

From early childhood interventions to adult outcomes: review on
short and long-term benefits

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Abstract

The literature on the outcomes and benefits of early childhood programs is growing much remains to be understood concerning the most effective interventions and their extrapolation to a broader context. A systematic review was conducted on childhood interventions and short-term outcomes, long-term adult outcomes and the circumstances and adult outcomes. 89 studies were deemed relevant for inclusion. Results indicate that early childhood programs can produce considerable gains in the long-run, on educational, health economic domains. Results are visible in the short-run, but long-term follow-ups indicate that their expression in adulthood in considerable, in some cases transcending to the next generation.

Keywords:

Early Childhood Interventions, Child development programs, short and long-term outcomes

1 Introduction

Early childhood interventions and programs focused on child development are important determinants of health status across the entire lifespan (Bundy *et al.*, 2007). The first years of life constitute the most promising opportunity for developing meaningful interventions that will have lasting impacts (Tanner, Candland and Odden, 2015). It is crucial for health and educational improvements, both in early life stages and the long-run, that we shift more attention to these programs.

In recent decades, interest in public investments during childhood and their long-lasting impact for society has raised around the world (Campbell *et al.*, 2014; García and Heckman, 2016). There is vast literature elaborating on the rationale behind investing in early and well-designed childhood programs, focused on healthcare, parenting counselling, education for healthcare or early pre-school educational programs (Bundy *et al.*, 2007).

It is widely accepted that these programs, primarily aiming to increase health related outcomes in childhood, also provide benefits that prevail further into later school years and adulthood (Tanner, Candland and Odden, 2015; Conti, Heckman and Pinto, 2016). More authors and institutions are focusing on the societal gains that can be attained in the long-run by investing in these programs. Growing interest on the importance of developmental conditions for adult outcomes has generated greater need for understanding the impact of early developmental programs. These can assist in closing the gaps that exist between different socioeconomic levels, preventing the loss of potential of children from low socioeconomic backgrounds in the long term. It is consensual that any strategy aiming to trigger any steady long-term outcomes must target children in their first years of life (Nores and Barnett, 2010). There is also consensus around the need to improve early development programs, although the level of agreement is far inferior when considering the most effective strategies to it.

This paper compiles and summarizes the recent evidence on the effects of early childhood interventions on adult outcomes as well as on the societal benefits of such interventions. Combining the insights attained with pertinent studies relating to childhood circumstance and adult outcomes, it is possible to produce a more meaningful analysis of the outcomes measured. Such study allows for a deeper understanding of the underlying context and true capabilities and benefits of these interventions while at the same time providing orientations on what makes interventions a successful investment.

Childhood adverse circumstances affect the human development process negatively. For instance, a generally lower socioeconomic status (SES) in childhood is negatively related to individuals' capabilities for reaching their full potential in adulthood (Galobardes, Lynch and Smith, 2004; Case, Fertig and Paxson, 2005). Adverse childhood experiences also have negative health consequences in terms of adult outcomes (Kalmakis and Chandler, 2015).

The educational dimension in childhood development programs has clearly identified benefits both in the short- and long-run, improving overall health-related adult outcomes (Currie, 2001; Reynolds, Ou and Topitzes, 2004; Reynolds, Temple and White, 2010; Campbell *et al.*, 2012; Ramon *et al.*, 2018). Comprehensive programs and interventions comprising a combination of educational and health related aspects (e.g. nutrition, healthcare services, parenting support) have proven to be effective in decreasing socioeconomic gaps between groups and increasing overall gains for children and society (Ouriemchi and Vergnaud, 2003; Boocock, 2011; Peacock *et al.*, 2013).

There is quantifiable evidence from over 30 interventions conducted all over the globe that benefits attained are sustainable in the long-run, and that programs with a combination of health and educational dimensions are particularly effective both in the short- and long-term (Barnett, 1995; Nores and Barnett, 2010; Boocock, 2011). Several cost-benefit-analysis have been conducted on various types of interventions at different stages of development, showing that there are gains that

can be attained from early investment in human health and development (Heckman *et al.*, 2010; Nores and Barnett, 2010; Reynolds, Temple and White, 2010; Reynolds A. J., Temple J.A., White B.A., Ou S., 2011; Campbell *et al.*, 2014; Hajizadeh *et al.*, 2017; Cannon *et al.*, 2018; Vieira and Carvalho, 2018).

Previous reviews have focused on the benefits of investing in early childhood interventions by expressing the results in comparison with other sub-groups of the population. Results for interventions in the short-run are more expressive in higher risk groups and under-developed countries (Nores and Barnett, 2010; Boocock, 2011). There is validated evidence on multiple educational interventions (no healthcare dimension) (Currie, 2001). Some studies focus on the validation of long-term impacts of various childhood programs with and without healthcare components (Barnett, 1995) and provide estimations for the benefit-cost analysis of these interventions (Reynolds, Temple and White, 2010; Cannon *et al.*, 2018)

Results indicate the importance of investing early, emphasizing that interventions that start pre-natally or in the early infancy produce more expressive results starting in the first years of schooling and extending well into adulthood, even if the effects attenuate over time. Home-visitation programs produce mixed results or not very expressive results when in comparison to high intensity interventions with or without a healthcare dimension. The results for the most influential interventions on disadvantaged children and communities indicate that investing in these groups produces substantially more expressive outcomes.

Besides providing an updated summary of the literature, that includes the most recent papers, this study makes two main contributions. First, it pays particular attention to the health dimension of early childhood interventions. Second, it includes a review of observational studies on the relationship between early childhood circumstances and adult outcomes, that complements the literature on the short- and long-term impacts of early childhood interventions.

In sum, this paper reviews the evidence from (1) studies on the (long-run) impacts of early childhood interventions on adult outcomes, (2) studies on the (short-/medium-run) impacts of early childhood interventions on child and adolescent outcomes, and (3) studies on the relationship between childhood circumstances and adult outcomes. We consider outcomes along health, socioeconomic, educational, and behavioural dimensions.

2 Conceptual Framework

A conceptual framework for analysing the impact of interventions in human development must incorporate both physiological and social factors to human development, as well as a rigorous analysis of growth factors for each development stage (Bundy *et al.*, 2007). Evidence from recent decades highlights the importance of investing in the early childhood stage (first 1000 days in particular), where both the brain and body experience a period of steady growth, different from the one occurring later on during puberty (Black *et al.*, 2008; Almond and Currie, 2011).

The exogenous determinants of individual development can be grouped into individual-, family or household-, and community-level determinants:

1. Individual specific and inherited characteristics (genetics and epigenetics);
2. Household characteristics, such as household income, parents' education level, parental time use, and home environment variables;
3. Community-related factors, including access to health services, quality of the environment, access to water and sanitation, among others.

Cunha and Heckman advocate that approximately half of the inequality in lifetime earnings in the American society can be explained by factors determined up to the beginning of adulthood

(Heckman, 2008). Given that more children are born in disadvantaged conditions, policies that target the development of these individuals will ultimately reduce inequality and increase productivity. In Heckman and Cunha (2007), the authors elaborate thoroughly on the economic model of the human capital production function, and emphasize how investments and child endowments interact to create a child's stock of human capital, with special emphasis on the gains that can potentially be achieved from early investments and considering childhood as separate periods of time.

Cunha and Heckman (2007) describe a cumulative model of the production of human capital that allows for the possibility of differing childhood investment stages as well as roles for the past effects and future development of both cognitive and socioemotional (“noncognitive”) skills. Their model highlights the interactive nature of skill building and investments from families, preschools and schools, and other agents. It posits that human capital accumulation results from self-productivity—skills developed in earlier stages bolster the development of skills in later stages—as well as the dynamic complementarity that results from the assumption that skills acquired prior to a given investment increase the productivity of that investment. Taken together, these two principles undergird the hypothesis that skill itself begets skill.

The rationale of skill formation presented in Heckman and Cunha (2007) demonstrates that returns on educational investment are higher for persons with initial higher ability, considering it formed at early age. Figure 1 shows the return to a marginal increase in investment at different stages of the life cycle starting from a position of low but equal initial investment at all ages.⁴

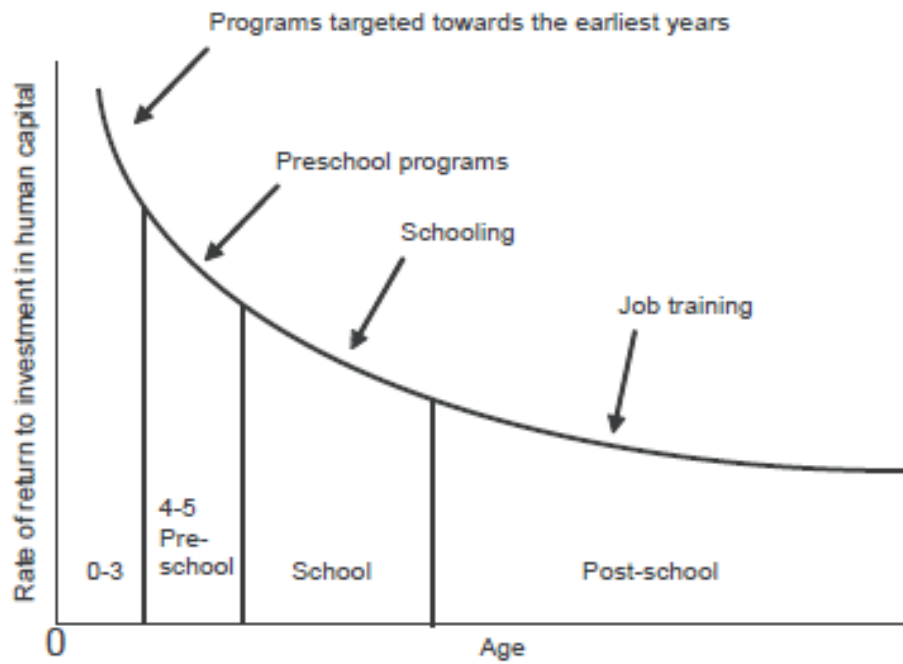


Figure 1: Return to a dollar (unit) invested at different ages from early age at each stage of human development. Adapted from (Heckman and Cunha, 2007).

3 Methodology

The search was performed in the electronic databases *PubMed*, *EconLit*, *NBER*, and *Google Scholar*, during October and early November 2018. We searched for the following keywords in the papers’ titles and abstracts: “*Adult labour market outcomes*”, “*Childhood health intervention*”, “*Childhood health program*”, “*Childhood investment*”, “*Early childhood intervention*”, “*Early childhood development*”, “*Maternal program*”, or “*Productive healthcare investment*”, combined with “*gains*”, “*benefits*”, “*adult outcomes*”, “*adult outputs*”, “*long-term follow up*” and “*follow-up*”. Examples of a search string in *Pubmed* are:

1. ((*childhood OR (early childhood)*)) AND (*program OR programs*) AND (*economic gains OR outputs OR outcomes*)
2. (((((*child health*[Title/Abstract]) AND *adult outcomes*[Title/Abstract]) AND *early childhood program*[Title/Abstract]) AND *labour market*) AND *follow up*) AND *economic gains*

The abstracts of retrieved papers (n=245) were screened for inclusion or exclusion. Included studies were published in peer-reviewed journals between 1990 and 2018. Relevant NBER working papers were also included. Grey literature was excluded. With a few exceptions, included studies concern

developed countries. We included mainly empirical studies, some of which including some type of cost-benefit analysis. Literature reviews were also included. In this process, 182 papers were dropped because they were either duplicates or not considered relevant.

The references of retrieved papers were manually searched for further material. A total of 26 new studies were added in round two.

The following flow-diagram, Diagram 1 illustrates the selection process. In the end, 89 studies were selected for review. They were categorized into the following three groups:

1. Studies on the impacts of early childhood interventions on adult outcomes
2. Studies on the impacts of early childhood interventions on child and adolescent outcomes
3. Studies on the relationship between childhood circumstances and adult outcomes

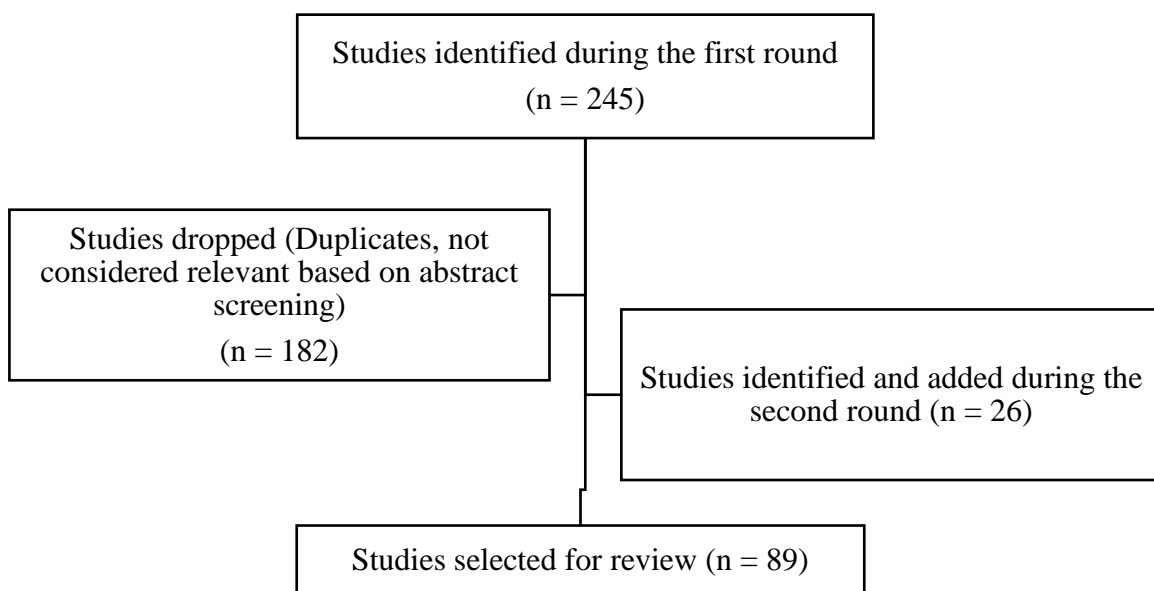


Diagram 1: Flow diagram of search and selection process.

4 Results

A total of 89 studies were analysed and divided in three groups as detailed in Table X. Note that some studies are included in more than one group, in case they assess both short- and long-run impacts of a particular intervention or program.

Table 1: Study classification and segmentation per major group.

Major group	Number of papers	Number of identified interventions	Comments
(1) Long-run impacts of interventions	24	11	Most representative interventions: - Carolina Abecedarian Project (ABC) - Chicago Child Parent Center Program (CPC) - Perry Preschool Program (PPP)
(2) Short-run impacts of interventions	6	6	Several recent interventions; short-run impacts of the interventions in group (1).
(3) Childhood circumstances and adult outcomes	14	n.a.	Main topics: adverse childhood experiences, childhood SES, childhood health status.

Notes: n.a.=not applicable. Total = 34 out of 89 papers deemed relevant for context and content on interventions and circumstances.

We may distinguish groups (1) and (2) from group (3) by thinking in terms of the explanatory variable of interest: for groups (1) and (2), it is participation in the intervention or program; for group (3) it varies, including childhood health, SES, etc. The dependent variables are the different outcomes considered, including health, labour market, socioeconomic outcomes or others.

4.1 Long-run impacts of interventions

We begin by describing in Table 2 briefly the three main programs and interventions that are the subject of several studies found: the Carolina Abecedarian Project (ABC), the Perry Preschool Program (PPP) and the Chicago Child Parent Center Program (CPC), (Table X).

The PPP was conducted in Michigan starting in 1962. It targeted disadvantaged children providing them with special preschool education from ages 3 to 5 and home-based parenting education and guidance. It did not possess a specific health component to it.

The ABC program took place in North Carolina starting in 1972. Besides providing the educational component similarly to the PPP, it also comprised a healthcare and nutritional component extending from birth up to age 8. The ABC and PPP targeted socioeconomically disadvantaged populations. In the case of the PPP, focus was given to children with lower IQ levels.

The CPC Program provided the most comprehensive services by implementing an intensive parent engagement component, outreach services and a complete component of healthcare services and nutrition.

Table 2: Relevant characteristics of the ABC, PPP and CPC. Information adapted from Conti, Heckman and Pinto (2016) and Temple and Reynolds (2007).

	ABC	PPP	CPC
Location	North Carolina, USA	Michigan, USA	Illinois, USA
Intervention years	1972-1983	1962-1967	1983-1985
Age of the children (duration of program)	Birth to 5 years old (2 nd stage: 5 to 8 years old)	3 to 5 years old	Preschool through grades 2 or 3 (~3 to 9 years old)
Sample Size	111	123	1539

Racial Composition	98% African American	100% African American	94% African American 64% Hispanic
Intensity of the program	8 hours per day 40 hours per week 50 weeks per year	2.5-3 hours per day 12.5-15 hours per week, 30 weeks per year	
Cost per child per year	12955 \$ (in 2010 US \$)	9604 \$ (in 2010 US \$)	8454 \$ (in 2002 US\$)
Dimensions of the Intervention / Program	- Pre-school Education - Home visiting, parenting guidance	- Pre-school Education - Home visiting, parenting guidance - Health care component - Nutritional component	- Parent Program - Outreach services - Health care component - Nutritional component
Tracking of the subjects	Up to age 21	Up to age 27 and then again at age 40	Up to age 22

Table A1 in the Annex summarizes the results of studies looking at the long-run impacts of the ABC, the PPP, and the CPC, as well as other less popular programs and interventions.

Remarkable overall analysis of the major interventions, ABC, PPP and CPC, reveals important information. According to Temple and Reynolds (2007), even though the costs of the programs differ significantly, the economic returns are evidently positive. The present value of the total economic benefits per participant, measured and projected over the life course, ranged from \$74,981 to \$138,486 (in 2002 US dollars). The present value of the net benefit for the ABC program was \$99,682. The net benefit per participant for the PPP was \$122,642 and for the CPC (per participant) the value was \$67,595.

Table 3: Summary of results from study of (Conti, Heckman and Pinto, 2016) concerning the results of the impacts of two interventions in childhood, in the US, in outcome in adult age, (30 to 40 years old), according to gender.

Intervention	Gender	Results						
		Self reported health status, BMI	Blood pressure and hypertension	Health insurance	Healthcare consumption	Physical activity and healthy diet	Smoking	Alcohol
Perry Preschool Project	Men	n.s.		n.s.	n.s.	+	--	n.s.
	Women	n.s.		n.s.	n.s.	+	n.s.	n.s.
Carolina Abecedarian Project	Men	n.s.	--	+	--	n.s.	n.s.	n.s.
	Women	n.s.	n.s.	n.s.	n.s.	+	n.s.	n.s.

Notes: +/-n.s.; positive effect/ negative effect/ not significative. White cell corresponds to a non-measured outcome.

In sum, for the interventions stated before, overall gains were achieved that transcended the immediate period of the intervention. Complete interventions/programs aiming for a combination of healthcare services, educational aid and family guidance prove to have better returns on investment but these components, when isolated, (consider PPP with no health component) also prove to have good results.

4.2 Short-run impacts of interventions

The interventions reported in this group concern, in their majority, vulnerable groups that were subjected to these interventions and later screened for comparison with control groups. The

interventions and programs identified target one specific aspect or dimension that is meant to be improved. The most important descriptive features are presented in Table 4. Whether it is oral health, parenting skills or nutrition, these interventions have a limited scope, a clear targeted group and very clear objectives. Most of them target mothers at risk and the programs start prenatally. Average period of these interventions is 2 to 3 years and participants are screened periodically during the intervention, and, in some cases, a few years after the interventions are over. Some follow-up studies were conducted in the short-term and very interesting data can be analysed that can provide valuable insights on the importance of investing in childhood healthcare and development programs. Below, the information on the targeted interventions can be found.

Table 4: Most relevant characteristics concerning the programs identified.

	<i>Programs / Interventions Descriptive Data</i>					
	Planning Health in School	Preparing for Life	My Baby & Me	Pro Kind	Medicaid (on Oral Health)	Nurse-Family Partnership
Author, year	Vieira and Carvalho (2018)	Doyle <i>et al.</i> (2015)	Guttentag <i>et al.</i> (2014)	Sandner <i>et al.</i> (2018)	Kranz <i>et al.</i> (2018)	Heckman <i>et al.</i> (2017)
Location	North of Portugal	Dublin, Ireland	USA	Germany	USA	Tennessee, USA
Age of child and duration of intervention	10 to 14 years old (duration 1 year)	Prenatally to 3 years old (duration 4 years)	Prenatally to 2.5 years old (duration ~3 years)	Prenatally to 2 years old (duration ~3 years)	2 to 6 years old (duration 4+ years)	Prenatally to 2 years old (duration ~3 years)
Sample Size (IG+CG)	449	233	361	755	68890	1138

Socially disadvantaged subjects?	random	yes	yes	yes	yes	yes
Time interval when the intervention took place	2010-2014	2008-2013	2008-2013	2006-2012	2003-2012	1990-1993
Intensity of the program	45 min learning module video per month, 8 modules in the year; several activities in school	Twice monthly home visits lasting around one hour. Average of 51 during the program plus a total of 10 hours for the parenting course	Two levels: High has 55 home visits and low includes phone calls	52 home visits with an average duration of 90 minutes	Insurance coverage, regular appointments for both states using this fluoride application or not	A total of 33 visits, (7 prenatally and 26 until age 2). Average duration of visit between 1-1.5 hours)
Unitary cost per child per year	36.14 € (in 2018 €)	Not available (although it reports positive cost benefit ratio)	Not available	~3191 €	Not available (although it reports cost savings)	Not available (although it reports cost savings in Medicaid and food stamps)
Dimensions of the Intervention / Program	- School based intervention focused in nutrition	- Community based intervention focused in parent education - Home visiting (commencing antenatally) - Parenting course	- Multimodul e parenting intervention and education	- Home visiting (commencing antenatally)	- Oral Health component	- Home visiting (commencing antenatally) promoting healthy behaviours and parenting skills

		(starting at age 2)				
Objective	Changing children behaviour to improve healthy eating and increase active living during adolescence: increasing physical activity through active play after school and weekends.	Experimentally modifying the parenting and home environment of disadvantaged families, on child physical health in the first 3 years of life in order to achieve better health conditions.	The intervention targeted specific parenting skills designed to alter trajectories of maternal and child development.	Study the impact of a home visiting program in a group with wide access to health care services.	Examine the association between years since a state implemented a fluoride varnished application policy and the odds of a publicly insured child having very good or excellent teeth.	Improvement of maternal and fetal health during pregnancy; the development of parenting skills; and planning of social and economic aspects of maternal life through counselling services.
Tracking of the subjects	1 year after the intervention	Accessed every 6 months during the intervention	Up to age 22	Accessed every 6 months during the intervention	Accessed over a 4+ year period	At ages 2, 6 and 12

In table A2 in Annex 1 it is possible to find more detailed information on the types of outcomes analysed for each of the studies found in the literature review. The majority of the studies demonstrates at least one positive outcome on either health, education or both on the short-run. It is possible to see from the interventions with a limited scope and duration, when measured solely in the short run, that there are benefits that are attained in terms of child development parameters, overall health status and cognitive development. Also, for the mothers, when measured for mental health, parenting skills and readiness to go back to work, the programs that include home visits, when excluded of all other components, still prove to be effective. When analysing, side by side, the

results attained for group (2) with the results attained for group (1), one can see where the basis for the sustainability of these results over times derives from. The benefits from investing in early childhood development programs can be seen in the short run and transcends the duration of the interventions, well into adolescence and early adulthood.

4.3 Childhood circumstances and adult outcomes

It has been widely studied that childhood circumstances, starting in the in-utero period, have an impact that lasts well after birth. Recent studies and reviews seem to indicate that shocks during this period might last well into adulthood or quite possibly, transcend to the next generation (Case, Fertig and Paxson, 2005; Almond, Currie and Duque, 2017). In this section, 15 relevant publications are analysed in detail with concern to the adult outcomes relating to different types of childhood circumstances. They can be categorized in the following:

- i) Pre-natal and post-birth exposure to ‘shocking events’;
- ii) Childhood adverse experiences;
- iii) Childhood health conditionings and
- iv) Childhood SES.

All this are then matched and studied with long-term follow-up studies and comparisons to the variation attained in adult outcomes, in the general domain of adult health status and healthcare utilization, labour market outcomes, adult SES or trans-generational effects, (when possible). In table A3 in Annex 1 it is disclosed a detailed list of the main results on the literature sorted by childhood circumstances and adult outcomes

5 Discussion

The results from groups (1) and (2) provide a sustainable rationale for the importance of investing in early childhood. Expressive gains can be attained both in the short and the long-run, both at the individual and societal level with clear economic benefits that can transcend the current generation. Combining that information with the sum-up of the importance of the early childhood circumstances from group (3), it is possible to build a bridge that connects and validates the importance of investing early through the comparison of intervened groups and control groups. To allow for social mobility to occur in a positive manner, intervening in the early childhood period is crucial.

Most studies on groups (1) and (2) have high internal validity. They are able to identify the causal effects of participation in the programs considered because participation is random or, if not random, intervention and comparison groups are made as comparable as possible, for example through matching. On the other hand, they may lack external validity. The extent to which the impacts of specific interventions on specific populations can be extrapolated to other contexts (other groups, countries, or nowadays) is limited.

The observational studies in group (3) provide findings that are more easily extrapolated, because they are based on large datasets, usually representative of one country's whole population. However, most studies in this group are descriptive, providing only associations between childhood circumstances and adult outcomes. Few studies try to address the endogeneity of childhood circumstances, by relying on the differences between twins or siblings for identification of a causal effect. The studies by Case and colleagues consider various measures in an attempt to disentangle the mechanisms that underlie the causal pathway from childhood circumstances to adult outcomes.

Besides covering the most recent studies and interventions that have not been included in prior reviews, this study complements prior literature by shedding more light on childhood interventions

that include a health component. Our main interest is on the long-term outcomes of childhood interventions. It also reviews studies that relate childhood circumstances to adult outcomes.

A vital question that still requires further research concerns the overall gains that can be achieved from implementing or expanding such programs for the general population. As the literature demonstrates, the gains are more expressive for the sub-groups in higher risk or poorer conditions. As a society, does the expansion of such programs pay up on the long-run? In educational and health care terms, preventing chronic disease incidence and elevating the rate of completion of educational cycles? Much remains to be answered and scientifically verified. We also lack evidence on the very long-term impacts of childhood interventions. For instance, knowing more about the benefits or lack thereof in terms of incidence of chronic conditions and other health outcomes in old ages is increasingly relevant in the face of aging societies. For this, we must wait at least another couple of decades for participants in the ABC, the PPP, the CPC and others to attain old age.

Results in this study inform policy makers on the benefits that can be attained from investing in early childhood, including which type of interventions may be more at improving adult outcomes and reducing the gap between the least and most well-off.

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