My research question focuses on one determinant of educational outcomes--kindergarten attendance, placing my research in the literature of human capital investments and early childhood interventions. I will begin my review of the literature broadly, with a review of the human capital literature's findings on the determinants of educational outcomes. I will then lay the groundwork of my theoretical approach, which is grounded in the work of Cunha and Heckman, before concluding with a review of the literature's empirical findings regarding the effects of kindergarten/preschool.

\subsection{Determinants of Educational Outcomes}

Broadly, we can categorize determinants of educational outcomes into two: 1) genetic endowments--often referred to as `ability'--and 2) human capital investments. First, we can think of genetic endowment as something fixed at birth; it's exceedingly difficult to measure, but the idea is that something like an individual's intelligence quotient (IQ) is indicative of `natural talent', \textit{independent} of their lived experiences. There is a great deal of evidence that endowments of talent, ability, or intelligence have an effect on educational attainment--one influential estimate of the correlation of intelligence and educational attainment is 0.5. \citep{Johnson2005} One study of twins in Australia, found that between 50 and 65\% of variance in educational attainments between sets of twins could be explained by genetic endowments, a finding in-line with preceding estimates. \citep{Miller2001} Behrman and Taubman estimate the share is 90 percent. \citep{Behrman1989} One longitudinal study of about 70,000 children in the United Kingdom found the correlation between a child's ``latent intelligence trait" and their standardized test scores 5 years later to be 0.81. \citep{Deary2007} Clearly, genetic endowments can't be ignored.

Studies examining the role of natural endowments in human capital accumulation, however, harbor fundamental flaws. First, they rely on a convoluted causal story; there's evidence that more time in school increases latent intelligence, creating a virtuous cycle. Additionally, the relationship between genetics and educational attainment is very heterogenous--there's evidence, for example, that as limits on women's opportunity to attain education decreased in the 1970s and 1980s, the relationship between genetics and educational attainment strengthened. \citep{Herd2019} The dominance granted genetics by the estimates described above may be wildly divergent in contexts where there are either greater constraints on access to education, or (as described below) the opportunity cost of education is so high as to entirely distort human capital investment decision-making.

The second issue with studying genetic endowments' effects on educational attainment, is that `latent talent' is very difficult to measure--hence the predominance of twin studies, where easy-to-measure genetic differences can be exploited to associate genetic variance with educational variance. \citep{Miller2001} For measuring genetic endowment outside of the twin context, however, some scholars have pointed out that standardized tests of intelligence resemble classroom work, putting into question the ability of these tests to distinguish between the endowments independent of a child's upbringing and the results of those upbringing. \citep{Johnson2009} The limits of measuring latent intelligence can be best illustrated with a simple example; what if a child is illiterate, and thus unable to complete the written test measuring their latent intelligence? In the context of my work and development in general, this is a rather profound problem.

These difficulties prevent me from studying genetic endowments in this research--thus, I focus on the latter category of determinants of educational attainment, human capital investments. While in theory I could incorporate variables collected during a mother's pregnancy (attempting to control for genetic endowments traced back to the ``fetal origins hypothesis"), such data would prohibitively restrict my sample size. \citep{Almond2011} I do attempt to control for \textit{some} genetic variation by including controls for health as well as visits to healthcare (perhaps a child is naturally sickly), although this is only a preliminary step towards understanding the role of genetics in human capital accumulation in Indonesia.

Second, I'll focus on my area of study--human capital decision-making. Becker began by understanding education as a form of investment; going to school is a choice, and the opportunity cost of attending school is the earnings one could attain by spending that time working and earning an income. \citep{Becker1975} Education obviously alters one's opportunities, and unlocks greater earning capacity--for example, in Indonesia, one estimate from 2020 finds that college graduate workers earn approximately a 60\% higher income than those who left school after senior high school. \citep{Yubilanto2020} This study found it takes 14 years of non-college work to compensate for \textit{not} receiving a bachelor's degree--while this may lead one to think To understand educational attainment, then, begins with understanding the decision to make that investment--a decision sometimes made by the household (this particularly applies to early childhood), and sometimes made by the individual (as a child ages, they increasingly make decisions for themselves).

The models that sprouted from Becker focused either on the relationship between macro earnings and macro schooling (through time-series analysis), or the decision of individuals to invest in education. \citep{Freeman1975} \citep{Willis1979} Other work attempts to combine this understanding of individuals' investment decision-making with household and community characteristics. \citep{Wilson2001} This approach is powerful, and its appeal is clear: for example, in developing countries such as Indonesia, where there is a very strong informal economy and agriculture remains an important sector, the opportunity cost of going to even junior high school may be significant and guide educational attainments such as junior or senior high school graduation. This causal story is, however, complicated by the dynamic nature of childhood investments.

Second, beyond genetic endowments, the literature has found that investments in human capital can determine educational attainment. If the genetic endowment of a child is fixed at birth, then human capital stock is anything but fixed, and changes according to investments. We can divide these investments into two broad categories: human capital investments \textit{within} the household, and human capital investments from \textit{without} the household. For the purpose of this literature review, I'll focus on investments from each of these categories in the early stages of life; henceforth, I'll refer to human capital investments made \textit{without} the household as early childhood interventions, such as attending Head Start in the United States or kindergarten in Indonesia.

My motivation to focus on early childhood is clear: there is overwhelming scientific evidence that at an early age, children's brains are more malleable and receptive to learning skills than at later ages. \citep{Cantor2019} \citep{Duncan2023} In particular, evidence has shown that children's brains are most malleable to new learning for the first five or six years of life--fitting into the early childhood education "window" lasting from birth to the age of 12. \citep{Slegers1997} Brain development doesn't occur just in a classroom--neglect as a child results in brain delays and dysfunction: during this early childhood window, a child is undergoing dynamic transformations, with human capital investments both within the home and without the home interacting in powerful ways. \citep{Perry1997} We can't understand the latter (i.e., the effect of kindergarten), without understanding the former.

The motivation for targeted early childhood programs such as Head Start rely on this interaction; some disadvantaged children are born into situations where neglect occurs--resulting in inequity in brain development and human capital between the advantaged and disadvantaged before a child even enters a classroom. Therefore, it's thought, human capital investments received in the classroom can compensate for a lack of investments made at home for disadvantaged children--promoting equity and efficiency. \citep{Heckman2011}

\subsection{Theoretical Approaches to Studying Early Childhood Education}

In addition to motivating early childhood interventions, economists have used these scientific findings about brain development to create models in which skills learned in early childhood are complementary with skills to be learned later in childhood, as well as an adult, i.e., the influential concepts of self productivity and dynamic complementarity posited by Cunha and Heckman. \citep{Cunha2007} While the dominant assumption of scholarly work previous to Cunha and Heckman followed Becker in treating childhood as a single period (with adulthood as a separate, succeeding, period), Cunha and Heckman instead treated childhood as two periods--with skills learned in the one period having a dynamic complementarity with skills in the second. \citep{Becker1986a} \citep{Cunha2007}

I build off this approach in conceiving of three general stages of childhood human capital investment. First, there's pre-kindergarten--I incorporate controls related to health and how often a child is taken to see a medical practitioner to get a sense of human capital in this very early stage. Second, there's kindergarten itself. Third, there's post-kindergarten--to avoid endogeneity, I don't control for individual characteristics post-kindergarten, although do I control for the theoretically exogenous changes to households, captured by their per-capita household expenditure over time. My research is built off of the assumption that investments made in these three periods interact--a specific hypothesis that I test later.\footnote{ In particular, by interacting health and household variables with kindergarten attendance.} For some more granular educational outcomes I further divide the post-kindergarten period, although again due to endogeneity concerns I limit covariates associated with post-kindergarten periods when analyzing the effect of kindergarten.

\subsection{Empirical Findings of Kindergarten's Effects}

Kindergarten in Indonesia is essentially the equivalent of preschool here in the United States; it's not compulsory and there exists state-owned options and private options (the latter of which is largely responsible for increases in kindergarten attendance, as seen in ~\ref{kinder\_numscatter}). Studies of preschool fall into two categories: 1) randomized control trials (RCTs) and 2) longitudinal studies. \citep{Duncan2013a} My project is the latter, as I track individuals from before they attend kindergarten to until after high school graduation.

I'll begin my review of the empirical findings on preschool's effects by examining the US context. Head Start in the United States is the most common subject of preschool studies: it's a program run by the US Federal Government since the 1960s, when it was established as part of the Great Society. Head Start targets low-income children, so that federal guidelines require 90\% of children served by the program come from families below the poverty line. \citep{Currie1993} The other two most popular US programs to study are the Perry Preschool Program and the Abecedarian Project, both of which are intensive and are implemented at a much smaller scale than the massive Head Start program. \citep{Heckman2010} \citep{Campbell2002} Because the latter two programs are intensive and revolve around very small class sizes, they're favored by scholars employing RCTs. On the other hand, most studies of Head Start rely on longitudinal designs.

Studies of Head Start have shown mixed results regarding its effect on later-life outcomes. In 1993, Thomas and Currie--using mother fixed-effects, just as I do--found that attending Head Start compared to either 1) attending other preschool programs or 2) not attending preschool at all, had some significant effects on test scores for white and Hispanic children, while program participation had no effect for Black children. \citep{Currie1993} For that paper, however, they focused only on \textit{short-term} effects: 10 years later, Thomas, Garces, and Currie revisited Head Start, this time looking at its effects on \textit{long-term} outcomes. Using mother fixed-effects once again, they found evidence that white children who attended Head Start were likelier to complete high school than their siblings who didn't--they also found \textit{some} evidence of the same effect for Black children. \citep{Garces2002} When looking at long-term effects, Thomas, Garces, and Currie, in particular, found strong evidence for a critical concept in the early childhood literature, ``fadeout".

Fadeout is an important concept in the early childhood interventions program; its basic premise is that the positive effects of participating in an early childhood intervention decrease or even approach insignificance as a child ages. \citep{Abenavoli2019} Fadeout is rooted in Cunha and Heckman's multi-stage approach to childhood; in particular, there's evidence that fadeout occurs only when high-quality interventions are not followed by subsequent high-quality educational experiences. \citep{Bailey2017} \citep{Lee1995} \citep{Jenkins2018} Fadeout also reveals significant heterogeneity among preschool programs, as high-quality ones are more durable than lower-quality programs. Clearly, fadeout is far from universal; there's even evidence that preschool leads to reduced adulthood delinquency and crime. \citep{Barnett2008} It's easy to see how this concern directly applies to the Indonesia case: classroom quality is a primary concern for policymakers as PISA test scores have failed to improve in recent years despite near-universal completion of primary school. \citep{Afkar2020} Therefore, fadeout--which I analyze by comparing kindergarten's effects on short- vs. medium- and long-term outcomes--is of prime concern for my research.

Work on preschool in the developing context is limited; this makes sense, as developing countries are less likely to have the overwhelmingly comprehensive multi-wave longitudinal household surveys like the Panel Study of Income Dynamics (PSID) that make researching programs like Head Start possible, particularly for the favored research design of mother fixed-effects, which requires a large number of households, and detailed within-household data. In this, the Indonesian Family Life Survey (for more details, see my ``Data" Section) presents an incredible opportunity.

There are reasons why these effects of preschool interventions might not translate to developing countries. \citep{Dean2020} First, instruction quality might be weaker. Second, the effects of preschool are naturally weighed against the counterfactual--and the counterfactual to early childhood intervention varies widely across contexts.\footnote{ In the US, for example, studies have shown declining effects for Head Start--this, however, is largely attributable to the improving counterfactual to participation, rather than changes in the program's characteristics.} And third, recalling Cunha and Heckman's conception of childhood, subsequent educational experiences can vary--and thus, through dynamic complementarity of skills across stages of childhood, alter the effects of kindergarten.

There's strong motivation to study kindergarten in developing countries--one estimate is that 200 million children below the age of 5 in developing countries don't reach developmental potential due to a lack of resources. \citep{GranthamMcGregor2007} There's a great deal of evidence that drastic increases in kindergarten attendance over time are driven by those with greater socioeconomic resources--a phenomenon that the Indonesian data supports. Overall, however, there's strong evidence that preschool has very strong positive effects--14 studies of developing countries estimate center-based preschool to have a median effect size of 0.33. \citep{Behrman2013} These same studies find significant effects of preschool on educational attainment and educational achievement. There's also significant evidence of fadeout among these studies.

For more specific estimates of kindergarten's effects, Dean and Jayachandran find that, in India, children participating in kindergarten perform 0.8 standard deviations better on cognitive tests than their peers, and that this advantage is persistent even if it decrease over time. \citep{Dean2020} They find no impact on socio-emotional development, however. The type of kindergarten a child attends also matters; one study in Ghana found children attending private kindergarten performed better than their peers who went to know kindergarten at all or who went to public kindergarten. \citep{Pesando2020}

One notable study of preschool in Uruguay, in particular, closely mirrors my research design. \citep{Berlinski2008} The authors found positive significant effects of preschool participation using family fixed-effects; by the age of 15, for example, children who participated in kindergarten completed an extra 0.8 years of education. They focused on grade repetition--ostensibly grade repetition being the result of a lack of skills, although such an approach is clouded by measurement error--as the transmission channel for preschool's effects. Grade repetition, on the other hand, is rare in Indonesia--and it doesn't help to resolve the Indonesian tension between positive educational outcomes on paper, and positive educational outcomes in practice (see the appendix for a more detailed discussion of the educational situation in Indonesia).