ABSTRACT

A Head Start on Health:
Early Childhood Interventions and Health Across the Life Course

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Rich theoretical and empirical literature link early childhood factors to adult health outcomes, providing evidence that health disparities start early in life and propagate throughout the life course, with non-cognitive skills being increasingly implicated in this relationship. Model preschool experiments such as Perry Preschool and Abecedarian give further support to this claim in addition to highlighting an important and perhaps more promising feature of the life course view of health – that interventions in early childhood might be leveraged to reduce the effects of early disadvantage on adult health. Despite this hopeful preliminary evidence, concerns remain over whether such experimental findings can be implemented on a broader scale. This thesis examines the role of Head Start, the United States' largest federally funded comprehensive early childhood program, in supporting the earlier findings from model preschool programs. I address the limitations and gaps in existing Head Start literature that prevent comprehensive analysis of long-term health outcomes and give recommendations for utilizing existing longitudinal data in the Children of the NLSY79 study, including rich information on health behaviors, self-rated health status, and non-cognitive factors, that can further our understanding of Head Start's impact on long-term health outcomes and the pathways through which early childhood interventions might act to influence adult health.

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A HEAD START ON HEALTH: EARLY CHILDHOOD INTERVENTIONS AND HEALTH ACROSS THE LIFE COURSE

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TABLE OF CONTENTS

CHAPTER ONE

Early Socioeconomic Disadvantage and Adult Health

"And so, in these days of difficulty, we Americans everywhere must and shall choose the path of social justice – the only path that will lead us to a permanent bettering of our civilization, the path that our children must tread and their children must tread, the path of faith, the path of hope and the path of love toward our fellow man."

Franklin D. Roosevelt, *The Philosophy of Social Justice Through Social Action*

Introduction

This research began as a mission to understand why, and how, and when inequalities in health arise and, most importantly, what we can do to ensure everyone has access to good health regardless of his or her background. As an aspiring physician, I have a responsibility to my future patients to be aware of the wide-ranging and dynamic social processes that impact health and well-being. These social processes are referred to as the social determinants of health and addressing these processes is a crucial component in preventing and reversing disparities in health that continue to plague our society. Children are a special subject of concern in preventing social inequality because adverse events that occur in childhood can propagate throughout the lifespan and across many fundamental domains of life. Interventions in early childhood have been proposed as tools for limiting the adverse effects of early disadvantage to promote better health and development and thus reduce inequalities. The present chapter provides a framework for understanding how early disadvantage perpetuates into adulthood. The models and factors within this chapter will be recurrent themes throughout this thesis to analyze past and present early childhood interventions and to provide directions to improve future study in this area.

Socioeconomic Disadvantage and Disparities in Health

Inequalities in health that are related to various dimensions of disadvantage—including social, economic, and environmental—are termed health disparities (Healthy People 2020). It is well established in sociology literature that socioeconomic status (SES), a marker of one's relative standing in the hierarchy of society as indicated by income, education, occupation, or a composite measure of some combination of the three, is associated with graded inequalities in health such that health tends to improve with increasing SES and, conversely, tends to suffer with decreasing SES (Phelan et al., 2010). The fact that this socioeconomic-driven health gradient has persisted, even in light of medical and public health advances that have drastically reduced the burden of infectious disease that previously plagued disadvantaged members of society, lead Phelan et al. (2010) to dub SES a "fundamental cause" of health inequality (p. 29). Socioeconomic status (SES) is a measure of one's relative position in society that is typically determined by some combination of indicators for income, education, and occupation. Socioeconomic disadvantage (SED) often refers to low SES as well factors that are often associated with low SES, including poor resources and increased exposure to risk (Kim et al., 2018), and has long been recognized as a potent predictor of adverse health outcomes.

More recent research has found that disadvantage in childhood can predict adverse health events even after controlling for SES and resources in adulthood. One landmark study reported that some adverse events *in utero* resulted in physiological changes that persisted into adulthood and predisposed individuals to cardiovascular disease (Almond & Currie, 2011). This led to Barker's *fetal origins* hypothesis, which is commonly cited alongside the *critical period* model that will be discussed later in this chapter (Almond & Currie, 2011). The critical period model is one of several models detailed in subsequent sections in order to develop a conceptual framework that is useful for understanding the mechanisms through which early SED affects health outcomes across the life course. This framework will then be used to illustrate how the development of psychological factors, including cognitive and noncognitive skills, are influenced by early SED and the ways in which these factors subsequently affect long-term health.

Life Course Models of Health

Increasing attention to early life origins of later health outcomes has opened a niche for theoretical models that explain the development of health across the life span and the mechanisms that facilitate such development. In general, the literature focuses on the *critical period* (also referred to as *latency*), *accumulation of risks*, and *pathway* models (Hertzman & Power, 2003; Pudrovska & Anikputa, 2013).

Critical Period

The terms critical period and sensitive period are sometimes used interchangeably in life course models, though Ben-Shlomo & Kuh (2002) explains that a sensitive period for health is defined as "a time period when an exposure has a stronger effect on development and hence disease risk than it would at other times" (p. 288), while a critical period is a finite length of time during which an exposure that is usually relatively innocuous can have long-term effects on health. Strict applications of the critical period model are typically used to illustrate how early insults that occur within a time-sensitive window can create a scarring effect on physiological or psychological systems that is irreversible and will have significant effects on adult health largely irrespective of other exposures that occur outside of the critical period (Ben-Shlomo & Kuh, 2002). However, the critical period model is also used to describe more general periods during development, often early in life, in which an individual has increased susceptibility to significant long-term health consequences. The vast and rapid development that occurs early in life implicate this stage of the life course as one in which SED might be particularly devastating. An association between early SED and adult health that is robust to mediators accounting for intermediate outcomes might be explained with a critical period model (Pudrovska & Anikputa, 2013).

Accumulation of Risks

The accumulation of risks model posits that increasing exposure to risk factors across the life course drives the association between early adversity and later health. In other words, the amount or *dosage* of risk rather than the timing matters most for shaping later outcomes (Hertzman & Power, 2003). Risk can accumulate either from exposure to multiple risk factors or an increased duration of exposure and then act in an additive or synergistic manner to influence adult health. Two variations in the accumulation of risks model stem from the repeated finding that risk factors tend to associate together and include the chains-of-risk and risk clustering models. Risk clustering refers to the tendency for multiple risk factors to be present at a single point in time, while the chains-of-risk model emphasizes the tendency for risks to be associated with one another in a sequential manner (Bauldry et al., 2012; Chartier et al., 2010; Ferraro & Shipee, 2009; Montez & Hayward, 2014). The concept of risk accumulation has especially gained prominence through the study of adverse child experiences (ACEs), where the presence of one ACE increases the probability of having additional adverse experiences compared to a child that has no ACEs (Whitaker et al., 2014). Greater numbers of ACEs have been shown to increase the likelihood of having a range of health conditions in adulthood (Whitaker et al., 2014) as well as affect child health behaviors that can in turn predict later health issues (Schuler et al., 2021).

Pathways

Pathway models hypothesize that early disadvantage manifests in later health outcomes indirectly by influencing trajectories. Support for such a model would be a relationship between early adversity and adult health that is almost entirely mediated by intermediate outcomes including educational attainment and income in adulthood. The *social mobility* model can be considered a type of pathway model that stresses the importance of upward or downward mobility, rather than early disadvantage, in dictating health outcomes (Willson & Shuey, 2016). Thus, someone that experiences SED as a child may be largely or wholly spared from the adverse health outcomes associated with SED if he or she experiences upward mobility and is able to move to a higher socioeconomic position in later life (Kwon et al., 2018; Willson & Shuey, 2016; Montez & Hayward, 2014)). In contrast, someone that has a relatively advantaged childhood may be subject to later poor health if he or she experiences downward mobility.

Life Cycle Skill Formation

In addition to life course models of health, an understanding of skill formation over the life cycle is useful for illustrating how SED can hinder the development of skills and have consequences for later health outcomes. Furthermore, skill development has emerged as a primary mechanism through which early childhood education might act as an intervention to prevent downstream effects associated with SED.

Useful Terminology

In order to understand the life cycle model of skill development, some terms and definitions need to be clarified. First, the term *skill* is used often within economics literature to refer to stocks of human capital that are acquired and developed over the life course (Thiel & Thomsen, 2013). This is in contrast to the term *trait,* which is generally connotated as being rather stable throughout life (Thiel & Thomsen, 2013). Second, the distinction between *cognitive* and *noncognitive* skills should be defined. This is made challenging by the fact that no uniform criteria exists that definitively separates cognitive from noncognitive factors, and the classification of a certain factor as cognitive or noncognitive sometimes depends on the individual researcher or their respective discipline. Factors encompassed under the umbrella of noncognitive skills are also sometimes referred to as *socio-emotional* or *personality* factors (Humphries & Kosse, 2017). Drawing a hard line between cognitive and noncognitive implies that such skills are independent, but is becoming increasingly evident that many measures capture both cognitive and noncognitive skills and that the formation of such skills occurs in a complementary fashion (Cunha & Heckman 2007). Additionally, the term noncognitive is often misleading because all noncognitive skills must involve cognition (Kell, 2018). It is clear that *cognitive* and *noncognitive* skills are not defined as clearly or as uniformly as one might hope.

Acknowledging the ambiguity surrounding cognitive and noncognitive skills, for the purposes of this thesis, the term *cognitive* will predominantly refer to the concept of general intelligence—often represented through IQ scores and assessments of academic achievement—to reflect the general terminology utilized by dominant figures in the study of noncognitive skill formation (see Cunha & Heckman, 2007; Cunha & Heckman, 2009). Noncognitive skills, then, will refer to those factors—including personality, attitudes, and behaviors—that contribute to outcomes across life and are not wholly captured by IQ or academic achievement. Special attention to the malleable nature of skills, at least in childhood, is crucial study. Traits or dispositions that formed very early in life (prior to preschool) and are static across time and space are of little consequence in early childhood interventions, especially compensatory programs such as Perry Preschool or Head Start that seek to remediate early life insults or disadvantage.

Skill Formation and Development

Recent scholarship, especially in economics, has begun to pay more attention to the formation and development of skills throughout the life cycle (Cunha & Heckman, 2007). Both cognitive and noncognitive skills are highly susceptible to positive and negative influences in early childhood, and environments that are both sensitive and responsive to a child's needs are very important for skill development (Magnuson &

Duncan, 2016). Early childhood, then, can be understood as a sensitive period for skill development in which investments by parents or other caregivers are especially important (Cunha & Heckman, 2007). The technology of skill development posits that skills formed early in life help to build similar skills in childhood and form the basis for skill-building in later stages (Cunha & Heckman, 2007). Parents' investment in their children is stratified along socioeconomic lines, and low parental SES is often associated with limited resources for early investments (Neubourg et al., 2018). Consequently, children from different socioeconomic backgrounds develop skills at different rates, and gaps in both cognitive and noncognitive skills are present during preschool and persist throughout the life course (Duncan et al., 2007). One way in which early childhood interventions are thought to boost adult outcomes is by compensating for parental constraints on early investments and helping children build cognitive and noncognitive skills in the preschool years that they will continue to develop throughout their lives (Magnuson & Duncan, 2016). Because skills are developed in early life and have influence on many domains of later success, they are likely contributors to mechanisms linking early childhood education and health in adulthood.

Skills and Health Across the Life Course

One important role of cognitive skills is the promotion of academic achievement and overall educational attainment, which has many potential downstream effects for health. Schools, especially institutions of higher education, often function as instruments of social stratification, sorting more highly-educated individuals into occupations and positions with better income, higher status, and greater access to resources that might facilitate better health (Hayward et al., 2014). Cognitive skills have been shown to moderate the effect of early SED on adult measures of health including self-rated health and mortality (Bridger & Daly, 2017). However, Conti et al. show that failing to include noncognitive skills in models overestimates the effect of early cognitive traits on later outcomes (2010). Early noncognitive skills may be associated with later health outcomes independent of cognitive skills (Carter et al., 2019). Additionally, other work has shown that cognitive and noncognitive skills have a dynamic relationship such that the formation of one facilitates the formation of the other in a back-and-forth manner (Cunha & Heckman, 2006). From this information, though it is difficult to ascertain the extent to which cognitive versus noncognitive skills affect health outcomes, we can infer that both seem to play a role in influencing health.

Cunha & Heckman find evidence supporting a sensitive period for the development of both cognitive and noncognitive skills, with cognitive skills being more sensitive to inputs at an earlier point in life than noncognitive skills, which continue developing into young adulthood (2010). From a life course perspective, childhood SED prevent the formation of skills during this critical period and lead to deficits that persist into adulthood and influence health. In addition, noncognitive skills may also differentially impact children that experience SED through processes of accumulated risk. Psychological skills, including noncognitive skills, can be crucial for coping with stress and adversity, both of which are common occurences for children experiencing SED (Nurius et al., 2015). As such, poorly developed or missing noncognitive skills may combine with clusters of risk or chains-of-risk to have synergistic negative effects on later health (Elliot & Chapman, 2016).

Several studies on relationships between specific noncognitive skills and health outcomes provides further support for the importance of noncognitive skills as determinants of health. Locus of control, or the extent to which one believes that she has control over her behavior and thus the consequences of that behavior, is a commonly studied noncognitive skill. An internal locus of control indicates a high belief in one's personal agency in controlling outcomes, while an external locus of control tends to attribute outcomes to uncontrollable external forces such as luck or fate (Lindström & Rosvall, 2014; Pedron et al., 2021). Childhood SED is linked to an external locus of control, potentially because children that experience more adversity tend to have less control over their situations in actuality and may lack access to resources that help to develop an internal locus of control (Pedron et al., 2021). A recent study has shown that an external locus of control partially mediates the association between SED in childhood and health behaviors in adulthood (Pedron et al., 2021). Thus, locus of control may have an indirect effect on health by shaping health behaviors. Another study showed that the accumulation of SED over the life course decreased the probability of having an internal health locus of control, defined as the belief that one has control over his or her health (Lindström & Rosvall, 2014).

The relationship between noncognitive skills and health may also be explained by a pathway model. Boylan et al. found that childhood SES was associated with positive parenting, which was subsequently associated with noncognitive skills including self-esteem, optimism, life engagement, and self-mastery (2018). These positive noncognitive skills predicted a higher SES in adulthood, and higher SES predicted better health (Boylen et al., 2018). Thus, the effects of childhood SED might also be transmitted through their impact on the child's later life trajectory and are largely influenced by noncognitive skills. Other noncognitive factors that can influence health include measures of personality in childhood. Hampson et al. found that childhood personality characteristics of agreeableness, conscientiousness, and intellect-imagination were positively related to educational attainment, and increased education predicted healthier eating habits and less smoking, which predicted better health status (2007).

As discussed throughout this chapter, there are many mechanisms through which early SED can influence health. A special emphasis has been placed on noncognitive skills due to an increasing awareness of their potential role in linking early SED to adult health. Such noncognitive factors will be of importance when considering the effects of two well-known but distinct early childhood interventions and are a growing area of study that can and should be applied to analyses of potential long-term outcomes from Head Start. The next chapter will investigate the background and design of the Perry Preschool and Abecedarian projects, their long-term outcomes for health, and noncognitive factors that might be driving such treatment effects. The two subsequent chapters will propose ways in which we can apply the findings from Perry Preschool and Abecedarian, as well as the models and factors described within this chapter, to bridge some of the gaps in our current understanding of Head Start's long-term outcomes.

CHAPTER TWO

Lessons From Model Preschool Programs

Background

The High/Scope Perry Preschool program and the Carolina Abecedarian Project, referred to throughout this work as model preschool programs, are two of the most well-known and cited early childhood interventions in the United States and are routinely used to demonstrate the power of early interventions in preventing or mitigating a host of poor adult outcomes. One area in which both programs have shown some markers of success is in improving adult health outcomes. The lasting influence of these two programs in particular is primarily due to the high-quality nature of their respective interventions, their use of a randomized-controlled experimental design, and their commitment to following up with program participants into adulthood. This last component in particular allows for analysis of outcomes that occur well after program cessation and provides insight into potential long-term benefits of early childhood interventions.

The previous chapter provided a literature review and a theoretical framework describing the relationship between conditions in early childhood and subsequent adult health outcomes. This chapter explores the Perry Preschool and Abecedarian programs and their reported effects on adult health outcomes as support for early childhood interventions as potential tools to reduce the long-term adverse effects of childhood SED and mitigate some of the health disparities that exist between the poor and affluent members of society. A thorough description of each program's components is given to facilitate hypotheses concerning the mechanisms through which these model preschools improved outcomes. The next chapter will detail limitations in the current literature that prevent adequate analysis regarding whether Head Start—a federally-funded and comprehensive early childhood education program with components reminiscent of both Perry Preschool and Abecedarian—might influence later health in a similar manner to model preschools.

Characteristics of Two Model Preschool Programs

The Perry Preschool Program

The High/Scope Perry Preschool program was spearheaded by Dr. David Weikert in the early 1960s (Conti et al., 2016). Its name is derived from its location in the school district of Perry Elementary School in Ypsilanti, Michigan (near Detroit), and the program began its first wave in 1962 (Conti et al., 2016; Berrueta-Clement et al., 1984). Born in the era of Lyndon B. Johnson's Great Society and the significant expansion of American welfare institutions, Perry Preschool sought to make its contribution to the "War on Poverty" by improving the life trajectories of black youths from low SES backgrounds deemed to be at-risk for failing in school (Marx, 2017; Schweinhart, 2003). As such, a core component of Perry's model was to promote social mobility, allowing children to offset the adverse effects of early SED by improving school trajectories.

In line with its aim to improve outcomes for disadvantaged children, participants for the Perry Preschool study were identified by a census of families with children attending Perry Elementary, neighborhood referrals, and door-to-door canvassing, and selected for enrollment in the study based on criteria of low socioeconomic status and low intellectual performance as indicated by IQ scores between 60 and 90 (Schweinhart, 2013). Socioeconomic status was assessed through a composite measure of parental educational achievement, employment status, and housing density (Berrueta-Clement et al., 1984). Based on these criteria, the children attending Perry Preschool, on average, had fewer resources available to promote development and were already facing deficits in cognitive ability than other peers of the same age.

Upon offer of participation in the study, almost all of the eligible children were enrolled (Heckman et al., 2010). After initial selection, four children moved away and one child died after the study began, leaving 123 children in the study sample (Schweinhart, 2013). The remaining children were randomly assigned to a treatment group that would participate in the preschool program or a control group that was not enrolled in any program and received no additional treatment outside data collection (Schweinhart, 2013). This poses a potential issue, as the lack of a placebo group receiving other non-preschool services may limit our ability to determine whether the eventual outcomes were due to the program itself or a placebo effect. There are also issues with the randomization protocol that will be discussed in detail later in this chapter. From the total sample of 123 children, 58 were randomly assigned to the treatment group to be enrolled in the preschool program and 65 were assigned to the control group (Berrueta-Clement et al., 1984). The first wave of participants attended one year of the preschool program at age four, while the four subsequent waves attended for two years beginning at age three and continuing through age four (Schweinhart, 2013). While it might be interesting to compare the treatment effect for children attending the program for one year versus two, this analysis is not available and is likely limited by the already small sample size that would be further truncated with such an analysis. Data was collected on an annual basis from entry into the program at age three through age fifteen and the original study participants underwent follow-ups at ages 19, 27, and 40 (Heckman et al., 2010).

The randomization protocol included several steps and began with the ranking of children according to IQ score at time of entry into the program (Heckman et al., 2010). Younger siblings were assigned to the same group as their elder sibling to prevent siblings in the control group obtaining spill-over treatment effects from a sibling participating in the preschool program (Schweinhart, 2013). Once children were ranked, even-numbered ranks were assigned to one unlabeled group and odd-numbered ranks to another, balancing the groups based on their IQ scores (Heckman et al., 2010). From there, pairs of children with similar initial IQ measures were exchanged to balance background characteristics such as gender and socioeconomic status (Berrueta-Clement et al., 1984). The unlabeled groups were then assigned to a preschool or no-preschool condition by flipping a coin and, once assigned, all families remained in the program (Berrueta-Clement et al., 1984). Five children with employed single parents were switched from the preschool to no-preschool group due to their parent's inability to comply with classroom activities and home visits (Berrueta-Clement et al., 1984). Consequently, the treatment and control groups differed significantly in maternal employment, though no other significant differences in background characteristics were found (Schweinhart, 2013).

Each program lasted 30 weeks, beginning in mid-October and running through May (Schweinhart, 2013) and consisted of 2.5 hours of daily classroom instruction for children in addition to one 90-minute weekly home visit (Conti et al., 2016). These weekly visits were an integral part of the Perry Preschool curriculum and were designed to promote active engagement of parent(s) in the educational process and the implementation of curriculum in both the home and formal school environment (Heckman, 2010). Another noteworthy curricular component was the recognition of children as being "intentional learners who learn best from activities that they themselves plan, carry out, and review afterwards" (Schweinhart, 2003). The duration of the preschool program and emphasis on parental involvement are both characteristics prominent in the Head Start program, which will be examined in the next chapter.

The role of the teacher in the Perry model was to create an environment in which the child could safely and appropriately engage in such activities, to observe the child's learning, and to facilitate the child's learning through joint-play and open-ended questions (Schweinhart, 2003). Originally called the "Cognitively Oriented Curriculum" (Berrueta-Clement et al., 1984), this active-learning approach was later renamed to High/Scope (Schweinhart, 2013). Four teachers attended to a group of 20 to 25 children in a given program year, resulting in a student-to-teacher ratio of 5 to 6 students per teacher that was set in order to meet the weekly home-visit requirement (Schweinhart, 2013; Berrueta-Clement et al., 1984). For contrast, the current Head Start performance standards require that class sizes be limited to no more than 20 students and that two teachers, or one teacher and a teaching assistant be present in each class (USDHHS, *Head Start Policy & Regulations*, 2016). The teaching staff consisted of ten teachers (seven white and three Black), each certified in elementary, early childhood, and special education, and at least one Black teacher was on staff at all times (Schweinhart, 2013).

The Carolina Abecedarian Project

Research for the Abecedarian Project started in 1971 and enrollment of participants began one year later, nearly a decade after the commencement of Perry Preschool (Campbell et al., 2002). The program took place at the Frank Porter Graham Child Development Institute at the University of North Carolina's Chapel Hill campus and its mission was to determine whether or not early childhood interventions could prevent educational set-backs and developmental delays that disproportionately affect children from low-income families (Campbell, 2002). Thus, rather than remediating existing deficits, this model sought to prevent achievement gaps.

Coming in at the tail-end of the golden age for early childhood research, the Abecedarian Project also served, in part, as a response to the seemingly underwhelming preliminary results from Head Start, which was founded in 1965 and took inspiration from previous early childhood programs such as Perry Preschool (Ramey et al., 1975). Specifically, Abecedarian sought to test whether the timing, duration, and intensity of early childhood interventions was critical for eventual outcomes and if the late application and low intensity of Head Start was to blame for its apparent failure (Ramey et al., 1975). Like Perry Preschool, Abecedarian has been largely deemed a success story within early childhood literature, and is often cited alongside the Perry Preschool project due to both having a true experimental design as well as longitudinal follow-ups.

Recruitment for the Abecedarian project took place in the summer of 1972, and potentially eligible families were identified through referrals by the University of North Carolina's teaching hospital as well as from the Orange County Department of Social

Services and other community agencies (Ramey et al., 1975). Families were identified and assessed for meeting criteria for inclusion in the study prior to the child's birth via home interviews with expecting mothers and subsequent interviews at the Graham Childhood Development Center if she met initial inclusion criteria (Ramey et al., 1975), and final eligibility was determined by these later interviews in addition to the mother's score on an IQ test (Campbell & Ramey, 2010).

Initial eligibility required a sufficient score on a high-risk index created prior to the study, which included a list of thirteen sociodemographic factors that were weighted according to each's presumed importance in predisposing a child to developmental delays (Campbell et al. 2002; Raney et al. 1975). This index included factors such as "parental education, family income, use of welfare funds, evidence of academic failure in other family members, and other indicators of problems within the family" (Campbell & Ramey, 2010). Additionally, as in Perry Preschool, children had to appear to be free of biological conditions that might be associated with or contribute to mental, sensory, or motor disabilities (Campbell et al., 2002). The focus on risk indexes is in line with the accumulation of risks model, and thus the Abecedarian model might be conceptualized as a preventive measure to reduce adverse outcomes associated with risk clustering and chains-of-risk. Additionally, the shift to targeting children at an earlier age is in line with critical period models, where early prevention is necessary and more effective than later life remediation attempts.

At the end of recruitment, 123 families were invited to enroll and 109 families eventually accepted their random assignment for a total sample size of 111 children at the start of the study (Campbell & Ramey, 2010), including one set of twins as well as a pair of siblings born fifteen months apart (Campbell et al., 2012). The final sample was predominantly Black, though race was not a criterion assessed during the selection process (Campbell et al., 2002). The median age for mothers of children in the Abecedarian project was 20 (Campbell et al., 2002), and a third were 17 or younger (Campbell & Ramey, 1991). Many of the mothers in the sample were unmarried (Campbell et al., 2002), had no earned income, and had less than a high school education (Campbell & Ramey, 1991). Additionally, about 45% of families in the final sample received public assistance (Campbell & Ramey, 2010).

Placement into control or treatment groups occurred at two separate points in the Carolina Abecedarian Project—prior to preschool and prior to entry into public school at age 5 (Campbell et al. 2012). Consequently, the amount of treatment ranged from a maximum of 8 years for children in the treatment group for both preschool and elementary school, to a minimum of no intervention (Campbell et al., 2012). Children in the preschool treatment received either 5 or 8 years of treatment on average depending on whether or not they were subsequently assigned to the school-age intervention (Campbell et al. 2012). The first round of random assignment (prior to preschool) involved pair-matching children based on "sex of the child, maternal IQ, number of siblings, and high-risk index scores" (Ramey et al., 1975).

Ultimately, 57 children were assigned to the treatment group and received full-day child care year round (Campbell et al., 2002). The other 54 children were assigned to a control group that received nutritional supplements for the first 15 months of life (Ramey et al., 1975), but no educational or other intervention was provided (Campbell et al., 2002). However, many Abecedarian controls attended various types of non-parental care (Campbell et al., 2002). Children in the preschool program also had access to on-site pediatric care (Campbell & Ramey, 2010), while those in the control group had access to well-baby care at local clinics for a low cost (Muennig et al., 2011). Subsequent follow-ups revealed that later outcomes were driven primarily by the preschool rather than school-age intervention, and analyses beginning at age 21 for participants only make comparisons based on preschool treatment differences (Campbell et al., 2012). As such, the school-age treatment protocol and conditions will be omitted.

Children attended the Abecedarian program for 9 hours per day (Conti et al., 2016), five days a week, year-round (Campbell & Ramey, 2010). Infants were allowed to enter the program beginning at six weeks of age, though the mean age at entry was about 4.5 months and the maximum age at entry was 6 months (Campbell & Ramey, 2010). As such, within the frameworks of life course health and life cycle skill development, we might hypothesize that Abecedarian would produce stronger impacts for its treatment children than Perry Preschool or other interventions that were shorter in length and/or took place later in childhood, especially in light of critical period models. The Abecedarian curriculum was devised by Joseph Sparling and Isabel Lewis and was "designed to enhance perceptual-motor, cognitive, language, and social development" (Campbell & Ramey, 2010). A special emphasis was placed on language, and teachers in the program were "extensively trained in enhancing sociolinguistic skills" (Campbell & Ramey, 2010). Other educational materials were highly individualized and designed to minimize maladaptive behavior and promote health adult-infant interactions to further nurture healthy development (Conti et al., 2016). In addition to language, development of cognition and adaptive behavior—especially socially adaptive behavior—were two other prominent goals of the educational intervention in early childhood (Campbell et al., 2002).

Long-Term Outcomes from Model Preschools

One of the hallmarks of Perry Preschool's lasting influence is its commitment to longitudinal follow-ups. These follow-ups occurred at approximately ages 15, 19, 27, and 40, and show long-term improvements across a variety of outcomes (Heckman et al., 2010). Perry Preschool participants at the age 27 follow-up were more likely to have graduated from high school, which in itself is a predictor of better adult outcomes including higher lifetime earnings and greater access to work (Belfield et al., 2005). Indeed, work by Heckman et al. show statistically significant improvements in income and employment for males at ages 27 and 40, and greater employment for women at ages 19 and 27 (2010). Preschool participants were also less likely to have ever been arrested or to have been incarcerated at the time of follow-up (Belfield et al., 2005).

Importantly for this thesis, participation in Perry Preschool also appears to produce health benefits in adulthood relative to controls. A follow-up of the Perry Preschool participants at age 40 assessed health behaviors such as traffic safety practices, tobacco, alcohol, & illicit substance use, and the use of preventive health services (Muennig et al., 2009). Participants in the treatment group demonstrated a significant reduction in risky health behaviors compared to controls that was largely driven by better traffic safety practices and decreased drug use (Muennig et al., 2009). Another study reported that Perry Preschool participants had practical reductions in daily tobacco use and heavy alcohol use, though these findings failed to reach statistical significance

(Englund et al., 2017). A statistically significant reduction was found in the likelihood of engaging in two or more health compromising behaviors, including frequent or heavy drug use, daily or regular tobacco use, and frequent or heavy alcohol use (Englund et al., 2017). Conti et al., when separating effects by gender, found that males in the Perry treatment group showed significant reductions in both intensity and prevalence of smoking at age 27 that were sustained through the age 40 follow-up (2016). The same study also found that treated males were more likely to make dietary changes at the 40-year-old follow-up, and that treated females were more likely to engage in regular physical activity (Conti et al., 2016).

Like Perry, the Abecedarian study also followed its participants into adulthood. These follow-ups showed that participants in the preschool treatment group were more likely to have graduated high school and to have attended a four-year college by age 21 (Schweinhart 2013) and were less likely to be teen parents (Duncan & Magnuson, 2013). Other longitudinal measures of Abecedarian participants showed improvements in health as indicated by lower risk factors for cardiovascular and metabolic disease (Campbell et al., 2014). Specifically, treated males had lower values of both systolic and diastolic blood pressure and were less likely to be in stage I hypertension (Campbell et al., 2014). Additionally, both treated males and females had significantly lower risk of coronary heart disease. Women in the treatment group also demonstrated health benefits including increases in physical activity, more nutritious diets, and a lower likelihood of consuming alcohol before the age of 17 (Campbell et al., 2014). Men in the treatment group had later onset of tobacco and marijuana use than controls (Campbell et al., 2014). Muennig et al.

similarly reported later onset of regular cigarette smoking and marijuana use, in addition to fewer incidences of smoking marijuana in the previous month (2011).

While the incidence of long-term benefits for children attending early interventions was an exciting new area for research, such findings were also a bit unexpected, particularly for Perry Preschool. Unlike Abecedarian, the Perry model contained no overt medical intervention and it had much lower standards for nutrition (Conti et al., 2016). Thus, it seems reasonable that health benefits may have accrued to participants indirectly through pathways of increased educational attainment and other measures of adult SES facilitated by enhanced school readiness, in line with the social mobility model. Though Perry Preschool participants showed significant gains in IQ scores during the program, these effects disappeared entirely for males shortly after completion of the program and remained only borderline significant for females (Heckman et al., 2013). In contrast, children in the Abecedarian preschool program did experience statistically significant IQ gains that persisted even after the program had concluded, which is more in line with the critical period model (Conti et al., 2016). Despite differences between programs in IQ treatment effects, both Perry Preschool and Abecedarian participants were found to have better health behaviors in adulthood (Conti et al., 2016).

Later analyses of factors that might mediate the treatment effects of Perry Preschool and health outcomes found noncognitive skills, specifically externalizing behavior, were the primary driver for reduced smoking behavior in males, and remained so even when educational attainment and SES in adulthood were controlled for (Conti et al., 2016). In females, increased academic motivation explained around 30% of the treatment effect on academic achievement at age eight, and reduced externalizing behavior was also found to have a significant on later life outcomes including health behaviors (Heckman et al., 2013). Similar analysis of the Abecedarian program treatment effects found that the long-term health outcomes were mediated by task orientation and childhood BMI and that childhood traits predicted better health even after controlling for adult SES (Conti et al., 2016). These findings lend further support to critical period models that hypothesize early life experiences influence future outcomes through mechanisms outside of their influence on future achievement.

Statistical Limits of Model Preschool Research

While model preschool programs are a crucial addition to early childhood research due to the high-quality nature of their interventions, their randomized-controlled experimental design, and their longitudinal follow-ups, they still suffer from some important limitations. Some such limitations are natural consequences of the aforementioned strengths. These limitations often pose significant issues for conducting statistical analysis and will be discussed throughout this section. While some studies do take into account the statistical challenges mentioned hereafter, many do not, and methodologies often vary in those that do conduct specialized analyses based on statistical challenges. Thus, it is important to keep such limitations in mind when discussing the impact of both Perry Preschool and Abecedarian interventions.

The use of a randomized-controlled design, while allowing for causal interpretations of program effects, necessarily places limits on the size of the sample for each intervention. Small sample sizes limit the generalizability of treatment effects to other populations as well as hinder the statistical analysis and interpretation of such treatment effects. Both the Perry Preschool and Abecedarian interventions had relatively small sample sizes, and while this is a common occurrence in social experiments, such small samples may violate assumptions of common statistical procedures and require the use more tailored methods of analysis (Conti et al., 2016). Additionally, the observance of multiple outcomes in both interventions requires sophisticated corrections for multiple hypotheses to prevent the rejection of a true null hypothesis. Failure to account for multiple hypotheses can lead to the erroneous reporting of significant treatment effects that arise by chance (Conti et al., 2016). Longitudinal follow-ups also introduce the potential for non-random attrition, or failure to continue participation in the intervention for reasons that might contribute to treatment outcomes, and as such this must also be taken into account (Conti et al., 2016).

Another difficulty arises from the fact that randomized-controlled designs can be difficult to implement perfectly, and compromised randomization protocols can lead to additional issues with statistical analysis. Perfect randomization ensures that treatment assignment is not correlated with any observed or unobserved differences in baseline characteristics. Violation of randomization protocol, however, introduces the potential for treatment effects to be influenced in part by baseline characteristics and can introduce differences in covariates between the treatment and control groups (Heckman et al., 2010). While the Abecedarian intervention was not subject to compromised randomization, some children in the Perry Preschool intervention were reassigned because maternal employment prevented compliance with home visits (Berrueta-Clement et al., 1984). Thus, for the Perry Preschool intervention, careful attention must be paid to violations of the randomization protocol and its implications for interpreting treatment effects.

CHAPTER THREE

Head Start and Limitations in the Literature

Project Head Start

President Lyndon B. Johnson's declaration of "War on Poverty" launched an era of social welfare that sowed the seeds for the inauguration of Head Start, a comprehensive preschool program designed to stop the cycle of poverty and provide disadvantaged children a fair shot at educational and labor market success (USDHHS, *History of Head Start*, 2019). In order to achieve these goals, Head Start takes a "whole child" approach to early childhood development that emphasizes cognitive, social-emotional, and physical domains of development as well as encourages active parental involvement in the child's learning (*The Head Start Model*, n.d.).). Though the program was officially launched in the summer of 1965, it existed only as an eight-week intervention until Congress approved funding for the more traditional nine month preschool program in 1966 (USDHHS, *History of Head Start*, 2019). The current Head School preschool model offers free services to promote early learning, health, and family well-being for children between the ages of three and five that meet eligibility criteria (USDHHS, *Head Start Services*, 2020). Like Perry Preschool and Abecedarian, Head Start also targets disadvantaged children by requiring at least ninety percent of preschool enrollment to include children with family income at or below the poverty line or eligible for public assistance, homeless children, or children in foster care (USDHHS, *Poverty Guidelines and Determining Eligibility for Participation in Head Start Programs,* 2020).

In 2019, the vast majority of Head Start preschool services were provided in center-based settings that operated full- or part-time (for a minimum of 3.5 hours) four or five days a week (USDHHS, *Head Start Program Facts*, 2020). Interventions provided within Head Start include planned and spontaneous learning experiences, health screenings, nutritious meals, referrals to preventive health services, and parental engagement programs (USDHHS, *Head Start Services*, 2020).

Head Start's age demographics and dedication to parental involvement is reminiscent of Perry Preschool, while its provision of preventative health services and nutrition are in line with the Abecedarian intervention. These similarities, in addition to the common theme of early learning across all three programs, might lead one to reasonably hypothesize that Head Start could exhibit long-term improvements in health outcomes similar to those found in both Perry Preschool and Abecedarian. Longitudinal study of Head Start enrollees could test the validity of two major critiques facing findings from model preschool programs: that statistical challenges should limit our confidence in observed benefits and that, even if valid, such benefits may be confined to high-quality and well-funded experimental environments. Furthermore, studying long-term outcomes of Head Start could add to the growing literature devoted to mechanisms through which early intervention programs operate, especially the potential role for noncognitive skills. Despite the promising evidence from Perry Preschool and Abecedarian, however, the current Head Start literature is decidedly more mixed. The rest of this chapter will explore the state of Head Start literature, highlighting limitations that have historically prevented its study and acknowledging gaps that future studies should aim to fill.

The State of Head Start Research

The Problem of Selection Bias

One of the earliest assessments of Head Start was conducted by the Westinghouse Learning Corporation and Ohio University and published in 1969, just a few years after the program's inception (Office of Economic Opportunity, 1969). The primary question this study sought to answer was as follows:

> (p. 1) Taking [Head Start] as a whole as it has operated to date, to what degree has it had psychological and intellectual impact on children that has persisted into the primary grades? (Westinghouse Learning Corporation, 1969)

To answer this question, the researchers compared a sample of children in first, second, and third grade that had attended either summer and full-time Head Start programs with a control group of children within the same grade level at the same school that were matched on several observable characteristics (Office of Economic Opportunity, 1969). The study concluded that neither Head Start group showed improvements in affective ability (indicated by measures of self-concept, attitudes, and classroom behavior) and only children who attended Head Start for the full year had any significant improvements in cognitive ability, though improvements were slight and not distinguishable on all cognitive measures (Office of Economic Opportunity, 1969).

A glaring limitation of this study is the reliance on *post hoc* assignments to treatment and control groups, which makes the study liable to selection bias (Barnow & Cain, 1977). Whereas randomized controlled trials are effective in ensuring that treatment and control groups are equally distributed and can reasonably assume that treatment conditions are causally related to treatment outcomes, observational studies are prone to confounding. The issue of selection bias, particularly negative bias, is a recurring issue that must be considered in Head Start because the targeted nature of the program means children that enroll tend to be more disadvantaged than their peers. Adequately reducing or eliminating unintended effects of selection requires the use of either experimental or well-designed quasi-experimental methods, and research on Head Start's outcomes for students have largely split into one of these two directions. One avenue of Head Start literature has moved toward studying existing datasets with quasi-experimental methods, including family fixed effects models, propensity scores, and regression discontinuities, to better control for pretreatment differences between groups that might be correlated with Head Start attendance (Pages et al., 2020; Deming, 2009, Currie & Thomas, 1995; Thompson, 2018). Meanwhile, a separate wealth of research has been developed from experimental data presented in the Head Start Impact Study (USDHHS, 2010). The contributions of these studies, as well as their strengths and limitations, will be analyzed in the following section.

The Head Start Impact Study

The Head Start Impact Study (HSIS) was mandated by Congress as part of the reauthorization of Head Start in 1998 with the goal of demonstrating causal effects of Head Start on children's outcomes (USDHHS, 2010). To do this, a nationally representative sample of 4,667 children aged three and four that were eligible for Head Start were randomly assigned to a treatment group or control group and data were collected beginning in 2002, when children entered Head Start, and continued through the spring of 2006, when children had finished first grade (USDHHS, 2010). Those assigned to the treatment group were allowed to enroll in Head Start, while those in the control group were denied enrollment in Head Start but were free to enroll in other forms of preschool or child care (USDHHS, 2010). In line with Head Start's mission to benefit the "whole child" (*The Head Start Model*, n.d), the HSIS was interested in measuring impacts across domains of cognitive and social-emotional development, health, and parenting (USDHHS, 2010).

General findings from the HSIS on cognitive outcomes, including language and literacy, pre-writing, and math skills, showed initial increases in standardized assessments of language and literacy that had largely disappeared by first grade for both three- and four-year-old's, which is similar to the pattern exhibited by Perry Preschool students (USDHHS, 2010). Social-emotional outcomes, indicated by measures of behavior, social skills, approaches to learning, adult-child relationships, and school adjustment, were mixed between age cohorts (USDHHS, 2010). The four-year-old cohort showed no significant improvements in social-emotional development throughout Head Start and kindergarten, but two unfavorable and one positive outcome emerged after first grade; in contrast, the three-year-old's were significantly less hyperactive at both the end of Head Start and kindergarten and had better parental relationships at the end of first grade (USDHHS, 2010). Finally, both cohorts show significant increases in measures of health that become mostly non-significant by the end of first grade while parenting impacts are concentrated in the three-year-old cohort and mostly reach non-significance by the end of first grade (USDHHS, 2010).

All in all, the findings from different domains are mixed across cohorts and, for the most part, fail to remain significant at the end of first grade. This data, combined with the Westinghouse study and other early analyses paint a rather unexceptional picture of

Head Start in which modest skill gains are quickly lost as children leave the program. Yet, there are a few limitations in the HSIS that prevent early conclusions regarding the efficacy of Head Start in boosting long-term outcomes. First, the counterfactual condition in the HSIS is markedly different from that in model preschool programs, likely due to the fact that the availability of early childhood programs has increased over the years (Zhai et al., 2014). Over half of the children in the control group obtained other preschool or child care, meaning Head Start's impact was assessed, in part, by whether it showed treatment effects above and beyond other preschool programs (USDHHS, 2010). Further complicating the matter is the issue of non-compliance, as not all children assigned to Head Start participated and some children assigned to the control group were able to enroll in other Head Start programs (Zhai et al., 2014). Due to this, several studies conduct intent-to-treat analyses alongside corrections for non-compliance (Zhai et al., 2014). After re-analyzing the HSIS effects according to differences in the counterfactual, Zhai et al. found that Head Start was most effective for measures of cognitive and noncognitive outcomes when compared to control children in parental care (2014).

Another important point to make is that, while the HSIS measures average treatment effects, children in the treatment group may not benefit from Head Start in a uniform fashion. Inter-individual differences in treatment effects may be the result of variance in environmental quality or the training and qualifications of Head Start teachers varied across preschool centers (USDHHS, 2010). Differences in children's backgrounds can also drive different experiences and effects, and the HSIS showed that child outcomes varied based on factors including the child's baseline academic skills, household risk, parental depression, and whether or not the child had special needs

(USDHHS, 2010). Kline & Walters (2016) found that Head Start treatment effects are increased in children that would have otherwise not attended a preschool program. Additionally, Morris et al. found larger treatment impacts on cognitive measures for children with low baseline testing performance, dual language learners, and children whose primary home language was Spanish rather than English (2018). While the HSIS suffered from many challenges, studies mentioned throughout this section have overcome some of these limitations to provide other meaningful conclusions.

Longitudinal Studies of Head Start

More recent studies have adopted innovative study designs in order to utilize existing longitudinal data. Such quasi-experimental studies can be used to study causal treatment effects in the absence of randomized-controlled trials. In fact, a meta-analysis on Head Start research found that the study design did not predict effect size, which aligns with other research suggesting that, like randomized controlled trials, quasi-experimental methods may be able to produce causal estimates (Shager et al., 2013). Carneiro & Ginja (2014) exploit eligibility rules and differences in Head Start funding to to create a natural experiment between Head Start participants and other children that would be eligible for Head Start but did not participate. Mid- and long-term finding from this study included reductions in behavioral problems, chronic conditions, and obesity in adolescence and reductions in crime in young adulthood (Carneiro & Ginja, 2014). Reductions in behavioral problems were found at ages 12-13, and a statistically significant reduction in depression symptoms measured by the CES-D were found at ages 16-17 (Carneiro & Ginja, 2014).

The Carneiro & Ginja study is strengthened by including specific alternative care options that include both enrollment in other preschool or in informal care as counterfactuals to Head Start. One limitation of this study is that it only measures effects through young adulthood, which might miss differences in chronic diseases or other health conditions that tend to develop later in the life course. Though the authors found little evidence of sustained cognitive benefits, improvements in behavior and health were maintained. As such, noncognitive skills may be an area of particular interest and indicates that further study on Head Start's noncognitive treatment effects may be an important ingredient for understanding the presence of long-term benefits in spite of cognitive fade-out (Carneiro & Ginja, 2014).

A pair of other notable studies also utilized the CNLSY data set to measure long-term outcomes. Deming (2009) and Pages et al. (2020) use pairs of siblings from the CNLSY and a fixed family design to estimate the long-term treatment effects of Head Start attendance. Measured outcomes in both studies include young adult indicators of educational attainment and self-reported health status (Deming, 2009; Pages et al., 2020). Deming finds that Head Start participation significantly improves outcomes on a summary index that includes high school graduation, college attendance, idleness, crime, teen parenthood, and health status (2009). Furthermore, he finds that this effect is greater for Black children and children experiencing a relatively higher amount of disadvantage (Deming, 2009). In regard to specific outcomes, Head Start participants were more likely to have graduated from high school and less likely to be in poor health as measured by self-rated health status.

The study by Pages et al. follows the methodology of Deming (2009), but includes an additional ten years of analysis for Deming's original cohorts and ten additional birth cohorts. In comparison to Deming, Pages et al. find that treatment effects of Head Start on the same summary index of adult outcomes were negative and significant for later cohorts, and that pooling Deming's original cohorts with the later cohorts reduced Head Start impacts to non-significance. Analyses for longer-term outcomes of Deming's original cohorts included completed years of schooling, college graduation rate, and adulthood earnings (Pages et al., 2020). Though Head Start was shown to increase years of schooling compared to children not attending preschool, no significant increases in college graduation rate nor adulthood earnings were found (Pages et al., 2020). While investigating school-age outcomes that might help to explain longer-term outcomes, Pages et al. found negative impacts of Head Start on reports from the Behavior Problems Index and smaller initial gains in cognitive scores (2020). Thus, the cohort differences are striking, and future study of Head Start would benefit from determining whether children's background characteristics influence the efficacy of the program and identifying subgroups of children that might experience more benefits from attendance than others.

Looking Forward

Recent focus on longitudinal studies for measuring long-term outcomes of Head Start participation are moving the existing Head Start literature in a good direction. As evidenced especially by the Perry Preschool program, long-term outcomes may exist even in the absence of significant cognitive gains. Additionally, both the Perry Preschool and Abecedarian programs have indicated a potential important role for non-cognitive outcomes in mediating long-term outcomes. The finding that long-term outcomes exist in spite of small or fading cognitive gains is mostly supported in the current Head Start literature, though treatment effects are relatively varied based on the specific outcome measured and may vary across population demographics. In the next and final chapter I will describe directions for future study that build on the few existing longitudinal studies to further expand our understanding of Head Start as a potential tool for reducing health disparities. I will address how future studies could benefit by shifting from economic perspectives to more sociological approaches that place a greater emphasis on Head Start within a life course health framework. Such research will not only help to further our understanding of the origins of health disparities, but might provide insight into ways in which Head Start and other early childhood interventions might be improved to improve long-term health outcomes.

CHAPTER FOUR

Directions for Future Study

Recommendations for Future Research

Children of the National Longitudinal Survey of Youth 1979

The U.S. Bureau of Labor Statistics, within the Department of Labor, conducted a series of National Longitudinal Surveys (NLS) in order to study labor market activities of U.S. men and women over the life course. Among these is the National Longitudinal Survey of Youth 1979 (NLSY79), which follows a nationally representative sample of 12,686 men and women born between 1957 and 1964. This NLSY79 contains a wide variety of data relevant to study of life course health, including information on education, employment, income, health, and attitudes (U.S. Bureau of Labor Statistics, *Topical Guide to the Data*, n.d.). The NLSY79 is a remarkable wealth of data in itself, but equally or perhaps even more exciting for researchers in early childhood education is its subsequent study of all children born to mothers from the original NLSY79 sample. This new sample, Children of the NLSY79 (CNLSY) is incredibly useful due in part to its rich data on maternal variables, inclusion of all children born to NLSY79 mothers in the sample, and its longitudinal study on those children beginning in early childhood and continuing through young adulthood (Wu & Li, 2005). As of 2016, the CNLSY sample contained 11,530 individuals split into Child and Young Adult cohorts, where those in the Child sample are eventually added to the Young Adult sample (U.S. Bureau of Labor Statistics, *Topical Guide to the Data*, n.d.).

Several studies of Head Start outcomes have used a family fixed effects model to compare siblings from the CNLSY that attended Head Start with siblings that attended other programs or did not attend any preschool (Currie & Thomas, 1995; Garces et al., 2002; Deming, 2009, Pages et al., 2020). Using this quasi-experimental model eliminates the effect of family-level characteristics, both observed and unobserved, that might be correlated with enrollment in Head Start and could thus introduce selection bias into the comparison between treatment and controls (Miller et al., 2019). While this model can be helpful, it faces threats to internal validity through potential sibling spill-over effects and within-family differences that might result in one sibling being more likely to enroll in Head Start than the other (Currie & Thomas, 1995). Family fixed effects models can also introduce external validity when systematic differences between families influence whether siblings differ on a treatment variable (Miller et al., 2019). Despite these limitations, the fixed family effects model dominates quasi-experimental studies of Head Start and seems to be one of the best methods for attempting to examine longitudinal treatment effects of Head Start in the absence of randomized-controlled experimental data. As such, future research on Head Start would benefit from continuing to use this model in combination with sibling data available in the CNLSY to explore long-term outcomes beyond those typically studied in cost-benefit analyses.

Key Measures

Treatment. Within the CNLSY, Head Start status can be assessed by the following questions: "*Has (child) ever been enrolled in a preschool program (excluding kindergarten)?"; "Has child ever been enrolled in day care?"; and "Has child ever been* *enrolled in the Head Start Program?"* (U.S. Bureau of Labor Statistics, *Education,* n.d). Measures indicating the child's age at entry to Head Start and the duration of attendance might also be useful variables to consider in future studies. Lee (2008) showed that effects on reading outcomes may be greater among children that enrolled in Head Start at age three vs. age four, and the Head Start Impact Study found many treatment effects that varied between age cohorts (USDHHS, 2010). The inclusion of variables indicating the type of care received by siblings that do not attend Head Start is also important, as the counterfactual to which Head Start is compared may substantially alter the effect sizes of outcomes (Zhai et al., 2014).

Health Outcomes. Both Perry and Abecedarian programs gathered data on health behaviors during follow-ups with participants in adulthood and found favorable impacts on at least some measure of health behaviors for each program, giving credence to the hypothesis that early childhood education might shape subsequent health behaviors/lifestyles (Englund et al., 2017). Risky health behaviors are stratified by socioeconomic status and increase the likelihood of adverse health events and mortality (Lantz et al., 1998). Studies have also shown that health behaviors tend to co-occur in patterned ways, termed health lifestyles, and such lifestyles are largely predicted by social background—especially household resources (Mollborn et al., 2014). Health lifestyles in early childhood can also be predictive of developmental trajectories in kindergarten (Mollborn et al., 2014). As such, the potential effect of early interventions in improving health behaviors/lifestyles should be of interest to not only researchers in early childhood education, but also those in public health, medicine, and other related fields.

Cognitive and Noncognitive Skills. Noncognitive skills have been an important theme throughout this thesis. Further understanding of the relationship between noncognitive skill development and long-term outcomes could be aided by measuring noncognitive indicators from the CNLSY in addition to measures of health. Such indicators include a set of questions about risk behavior in children, questions about child depression, and the Self-Perception Profile for Children, which measures self-worth and self-competence (U.S. Bureau of Labor Statistics, *Attitudes, Expectations, Non-Cognitive Tests, Activities*, n.d.). Adolescent measures of personality traits from the Ten-Item Personality Inventory (TIPI), depression symptoms from the Center for Epidemiological Studies Depression Scale (CES-D), self-concept and locus of control from the Pearlin Mastery Scale, self-esteem the Rosenberg Self-Esteem Scale, and indicators of risk taking are also available in some survey years and could provide rich information about the effect of Head Start on noncognitive outcomes (U.S. Bureau of Labor Statistics, *Attitudes, Expectations, Non-Cognitive Tests, Activities*, n.d.). However, traditional cognitive measures including IQ and achievement test scores should also be assessed in order to provide a better picture of the relative influence of either domain on long-term outcomes as well as to help illustrate how and where both cognitive and noncognitive skills might fit into life course models of health.

Filling in the Gaps

Evidence from model preschool programs, as well as existing short- and long-term studies of Head Start, show that participation in early childhood education can boost outcomes in adulthood across many domains, one of which is health. Existing longitudinal data on Head Start with multiple indicators of health and noncognitive measures provides the opportunity to examine this widely-implemented early childhood intervention through the lens of life course health. While more studies are beginning to look at longitudinal treatment effects of Head Start, many do so from an economics perspective that tends to be more interested the return-on-investment for key labor market outcomes rather than the specific channels through which early childhood education might be producing these benefits. Drawing on the life course health framework, we might expect the *pathways* model to be one channel through which Head Start influences adult health. In Perry Preschool, differences in health insurance coverage between treatment and control groups exhibited a pathway trajectory and were mediated almost entirely by adult SES, specifically occupation.

Health outcomes such as being overweight or obese, engaging in risky health behaviors, and measures of self-rated health that are not as directly linked to adult occupation may operate through other or even multiple life course models. Though the accumulation of risk pathway was discussed earlier, its counterpart is the accumulation of advantage pathway. If Head Start is effectively improving the life trajectories of its students, we might expect that differences between Head Start students and their siblings that do not attend Head Start will increase as they get older. If Head Start confers an advantage for children, relative to their siblings, this advantage could accumulate sequentially such that increased academic readiness might lead to higher educational attainment, which can influence job prestige, which can influence income, and all of which might influence health.

Another hypothesis in line with the arguments from Knudsen et al. (2006) is that early childhood education might act according to the critical period model by conferring skills and/or preventing the biological or psychological embedding of risk factors associated with SED during periods of development that are especially susceptible to inputs or the lack thereof. Much of the life course health literature focuses on how social structures and other factors help the healthy remain healthy and the unhealthy remain unhealthy. Yet, finding and understanding mechanisms to break intergenerational cycles of disadvantage is clearly an important goal for those that study life course health.

Following the work of Heckman and colleagues, one direction in which the Head Start research should venture is to analyze the treatment effect of Head Start on both noncognitive skills and health outcomes. The theoretical background for interactions between life cycle skill formation and life course health have been discussed earlier in this thesis, and subsequent study of the Perry Preschool and Abecedarian have given further support for noncognitive channels as a mechanism linking early childhood education to health in later life. Several attitude scales that are not present in the Child sample were added to the Young Adult sample of the CNLSY, effectively covering a wide range of commonly referenced noncognitive skills, including self-concept and mastery, self-esteem, risk taking behavior, and personality. The creation of a larger summary index of health that includes other measures such as BMI, health behaviors/lifestyles, and depression might also be beneficial for determining whether improvements on separate indicators of health found in Carneiro & Ginja (2014), Anderson et al. (2010), and Thompson (2018) can be replicated within a different sample.

Finally, drawing on earlier findings that Head Start differentially benefits its participants and the surprising Pages et al. (2020) results indicating negative outcomes of Head Start attendance for younger cohorts of the CNLSY in comparison to the generally positive outcomes from Deming's (2009) study of older cohorts within the same sample, future research should continue to try to gauge whether short- and long-term benefits to Head Start differ across subgroups. Notably, the Pages et al. (2020) and Deming (2009) cohorts differed on mother's age at childbirth and a pretreatment index that included maternal demographics such as income, health, and work history, with both measures favoring the younger cohorts born to older mothers (Pages et al., 2020). When exploring the ways in which Perry Preschool and Abecedarian affected health outcomes, Conti et al. (2016) found differences in treatment effects when analyses were conducted by gender, indicating that a study of Head Start and adult health might also benefit from gender-specific analyses. Examining variance in treatment effect across subgroups could provide insight regarding which students seem to benefit the most from Head Start as well as add to our understanding of the role early childhood interventions might play in life course models of health.

Utilizing the suggestions above will necessarily have limitations in addition to benefits. As mentioned earlier, even with quasi-experimental design methods, observation studies are liable to selection bias and thus have limits to determining causality. Thus, any reported associations between Head Start and future health would need to be interpreted with caution. Additionally, conducting a longitudinal study on a cohort that attended Head Start decades ago is necessarily limited because both the program and the social climate have evolved over time. Thus, the results of this study may be limited in their generalizability to Head Start as it exists today. However, I believe that this work will be important in spite of these limitations because it will improve our knowledge regarding how and when interventions in childhood might improve health over the life course. Life course models of health provide rich information about the ways in which SED shapes health outcomes throughout the life course, but their greatest strength is in informing ways in which interventions might break negative cycles and promote long-lasting health benefits. Head Start, as one of the United States' largest early childhood interventions, is a reasonable target for study into how such interventions might alter trajectories illustrated by life course health models. Reducing health disparities should be a goal for all members of society and further research into early childhood interventions will hopefully help to promote this cause and move us further toward a reality in which good health is within reach for all members of society.

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