healthy menus for meals and snacks. Meal planning provides an opportunity for children to discuss which foods they like and think are healthy, and to learn about and taste new healthy foods. Because children often do not like new foods until they have tasted them a few times, new foods should be introduced gradually and should be repeated.<sup>139</sup> In order to reduce costs, menus can also be rotated seasonally and should depend on local produce when possible. Children can also learn how to cook simple, healthy meals. For example, a preschool in New Jersey's Abbott preschool program has a special kitchen designed specifically for the use of young children.

However, providing healthy meals and exercise instruction in preschool is not enough. Parents should be involved and encouraged to extend healthy eating and exercise habits beyond the classroom doors and into

their homes. Preventing obesity requires a lifestyle change for many children and therefore, being healthy only during school hours will not suffice. Parents must learn about healthy meal options and the benefits of active outdoor play over watching television or playing electronic games. Impacting parent behavior is a major challenge. During the Hip Hop to Health intervention, parents often did not take advantage of the parent nutrition and physical activity classes<sup>140</sup> and the Healthy Start program found no significant changes to children's dietary intake outside of school.<sup>141</sup> A more intensive approach may be needed to help effect these lifestyle changes. This may include assistance in accessing affordable healthy foods, guidance on incorporating exercise into the day, and assistance in finding safe places for children to play, which could also be incorporated into parenting interventions. Communities with sidewalks that promote walking as well as safe-playgrounds can help encourage parents and children to get outside and play. Preschool programs might consider making their playgrounds available to their students after school and on the weekend, especially in communities with no other safe outdoor play spaces.

*6. In developing nations and low-income areas, early childhood programs should offer nutrition supplementation to reverse the effects of malnutrition.*

Research in developing nations suggests that providing educational services to young, malnourished children may not be enough to help close the achievement gap. Instead, a combination of nutrition supplementation and educational programs may be more effective to promote optimal development.<sup>142</sup> This strategy may also prove effective in severely impoverished areas in the U.S. and other developed nations where child malnutrition is prevalent. Beyond receiving an adequate caloric intake, children around the world can benefit from nutrition supplementation to address deficits such as protein, calcium, vitamin C, or zinc, based on their specific needs, again in combination with education or development

programs. That is, dietary supplementation should be tailored to meet the specific needs of the community or it will not be effective. Without the proper nutrition, children's brain development and health, and consequently their cognitive development, will suffer and they will not reach their full developmental potential, and likely perpetuate their poverty.<sup>143</sup>

*7. Access to health and nutrition services should be based on the needs of the child and family. Some may need extensive assistance while others may need very limited help.*

Early childhood programs could offer an initial screening to help determine the child's and family's needs and together with the family could plan a course of action. Some children and families may need access to a wide range of health services, including help planning nutritious meals, nutrition supplementation, health insurance, and parenting interventions to reduce abuse and neglect. Other families may need fewer services, for example help finding a doctor if they are new to the community.

*8. Include an emphasis on supporting children's social-emotional development, including self-regulation skills.*

In light of recent evidence of a robust relationship between childhood self-regulation and a variety of health outcomes<sup>144</sup> and that improvement in self-regulation may contribute to long-term impacts of early childhood interventions, early childhood programs and parenting interventions should include a focus on improving early self-regulation skills. A handful of curricula have been found to be effective in improving children's self-regulation abilities: *Tools of the Mind*, Promoting Alternative Thinking Strategies (PATHS), Head Start REDI, and the Chicago School Readiness Project.<sup>145</sup> However, other developmentally appropriate curricula also address this domain. Evaluations of early childhood programs should examine impacts on self-regulation in the short and long term.

*9. More health-related early education research is needed. Health outcomes should be included in evaluations of*

*impacts of early childhood programs as well as benefit-cost analyses.*

Much of the research on early education programs and health occurred many years ago and may not fully reflect the reality of today's early education programs. Most of the programs that have been studied target low-income, at risk preschoolers (with the majority occurring in the United States). However, today more and more young children from all economic backgrounds are in out-of-home care and preschool programs are proliferating around the globe. New studies should be conducted to inform policy and practice regarding cost-effective approaches to producing direct and indirect health effects.

Health has not been a focus of most recent evaluations of preschool programs. One exception is the Head Start Impact Study which did include measures of health. However, these measures were based on parent reports of, for example, whether or not the child has health insurance. It did not include more direct measures or health such as BMI, weight, height, or lead levels. Future research should take a more in depth approach to evaluating children's health as well as impacts on children's health. For example, evaluations could measure the nutritional value of meals served, the amount of children's physical activity, as well as the child's height, weight, and BMI. Children's absence records, an indicator of health, should also be obtained. If funding permits, blood screenings can assess toxins, nutrients, and cholesterol, and spit samples can be used to measure cortisol, an indicator of stress. These aspects of whole-child development may impact not only short- and long-term health but also academic progress and achievement. Including impacts on these more objective, direct indicators of health in benefit-cost analyses may unmask some previously unmeasured cost savings of preschool.

Another problem with the current research and benefit-cost analyses is that even the most long-term have only followed participants through young adulthood or middle age. The evaluation of the Perry Preschool Program has

followed participants through age 40<sup>146</sup> but studies have yet to examine the impacts of preschool on the elderly, which is when effects of chronic diseases are more likely to be manifest.<sup>147</sup> Thus, even the studies that include health may underestimate the health impacts of early education programs. Thus, continuing to follow former preschool participants as they age will enable researchers to better determine the lifelong impacts of preschool education on participant health.

## **Conclusion**

A variety of early childhood programs have been found to positively influence health in the short and long term.<sup>148</sup> The potential economic returns from such health benefits are substantial, but have not always been included in benefit-cost analyses or in policy debates regarding public investments in early childhood development programs.

The direct and indirect pathways depicted in Figures 1, 2, and 3 illustrate the multiple avenues through which early care and education as well as parenting programs can contribute to better health over the life course. The indirect pathways are at least as important as the direct pathways, though those also are important particularly where children's development is compromised by severe malnutrition, poor prenatal conditions, or stress associated with neglect or abuse and poverty. Early childhood policies and programs should be designed with a view toward optimal influence through all pathways given the circumstances of the children and families to be served. The policy recommendations provided above were made in light of this principle, recognizing that the specific features that make programs highly effective will depend on the characteristics of the children and families served and the contexts in which they live.



Figure 1. Direct Effects of Early Childhood Education Programs on Health

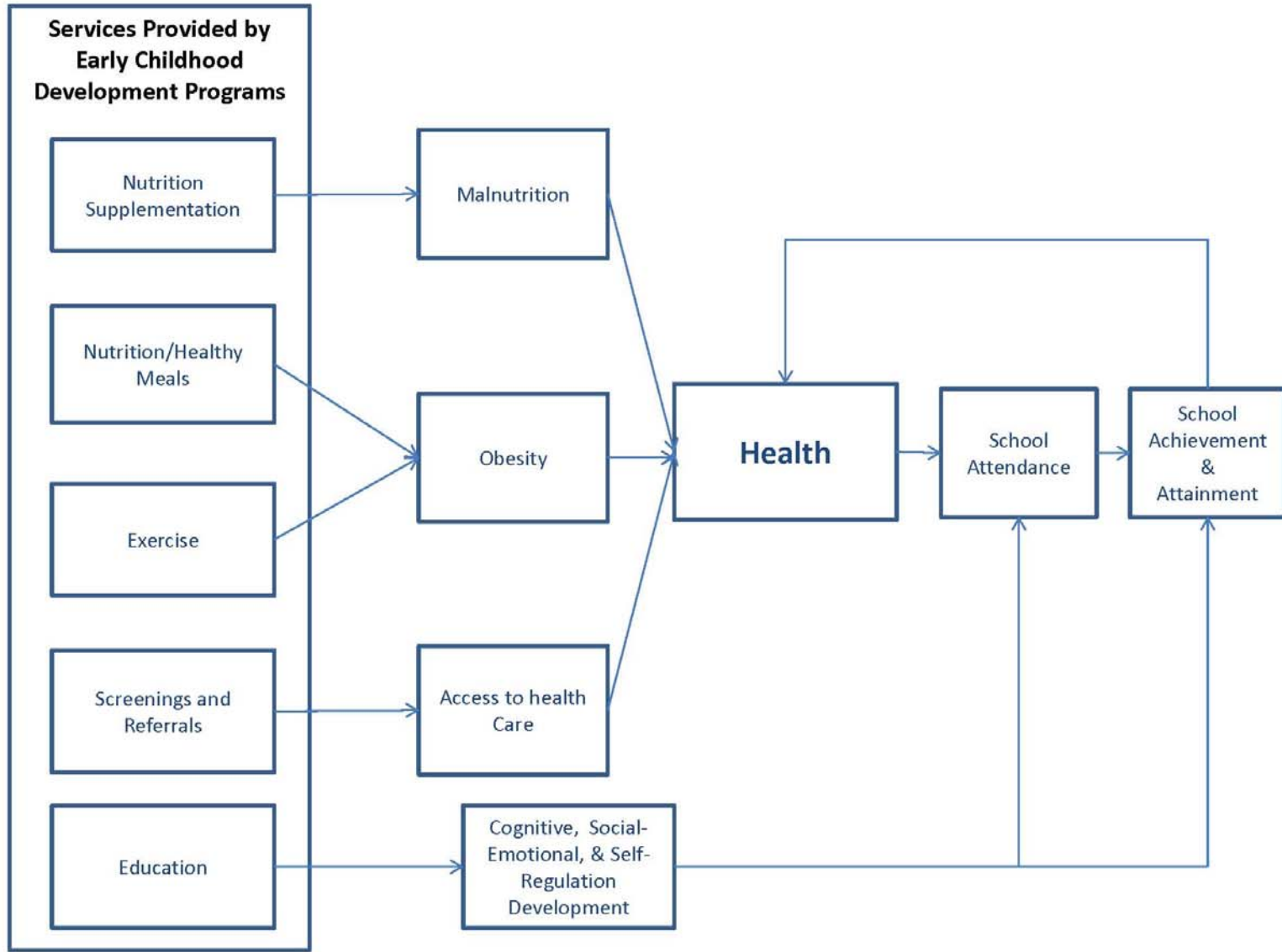


Figure 2. Impacts of Parenting Programs on Children's Health

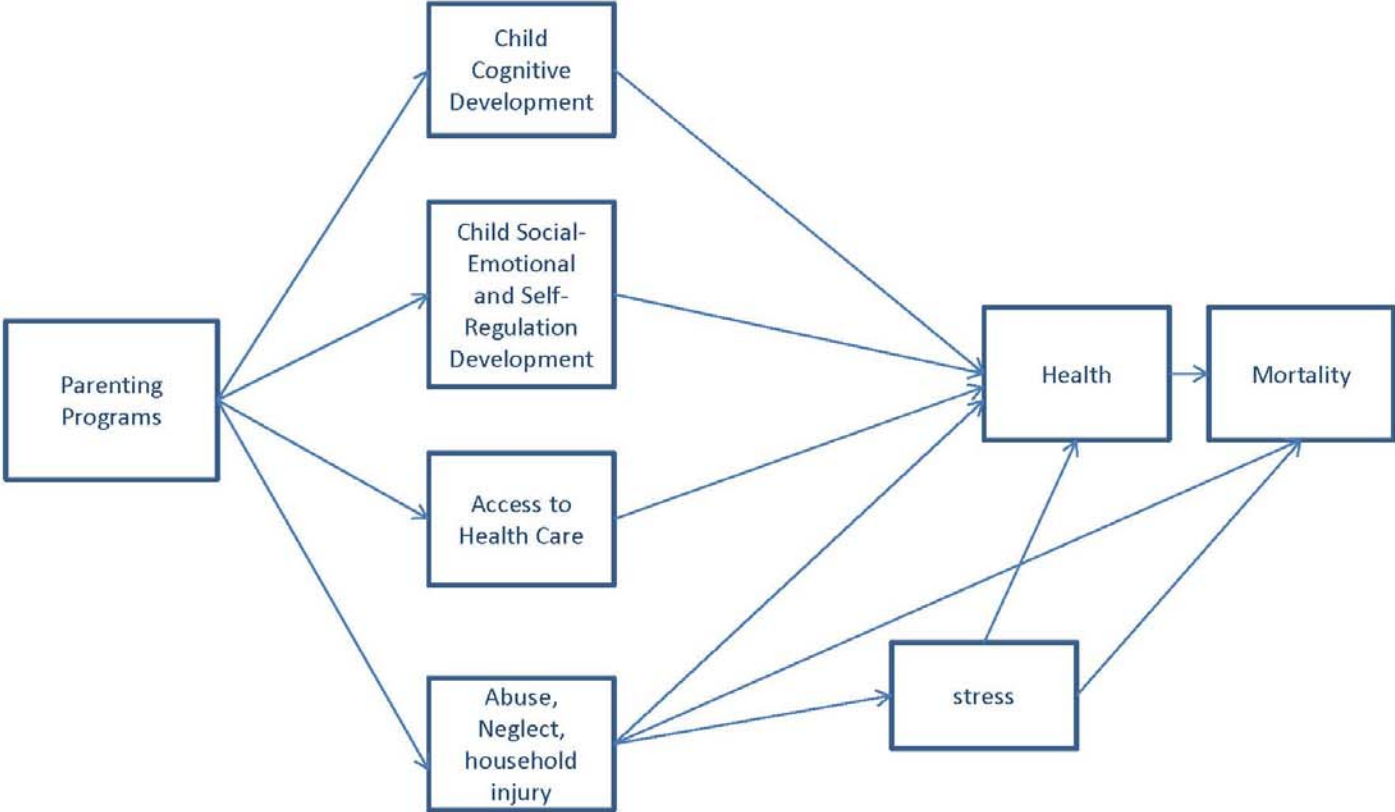
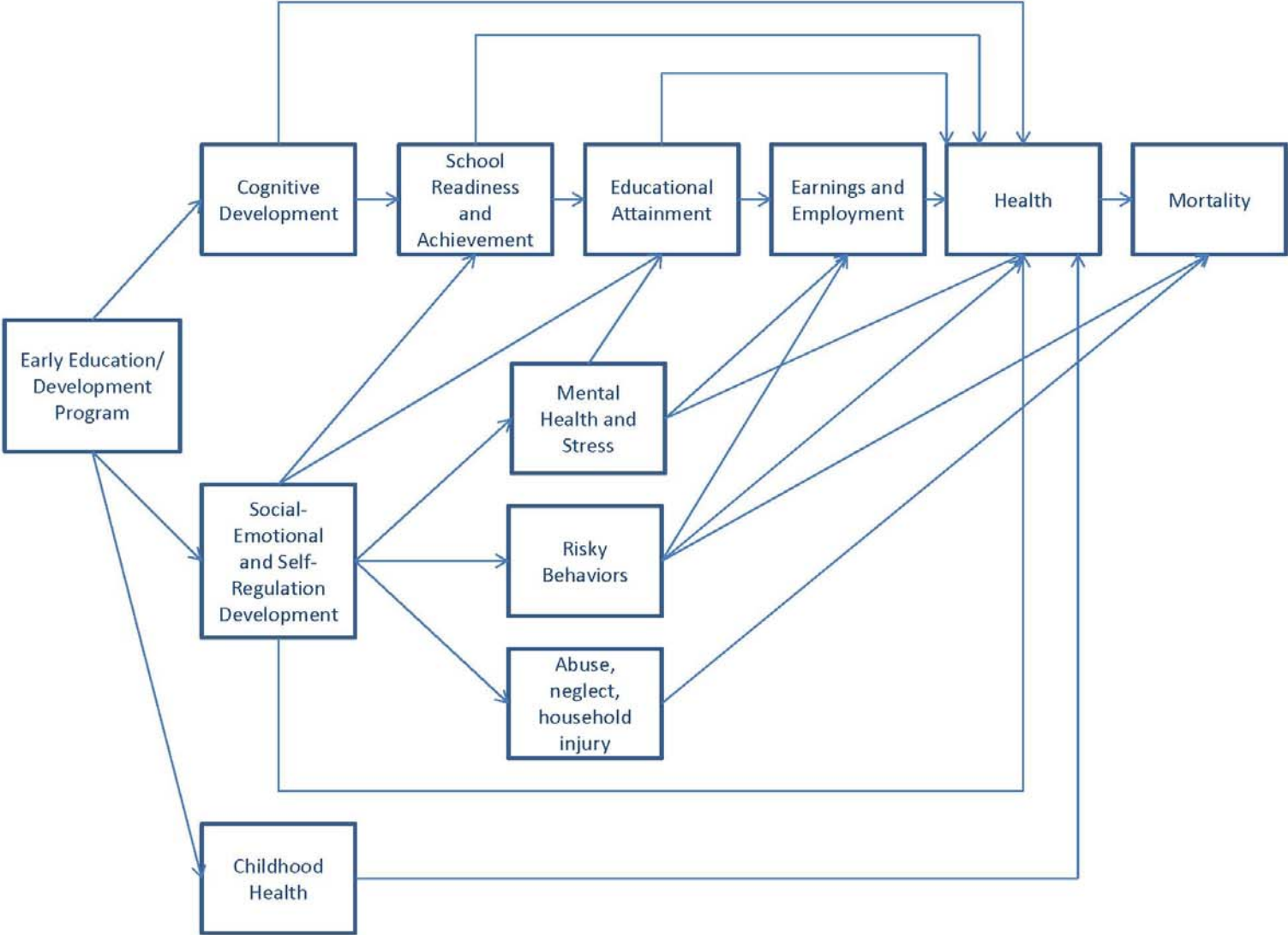


Figure 3. Long-Term Impacts of Early Childhood Education Programs on Health



## Endnotes

- <sup>1</sup> Hale, B.A., Seitz, V., & Zigler, E. (1990). Health services and head start: A forgotten formula. *Journal of Applied Developmental Psychology, 11*, 447-458.
- <sup>2</sup> <http://www.cdc.gov/men/lcod/2009/LCODBBlackmales2009.pdf>.
- <sup>3</sup> <http://www.kaiseredu.org/issue-modules/us-health-care-costs/background-brief.aspx>.
- <sup>4</sup> W. S. Barnett (2011). Four Reasons the United States Should Offer Every Child a Preschool Education. In E.F. Zigler, W.S. Gilliam, & W.S. Barnett (Eds.), *The pre-k debates: Current controversies and issues*. Baltimore: Brookes Publishing.
- <sup>5</sup> U.S. Department of Health and Human Services, Administration for Children and Families (January 2010). Head Start Impact Study. Final Report. Washington, DC.
- <sup>6</sup> Farrell, P. & Fuchs, V.R. (1982). Schooling and health: The cigarette connection. *Journal of Health Economics, 1*, 217-230. Kenkel, D., Lillard, D., & Mathios, A. (2006). The roles of high school completion and GED receipt in smoking and obesity. *Journal of Labor Economics, 24*(3), 635-660.
- <sup>7</sup> Hayman, L.L., & Reineke, P.R. (2003). Preventing coronary heart disease: The implementation of health lifestyle strategies for children and adolescents. *The Journal of Cardiovascular Nursing, 18*(4), 294-301. Stolley, M.R., Fitzgibbon, M.L., Dyer, A., Van Horn, L., KauferChristoffel, K., & Schiffer, L. (2003). Hip-hop to health jr., an obesity prevention program for minority preschool children: Baseline characteristics of participants. *Preventive Medicine, 36*, 320-329.
- <sup>8</sup> Halfon, N., & Hochstein, M. (2002). Life course health development: An integrated framework for developing health, policy, and research. *The Milbank Quarterly, 80*(3), 433-479.
- <sup>9</sup> Hayman & Reineke, 2003.
- <sup>10</sup> [http://nces.ed.gov/programs/digest/d12/tables/dt12\\_053.asp](http://nces.ed.gov/programs/digest/d12/tables/dt12_053.asp).
- <sup>11</sup> [http://nces.ed.gov/programs/digest/d11/tables/dt11\\_056.asp](http://nces.ed.gov/programs/digest/d11/tables/dt11_056.asp).
- <sup>12</sup> [http://nces.ed.gov/programs/digest/d11/tables/dt11\\_057.asp](http://nces.ed.gov/programs/digest/d11/tables/dt11_057.asp).
- <sup>13</sup> Pianta, R. C., Barnett, W. S., Burchinal, M., & Thornburg, K. (2009). The effects of preschool education: What we know, how public policy is or is not aligned with the evidence base, and what we need to know. *Psychological Science in the Public Interest, 10*(2), 49-88.
- <sup>14</sup> International Labor Office. (2012). *Right beginnings: Early childhood education and educators*. Geneva: ILO.
- <sup>15</sup> OECD (2012). *Education at a Glance 2012: OECD Indicators*. Paris: OECD Publishing. <http://dx.doi.org/10.1787/eag-2012-en>. International Labor Office, 2012.
- <sup>16</sup> Bennett, J., & Tayler, C. P. (2006). *Starting strong II: Early childhood education and care*. Paris: OECD. Burger, K. (2010). How does early childhood care and education affect cognitive development? An international review of the effects of early interventions for children from different social backgrounds. *Early Childhood Research Quarterly, 25*, 140-165.
- <sup>17</sup> Britto, P. R., Yoshikawa, H., & Boller, K. (2011). Quality of Early Childhood Development Programs in Global Contexts. *Social Policy Report, 25*(2). Walker, S.P., Wachs, T.D., Grantham-McGregor, S., Black, M.M., Nelson, C.A., Huffman, S.L., ... Richter, L. (2011). Inequality in early childhood: risk and protective factors for early child development. *The Lancet, 378*(9799), 1325-1338.
- <sup>18</sup> Alkire, S. (2002). Dimensions of human development. *World Development, 30*(2), 181-205. Alkire, S. (2005). Why the capability approach? *Journal of Human Development, 6*(1), 114-130. Alkire, S., & Chen, L. (2004). Global health and moral values. *The Lancet, 364*(9439), 1069-1074.
- <sup>19</sup> Dalton, S. (2004). *Our overweight children: What parents, schools, and communities can do to control the fatness epidemic*. Berkley: University of California Press.
- <sup>20</sup> Center for Disease Control (2007). *Overweight and obesity*. Retrieved March 19, 2007 from <http://www.cdc.gov/nccdphp/dnpa/obesity/>.

- 21 World Health Organization (May 2012). *Obesity and overweight*. <http://www.who.int/mediacentre/factsheets/fs311/en/index.html>
- 22 [http://apps.who.int/gb/archive/pdf\\_files/WHA55/ea5514.pdf](http://apps.who.int/gb/archive/pdf_files/WHA55/ea5514.pdf).
- 23 Omer, S.B., Salmon, D. A., Orenstein, W. A., deHart, P, M., & Halsey, N. (2009). Vaccine refusal, mandatory immunization, and the risks of vaccine-preventable disease. *The New England Journal of Medicine*, 360, 1981-1988.
- 24 Bloom, B., & Cohen, R.A. (2007). Summary Health Statistics for U.S. Children: National Health Interview Survey, 2006. National Center for Health Statistics. *Vital Health Statistics 10(234)*. Bloom, B., Dey, A.N., & Freeman, G. (2006). Summary Health Statistics for U.S. Children: National Health Interview Survey, 2005. National Center for Health Statistics. *Vital Health Statistics, 10(231)*.
- 25 Muggah, R. (2012). Researching the urban dilemma: Urbanization, poverty, and violence. International Development Research Center. Access online: [http://www.idrc.ca/EN/Programs/Social\\_and\\_Economic\\_Policy/Governance\\_Security\\_and\\_Justice/Documents/Researching-the-Urban-Dilemma-Baseline-study.pdf](http://www.idrc.ca/EN/Programs/Social_and_Economic_Policy/Governance_Security_and_Justice/Documents/Researching-the-Urban-Dilemma-Baseline-study.pdf).
- 26 Alexander, R., Baca, L., Fox, J.A, Frantz, M., Glanz, S., Huffman, L.D., ... Christeson, W. (2003). *New hope for preventing child abuse and neglect: Proven solutions to save lives and prevent future crimes*. Fight Crime: Invest in Kids. Retrieved from website March 3, 2013 from <http://www.fightcrime.org/wpcontent/uploads/sites/default/files/reports/Nat%20CAN%20Report%202003.pdf>.
- 27 de Walque, D. (2011). Conflicts, epidemics and orphanhood: The impact of extreme events on the health and educational achievements of children. In H. Alderman (Ed.). *No Small Matter: The Impact of Poverty, Shocks, and Human Capital Investments in Early Childhood Development*. The World Bank: Washington, D.C.
- 28 Muggah, 2012.
- 29 McCoy, D.C., Raver, C.C., & Sharkey, P. (under review). Child information processing and selective attention following exposure to chronic and acute neighborhood violence.
- 30 McCloskey, L.A., Figueredo, A.J., & Koss, M. P. (1995). The effects of systemic family violence on children's mental health. *Child Development*, 66(5), 1239-1261. Moylan, C. A., Herrenkohl, T.I., Sousa, C., Tajima, E.A., Herrenkohl, R.C., & Russo, M.J. (2010). The effects of child abuse and exposure to domestic violence on adolescent internalizing and externalizing behavior problems. *Journal of Family Violence*, 25(1), 53-63.
- 31 Stewart, F. (2003). Conflict and the millennium development goals. *Journal of Human Development*, 4(3), 325-351. Bellamy, C. (2004). *State of the world's children 2005: Childhood under threat*. New York: Unicef. Accessed online: [http://www.unicef.org/publications/files/SOWC\\_2005\\_\(English\).pdf](http://www.unicef.org/publications/files/SOWC_2005_(English).pdf). de Walque, 2011.
- 32 de Walque, 2011.
- 33 de Walque, 2011.
- 34 Blair, C., & Raver, C. C. (2012). Child development in the context of adversity: Experiential canalization of brain and behavior. *American Psychologist*, 67(4), 309-318.
- 35 Blair, C., Raver, C.C., Granger, D., Mills-Koonce, R., Hibel, L., and The Family Life Project Key Investigators. (2011). Allostatic and allostatic load in the context of poverty in early childhood. *Development and Psychopathology*, 23, 845-857. Hertzman, C., & Boyce, T. (2010). How experience gets under the skin to create gradients in developmental health. *Annual Review of Public Health*, 31, 329-347. Shonkoff, J.P., Boyce, W.T., & McEwen, B.S. (2009). Neuroscience, molecular biology, and the childhood roots of health disparities: Building a new framework for health promotion and disease prevention. *Journal of the American Medical Association*, 301(21), 2252-2259.
- 36 Shonkoff, Boyce & McEwen, 2009.
- 37 Dawson, G., Ashman, S.B., & Carver, L.J. (2000). The role of early experiences in shaping behavioral and brain development and its implications for social policy. *Development and Psychopathology*, 12(4), 695-712. Gunnar, M.R., Frenn, K., Wewerka, S.S., Van Ryzin, M.J. (2009). Moderate versus severe early life stress: Associations with stress reactivity and regulation in 10-12



- year-old children. *Psychoneuroendocrinology*, 34, 62-75. Thompson, R.A., & Nelson, C.A. (2001). Developmental science and the media. *American psychologist*, 56(1), 5-15.
- <sup>38</sup> American Academy of Pediatrics Policy Statement (2005). Quality early education and child care from birth to kindergarten. *Pediatrics*, 115(1), 187-191, p. 187.
- <sup>39</sup> Spernak, S.M., Schottenbauer, M.A., Ramey, S.L., & Ramey, C.T. (2006). Child health and academic achievement among former head start children. *Children and Youth Services Review*, 28, 1251-1261.
- <sup>40</sup> Anderson, L.M., Shinn, C., Fullilove, M.T., Scrimshaw, S., Fielding, J.E., Normand, J., Carande-Kulis, V.G., et al. (2003). The effectiveness of early childhood development programs: A systematic review. *American Journal of Preventive Medicine*, 24 (3S), 32-46. Abbott-Shim, M., Lambert, R., & McCarty, F. (2003). A comparison of school readiness outcomes for children randomly assigned to a Head Start program and the program' wait list. *Journal of Education for Students Placed at Risk*, 8(2), 191-214. Hale, Seitz & Zigler, 1990. Ross, C.E., & Wu, C. (1995). The links between education and health. *American Sociological Review*, 60(5), 719-745. Ross, C.E., & Wu, C. (1996). Education, age, and the cumulative advantage in health. *Journal of Health and Social Behavior*, 37(1), 104-120. Strauss, J., & Thomas, D. (1998). Health, nutrition, and economic development. *Journal of Economic Literature*, 36, 766-817.
- <sup>41</sup> Ball, T.M., Castro-Rodriguez, J.A., Griffith, K.A., Holberg, C.J., Martinez, F.D., & Wright, A.L. (2000). Siblings, day-care attendance, and the risk of asthma and wheezing during childhood. *The New England Journal of Medicine*, 343, 538-543. Celedón, J.C., Wright, R.J., Litonjua, A.A., Sredl, D., Ryan, L., Weiss, S.T., Gold, D.R. (2003). Day care attendance in early life, maternal history of asthma, and asthma at the age of 6 years. *American Journal of Respiratory Critical Care Medicine*, 167, 1239-1243. Haby, M.M., Marks, G.B., Peat, J.K., & Leeder, S.R. (2000). Daycare attendance before the age of two protects against atopy in preschool age children. *Pediatric Pulmonology*, 30, 377-384. Hagerhed-Engman, L., Bornehag, C.G., Sundell, J., & Aberg, N. (2006). Day-care attendance and increase risk for respiratory and allergic symptoms in preschool age. *Allergy*, 61, 447-453. Infante-Rivard, C., Amre, D., Gautrin, D., & Malo, J.L. (2001). Family size, day-care attendance, and breastfeeding in relation to the incidence of childhood asthma. *American Journal of Epidemiology*, 153(7), 653-658. Krämer, U., Heinrich, J., Wjst, M., & Wichman, H.E. (1999). Age of entry to day nursery and allergy in later childhood. *The Lancet*, 353, 450-454. Nafstad, P., Brunekreef, B., Skrandal, A., & Nystad, W. (2005). Early respiratory infections, asthma and allergy: 10-year follow-up of the Oslo birth cohort. *Pediatrics*, 116(2), e255-e262.
- <sup>42</sup> Ackerman, S.J., Duff, S.B., Dennehy, P.H., Mafilios, M.S., & Krilov, L.R. (2001). Economic impact of an infection control education program in a specialized preschool setting. *Pediatrics*, 108(6). Kotch, J.B., Weigle, K.A., Weber, D.J., Clifford, R.M., Harms, T.O., Loda, F.A., ... Faircloth, A.H. (1994). Evaluation of a hygienic intervention in child day-care centers. *Pediatrics*, 94, 991-994.
- <sup>43</sup> Hale, Seitz & Zigler, 1990.
- <sup>44</sup> U.S. Department of Health and Human Services, Administration for Children and Families, January 2010.
- <sup>45</sup> Currie, J. & Thomas, D. (1995). Does Head Start make a difference? *The American Economic Review*, 85(3), 341-364.
- <sup>46</sup> Love, J.M., Kisker, E.E., Ross, C., Raikes, H., Constantine, J., Boller, K. et al., (2005). The effectiveness of early head start for 3-year-old children and their parents: Lessons for policy and programs. *Developmental Psychology*, 41(6), 885-901.
- <sup>47</sup> Kroop, N., Kotch, J., Harris, S., & the UNC-FPG Smart Start Evaluation Team. *The Effect of Smart Start Health Interventions on Children's Health and Access to Care*. The University of North Carolina at Chapel Hill, 2001.
- <sup>48</sup> Casey, P.H., Bradley, R.H., Whiteside-Mansell, L., Barrett, K., Gossett, J.M., & Simpson, P.M. (2009). Effect of early intervention on 8-year growth status of low-birth-weight preterm infants. *Archives of Pediatrics and Adolescent Medicine*, 163(11), 1046-1053.
- <sup>49</sup> D'Onise, K., Lynch, J.W., Sawyer, M.G., McDermott, R.A. (2010). Can preschool improve child health outcomes? A systematic review. *Social Science & Medicine*, 70(9), 1423-40.
- <sup>50</sup> Belfield, C.R., Kelly, I.R. (in press). Early education and health outcomes of a 2001 U.S. Birth Cohort. *Economics & Human Biology*. <http://dx.doi.org/10.1016/j.ehb.2012.05.001>.

- 51 Williams, C.L., Squillance, M.M., Bollella, M.C., Brotanek, J., Campanaro, L., D'Agostino, C., et al. (1998). Healthy Start: A comprehensive health education program for preschool children. *Preventive Medicine*, 27, 216-223. P 216. Williams, C.L., Strobino, B.A., Bollella, M. & Brotanek, J. (2004). Cardiovascular risk reduction in preschool children: The "Healthy Start" project. *Journal of the American College of Nutrition*, 23(2), 117-123. Hayman & Reineke 2003. Williams, C.L., Bollella, M.C., Strobino, B.A., Spark, A., Nicklas, T.A., Tolosi, L.B., & Pittman, B.P. (2002). "Healthy-Start": Outcome of an intervention to promote a heart healthy diet in preschool children. *Journal of the American College of Nutrition*, 21(1), 62-71.
- 52 Fitzgibbon, M.L., Stolley, M.R., Dyer, A.R., VanHorn, L., & KauferChristoffel, K. (2002). A community-based obesity prevention program for minority children: Rationale and study design for hip-hop to health Jr. *Preventive Medicine*, 34, 289-297. Fitzgibbon, M.L., Stolley, M.R., Schiffer, L., Van Horn, L., KauferChristoffel, K., & Dyer, A. (2005). Two-year follow-up results for hip-hop to health jr: A randomized controlled trial for overweight prevention in preschool minority children. *The Journal of Pediatrics*, 146, 618-625. Stolley, Fitzgibbon, Dyer, Van Horn, KauferChristoffel & Schiffer, 2003.
- 53 Williams, Squillance, Bollella, Brotanek, Campanaro, D'Agostino, et al., 1998. Williams, Strobino, Bollella & Brotanek, 2004. Hayman & Reineke, 2003. Williams, Bollella, Strobino, Spark, Nicklas, Tolosi & Pittman, 2002.
- 54 Barnett, W.S., & Brown, K.C. (2000). *Dental health policy analysis series: Issues in children's access to dental care under Medicaid*. American Dental Association: Chicago.
- 55 Abbott-Shim, Lambert & McCarty, 2003. Hale, Seitz & Zigler, 1990.
- 56 Barnett & Brown, 2000.
- 57 Barnett, W.S., Tarr, J., & Frede, E. (1999). *Early childhood education needs in low-income communities*. New Brunswick, NJ: Center for Early Education at Rutgers.
- 58 Tang, J.M.W., Altman, D.S., Robertson, D.C., O'Sullivan, D.M., Douglas, J.M., & Tinanoff, N. (1997). Dental caries prevalence and treatment levels in Arizona preschool children. *Public Health Reports*, 112, 319-329.
- 59 U.S. Department of Health and Human Services, Administration for Children and Families, January 2010.
- 60 Alexander, Baca, Fox, Frantz, Glanz, Huffman, et al., 2003. Gomby, D.S., Culross, P.L., & Behrman, R.E. (1999). Home visiting: Recent program evaluations – analysis and recommendations. *The Future of Children*, 9(1), 4-26.
- 61 Alexander, Baca, Fox, Frantz, Glanz, Huffman, et al., 2003.
- 62 Olds, D.L., Henderson, C.R., Kitzman, H.J., Eckenrode, J.J., Cole, R.E., & Tatelbaum, R.C. (1999). Prenatal and infancy home visitation by nurses: Recent findings. *The Future of Children*, 9(1), 44-65.
- 63 Olds, D., Eckenrode, J., Henderson, C.R., Kitzman, H., Powers, J., Cole, R. et al. (1997). Long-term effects of home visitation on maternal life course and child abuse and neglect: Fifteen-year follow-up of a randomized trial. *Journal of the American Medical Association*, 278(8), 637-643.
- 64 Howard, K.S., & Brooks-Gunn, J. (2009). The role of home-visiting programs in preventing child abuse and neglect. *The Future of Children*, 19(2), 119-146.
- 65 Daro, D.A., & Harding, K.A. (1999). Health families America: Using research to enhance practice. *The Future of Children*, 9 (1), 152-176. Howard & Brooks-Gunn, 2009.
- 66 Reynolds, A.J., & Robertson, D.L. (2003). School-based early intervention and later child maltreatment in the Chicago longitudinal study. *Child Development*, 74(1), 3-26.
- 67 Reynolds, A.J., Temple, J.A., Ou, S.R., Robertson, D.L., Mersky, J.P., Topitzes, J.W., & Niles, M.D. (2006). *Effects of a school-based, early childhood intervention on adult health and well being: A 20-year follow up of low-income families*. Early Childhood Research Collaborative Paper Series.
- 68 Reynolds, A.J., Temple, J.A., Robertson, D.L., & Mann, E.A. (2001). 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. *Journal of the American Medical Association*, 285(18), 2339-2346.
- 69 Love, Kisker, Ross, Raikes, Constantine, Boller, et al., 2005.

- 70 Bradley, R.H., Whiteside, L., Mundfrom, D.J., Casey, P.H., Caldwell, B.M., & Barrett, K. (1994). Impact of the infant health and development program (IHDP) on the Home Environments of infants born prematurely and with low birthweight. *Journal of Educational Psychology*, 86(4), 531-541. The Infant Health and Development Program. (1990). Enhancing the outcomes of low-birth-weight, premature infants: A multisite, randomized trial. *Journal of the American Medical Association*, 263, 3035–3042.
- 71 [http://www.acf.hhs.gov/sites/default/files/opre/early\\_head\\_start\\_university\\_partnership\\_grants\\_buffering\\_children.pdf](http://www.acf.hhs.gov/sites/default/files/opre/early_head_start_university_partnership_grants_buffering_children.pdf).
- 72 Nores, M. & Barnett, W.S., (2010). Benefits of early childhood interventions across the world: (Under) Investing in the very young. *Economics of Education Review* 29, 271 – 282.
- 73 Fernald, L.C.H., Gertler, P.J., & Neufeld, L.M. (2008). Role of cash in conditional cash transfer programmes for child health, growth, and development: an analysis of Mexico’s *Oportunidades*. *The Lancet*, 371, 828-837.
- 74 Behrman, J.R., & Hoddinott, J. (2005). Programme evaluation with unobserved heterogeneity and selective implementation: The Mexican PROGRESA impact on child nutrition. *Oxford Bulletin of Economics and Statistics*, 67(4), 547-569. Buddelmeyer, H., & Skoufias, E. (2003). *An Evaluation of the Performance of Regression Discontinuity Design on PROGRESA*. Discussion Paper, Bonn, Germany: The Institute for the Study of Labor. Fernald, Gertler & Neufeld, 2008. Huerta, M. (2006). Child health in rural Mexico: Has PROGRESA reduced children’s morbidity risks? *Social Policy and Administration*, 40(6), 652-677. Rivera, J.A., Sotres-Alvarez, D., Habicht, J.P., Shamah, T., & Villalpando, S. (2004). Impact of the Mexican program for education, health, and nutrition (PROGRESA) on rates of growth and anemia in infants and young children. *Journal of the American Medical Association*, 291(21), 2563-2570.
- 75 Perez-Escamilla, R. & Pollitt, E. (1995). Growth improvements in children above 3 years of age: The Cali study. *Journal of Nutrition*, 125, 885-893.
- 76 Gardner, J.M., Powell, C.A., Baker-Henningham, H., Walker, S.P., Cole, T.J., & Grantham-McGregor, S.M. (2005). Zinc supplementation and psychosocial stimulation: effects on the development of undernourished Jamaican children. *The American Journal of Clinical Nutrition*, 82, 399-405.
- 77 Watanabe, K., Flores, R., Fujiwara, J., & Tran, L.T.H. (2005). Early childhood development interventions and cognitive development of young children in rural Vietnam. *The Journal of Nutrition*, 135, 1918-1925.
- 78 Campbell, F.A., Ramey, C.T., Pungello, E., Sparling, J., & Miller-Johnson, S. (2002). Early education: Young adult outcomes from the Abecedarian project. *Applied Developmental Science*, 6(1), 42-57. Cutler, D.M., & Lleras-Muney, A. (2006). *Education and health: Evaluating theories and evidence*. Working Paper. Cambridge, MA: National Bureau of Economic Research. Goldman, D., & Lakdawalla, D. (2001). *Understanding health disparities across education groups*. Working Paper 8328. Cambridge, MA: National Bureau of Economic Research. Kenkel, Lillard & Mathios, 2006. Reynolds, Temple, Ou, Robertson, Mersky, Topitzes & Niles, 2006. Schweinhart, L.J., Montie, J., Xiang, Z., Barnett, W.S., Belfield, C.R., & Nores, M. (2005). Lifetime Effects: The High/Scope Perry Preschool Study Through Age 40. Monographs of the High/Scope Educational Research Foundation Number One. Michigan: High/Scope Press.
- 79 Campbell, Ramey, Pungello, Sparling & Miller-Johnson, 2002.
- 80 Barnett, W.S.(1993). Benefit-cost analysis of preschool education: Findings from a 25-year-follow-up. *American Journal of Orthopsychiatry*, 63(4), 500-508. Barnett, W.S., & Masse, L.N. (2007). Comparative benefit-cost analysis of the Abecedarian program and its policy implications. *Economics of Education Review*. 26, 113-125. Reynolds, A.J., Temple, J.A., White, B.A.B., Ou, S.R., & Robertson, D.L. (2011). Age 26 cost-benefit analysis of the Child-Parent Center Early Education Program. *Child Development*, 82(1), 379-404. Schweinhart, L.L, Barnes, H.V., Weikart, D.P., Barnett, W.S., & Epstein, A.S. (1993). Significant benefits: The High/Scope Perry Preschool Study through Age 27. (Monographs of the High/Scope Educational Research Foundation, 10). Ypsilanti, MI: High/Scope Press.
- 81 Cutler & Lleras-Muney, 2006. Cutler, M.D., & Lleras-Muney, A. (2012). Education and health: Insights from international comparisons. NBER Working Paper. Cambridge, MA. Cutler, D.M., Meara, E.R., & Richards, S. (2008). The gap gets bigger: Changes in mortality and life expectancy by education, 1981-2000. *Health Affairs*, 27(2), 350-360. Kenkel, D.S. (1991). Health behavior, health knowledge, and school. *Journal of Political Economy*, 99(2), 287-305. Lleras-Muney, A. (2005). The relationship between education and adult mortality in the United States. *Review of Economic Studies*, 72, 189-221.

- 82 Schultz, T.W. (1961). Investment in Human Capital. *The American Economic Review*, 51(1), 1-17. Weisbrod, B.A. (1962). Education and investment in human capital. *Journal of Political Economy*, 70(5), 106-123.
- 83 Strauss & Thomas, 1998.
- 84 Abbott-Shim, Lambert & McCarty, 2003. Barnett & Brown, 2000. Hale, Seitz & Zigler, 1990.
- 85 Mossberg, H.O. (1989). 40-year follow-up of overweight children. *The Lancet*, 2, 491-493. Nieto, F.J., Szklo, M., & Comstock, G.W. (1992). Childhood weight and growth rate as predictors of adult mortality. *American Journal of Epidemiology*, 136(2), 201-213.
- 86 Campbell, Ramey, Pungello, Sparling & Miller-Johnson, 2002. Reynolds, Temple, Ou, Robertson, Mersky, Topitzes & Niles, 2006. Strauss & Thomas, 1998.
- 87 Campbell, F.A., Pungello, E.P., Miller-Johnson, S., Burchinal, M., & Ramey, C.T. (2001). The development of cognitive and academic abilities: Growth curves from an early childhood educational experiment. *Developmental Psychology*, 37(2), 231-242. Frede, E., Jung, K., Barnett, W. S., & Lamy, C. E., & Figueras, A. (2007). *The Abbott preschool program longitudinal effects study*. New Brunswick, NJ: National Institute for Early Education Research, Rutgers University. Accessed Online: <http://nieer.org/resources/research/APPLES.pdf>. Gormley, W.T., Gayer, T., Phillips, D., & Dawson, B. (2005). The effects of universal pre-K on Cognitive Development. *Developmental Psychology*, 41(6), 872-884. Hustedt, J.T., Barnett, W.S., Jung, K., & Friedman, A.H. (2010). *The New Mexico PreK evaluation: Impacts from the fourth year (2008-2009) of New Mexico's state-funded preK program*. New Brunswick, NJ: National Institute for Early Education Research, Rutgers University. Magnuson, K. A., & Waldfogel, J. (2005). Early childhood care and education: Effects on ethnic and racial gaps in school readiness. *Future of Children*, 15(1), 169-196. Nores & Barnett, 2010. Schweinhart, L. J., & Weikart, D. P. (1981). Effects of the Perry Preschool Program on youths through age 15. *Journal of the Division for Early Childhood*. Reston, VA: Council for Exceptional Children.
- 88 Cutler & Lleras-Muney, 2006.
- 89 Anderson, K., Foster, J., & Frisvold, D. (2008). *Investing in health: The long-term impact of Head Start*. Accessed online: [http://www.aeaweb.org/assa/2005/0107\\_0800\\_1205.pdf](http://www.aeaweb.org/assa/2005/0107_0800_1205.pdf). Chevalier, A., & Feinstein, L., (2006). *Sheepskin or Prozac: The Causal Effect of Education on Mental Health*. London, England: Centre for the Economics of Education. de Walque, D. (2004). *Education, information, and smoking decisions: Evidence from smoking histories, 1940-2000*. World Bank Policy Research Working Paper 3362. Kenkel, 1991.
- 90 Goldman & Lakdawalla, 2001.
- 91 de Walque, 2004. Kenkel, 1991.
- 92 Cutler & Lleras-Muney, 2006. Evans, W.N., & Montgomery, E. (1994). *Education and health: Where there's smoke there's an instrument*. Working Paper. Cambridge, MA: National Bureau of Economic Research. Goldman & Lakdawalla, 2001. Rosen, L., Manor, O., Engelhard, D., Brody, D., Rosen, B, Peleg, H., ... Zucker, D. (2006). Can a handwashing intervention make a difference? Results from a randomized controlled trial in Jerusalem preschools. *Preventive Medicine*, 42, 27-32.
- 93 Blair, C., Berry, D.J., Friedman, A.H. (2012). The development of self-regulation in infancy and early childhood: An organizing framework for the design and evaluation of early care and education programs for children in poverty. In S.L. Odom, E. Pungello, N. Gardner-Neblett (Eds.), *Re-visioning the beginning: The implications of developmental and health science for infant/toddler care and poverty*. Guilford Press.
- 94 Love, Kisker, Ross, Raikes, Constantine, Boller, et al., 2005.
- 95 U.S. Department of Health and Human Services, Administration for Children and Families (June 2005). *Head Start Impact Study: First Year Findings*. Washington, DC.
- 96 Nores & Barnett, 2010.
- 97 McCartney, K., Burchinal, M., Clarke-Stewart, A., Bub, K. L., Owen, M. T., Belsky, J., & the NICHD Early Child Care Research Network. (2010). Testing a series of causal propositions relating time in child care to children's externalizing behavior. *Developmental Psychology*, 46(1), 1-17.

- 98 Diamond, A., Barnett, W.S., Thomas, J., & Munro, S. (2007). Preschool program improves cognitive control, *Science*, 318, 1387-1388.
- 99 Raver, C. C., Jones, S. M., Li-Grining, C. P., Zhai, F., Metzger, M. W., & Solomon, B. (2009). Targeting children's behavior problems in preschool classrooms: A cluster-randomized controlled trial. *Journal of Consulting and Clinical Psychology*, 77, 302-316.
- 100 Raver, C. C. , Jones, S. M., Li-Grining, C. P., Zhai, F., Bub, K., & Pressler, E. (2011). CSRP's impact on low-income preschoolers' pre-academic skills: Self-regulation and teacher-student relationships as two mediating mechanisms. *Child Development*, 82(1), 362–378.
- 101 Moffitt, T.E., Arseneault, L, Belsky, D., Dickson, N., Hancox, R.J., Harrington, H., ... Caspi, A. (2011). A gradient of childhood self-control predicts health, wealth, and public safety. *Proceedings of the National Academy of Sciences, USA*, 108, 2693-2698.
- 102 de Walque, 2004. Kenkel, 1991.
- 103 Reynolds, Temple, Ou, Robertson, Mersky, Topitzes & Niles, 2006. Topitzes, J., Godes, O., Mersky, J.P., Ceglarek, S., & Reynolds, A.J. (2009). Educational success and adult health: Findings from the Chicago Longitudinal Study. *Prevention Science*, 10, 175-195.
- 104 Schweinhart, Montie, Xiang, Barnett, Belfield & Nore, 2005.
- 105 de Walque, 2004. Kenkel, Lillard & Mathios, 2006. Sander, W. (1995). Schooling and quitting smoking. *The Review of Economics and Statistics*, 77(1), 191-199.
- 106 Anderson, Foster, & Frisvold, 2008.
- 107 Reynolds, A.J., Temple, J.A., Ou, S.R., Robertson, D.L., Mersky, J.P., Topitzes, J.W., & Niles, M.D. (2007). 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 and Adolescent Medicine*, 161(8), 730-739.
- 108 Schweinhart, Montie, Xiang, Barnett, Belfield & Nore, 2005.
- 109 Campbell, Ramey, Pungello, Sparling & Miller-Johnson, 2002.
- 110 Cutler & Lleras-Muney, 2006.
- 111 Schultz, 1961. Weisbrod, 1962.
- 112 Schweinhart, Montie, Xiang, Barnett, Belfield & Nore, 2005.
- 113 Campbell, Ramey, Pungello, Sparling & Miller-Johnson, 2002.
- 114 McLaughlin, A.E., Campbell, F.A., Pungello, E.P., & Skinner, M. (2007). Depressive symptoms in young adults: The influence of the early home environment and early educational child care. *Child Development*, 78(3), 746-756.
- 115 Reynolds, Temple, Ou, Robertson, Mersky, Topitzes & Niles, 2006.
- 116 Topitzes, Godes, Mersky, Ceglarek & Reynolds, 2009.
- 117 Raine, A., Mellinger, K., Liu, J., Venables, P., Mednick, S.A. (2003). Effects of environmental enrichment at ages 3-5 years on schizotypal personality and antisocial behavior at ages 17 and 23 years. *American Journal of Psychiatry*, 160, 1627-1635.
- 118 Hertzman, C. & Wiens, M. (1996). Child development and long-term outcomes: A population health perspective and summary of successful interventions. *Social Science and Medicine*, 43(7), 1083-1095.
- 119 Knudsen, E.I., Heckman, J.J., Camern, J.L., & Shonkoff, J.P. (2006). Economic, neurobiological, and behavioral perspectives on building America's future workforce. *Proceedings of the National Academy of Sciences*, 103(27), 10155-10162.
- 120 Hertzman & Wiens, 1996.
- 121 Knudsen, Heckman, Camern & Shonkoff, 2006.

- 122 Woolf, S.H., Husten, C.G., Lewin, L.S., Marks, J.S., Fielding, J.E., & Sanchez, E.J. (2009). *The economic argument for disease prevention: Distinguishing between value and savings*. Partnership for Prevention. Accessed online: <http://www.prevent.org/data/files/initiatives/economicargumentfordiseaseprevention.pdf>.
- 123 [http://nces.ed.gov/programs/digest/d11/tables/dt11\\_056.asp](http://nces.ed.gov/programs/digest/d11/tables/dt11_056.asp).
- [http://nces.ed.gov/programs/digest/d11/tables/dt11\\_057.asp](http://nces.ed.gov/programs/digest/d11/tables/dt11_057.asp).
- 124 Barnett, W.S., Carolan, M.E., Fitzgerald, J., & Squires, J.H. (2012). *The state of preschool 2012: State preschool yearbook*. New Brunswick, NJ: National Institute for Early Education Research, Rutgers University.
- 125 Daro, D. & Dodge, K. (2010). Strengthening home-visiting intervention policy: expanding reach, building knowledge. In R. Haskins and W.S. Barnett (Eds.). *Investing in young children: New directions in federal preschool and early childhood policy* (79-88). Washington, DC: Brookings Institution.
- 126 Bright Futures and American Academy of Pediatrics (2010). *Recommendations for Preventive Pediatric Health Care*. Accessed 9 August 2010 from <http://brightfutures.aap.org/pdfs/AAP%20Bright%20Futures%20Periodicity%20Scheduled%20101107.pdf>.
- 127 Barnett, Carolan, Fitzgerald & Squires, 2012.
- 128 <http://www.childrensdefense.org/policy-priorities/childrens-health/uninsured-children/uninsured-childrenstate.html>.
- 129 Belfield, C.R., Kelly, I.R., Early education and health outcomes of a 2001 U.S. Birth Cohort. *Econ. Hum. Biol.* (in press), <http://dx.doi.org/10.1016/j.ehb.2012.05.001>.
- 130 International Labor Office. 2012.
- 131 Engle, P.L, Fernald, L.C.H., Alderman, H., Behrman, J., O’Gara, C., Yousafzai, A., ... the Global Development Steering group. (2011). Strategies for reducing inequalities and improving developmental outcomes for young children in low-income and middle-income countries. *The Lancet*, 37, 1339-1353.
- 132 Dalton, 2004.
- 133 Barnett, W.S., Carolan, M.E., Fitzgerald, J., & Squires, J.H. (2011). *The state of preschool 2011: State preschool yearbook*. National Institute for Early Education Research. New Brunswick, NJ.
- 134 Head Start Performance Standards. <http://eclkc.ohs.acf.hhs.gov/hslc/standards/Head%20Start%20Requirements/1304/1304.23%20Child%20nutrition.htm>.
- 135 <http://www.fns.usda.gov/cnd/care/>.
- 136 Barnett, Carolan, Fitzgerald & Squires, 2012.
- 137 [http://www.fns.usda.gov/cnd/Lunch/AboutLunch/ProgramHistory\\_6.htm](http://www.fns.usda.gov/cnd/Lunch/AboutLunch/ProgramHistory_6.htm).
- [http://www.fns.usda.gov/cnd/governance/legislation/PL111-296\\_Summary.pdf](http://www.fns.usda.gov/cnd/governance/legislation/PL111-296_Summary.pdf).
- 138 <http://www.fns.usda.gov/tn/healthierus/index.html>.
- 139 Dalton, 2004.
- 140 Fitzgibbon, Stolley, Schiffer, Van Horn, KauferChristoffel & Dyer, 2005.
- 141 Williams, Bollella, Strobino, Spark, Nicklas, Tolosi & Pittman, 2002.
- 142 Nores & Barnett, 2010.
- 143 Grantham-McGregor, S., Cheung, Y., Cueto, S. Glewwe, P., Richter, L., & Strupp, B. (2007). Developmental potential in the first 5 years for children in developing countries. *The Lancet*, 369(9555) 60-70.
- 144 Moffitt, et al. 2011.

<sup>145</sup> Bierman, K.L., Domitrovich, C.E., Nix, R.L., Gest, S.D., Welsh, J.A., Greenberg, M.T., ... Gill, S. (2008). Promoting academic and social-emotional school readiness: The Head Start REDI program. *Child Development*, *79*, 1802-1817. Bierman, K.L., Nix, R.L., Greenberg, M.T., Blair, C. & Domitrovich, C.E. (2008). Executive functions and school readiness intervention: Impact, moderation, and mediation in the Head Start REDI Program. *Development and Psychopathology*, *20*, 821-843. Diamond, Barnett, Thomas & Munro, 2007. Domitrovich, C.E., Cortes, R.C., & Greenberg, M.T. (2007). Improving young children's social and emotional competence: A randomized trial of the preschool "PATHS" curriculum. *Journal of Primary Prevention*, *28*, 67-91. Raver, Jones, Li-Grining, Zhai, Bub & Pressler, 2011.

<sup>146</sup> Schweinhart, Montie, Xiang, Barnett, Belfield & Norens, 2005.

<sup>147</sup> Anderson, Foster, & Frisvold, 2008.

<sup>148</sup> Reynolds, Temple, Ou, Robertson, Mersky, Topitzes & Niles, 2006.

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