ECONOMIC RESEARCH FORUM

منتدى البحوث الاقتصادية

2015

working paper series

THE DETERMINANTS OF CHILD HEALTH DISPARITIES IN JORDAN

Caroline Krafft

Working Paper No. 950

THE DETERMINANTS OF CHILD HEALTH DISPARITIES IN JORDAN

Caroline Krafft

Working Paper 950

October 2015

I thank Ragui Assaad, Marc Bellemare, Paul Glewwe, Massoud Karshenas, Deborah Levison, seminar participants at the University of Minnesota, and conference participants at the Economic Research Forum's 2015 Annual Conference for valuable questions, comments, and suggestions.

Send correspondence to:
Caroline Krafft
University of Minnesota
kraff004@umn.edu

First published in 2015 by
The Economic Research Forum (ERF)
21 Al-Sad Al-Aaly Street
Dokki, Giza
Egypt
www.erf.org.eg

Abstract

The first few years of children's lives provide a crucial window for their human development. Malnutrition, as a form of faltering development in the early years of life, has lasting consequences in terms of education, labor market, and adult health outcomes. Early childhood is also the period when inequality originates and the intergenerational transmission of poverty and inequality begins. It is therefore important to identify the causes of poor health in early childhood and to understand what drives inequality in early health and nutrition in order to provide children with equal chances for healthy growth. In Jordan, there are substantial socio-economic disparities in children's health and nutrition. This paper examines the determinants and mediators of health disparities in children's height and weight in Jordan, focusing on factors that might mediate socio-economic disparities, including parental health knowledge, food quantity and quality, health conditions, the health environment, and prenatal development. While this paper demonstrates that the health environment and food quantity and quality contribute to inequality in child health, these effects mediate only a small share of socio-economic disparities. A large share of inequality in children's health is determined prenatally, for instance through disparities in fetal growth.

JEL Classifications: I14, D63, J24, I12, I15

Keywords: Inequality; Child health; Nutrition; Early childhood development; Jordan

ملخص

السنوات القليلة الأولى من حياة الأطفال توفر نافذة حاسمة للتنمية البشرية. سوء التغذية، كشكل من أشكال تعثر التنمية في السنوات الأولى من الحياة، له عواقب دائمة في مجالات التعليم وسوق العمل، والنتائج الصحية على الكبار. مرحلة الطفولة المبكرة هي أيضا الفترة التي تنبع من عدم المساواة ويبدأ عبر الأجيال الفقر وعدم المساواة. ولذلك فمن المهم تحديد الأسباب للصحة السيئة في مرحلة الطفولة المبكرة وفهم ما يدفع لعدم المساواة في الصحة والتغذية المبكرة من أجل تزويد الأطفال بفرص متساوية لنمو صحي. في الأردن، هناك فوارق اجتماعية واقتصادية كبيرة في صحة الأطفال وتغذيتهم. وتبحث هذه الورقة محددات من الفوارق الصحية في ارتفاع الطفل والوزن في الأردن، مع التركيز على العوامل التي قد توسط الفوارق الاجتماعية والاقتصادية، بما في ذلك المعرفة الأبوية الصحية، كمية الغذاء ونوعيته، والظروف الصحية، والبيئة الصحية، وتطوير ما قبل الولادة. في حين توضح هذه الورقة أن البيئة الصحية وكمية الغذاء ونوعيته تساهم في عدم المساواة في مجال صحة الطفل، فان هذه الآثار لا تكون سوى حصة صغيرة من الفوارق الاجتماعية والاقتصادية. يتم تحديد حصة كبيرة من عدم المساواة في صحة الأطفال قبل الولادة، على سبيل المثال من خلال التفاوت في نمو الجنين.

1. Introduction

The first few years of children's lives provide a crucial window for human development. Faltering growth and development in the early years are difficult to reverse. Early mis-steps in human development have far reaching consequences for children's human capital, affecting later development potential, school success, labor market outcomes, and adult health. Early childhood[1] is also the period when inequality originates and the intergenerational transmission of poverty begins. When children suffer from malnutrition in the early years, it damages their psycho-social development (Dercon & Sánchez, 2013), causes poorer school performance (Glewwe & Miguel, 2008), impairs adult health (Victora et al., 2008), and ultimately lowers wages (Grantham-McGregor et al., 2007). It is therefore of paramount importance to identify the causes of poor early health and nutrition, and to understand what drives inequality in early health and nutrition, in order to provide children with equal chances for healthy growth.

The specific focus of this paper is identifying the mechanisms that mediate socio-economic inequalities in height and weight in Jordan. Essentially, this paper quantifies inequality, first as it relates solely to socio-economic status (parental education, employment, and wealth) and then with the addition of a number of other factors, such as feeding practices, which might be mechanisms through which socio-economic inequality occurs. Comparing inequality across these specifications allows for an assessment of the roles of different factors in both total inequality and mediating socio-economic disparities. A number of potential mediators of socio-economic inequality are examined, including parental health knowledge, food quantity and quality, health conditions, the health environment, and prenatal development.

While numerous papers have examined the roles of socio-economic status in child health inequality (Assaad, Krafft, Hassine, & Salehi-Isfahani, 2012; Khawaja, Dawns, Meyerson-Knox, & Yamout, 2008; Monteiro et al., 2010; Wagstaff, van Doorslaer, & Watanabe, 2003; Wagstaff & Watanabe, 2000; Wamani, Tylleskär, Astrøm, Tumwine, & Peterson, 2004; World Bank, 2012; Zere & McIntyre, 2003), there has been little research on the factors that mediate these socio-economic disparities. Identifying the factors that mediate inequality in early health is crucial to understanding the causes of faltering and disparate early growth and a necessary precursor to designing interventions to reduce inequality and ensure healthy growth.

Malnutrition, by definition, is the result of inadequate food quality and quantity. However, a large number of different behaviors and practices, such as breastfeeding, complementary feeding, total calorie intake, and dietary diversity can contribute to nutrition. The disease environment, public health inputs (such as sanitation, water, and access to medical services), as well as parents' health practices and knowledge can contribute substantially to deficiencies in height and weight. Shortfalls in growth may also be shaped by children's development prior to birth, mediated through maternal health and nutrition and fetal growth. The roles of these different factors in malnutrition, and in mediating socio-economic inequality in child health, remain an unanswered question, and one with important policy implications for addressing malnutrition and the unequal distribution of child health both in Jordan and globally.

To understand the determinants of child health inequality in Jordan, this paper uses Jordan's 2012 Demographic and Health Survey (DHS). Jordan is a country with substantial socio-economic inequality in child health, but moderate levels of malnutrition overall. While children from high

[1] The term "early childhood" lacks a single clear definition in the literature. The margins of early childhood are uncertain in both whether the prenatal period is included in early childhood and how late early childhood extends. In this paper, the term early childhood is used to broadly refer to development from conception until the age of school entry. Specific analyses may use narrower time windows as noted.

socio-economic status backgrounds (for instance, from wealthier families) experience a healthy pattern of growth, children from poorer backgrounds experience poor and faltering early health. This clear differentiation in child health by socio-economic status makes Jordan an ideal case for studying the determinants of health disparities. The data available in the 2012 DHS for Jordan also provide a number of advantages in terms of rich information on socio-economic characteristics and detailed information about a wide variety of factors that could potentially mediate child health inequality. For example, the 2012 DHS includes information on food quantity and quality, with information on the feeding of a variety of different types of foods and the frequency of feeding. Information is also available on the mother's health knowledge, the health inputs and environment, health conditions, and prenatal development. The richness of these data allows for an assessment of the relative roles of different mediating factors in child health inequality, focusing on children under age two.

The findings of this paper demonstrate that a number of different factors contribute to inequality in child health. Some of the factors contributing to inequality in child health act as mediators for socio-economic disparities and others have impacts that are independent of socio-economic status. The factors that tend to be the targets of malnutrition interventions, such as feeding practices and health knowledge (Horton, Shekar, McDonald, Mahal, & Brooks, 2010; World Bank, 2006, 2010), are not the most important mediators of socio-economic inequalities in child health in Jordan. Prenatal factors play the largest role in mediating socio-economic disparities in child health. Both birth weight (a measure of fetal growth) and maternal anthropometrics make large contributions to overall inequality and mediate socio-economic inequalities. These findings suggest that addressing inequality and deficits in child health will require sustained targeting of maternal health and nutrition before and during pregnancy. Policies and programs that target malnutrition during the early years may already be too late for many children in Jordan.

The paper proceeds as follows. Section 2 discusses the state of current knowledge on child health and nutrition. Section 3 provides a conceptual framework for child health and inequality. In section 4, the methods for measuring and decomposing inequality in height and weight are described. Section 5 describes the data, sample, and variables used in the analysis. Section 6 presents the results, first in terms of patterns of health and socio-economic status, and then in terms of inequality of opportunity in child health and the factors that mediate this inequality. Section 7 concludes with a discussion of the policy implications of these findings and suggests important directions for future research.

2. Literature on Child Health and Nutrition

Children's early health has long-lasting consequences. Early malnutrition has been linked to a number of negative later life outcomes across a wide variety of developmental domains. Victora et al. (2008) examine the links between undernutrition and human capital, and find that height-for-age at age two is the best predictor of adult human capital. Glewwe and Miguel (2008) review what is known about the impact of child health and nutrition on educational outcomes, and conclude that, although there are substantial challenges in estimating such relationships, the best evidence finds significant and sizeable impacts of child health on educational outcomes. Dercon and Sánchez (2013) show that, even after controlling for other factors, height-for-age early in life predicts psycho-social competencies in adolescents, including self-efficacy, self-esteem, and educational aspirations. These have been also linked to adult earnings. Stunting, as a measure of inadequate height-for-age, has been linked with poorer cognitive development, school achievement, adult economic and health outcomes, and health of subsequent generations (Dewey

& Begum, 2011). Thus, identifying the causes of malnutrition is considered a crucial element of promoting human and economic development (Victora et al., 2008).

Black et al. (2008) have a useful framework for understanding the causes and consequences of child undernutrition. They identify the basic causes of undernutrition as the social, economic, and political context, feeding into lack of capital (including financial, human, physical, social, and natural capital). These basic causes in turn generate the underlying factors affecting malnutrition, including income poverty, employment, type of dwelling, assets, and financial transfers. These underlying causes manifest themselves as: (1) household food insecurity, (2) inadequate care, and (3) an unhealthy household environment and lack of health services. These three underlying causes drive the immediate causes of malnutrition, namely disease and inadequate dietary intake (which can interact) (Black et al., 2008). Considering the multitude of potential causes of undernutrition suggests a large number of potential pathways through which inequality in child health and especially socio-economic disparities could occur.

Malnutrition may also be directly passed across generations, as women who are malnourished are themselves more likely to have children with poor nutrition, especially low birth weights (Victora et al., 2008). As a result of these different mechanisms, inequalities in child health due to disparities in economic status may also be an important part of the intergenerational transmission of socioeconomic status (Case, Lubotsky, & Paxson, 2002; Currie & Moretti, 2007). Thus, understanding the roles of different factors in child health can play a key role in addressing not only contemporaneous inequality, but also its intergenerational transmission.

The multitude of different factors that can contribute to poor early health and nutrition is reflected in the diverse body of research on challenges to early health and interventions to promote and protect early development. Inadequate fetal development, measured in terms of intra-uterine growth restriction (IUGR), resulting in low birth weight (or being small-for-gestational age) has been identified as a key early factor in malnutrition, one that is often an outcome of maternal undernutrition or stunting (Bhutta et al., 2008; Black et al., 2008, 2013; Dewey & Begum, 2011; Victora et al., 2008). Programs targeting pregnant mothers with additional calories and micronutrients are therefore considered an important intervention (Bhutta et al., 2008).

Once children are born, feeding is a key target of interventions. There is a large body of literature showing that promoting exclusive breastfeeding, considered best practice for children under six months, can increase rates of breastfeeding. Although breastfeeding does have other health effects, such as reducing mortality, there is no clear evidence that breastfeeding will increase children's height and weight (Bhutta et al., 2008). Complementary feeding (the introduction of foods to infants) support and education programs are also considered crucial interventions to address feeding practices, and such programs have been demonstrated to increase children's height in both food secure and food insecure populations (Bhutta et al., 2008).

Conditional cash transfers have been shown to improve growth and reduce stunting, although it is unclear if it is the health and nutrition conditions of the transfers or the increase in income that drive these effects (Gertler, 2004). Estimates of the income elasticity of energy intakes and specific nutrients suggest that increases in income would improve child health and nutrition (Bhargava, 2014). Specific micronutrients, such as zinc, can reduce malnutrition, and potentially intra-uterine growth restriction as well (Bhutta et al., 2008). Hygiene interventions, such as hand-washing, water quality, and sanitation, are also important for reducing diarrhea and thus improving nutrition outcomes (Bhutta et al., 2008; Spears, 2013).While the current literature does effectively document a wide variety of threats to nutrition and potential interventions across studies, it does a relatively poor job of addressing the issue of the relative roles of different factors in child health and nutrition, primarily focusing instead on single issues or assessing single interventions.

Although there are a complex variety of inter-related causes of malnutrition, the empirical literature on the determinants of health and nutrition that does examine multiple potential factors tends to focus on the most easily measured factors, including socio-economic factors such as parents' education and wealth, geographic location, access to clean water and sanitation, and gender (Assaad, Krafft, Hassine, & Salehi-Isfahani, 2012; Khawaja, Dawns, Meyerson-Knox, & Yamout, 2008; Monteiro et al., 2010; Wagstaff, van Doorslaer, & Watanabe, 2003; Wagstaff & Watanabe, 2000; Wamani, Tylleskär, Astrøm, Tumwine, & Peterson, 2004; World Bank, 2012; Zere & McIntyre, 2003). The mechanisms through which socio-economic factors impact child health have received limited attention, despite their important implications for child health. One area that has received some attention in the literature is how mother's schooling affects health (Behrman & Wolfe, 1987; Desai & Alva, 1998; Glewwe, 1999).

Other mechanisms have received scant attention in the literature. For example, although inadequate diet, in terms of quality and quantity, is a clear proximate cause of malnutrition (Bhargava, 2014), its role in inequalities in health and nutrition has not been adequately examined. Whether socio-economic inequalities are mediated through food quantity or food quality, or whether socio-economic and food effects are relatively distinct, has substantially different implications for the types of policies that are needed to address under-nutrition. For instance, it might be the case that feeding practices are sub-optimal regardless of socio-economic status, and thus feeding practices do not contribute to socio-economic inequality in malnutrition but do contribute to overall inequality. In contrast, differences in access to water and sanitation may affect nutrition and vary substantially by socio-economic status. Targeting food aid to the poor would, in such a case, be a poor policy for addressing either overall malnutrition or decreasing inequalities, while targeted improvements in water and sanitation would be highly effective for both goals.

3. Conceptual Framework

3.1 Child health production

The literature on the causes of child malnutrition (Bhutta et al., 2008; Black et al., 2008) and the general health production function literature (Cebu Study Team, 1992; Rosenzweig & Schultz, 1983; Strauss & Thomas, 1998), as well as previous work on child health inequality (Assaad, Krafft, Hassine, & Salehi-Isfahani, 2012), can serve as a starting point for understanding the determinants of children's height and weight. This paper posits the following general child health production function:

$$H=h(F, K, N, E, D, P; S, v) \quad (1)$$

where a vector of health outputs, H (height, weight), is produced by the function $h()$, based on a series of vectors of health inputs including food, F, health knowledge, K, health conditions and practices, N, the health environment, E, maternal demographic and anthropometric characteristics, D, and prenatal development, P. The health inputs are selected in part by parents, and this selection may be affected by socio-economic characteristics, S, such as education, wealth, and income. S may also shape the technology of the production function.

The budget constraint households face is a particularly important part of the role of S in shaping inputs. In general, families can be assumed to be selecting health inputs for their children to maximize utility in the face of their budget constraints (Cebu Study Team, 1992; Rosenzweig & Schultz, 1983; Strauss & Thomas, 1998). However, some aspects of health inputs, such as access to health care or the disease environment, may be linked to socio-economic status, for instance the government providing fewer health centers in poorer neighborhoods, without being under the control of parents. In assessing the empirical relationship between health and socio-economic status, both parents' choices based on socio-economic status and other relationships between socio-economic status and inputs will be detected.

The child health production model also includes an element of random genetic variation, v, that affects height and weight. When estimating the determinants of health, this term will also pick up any unobservable determinants. If unobserved determinants are correlated with observed determinants, the estimated impact of observed determinants may be biased. For instance, in models of the determinants of child health where clean water is not accounted for, the direct role of food in the health production function will be over-stated if, for instance, food insecure families live in areas with less access to clean water.

3.2 Inequality

Inequality is both reprehensible and inevitable—not everyone can earn the same income, or be the same height. How, then, can economists or policy makers distinguish "problematic" inequality from "natural" inequality? Roemer (1998), drawing on various strands of political philosophy and economics, articulated a powerful and popular answer to this question with the concept of inequality of opportunity. He proposed that when considering inequality in outcomes, the portion due to "circumstances" beyond an individual's control should be distinguished from the portion due to "effort."[2] Inequality in outcomes due to effort is morally acceptable, as effort is, by definition, under an individual's control—and also creates powerful incentives in the marketplace, as when individuals receive unequal wages in recognition of unequal effort. In contrast to effort, circumstances are factors that are outside an individual's control, such as gender, the location of birth, or parents' education. Inequality due to circumstances is considered to not be morally justifiable. This circumstance-related inequality is called inequality of opportunity.

There are some problems with Roemer's original conceptualization of inequality of opportunity when considering child health outcomes. First, when considering young children, no circumstances are under children's control. No differences in height or weight could be reasonably attributed to infants' inadequate "effort" to grow. Thus, under Roemer's framework, all inequality in outcomes for this age group is, by definition, inequality of opportunity. This definition yields a very unrealistic standard of equality of opportunity requiring equal heights and weights for all children. This paper, as others have done (Assaad, Krafft, Hassine, & Salehi-Isfahani, 2012), modifies Roemer's concept to consider inequality of opportunity as only that inequality which is due to *observable* circumstances. Since not all circumstances are observable, or observed in survey data, inequality of opportunity measured on observable circumstances is therefore a lower bound on true inequality of opportunity. The remainder of inequality is considered to be "luck." This partitioning of inequality based on what is observed in survey data has been identified as a serious shortfall, particularly when drawing policy implications (Kanbur & Wagstaff, 2014). Yet even the critics of inequality of opportunity note that the underlying exercise in assessing inequality of opportunity, analyzing the determinants of various outcomes, is valuable (Kanbur & Wagstaff, 2014). Thus, this paper uses the inequality of opportunity approach as a method for summarizing

[2] The inequality of opportunity literature can also allow for factors within an individual's control to be influenced by circumstances. For instance, the "effort" exerted in school or work is likely to be affected by one's circumstances, and can be considered as an indirect form of inequality of opportunity (Bourguignon, Ferreira, & Menendez, 2007).

the determinants of child health inequality, a method which quantifies the role of those determinants and their mediators, and additionally grounds them in an ethical framework.

4. Methods

4.1 Creating a single measure of height and weight

It is not possible to simply decompose inequality in height and weight directly. Height and weight progress with children's age, and inequality identified by directly examining height and weight will be confounded by relationships between height and weight, the age distribution, and covariates. One common method, which this paper uses, is to measure height and weight in terms of z-scores calculated by comparing observed height and weight to reference distributions of healthy children of the same age and sex. The resulting measures are referred to as height-for-age, weight-for-age, and weight-for-height. Height-for-age and stunting (2 SD below the median of the healthy reference population in terms of height-for-age) effectively capture long-term, chronic malnutrition. Weight-for-height and wasting (2 SD below the median of the healthy reference population in terms of weight-for-height) indicate rapid weight loss or acute temporary malnutrition (Black et al., 2008). Height-for-age thus is, in part, an accumulated history of weight over time. Weight-for-age and underweight (2 SD below the median of the healthy reference population in terms of weight-for-age) include elements of both height-for-age and weight-for-height.

The WHO reference for z-scores is used, as it is the most recent growth standard (World Health Organization, 2006). Particularly for children, there does not appear to be ethnic variation in growth (Bustos, Amigo, Muñoz, & Martorell, 2001; Ulijaszek, 2001), and so the WHO reference can be used globally. The healthy reference populations have a constant mean and variance in the z-score. Z-scores do not, however, have a particularly intuitive interpretation in terms of inequality, and would alter the inequality indices. Z-scores also are problematic to use directly in inequality indices because they can be negative, and the best inequality index for examining inequality in child health cannot handle negative numbers. Therefore, z-scores are transformed back into height and weight measures in their natural units of centimeters and kilograms, but standardized relative to the distribution of a single reference age and gender—in this case, a 24-month old female child is used. This transformation, proposed by Pradhan, Sahn, and Younger (2003) allows for a more intuitive and less arbitrary scale in the inequality calculations, and has been used in past studies (Assaad, Krafft, Hassine, & Salehi-Isfahani, 2012; Pradhan, Sahn, & Younger, 2003). Because the transformation, particularly for height-for-age, is essentially multiplying the z-score and adding a constant (World Health Organization, 2006), it will have little impact on either the regressions or the resulting inequality measures.

The standardized height, h_s, is calculated as:

$$h_s = F_{\bar{a},\bar{g}}^{-1}(F_{a,g}(h)) \qquad (2)$$

where $F_{a,g}$ is a function that outputs height z-scores based on the distribution in the WHO healthy reference population for an individual age a and gender g. The observed height of that individual is h, $\bar{a}$ = 24 months, and $\bar{g}$ = female. Essentially, the z-score for a child of observed height h, age a, and gender g is calculated from $F_{a,\mathrm{g}}(h)$. The z-score is then used in the inverse function, $F_{\bar{a},\bar{g}}^{-1}()$ to calculate the height for a 24-month-old female with that z-score. An equivalent transformation is used for weight-for-age or weight-for-height.

4.2 Inequality decompositions

Assessing the role of different factors in child health inequality and in mediating socio-economic inequality requires estimating both total inequality in child health outcomes (transformed height and weight) and the shares attributable to socio-economic factors before and after accounting for the potential mediators such as feeding or prenatal factors. The choice of inequality index, the path of decomposition (direct or residual) and whether parametric or non-parametric methods are used for decompositions will all affect resulting estimates of inequality and shares (Ferreira & Gignoux, 2008).

In order to assess the shares of inequality attributable to different circumstances, that is to distinguish inequality of opportunity from the residual attributed to luck, it is necessary to have a decomposable index. Generalized entropy (GE) indices are a class of inequality indices that are decomposable and have a number of other desirable theoretical and practical properties (Duclos & Araar, 2006). The GE(0) index (also known as the Theil-L index or the mean logarithmic deviation) measures the average deviation between the logarithm of the mean and the logarithms of observed values of a continuous variable as follows (Duclos & Araar, 2006):

$$\mathrm{GE}(0) = \int_0^1 \left(ln(\mu) - ln(Q(p)\right)\!\big) dp \qquad (3)$$

where μ is the mean value of the continuous variable of interest (transformed height, weight), p is the cumulative proportion of the population, where the population has been ordered from lowest to highest values of the variable of interest (i.e., shortest to tallest heights), and $Q(p)$ is the value of the continuous variable (height) at cumulative proportion p. The GE(0) index emphasizes inequality at the lower end of the distribution, which is desirable in assessing child health, as extreme malnutrition is of particular concern.[3]

The GE(0) index can be decomposed into inequality of opportunity directly or indirectly (as a residual). A smoothed distribution can be used to eliminate all the residual inequality (leaving only inequality due to circumstances) or a standardized distribution can be used to eliminate all inequality due to circumstances (leaving only residual inequality due to luck). The smoothed distribution allows for an estimate of the share of inequality of opportunity in total inequality directly, while the standardized distribution calculates it as a residual (Ferreira & Gignoux, 2008). Only the GE(0) measure will generate the same results for both direct and residual methods (Duclos & Araar, 2006; Ferreira & Gignoux, 2008).[4] This paper uses the standardized distribution, using the residual approach to calculating inequality of opportunity because, as discussed below, child health and nutrition deteriorates with age. Age is also correlated with a number of other characteristics, such as feeding practices, and thus it is necessary to control for age. However, it would be undesirable to treat age as a circumstance, as all children will pass through different ages. Using the standardized distribution to estimate inequality of opportunity with age *not* being treated as a circumstance makes it possible to estimate inequality of opportunity without age confounding estimates.

---

[3] The GE indices (and their transformations) are also the measures that satisfy standard axioms and decomposability for measuring inequality in a continuous outcome (Cowell, 2000). These axioms have been derived in a context of income inequality, but appear transferable to the context of health inequality, particularly in the absence of an axiomatic approach for health or child nutrition.

[4] For indices other than GE(0), removing inequality due to circumstances or removing inequality due to luck will yield different estimates of inequality of opportunity because of additional terms in the decomposition. See, for instance, the decomposition of the coefficient of variation squared (Roemer, 2014) or other generalized entropy measures (Ferreira & Gignoux, 2011).

While both parametric and nonparametric methods can be used to estimate how outcome *y* depends on circumstances, *C*, there are substantial tradeoffs associated with each of these two methods (Ferreira & Gignoux, 2008). Nonparametric methods allow one to partition the population into *k* groups, without any functional form assumptions on the relationships between circumstances and outcomes, simply comparing the group means and the population mean to estimate inequality. The main downside of this method is that, in order to retain adequate cell sizes for typical samples, very few circumstances rapidly exhaust the possibilities for decomposition. For instance, a relatively parsimonious specification, with three regions, three mother's education levels, two genders, and five wealth quintiles requires 90 groups to be estimated. With a minimum cell size of 100, this already requires 9,000 observations. It also does not allow for the use of continuous variables, unless they too are partitioned (for instance, partitioning food intake into more than four feedings or less than four feedings), which will substantially reduce the inequality attributable to these variables. Nonparametric methods were therefore not considered for this paper, since a large number of variables are of interest, as well as continuous and count variables such as birth weight and number of feedings.

Parametric methods require functional form assumptions (Ferreira & Gignoux, 2011). For instance, ordinary least squares (OLS) regressions, the method used in this paper, assume that circumstances are additive, although interactions can relax this assumption somewhat. The assumed additive functional form substantially reduces the data requirements, and allows for the assessment of potentially many more circumstances contributing to inequality.

Recall that two relationships are of interest: both how socio-economic circumstances, *S*, generate child health disparities and how these disparities are mediated through a number of different factors, *M* (*F, K, N, E, D, P* in (1)). Thus, in line with studies that decompose inequality into the direct and indirect effect of circumstances (Bourguignon, Ferreira, & Menendez, 2007), I will estimate both a "reduced form" model with just socio-economic status and a "structural" model that allows for disentangling the effects of socio-economic mediators (as well as any additional effects they may have). Essentially, I am assuming that *M* are a function of socio-economic status, *S*:

$$M_i = S_i\gamma + \eta_i \qquad (4)$$

where γ are the coefficients that link the socio-economic variables with the mediators.

The direct effects of socio-economic status (or residual effects of omitted variables, as socio-economic status should not act as a direct input) and the indirect effects through *M* on *y* (height and weight measures) can then be disentangled by estimating:

$$y_i = S_i\alpha + M_i\beta + \upsilon_i \qquad (5)$$

This can be contrasted with the "reduced form" effects of socio-economic status:

$$y_i = S_i(\alpha + \beta H) + \eta_i\beta + \upsilon_i \qquad (6)$$

Which are readily estimated as

$$y_i = S_i\delta + \omega_i \qquad (7)$$

Estimating first (7) and then (5) allows for a comparison of the magnitude of socio-economic effects and their mediators. Estimating (5) with subsets of *M*, such as those elements of the early environment only or prenatal environment only, can allow for identification of the relative role of different factors in mediating disparities by looking at the shifts in the contributions of *S* to inequality as various mediators are added.

To move from the estimation of regressions to inequality shares, let the equation

$$y_i = C_i\psi + \varepsilon_i \tag{8}$$

with the vector *C* be used as a generalization of (5) and (7), where *C* is some mix of *S* and possibly elements of *M.* Then the estimated parameters, $\hat{\psi}$, are used to compute standardized distributions, $\tilde{y}_i$, as (Ferreira & Gignoux, 2011):

$$\tilde{y}_i = \bar{C}\hat{\psi} + \hat{\varepsilon}_i \tag{9}$$

Where $\bar{C}$ is the vector of sample mean circumstances and $\hat{\varepsilon}_i$ is the estimated residual from equation (8). After differences in circumstances are controlled for by using mean circumstances, the remaining variability is exclusively in the residual, i.e. *within* types or circumstance groups. These $\tilde{y}_i$ can be used to calculate inequality of opportunity, θ_r, residually as a share of total inequality (Ferreira & Gignoux, 2008):

$$\theta_r = 1 - {GE_0(\{\tilde{y}_i\})}/{GE_0(\{y_i\})} \tag{10}$$

Inequality of opportunity can thus be interpreted as the share of total inequality due to circumstances.

The partial shares of a circumstance or group of circumstances *J* in inequality can be calculated based on a counterfactual standardized distribution (Ferreira & Gignoux, 2008):

$$\tilde{y}_i^{\,J} = \bar{C}^J\hat{\psi}^J + C_i^{j\neq J}\psi^{j\neq J} + \hat{u}_i \tag{11}$$

This is then used to estimate the share of circumstance set *J* in total inequality as:

$$\theta_r^J = 1 - {GE_0(\{\tilde{y}_i^{\,J}\})}/{GE_0(\{y_i\})} \tag{12}$$

These partial shares are the focus of this paper, especially how shares for socio-economic inequality are mediated through different determinants such as health knowledge or the health environment. Both inequality of opportunity and partial shares can be tested for statistical significance by generating bootstrapped standard errors around the estimates.

4.3 The problem of measurement error

Measurement error is a potential problem for both estimating inequality of opportunity and whether different factors mediate socio-economic inequality. A number of different variables could be mis-measured, starting with anthropometric measures. Although height and weight are the best-measured anthropometric measures (Ulijaszek & Kerr, 1999), major problems can still occur in fielding such measurements (Department of Statistics & Macro International Inc., 2008). Missing information on anthropometric indicators (data are missing for 7% of children) is relatively random (Department of Statistics (Jordan) & ICF International, 2013) and unlikely to induce bias. If there is random measurement error in the dependent variables (height, weight), the regressions of these outcomes on circumstances will not be biased (Bound, Brown, & Mathiowetz, 2001). However, the estimate of total inequality is likely to be biased upwards by random errors, thus increasing the denominator but not the numerator of inequality of opportunity and under-estimating inequality of opportunity.

Socio-economic status is surely measured with error, as, first, not all dimensions of socio-economic status are captured. For instance, there are data on wealth based on an asset index, but not on incomes. Measurements of socio-economic status that are available can be expected to have some degree of random error. In the regressions of anthropometric outcomes on circumstances, (randomly) mis-measured covariates will have coefficients that suffer from attenuation bias (Bound, Brown, & Mathiowetz, 2001). This will lead to an under-estimate of inequality of opportunity in child health related to socio-economic status. Overall, given at least some degree of measurement error and certainly missing dimensions of socio-economic status, the estimated inequality of opportunity in child health from socio-economic status is a lower bound.

When adding additional covariates that might mediate socio-economic inequality or have independent effects on child health inequality, an array of different measurement error problems might occur. Again, it is likely that many of the circumstances will be measured with error, leading to attenuation bias in the regressions. This attenuation bias will in turn lead to an under-estimate of inequality of opportunity. An additional set of considerations arises in comparing the partial effects for different sets of circumstances. Some dimensions of circumstances are likely to be better measured than others. Child gender, for instance, will probably be better measured than recall reports of whether breastfeeding initiation after birth was immediate, after one hour, or two hours, etc. This means that the estimated partial effects may be differentially attenuated depending on how extensive measurement error is. The comprehensiveness of the observed variables in capturing a concept is also going to be a factor; child gender can fairly readily be captured by a single variable, but health knowledge or differences in feeding practices are not so readily measured. Findings must then be interpreted with some caution in terms of what is included as well as what is likely to be accurately measured.

A final problem arises in assessing the mediating roles of different factors in child health inequality. The assessment of factors' mediating roles will be affected by the extent of differential measurement in relation to links with socio-economic status. For instance, sewage connections may be closely related to housing characteristics and durable assets, which are captured by the wealth index, while the frequency of protein consumption relates more closely to current income, which is not measured directly but is proxied with assets and employment. Thus, if both sewage connections and protein feeding frequency actually equally mediate socio-economic disparities in child health, one would expect that sewage connections would appear to mediate more of socio-economic inequality of opportunity in this paper's necessarily partial and mis-measured estimates. Similarly, although the production function suggests that socio-economic status should have no direct effects on child health after all inputs have been accounted for, with mis-measured and limited information on inputs, it is likely that some partial effects from socio-economic inequality of opportunity will remain even after including all the available mediators.

All of these measurement problems of partial information, mis-measurement, and differentially captured mediation will be further exacerbated if any of the measurement error is systematic (related to covariates). For instance, survey teams may have rushed through interviews with poorer households that had poor heating and taken more care at richer households that were well-heated. Or families from poorer households might be more sensitive about appearing to be poor, in terms of having limited food, and so they inflated the frequency of children's meals. These types of errors can introduce a large number of potential biases into the data.

In an ideal world, it might be possible to correct the measurement error problems. For instance, instrumental variables can be used to correct random measurement errors. However, instrumental variable solutions to measurement error cannot be used when there is measurement error in a binary or categorical variable (i.e., most of the variables analyzed in this paper). This is due to measurement error in such variables being non-classical; there is always a correlation between the error and the true value (Bound, Brown, & Mathiowetz, 2001). Additionally, even for the continuous variables, a large number of valid instruments would be required to identify all of the potentially mis-measured variables. Such variables are not available in the DHS data, so no corrections for measurement error are undertaken. Overall, the different types of measurement error are likely to lead to under-estimates of inequality of opportunity, but to potentially differential extents for different variables. Thus, caution is required in interpreting the findings that follow.

5. Data

5.1 The sample

This paper uses the 2012 DHS for Jordan. The survey sampled 15,190 households and 11,352 ever-married women ages 15-49 (Department of Statistics (Jordan) & ICF International, 2013). The survey is nationally representative. The data include anthropometric information (height and weight) for children under age 5, with a two-thirds random sample of households selected for anthropometric measurements. The 2012 DHS also includes questions that refer specifically to the youngest child under two years of age. For instance, food consumed by the child in the day preceding the survey, as well as the number of times during the day the child had consumed foods is collected only for the youngest child under two. Thus, for the analyses of inequality of opportunity, the sample is further limited to 2,230 young children. Any expansion in inequality occurring past this age or any catch-up in growth will not be captured by this analysis.

5.2 The covariates

In order to identify the drivers of socio-economic disparities in children's nutrition, this paper first examines a number of socio-economic characteristics, such as parents' education and wealth, and their relationships with children's growth. Secondly, this paper incorporates a large number of measures of inputs to the child health production function, such as parents' health knowledge or feeding practices. These inputs are the mechanisms through which socio-economic disparities may be mediated. Comparing the estimates of inequality of opportunity with and without the input variables allows for an assessment of the mediating role of different inputs, such as feeding practices.

Table 1 describes in detail how individual variables are aggregated into categories. Two broad categories of socio-economic variables are considered, parents' education and "wealth and employment." Parents' education incorporates the mother's and father's education categorically. Wealth and employment incorporates the household wealth score (a factor variable),[5] parents' employment statuses, and employed parents' occupations. Education and wealth/employment may have different effects and different mediators in determining child health outcomes. For instance, parents' education may mediate health knowledge, while wealth and employment may mediate food quantity and quality.

In assessing the mediators of disparities, gender is considered (comparing females to males), to investigate whether gender discrimination is occurring generally or along socio-economic lines. Geographic differences are examined, in terms of governorates, rural versus urban, refugee camps versus non-refugee areas, and badia (arid areas) versus non-badia. Place of residence is not directly an input into the health production function. However, a number of potential mediators that cannot readily be measured in the data may be captured by place of residence, such as the local climate. Thus, if geographic differences mediate socio-economic disparities, this may be due to the disease environment, or differences in access to services such as sanitation, water, or health care.

[5] Because the wealth score provided with the data is a standardized factor, including negative values, in order to incorporate the wealth factor and its square into regressions appropriately, the wealth factor had to be shifted into purely positive terms. This was done by adding the minimum value of the standardized variable to all wealth scores.

Geographic differences might also pick up ethnic disparities in health if certain ethnic populations are geographically concentrated.

Feeding practices are a key area of investigation, as these are both a target of policy interventions and a frequently posited mediator for socio-economic disparities. Children from poorer families may consume less food, or less diverse food. They may also be less likely to be breastfed. Information on breastfeeding initiation, whether a child is currently breastfed, exclusively breastfed, or fed with a bottle is incorporated into the category "food." In addition, the (categorical) frequency of feeding is incorporated. Being fed once, twice, thrice, or four or more times per day is the categorical breakdown. The frequency of feeding is a proxy for energy intake, and depending on their breastfeeding status and age, children should be fed at least two or three meals a day, plus one or two snacks (Department of Statistics (Jordan) & ICF International, 2013; World Health Organization, 2005, 2008). The number of different types of foods, achieving a minimum daily variety of foods, and achieving certain minimums within certain types of foods, such as protein, all play an important role in adequate nutrition (Department of Statistics (Jordan) & ICF International, 2013; World Health Organization, 2005, 2008). Food types in the data are detailed to the level of "yogurt" or "carrots, red potatoes, or pumpkin." The paper aggregates information to assess the number of liquids, proteins, grains, and fruits/leafy vegetables fed as a part of the "food" category. Because feeding practices are closely related to age, age in months is controlled for, since, as discussed below, height- and weight-for-age decay over time, and could confound food/nutrition relationships. However, age is not considered a circumstance or mediator in the analyses.

Mother's health knowledge has been demonstrated in other contexts to be an important mediator of socio-economic disparities in child health (Glewwe, 1999). There are a large number of questions about mother's health knowledge in the DHS data. Variables for mother's knowledge of tuberculosis and oral rehydration salts (ORS) are incorporated into the analysis as measures of health knowledge that are likely to directly affect child health. A factor variable based on women's family planning knowledge is also included as a measure of general health knowledge.[6]

Health conditions, and how they are managed, may mediate socio-economic disparities in health and nutrition. Diarrhea and infection in particular have been linked to malnutrition (Glewwe, Koch, & Nguyen, 2004; World Bank, 2010). Although the entire history of episodes of illness is likely to drive current nutritional status, in the DHS data the only information on diarrhea is whether it has occurred in the past two weeks, along with its persistence (whether it is still ongoing). Likewise information on fever/cough in the past two weeks and its persistence is incorporated. These measures together comprise the category of health conditions.

A wide set of factors affect the health environment children experience. On the household level, the drinking water source, sewer connection, distance to health facilities, incidence of family smoking, and crowding (persons per room) may all mediate socio-economic disparities in nutrition by affecting the child's health environment. Since the DHS samples in clusters of approximately 20 households, the local (cluster) level health environment can be measured in terms of the drinking water source, sewer connections, and wealth of other households, all of which are likely

[6] Additional data not included in the analyses measure health knowledge about HIV/AIDS, knowledge of sexually transmitted infections, knowledge of the fertile period, and other questions about knowledge of tuberculosis (Department of Statistics (Jordan) & ICF International, 2013). These questions were less relevant to both child health and as a measure of general health knowledge, since, for instance, there are less than 1000 reported cases of HIV in Jordan (Department of Statistics (Jordan) & ICF International, 2013). Interpretation of the additional questions was also potentially problematic, as disease and transmission knowledge could be indicative of illness rather than general health knowledge.

to contribute to the health of children, particularly in terms of the potential disease environment in their community.

Two final factors that are considered are mother's demographics and a child's birth weight (as recalled by the mother). Mother's demographics incorporate both the age (categorically) and height of the mother. Weight of the mother was considered, but could be a product (rather than a cause) of the conditions that lead to child malnutrition. Mother's height (particularly her own stunting and malnutrition during childhood) has been shown to transmit across generations (Bhalotra & Rawlings, 2011). Mother's age at birth also has an important effect on health and nutrition outcomes (Kozuki et al., 2013). Teenaged mothers are particularly a hazard to child health, but are also fairly rare in Jordan, with only 5% of 15-19 year-olds pregnant or having had a child (Department of Statistics (Jordan) & ICF International, 2013). Birth weight, particularly low versus normal birth weight, has been shown in other contexts to drive long-term health and nutrition outcomes (Bhutta et al., 2008; Black et al., 2008, 2013; Dewey & Begum, 2011; Victora et al., 2008). Birth weight is likely to be a function of maternal nutrition and health preceding and during pregnancy, and socio-economic conditions will likely affect maternal and fetal health and nutrition. Birth weight may also pick up the effects of prematurity, as there is no gestation length/prematurity data in the DHS. Mother's demographics and birth weight together are considered to be mediators of the prenatal environment, while the health environment, health conditions, health knowledge, feeding, gender, and geographic differences will mediate primarily the early (post-natal) environment.

In order to quantify socio-economic disparities in child nutrition and to assess their mediators, the inequality decompositions are undertaken in sequence. This paper first estimates parametric regressions of the determinants of the standardized anthropometric measures and inequality of opportunity for socio-economic characteristics (education, wealth and employment) alone. Gender, geographic differences, food/feeding, health knowledge, health conditions, and the health environment are then added to the regressions to estimate how much of the socio-economic effects are mediated through these measures (how much the partial effects decrease after controlling for mediators). Lastly, mother's demographics and the child's birth weight are added to the analyses. This division of added regressors allows for the identification of socio-economic mediators after birth, and preceding birth, by comparing the latter two analyses.

6. Results

6.1 Patterns of health and nutrition

Overall, Jordan has a moderate problem with malnutrition. Figure 1 shows the distribution of height-for-age, weight-for-age, and weight-for-height z-scores for children under age five. Around 7.6% of children are stunted and the average height-for-age is -0.39 SD. Around 3.0% of children under age five are underweight and the average weight for age is -0.10 SD; weight falls just slightly short of a healthy reference distribution. Given the patterns for weight- and height-for-age, it is unsurprising that just 2.4% of children are wasted, and the average weight-for-height is 0.17 SD.

These rates of stunting and underweight are significantly higher than those expected in a healthy reference population (2.3% (World Health Organization, 2006)) at statistical significance levels below 0.1%. Average height-for-age and weight-for-age are similarly below zero with significance levels below 0.1%. Wasting is not significantly different from 2.3%, but average weight-for-height is above zero with significance levels below 0.1%.

The pattern of nutrition by age shows different outcomes for average nutrition and acute malnutrition (Figure 2). At birth and during the first year of life, average height-for-age, weight-for-age, and weight-for-height in standard deviations are similar to that for the reference population. Stunting, underweight, and wasting are relatively high at birth and decrease over the first year of life. With some moderate fluctuations, height and weight measures fall starting at 10 months, with an especially steep decline through 20 months. Both stunting and being underweight increase from 10 months to 20 months of age before leveling off and slowly decreasing over time. In developmental terms, this suggests that on average children experience deteriorating nutrition throughout the early years, but that acute malnutrition may be offset over time.

6.2 Health and socio-economic status

There are large differences in health and nutrition by socioeconomic status in Jordan. Although breaking the data down by both child's age in months and wealth quintile is somewhat noisy, Figure 3 shows that overall children from less wealthy households have poorer nutrition outcomes. Only children from the richest quintile remain near the healthy reference median for height in Jordan. The poorest quintile has particularly low height-for-age and high stunting, with the worst period between 30-40 months before some recovery and partial convergence towards the other wealth groups. The patterns of growth presented by poorer children in Jordan are similar to those seen throughout low and middle income countries (Shrimpton et al., 2001; Victora, de Onis, Hallal, Blössner, & Shrimpton, 2010). Although differences in weight-for-age are smaller, there is also a clear socioeconomic gradient in weight-for-age and being underweight. Weight-for-height, likely to measure transitory nutritional status, does not show such clear patterns.

Figure 4 examines whether these differences by wealth are significantly different across the age distribution, showing the smoothed values of height-for-age, weight-for-age, and weight-for-height for children from the richest and poorest quintiles. In addition, 95% confidence intervals are presented. Over almost all of the age distribution for height-for-age, the mean values for the children from the richest and poorest quintiles lie outside of each other's confidence intervals. For weight-for-age the confidence intervals alternately do and do not overlap each other's mean values, particularly depending on which confidence interval one is looking at. Weight-for-height shows no clear pattern nor significant differences.

Focusing on the youngest child under two, the sample for the inequality of opportunity analysis, Table 2 shows anthropometric indicators, as well as the distribution of the sample, by socio-economic status. There is a clear socio-economic gradient by parents' education, with children of secondary educated parents showing a substantial improvement in health over preceding levels of education, and children of university educated parents being particularly well-off. It is also only among the richest fifth of households that stunting, underweight, and wasting are all below the level observed in the healthy reference population, while the poorest quintile is clearly the worst off. For instance, 16.7% of children from the poorest quintile are stunted compared to 0.7% of the richest children. Employment characteristics, which may be related to income, wealth, and education, also show clear socio-economic differences. Children with parents in white-collar occupations, such as professionals or managers, have better nutrition outcomes. Overall, there are clear disparities in child health by socio-economic status. However, the mediators of these factors are not immediately obvious, and are important information for designing interventions to address both inequality and lingering malnutrition in Jordan.

6.3 Inequality of opportunity in child health

The first set of parametric regressions modeling the determinants of the standardized anthropometric measures yields estimated inequality of opportunity for socio-economic characteristics (education, wealth and employment) alone. This specification is referred to as

"SES." In order to estimate the role of different factors in mediating socio-economic inequality, gender, geographic differences, food/feeding, health knowledge, health conditions, and the health environment are then added to the regressions. This specification's additions are referred to as "+ Early Environment." The final specification adds mother's demographics and the child's birth weight, which is referred to as "+ Prenatal Environment." Partitioning the added regressors in this fashion allows for the identification of socio-economic economic disparities, mediators after birth, and preceding birth, by comparing the various analyses. Table 3 shows, for the analysis sample, the summary statistics for the different circumstances and covariates.

Table 4 (for height-for-age), Table 5 (for weight-for-age), and Table 6 (for weight-for-height) all show the underlying regressions for the outcomes transformed into the anthropometrics of a 24-month-old female, based on z-scores. Regressions are presented both without and with the addition of controls for age in months. Estimates of inequality of opportunity are based on the regressions where age is included as a control, but does not to contribute to estimated inequality of opportunity. Since age can contribute to total inequality but does not contribute to inequality of opportunity, inequality of opportunity measured here is likely to underestimate inequality of opportunity in children's long-term outcomes.

Figure 5 presents inequality of opportunity under different specifications for the three anthropometric outcomes. Values underlying the figure, bootstrapped standard errors, and statistical significance are presented in Table 7. There is substantial (and, in the cases of height- and weight-for-age, statistically significant) socio-economic inequality of opportunity. In terms of height-for-age, 6.4% of total inequality is socio-economic inequality of opportunity. Approximately 4.3% of inequality in weight-for-age is socio-economic inequality of opportunity and 2.1% of weight-for-height.

Comparing subsequent specifications, it is notable how much additional inequality is explained with the added variables, suggesting that while the covariates may mediate socio-economic inequalities to some extent, they also have additional contributions to inequality that are unrelated to socio-economic status. Substantial measurement error in socio-economic status could also cause the addition of other variables to have an apparent direct role in inequality of opportunity when in fact the other variables are also mediating differences related to socio-economic status. Inequality of opportunity in height rises from 6.4% to 13.6% with the addition of early environmental factors, and further to 25.1% with the addition of the prenatal environment (mother's demographics and birth weight). The increase with the addition of the prenatal environment is particularly notable on two grounds; first, it is large, almost doubling inequality of opportunity, suggesting that more than half of nutrition inequality is determined prior to birth. Second, the resulting level of inequality of opportunity, 25.1%, is very large, particularly given that inequality related to age, which is substantial, contributes to total inequality, and that much of natural genetic variation remains unaccounted for.

A similar pattern of increasing inequality of opportunity with the addition of variables across specifications is observed for weight-for-age and weight-for-height. Inequality of opportunity in weight-for-age rises from 4.3% with socio-economic status only to 12.9% with the addition of the early environment, and then 22.8% with the addition of prenatal environment. Again, there is both a large increase and a high level of inequality of opportunity after adding the prenatal environment. Weight-for-height rises from 2.1% to 7.3% and then 9.9% as the early and prenatal environment are added. Notably, the addition of the prenatal environment explains only a little more, which is consistent with weight-for-height being driven by short-term fluctuations in nutrition and health.

Some of the inequality of opportunity detected here as relating to the prenatal environment may be related to genetic variation in anthropometrics and growth. The importance of genetic variation in human development generally is vigorously debated in terms of nurture versus nature (Goldberger, 1979). There are a wide range of estimates of the proportion of differences due to genetic factors (heritability) for height and weight (Baker, Reynolds, & Phelps, 1992; Dubois et al., 2012; Livshits, Peter, Vainder, & Hauspie, 2000; Towne, Guo, Roche, & Siervogel, 1993). Genetic factors affect not just birth weight or length, but also the parameters of growth patterns (growth curves) after birth. A study using data from 23 twin birth-cohorts across four countries found that heritability was low at birth (4.8% to 8.7%) but increased with age. Thus, some of the estimated inequality of opportunity in terms of the prenatal environment may be related to genetic variation.

6.4 Mediators (partial effects) in inequality of opportunity of child health

A number of different factors mediate inequality of opportunity in child health. Figure 6 presents the partial effects for different categories of variables, in terms of shares of total inequality under different specifications for the different anthropometric outcomes. Values underlying the figure are in Table 7. Looking at socio-economic status alone, there are effects for both parents' education and wealth and employment, particularly for height- and weight-for-age. Around 4.6% of height-for-age inequality is due to wealth and employment, and 3.0% due to parents' education.[7] Weight-for-age likewise shows a larger wealth and employment than education effect, but the opposite is true for weight-for-height.

Adding the child's early environment reduces the impact of parent's education, but has little or no effect on the wealth/employment effects for weight-for-age or height-for-age (but reduces wealth/employment effects more than education effects for weight-for-height). Little of the long-term patterns of inequality in nutrition by wealth or employment are mediated through the early environment; it is not feeding, health knowledge, health conditions, or the health environment that contribute to wealth/employment inequality, but these do have some effect on education related socio-economic inequalities. That these factors are mediating little wealth/employment effect and only a modest education effect is particularly interesting given that, in a number of dimensions of these health inputs, there is clear socio-economic inequality. For instance, although there are not large socio-economic differences in breast-feeding, there are socio-economic disparities for mother's education and especially wealth in terms of complimentary feeding (Department of Statistics (Jordan) & ICF International, 2013). Yet these differences do not seem to be driving the socio-economic disparities in child health observed in Jordan.

However, when adding the prenatal environment, there is a larger drop in wealth/employment inequality of opportunity and a small drop in education related inequality (for height- and weight-for-age). The pattern of prenatal factors mediating wealth and employment differences but not education differences was confirmed by adding the prenatal factors alone (excluding the early environment) to the SES variables and seeing a large decrement in wealth and employment but not in education.

Thus, wealth and employment disparities are mediated in large part by prenatal development. Notably there remain substantial disparities by socio-economic status even after the many

[7] Partial effects do not necessarily add exactly to total inequality of opportunity.

variables included have been added.[8] Insufficiently precise measurements of other covariates, such as health knowledge, may contribute to these lingering effects, but they also suggest that there are other socio-economic effects not yet measured or accounted for that may contribute to socio-economic disparities; issues such as the disease environment (poorer families living in areas with higher burdens of parasites, for instance) may drive these remaining effects.

A number of different individual partial effects mediate socio-economic status or make additional substantial contributions to inequality in children's nutrition. There is essentially no gender inequality, and only small and insignificant geographic inequality. Food and feeding practices do contribute substantially to inequality, particularly to weight. The smaller contributions to height may be because concurrent feeding affects weight, and the full history of feeding affects height, so effects on height are underestimated. Around 4% of inequality in weight-for-age is related to feeding, and this is statistically significant. Health knowledge has at most a small and never statistically significant contribution. Because parents' health knowledge may manifest itself in terms of feeding practices or health conditions, the importance of health knowledge is particularly likely to be under-estimated. However, if, for instance, knowledge of ORS played a central role in health inequality, that should still be picked up in terms of an impact of health knowledge rather than other covariates. Health conditions likewise have small and insignificant effects, although health conditions are only measured for the past two weeks and not a full history.

The early health environment, on both the household and local level, does have a large and statistically significant contribution to inequality of opportunity for height-for-age, contributing around 5% of total inequality. In the regressions (Table 4), cluster level wealth, sanitation, and water all have large effects and appear to matter more than the corresponding household level characteristics, suggesting that the health/disease environment contributes to inequality in height primarily on a community rather than household level.

The contributions of maternal demographics (age and height) are large and significant for height-for-age, where they contribute 6.4% of total inequality. Effects are smaller (2% or 1%) and insignificant for the weight measures. The effects of maternal demographics, driven primarily by mother's height (Table 4) are a clear intergenerational transmission of long-term nutritional outcomes. Transmission of genetic factors across generations may play an important role in the effects of maternal demographics, but given estimates of heritability (Dubois et al., 2012), which should also manifest in measures like birth weight, genetic factors can be expected to only be part of the relationship across generations. Both "nature" (genetic factors) and "nurture" have been identified as key factors in the intergenerational transmission of health, economic, and education outcomes (Behrman & Rosenzweig, 2004; Bjorklund, Lindahl, & Plug, 2006). Other mechanisms may be occurring. For instance, maternal undernutrition has been linked to low birth weight (Victora et al., 2008) and maternal height has been linked to stunting, and underweight in global studies (Ozaltin, Hill, & Subramanian, 2010).

Much of children's nutrition is also driven by health and nutrition accumulated prior to birth; 11.3% of inequality in height-for-age and 12.0% of inequality in weight-for-age is determined by weight at birth (both are statistically significant). In Jordan, 13.8% of births have low birth weight (weigh less than 2.5 kg) (Department of Statistics (Jordan) & ICF International, 2013). Although comparability of national statistics may be problematic, this is a relatively high share of low birth

[8] Differences by socio-economic status are unlikely to be driven by particular components of the asset index, such as refrigerators, freezers, or dishwashers, which might affect food safety, as there is little variation in household ownership of these three assets. Almost all families have refrigerators, less than 10% have freezers, and almost none have dishwashers.

weight infants, particularly considering Jordan's performance on other anthropometric measures. The shares for the United States and United Kingdom are 8% and the average for the least developed countries is 13% (UNICEF, 2014). Weight-for-height, capturing short-term fluctuations, has only a 1.6% contribution from initial status, consistent with prenatal growth affecting long-term patterns but not short-term fluctuations.

6.5 Further explorations of mediators of inequality in child health

The role of prenatal factors in overall inequality of opportunity in child health and particularly in mediating socio-economic opportunity is notable. Figure 7 and Figure 8 further explore the relationship of socio-economic status, specifically wealth, with mother's height and birth weight. Looking first at birth weight (Figure 7), there are clear differences in the pattern of birth weights by wealth quintile, with children in the poorest quintile in particular having a disproportionate share of low birth-weight (below 2.5 kilogram) infants and generally slightly lower birth weights overall. There is a clear gradient (not shown) through the richest quintile, with children from the richest quintile particularly disproportionately represented among relatively heavier birth weights.

There is a similar gradient for mother's height by wealth quintile (Figure 8), with a particularly strong gradient in the share of children whose mothers have short stature by wealth. Short stature here is defined as a height less than 151.1 centimeters, the 3rd percentile of the CDC reference for a healthy 20 year old female (Centers for Disease Control, 2001). The entire distribution for the poorest quintile appears shifted to lower heights relative to the other wealth quintiles (only richest shown), while mothers from the richest wealth quintile are disproportionately likely to have heights near 170 centimeters, in the taller end of the distribution. These prenatal disparities in fetal growth and maternal height have clear gradients by wealth, especially at the lower ends of the distributions where they are particularly likely to have adverse consequences for children's growth and health. Although genetic factors inherited across generations could contribute to some extent to the impact of prenatal factors on inequality of opportunity in child health, prenatal factors are also closely linked with socio-economic status. One study of twins actually suggests that the impact of birth weight, as a prenatal factor, on adult outcomes would actually be underestimated in cross-sectional estimates that do not account for genetic endowments (Behrman & Rosenzweig, 2004). The disproportionate share of low birth weights and short mothers in the lowest wealth quintile in particular suggests important links between socio-economic status, the prenatal environment, and child growth, links that will in turn impact adult outcomes.

While prenatal factors were identified as playing a larger role in child health inequality and socio-economic disparities, it may be the case that prenatal factors are better measured than early environmental factors, and thus measurement quality is driving the results. One factor that has been identified as a particularly important mediator of child malnutrition is diarrhea, due to the fact that the prevalence of diarrhea tends to rise at the same point in time as the precipitous decline in children's nutrition (Glewwe, Koch, & Nguyen, 2004). Figure 9 explores the relationship between diarrhea, its persistence, socio-economic status, and children's age. The percentages of children who had diarrhea within the past two weeks (but do no longer) and children who had persistent diarrhea are graphed against children's age for the children from the poorest and richest quintiles. Recall from Figure 2 and Figure 3 that the major decline in child nutrition occurs from approximately 10 months to 20 months. As Figure 9 shows, diarrhea is relatively low in the few months after birth and then rises, with the peak prevalence occurring in the 10-20 month range. The rise in diarrhea coincides with the period when children are increasingly interacting with foods and becoming increasingly mobile, exposing them to substantially more germs.

However, the comparison of the poorest and richest children's experience of diarrhea is not consistent with the faltering of poor (but not rich) children's growth being due to diarrhea; very similar patterns of diarrhea occur from 0-20 months for the poorest and richest children. While the poorest children initially have slightly higher rates of persistent diarrhea, rates converge by the time when the poorest children start to falter in their growth. Differences in diarrhea prevalence by wealth occur primarily from 20 months onwards, which is when growth faltering stops, mean height-for-age stabilizes, and some recovery begins. Additional analysis also demonstrated that treatment of diarrhea (oral rehydration salts, antibiotics, etc.) was similar across wealth quintiles. Although these analyses are not the same as being able to include the full history of diarrhea and other health episodes in the calculations of child health inequality, they do indicate that diarrhea is unlikely to be the driving cause of the precipitous decline in child health for poorer children, while richer children continue to develop relatively normally.

6.6 Simulating policy priorities

The sizeable inequality of opportunity attributable to prenatal factors translates into large differences in children's anthropometric outcomes. As a further demonstration of the relatively large role of prenatal factors in child health and child health inequality, Figure 10 shows how different circumstances can lead to substantially different child health outcomes for selected covariates from the regressions: birth weight, mother's height, the frequency of daily protein feedings, diarrhea and its persistence, and cluster level sewage connections. These are some of the circumstances that have the greatest impact in the regressions. The figure demonstrates what would happen to average height-for-age z-scores if each circumstance were moved from the 5^{th} to 95^{th} percentile of its distribution (with all other circumstances as observed) as a demonstration of the importance of these different factors. This shift in birth weights represents a movement from average z-scores of -0.88 to 0.28. A shift from the 5^{th} to 95^{th} percentile in mother's height moves z-scores from -0.61 to 0.17. Increasing the frequency of daily protein feedings from the 5^{th} to 95^{th} percentile of the distribution raises average z-scores from -0.40 to 0.00. Going from persistent diarrhea to none increases z-scores from -0.56 to -0.21. Raising the cluster level sewerage from none to universal raises z-scores from -0.48 to 0.02.

If these different simulations are considered as policy interventions, targeting birth weights is by far the highest impact intervention, increasing z-scores 1.17, equivalent to 3.8 centimeters for a 24-month female. Shifting the distribution of mother's heights leads to a 0.79 change, equivalent to 2.5 centimeters for a 24-month female. Although actually changing mother's heights is a very long-term change, targeting mothers with short stature for nutrition support could have similar effects. All the rest of the potential policy levers—increasing the frequency of protein feedings, eliminating diarrhea, and moving to universal sewerage—have much smaller policy impacts, less than 0.50 differences in z-scores, or between 1.1 and 1.6 centimeters of height. While still valuable, the impact of such investments pales in comparison to interventions targeting the prenatal period.

Although prenatal factors have the greatest impact on child nutrition outcomes, it is not necessarily the case that they are the best policy alternative. Determining priority policies for child health and nutrition would require an assessment of the relative costs and benefits of different approaches. The existing evidence indicates that the benefits of reducing low birth weight are substantial, but only some interventions, such as targeting women with poor obstetric histories, have sufficient information to assess benefit-cost ratios. A few interventions are clearly promising; for instance, providing medicine to women with poor obstetric histories has benefit-cost ratios in the range of 4-35 (Behrman, Alderman, & Hoddinott, 2004).

Additional studies assessing the relative costs and benefits of alternative interventions to reduce low birth weight, such as protein/energy supplementation for women, would be extremely valuable. Programs to improve birth weight have been identified as an area with limited evidence, particularly in comparison to growth promotion and micronutrient programs (Horton, Shekar, McDonald, Mahal, & Brooks, 2010; World Bank, 2006). Additional analyses of the predictors of birth weight in the Jordanian 2012 DHS suggest that some of the policy levers for child health and nutrition may also be effective for fetal and maternal nutrition. For instance, community-level sewage access was predictive of birth weight (results not shown), a pattern that may be due to a relationship between local sanitation, mother's health and weight-gain during pregnancy, and fetal growth.

7. Discussion and Conclusions

Children's early development has important implications for their long-term wellbeing. Faltering growth during the early years—or indeed, even before birth—leads to worse health, education and labor market outcomes by adulthood. Early childhood is also the starting point for inequalities in children's development, determined by circumstances entirely outside of their control. This paper demonstrated that there are substantial socio-economic disparities in child health in Jordan, particularly in terms of height, which is the best measure of accumulated nutrition (or lack of nutrition) and crucially related to a number of different dimensions of human development.

A large number of different possible determinants for inequality of opportunity in child health were examined, which might mediate socio-economic disparities as well as make additional contributions to inequality. While food and feeding contributed substantially to inequality in weight, they appeared to mediate little of the observed socio-economic disparities. The effects of parental education were only slightly reduced, and the effects of wealth and employment relatively unchanged with the addition of early environmental measures. Health knowledge, geographic differences, and gender had small contributions at most. The health environment, particularly local water, sanitation, and wealth did contribute substantially to inequality of opportunity, but did not appear to drive socio-economic disparities, instead largely making additional contributions to inequality.

Notably, almost half of the maximum explained inequality in weight-for-age and height-for-age was driven by outcomes that were determined prenatally. Birth weight in particular, which is likely to be a measure of poor maternal health and nutrition leading to intra-uterine growth restriction, played a large role in inequality. Other studies have likewise found that a large share (20%) of stunting is attributable to insufficient fetal growth (Christian et al., 2013). In utero rainfall (and therefore nutritional) shocks have been shown to have a larger effect on long term growth than shocks in the first two years of life (Leight, Glewwe, & Park, 2015). Maternal demographics (especially height) also played a large role in unequal height-for-age and represent intergenerational transmission of health inequalities.

Some of the estimated inequality due to prenatal measures may also be related to natural genetic variation, but estimates of heritability (Baker, Reynolds, & Phelps, 1992; Dubois et al., 2012; Livshits, Peter, Vainder, & Hauspie, 2000; Towne, Guo, Roche, & Siervogel, 1993), which measure the share of variation in health outcomes due to genetic factors, indicate that natural genetic variation is likely to be only a small part of these prenatal effects. Studies have also directly linked prenatal nutrition (birth weight) with adult health outcomes, as well as schooling and labor market outcomes, even after controlling for genetic endowments (Behrman & Rosenzweig, 2004). The general importance of the prenatal environment to later life outcomes such as education, income, and health has also been emphasized in the "fetal origins" literature (Almond & Currie, 2011a). Prenatal development tends to be more important than post-natal development for the formation of human capital, although both periods make important contributions (Almond & Currie, 2011b).

These findings, particularly the substantial socio-economic disparities and the large disparities that are determined prenatally, have important implications for nutrition policy and policies addressing health and nutrition inequalities. The large role of prenatal factors suggests an important emphasis in health and nutrition interventions is intervening before and during pregnancy (Black et al., 2013). However, much of the current landscape of research, policy, and interventions places the greatest emphasis on the early environment and issues such as breastfeeding, complementary feeding, or health knowledge and behaviors (Bhutta et al., 2008; Black et al., 2013; Horton, Shekar, McDonald, Mahal, & Brooks, 2010; World Bank, 2006, 2010), issues that, while important, are relatively secondary, at least in Jordan. These findings suggest that the emphasis on countering malnutrition after children are born may already be too late in Jordan. Although this study looked at only one country, research in other contexts suggests that other countries may have similar deficits in prenatal growth that drive early malnutrition. For instance, in an indigenous population in Guatemala that had an approximately 50% rate of stunting at 0-6 months, the strongest predictor of early infant growth failure was impaired fetal growth (Berngard et al., 2013).

Given the near-universal use of prenatal care and the relatively high frequency of such care in Jordan (Department of Statistics (Jordan) & ICF International, 2013), an important entry point for potential interventions in Jordan will be addressing maternal nutrition and fetal growth within prenatal care. Follow-up care related to birth weight (determined at delivery) could also be crucial to redressing disparate health outcomes that are related to poor fetal growth and low birth weight. Targeting the health and nutrition of children with poor nutrition status at birth for additional support will be an important part of improving nutrition—and reducing socio-economic disparities. Globally, public health spending plays a particularly important role in the health of the poor (Bidani & Ravallion, 1997), so public health interventions for prenatal nutrition and development may be particularly important.

The findings of this paper indicate a number of important directions for future research. The far more detailed specification of inequality of opportunity in this paper as compared to previous work (Assaad, Krafft, Hassine, & Salehi-Isfahani, 2012; El-Kogali & Krafft, 2015; Krafft & El-Kogali, 2014) has led to a far higher estimate of inequality of opportunity in child health than previous work had indicated for Jordan or other countries in the region. This paper's relatively high estimate of inequality suggests that there are a large number of important factors omitted (or, more often, not available in the data) in assessing child health inequality. The contributions of factors such as birth weight and feeding need to be considered in other contexts.

Although the 2012 DHS for Jordan had relatively rich data, the factors included in this paper were measured imperfectly. For instance, data was available about feeding frequency, but this is only a rough proxy for caloric or energy intake, so the effects estimated here are likely a lower bound on true inequality of opportunity. Measurement problems may also differentially affect the estimated partial effects, depending on how well-measured different factors are (see earlier discussion on measurement error). In Jordan, as well as in other contexts, there is a clear need for much richer data to assess the determinants of children's health and nutrition and the drivers of inequality in these important outcomes. An important contribution of this paper is its discussion of the complexities of identifying disparities and their mediators in the context of measurement error, a neglected issue in studies of health inequality.

Further research is needed in other countries to assess whether the pattern of predominant prenatal factors, which has also been found to occur in other contexts (Berngard et al., 2013; Neumann & Harrison, 1994), is widespread. There is also little research on the impact of nutrition interventions during pregnancy, but existing evidence is potentially promising, especially when mothers have poor nutritional status (Merialdi et al., 2003; Rasmussen & Habicht, 2010). Particularly if this pattern is common globally, future research needs to investigate interventions targeting not only early childhood nutrition after children are born, but also maternal and fetal nutrition and health to assess how to best prevent or remediate these key drivers of child malnutrition.

References

Almond, D., & Currie, J. (2011a). Killing Me Softly: The Fetal Origins Hypothesis. *Journal of Economic Perspectives*, *25*(3), 153–172.

Almond, D., & Currie, J. (2011b). Human Capital Development before Age Five. In D. Card & O. Ashenfelter (Eds.), *Handbook of Labor Economics* (Vol. 4, pp. 1315–1486). Elsevier B.V.

Assaad, R., Krafft, C., Hassine, N. B., & Salehi-Isfahani, D. (2012). Inequality of Opportunity in Child Health in the Arab World and Turkey. *Middle East Development Journal*, *4*(2), 1–37.

Baker, L. A., Reynolds, C., & Phelps, E. (1992). Biometrical Analysis of Individual Growth Curves. *Behavior Genetics*, *22*(2), 253–264.

Behrman, J. R., Alderman, H., & Hoddinott, J. (2004). Hunger and Malnutrition. In B. Lomborg (Ed.), *Global Crises, Global Solutions*. Cambridge: Cambridge University Press.

Behrman, J. R., & Rosenzweig, M. R. (2004). Returns to Birthweight. *Review of Economics and Statistics*, *86*(2), 586–601.

Behrman, J. R., & Wolfe, B. L. (1987). How Does Mother's Schooling Affect Family Health, Nutrition, Medical Care Usage, and Household Sanitation? *Journal of Econometrics*, *36*, 185–204.

Berngard, S. C., Berngard, J. B., Krebs, N. F., Garcés, A., Miller, L. V., Westcott, J., Wright, L. L., Kindem, M., & Hambidge, K. M. (2013). Newborn Length Predicts Early Infant Linear Growth Retardation and Disproportionately High Weight Gain in a Low-Income Population. *Early Human Development*, *89*(12), 967–972.

Bhalotra, S., & Rawlings, S. B. (2011). Intergenerational Persistence in Health in Developing Countries: The Penalty of Gender Inequality? *Journal of Public Economics*, *95*(3-4), 286–299.

Bhargava, A. (2014). *Diet Quality, Child Health, and Food Policies in Developing Countries*. *World Bank Policy Research Working Paper No. 7072*. Washington, DC.

Bhutta, Z. A., Ahmed, T., Black, R. E., Cousens, S., Dewey, K., Giugliani, E., Haider, B. A., Kirkwood, B., Morris, S. S., Sachdev, H. P. S., & Shekar, M. (2008). What Works? Interventions for Maternal and Child Undernutrition and Survival. *Lancet*, *371*(9610), 417–40.

Bidani, B., & Ravallion, M. (1997). Decomposing Social Indicators Using Distributional Data. *Journal of Econometrics*, *77*, 125–139.

Bjorklund, A., Lindahl, M., & Plug, E. (2006). The Origins of Intergenerational Associations: Lessons from Swedish Adoption Data. *Quarterly Journal of Economics*, *121*(3), 999–1028.

Black, R. E., Allen, L. H., Bhutta, Z. A., Caulfield, L. E., de Onis, M., Ezzati, M., Mathers, C., & Rivera, J. (2008). Maternal and Child Undernutrition: Global and Regional Exposures and Health Consequences. *Lancet*, *371*(9608), 243–60.

Black, R. E., Victora, C. G., Walker, S. P., Bhutta, Z. A., Christian, P., de Onis, M., Ezzati, M., Grantham-McGregor, S., Katz, J., Martorell, R., & Uauy, R. (2013). Maternal and Child Undernutrition and Overweight in Low-Income and Middle-Income Countries. *Lancet*, *382*(9890), 427–51.

Bound, J., Brown, C., & Mathiowetz, N. (2001). Measurement Error in Survey Data. *Handbook of Econometrics*, *5*, 3705–3843.

Bourguignon, F., Ferreira, F. H. G., & Menendez, M. (2007). Inequality of Opportunity in Brazil. *Review of Income and Wealth*, *53*(4), 585–618.

Bustos, P., Amigo, H., Muñoz, S. R., & Martorell, R. (2001). Growth in Indigenous and Nonindigenous Chilean Schoolchildren from 3 Poverty Strata. *American Journal of Public Health*, *91*(10), 1645–1649.

Case, A., Lubotsky, D., & Paxson, C. (2002). Economic Status and Health in Childhood: The Origin of the Gradient. *American Economic Review*, *92*(5), 1308–1334.

Cebu Study Team. (1992). A Child Health Production Function Estimated from Longitudinal Data. *Journal of Development Economics*, *38*, 323–351.

Centers for Disease Control. (2001). Growth Charts - Data Table of Stature-for-Age Charts. Retrieved February 28, 2015 from http://www.cdc.gov/growthcharts/html_charts/statage.htm#females

Christian, P., Lee, S. E., Angel, M. D., Adair, L. S., Arifeen, S. E., Ashorn, P., Barros, F. C., Fall, C. H. D., Fawzi, W. W., Hao, W., Hu, G., Humphrey, J. H., Huybregts, L., Joglekar, C. V., Kariuki, S. K., Kolsteren, P., Krishnaveni, G. V., … Black, R. E. (2013). Risk of Childhood Undernutrition Related to Small-for-Gestational Age and Preterm Birth in Low- and Middle-Income Countries. *International Journal of Epidemiology*, *42*(5), 1340–1355.

Cowell, F. A. (2000). Measurement of Inequality. In A. B. Atkinson & F. Bourguignon (Eds.), *Handbook of Income Distribution* (Vol. 1, pp. 87–166). Elsevier Science B.V.

Currie, J., & Moretti, E. (2007). Biology as Destiny? Short- and Long-Run Determinants of Intergenerational Transmission of Birth Weight. *Journal of Labor Economics*, *25*(2), 231–264.

Department of Statistics (Jordan), & ICF International. (2013). *Jordan Population and Family Health Survey 2012*. Calverton, Maryland: Department of Statistics and ICF International.

Department of Statistics, & Macro International Inc. (2008). *Jordan Population and Family Health Survey 2007*. Calverton, Maryland: Department of Statistics and Macro International Inc.

Dercon, S., & Sánchez, A. (2013). Height in Mid Childhood and Psychosocial Competencies in Late Childhood: Evidence from Four Developing Countries. *Economics and Human Biology*, *11*(4), 426–432.

Desai, S., & Alva, S. (1998). Maternal Education and Child Health: Is There a Strong Causal Relationship? *Demography*, *35*(1), 71–81.

Dewey, K. G., & Begum, K. (2011). Long-Term Consequences of Stunting in Early Life. *Maternal & Child Nutrition*, *7*, 5–18.

Dubois, L., Ohm Kyvik, K., Girard, M., Tatone-Tokuda, F., Pérusse, D., Hjelmborg, J., Skytthe, A., Rasmussen, F., Wright, M. J., Lichtenstein, P., & Martin, N. G. (2012). Genetic and Environmental Contributions to Weight, Height, and BMI from Birth to 19 Years of Age: An International Study of over 12,000 Twin Pairs. *PLoS ONE*, *7*(2), e30153.

Duclos, J.-Y., & Araar, A. (2006). *Poverty and Equity: Measurement, policy and estimation with DAD*. New York, NY: Springer International Development Research Centre.

El-Kogali, S., & Krafft, C. (2015). *Expanding Opportunities for the Next Generation: Early Childhood Development in the Middle East and North Africa*. Washington, DC: World Bank.

Ferreira, F., & Gignoux, J. (2008). The Measurement of Inequality of Opportunity: Theory and an Application to Latin America. World Bank Policy Research Working Paper No. 4659. Washington, DC.

Ferreira, F., & Gignoux, J. (2011). The Measurement of Inequality of Opportunity: Theory and an Application To Latin America. *Review of Income and Wealth*, *57*(4), 622–657.

Gertler, P. (2004). Do Conditional Cash Transfers Improve Child Health? Evidence from PROGRESA's Control Randomized Experiment. *The American Economic Review*, *94*(2), 336–341.

Glewwe, P. (1999). Why Does Mother's Schooling Raise Child Health in Developing Countries? Evidence from Morocco. *Journal of Human Resources*, *34*(1), 124–159.

Glewwe, P., Koch, S., & Nguyen, B. L. (2004). Child Nutrition, Economic Growth, and the Provision of Health Care Services in Vietnam. In P. Glewwe, N. Agrawal, & D. Dollar (Eds.), *Economic Growth, Poverty, and Household Welfare in Vietnam* (pp. 351–390). Washington, DC: World Bank.

Glewwe, P., & Miguel, E. A. (2008). The Impact of Child Health and Nutrition on Education in Less Developed Countries. In T. P. Schultz & J. Strauss (Eds.), *Handbook of Development Economics* (Vol. 4, pp. 3561–3606). Elsevier B.V.

Goldberger, A. S. (1979). Heritability. *Economica*, *46*(184), 327–347.

Grantham-McGregor, S., Cheung, Y. B., Cueto, S., Glewwe, P., Richter, L., Strupp, B., & International Child Development Steering Group. (2007). Developmental Potential in the First 5 Years for Children in Developing Countries. *Lancet*, *369*, 60–70.

Horton, S., Shekar, M., McDonald, C., Mahal, A., & Brooks, J. K. (2010). *Scaling Up Nutrition: What Will It Cost?* Washington, DC: World Bank.

Kanbur, R., & Wagstaff, A. (2014). How Useful Is Inequality of Opportunity as a Policy Construct? World Bank Policy Research Working Paper No. 6980. Washington, DC.

Khawaja, M., Dawns, J., Meyerson-Knox, S., & Yamout, R. (2008). Disparities in Child Health in the Arab Region during the 1990s. *International Journal for Equity in Health*, *7*(24), 1–10.

Kozuki, N., Lee, A. C. C., Silveira, M. F., Sania, A., Vogel, J. P., Adair, L., Barros, F., Caulfield, L. E., Christian, P., Fawzi, W., Humphrey, J., Huybregts, L., Mongkolchati, A., Ntozini, R., Osrin, D., Roberfroid, D., Tielsch, J., … Katz, J. (2013). The Associations of Parity and Maternal Age with Small-for-Gestational-Age, Preterm, and Neonatal and Infant Mortality: A Meta-Analysis. *BMC Public Health*, *13*(Suppl 3), S2.

Krafft, C., & El-Kogali, S. (2014). Inequalities in Early Childhood Development in the Middle East and North Africa. Economic Research Forum Working Paper Series No. 856. Cairo, Egypt.

Leight, J., Glewwe, P., & Park, A. (2015). The Impact of Early Childhood Shocks on the Evolution of Cognitive and Non-Cognitive Skills. In *Allied Social Science Associations 2015 Annual Meeting*. Boston, MA.

Livshits, G., Peter, I., Vainder, M., & Hauspie, R. (2000). Genetic Analysis of Growth Curve Parameters of Body Weight, Height and Head Circumference. *Annals of Human Biology, 27*, 299–312.

Merialdi, M., Carroli, G., Villar, J., Abalos, E., Gülmezoglu, A. M., Kulier, R., & de Onis, M. (2003). Nutritional Interventions during Pregnancy for the Prevention or Treatment of Impaired Fetal Growth: An Overview of Randomized Controlled Trials. *The Journal of Nutrition*, *133*(5 Suppl 2), 1626S–1631S.

Monteiro, C. A., Benicio, M. H. D., Conde, W. L., Konno, S., Lovadino, A. L., Barros, A. J. D., & Victora, C. G. (2010). Narrowing Socioeconomic Inequality in Child Stunting: The Brazilian Experience, 1974-2007. *Bulletin of the World Health Organization*, *88*(4), 305–11.

Neumann, C. G., & Harrison, G. G. (1994). Onset and Evolution of Stunting in Infants and Children. Examples from the Human Nutrition Collaborative Research Support Program. Kenya and Egypt Studies. *European Journal of Clinical Nutrition*, *48 Suppl 1*, S90–102.

Ozaltin, E., Hill, K., & Subramanian, S. V. (2010). Association of Maternal Stature with Offspring Mortality, Underweight, and Stunting in Low- to Middle-Income Countries. *JAMA*, *303*(15), 1507–1516.

Pradhan, M., Sahn, D. E., & Younger, S. D. (2003). Decomposing World Health Inequality. *Journal of Health Economics*, *22*(2), 271–93.

Rasmussen, K. M., & Habicht, J.-P. (2010). Maternal Supplementation Differentially Affects the Mother and Newborn. *The Journal of Nutrition*, *140*, 402–406.

Roemer, J. E. (1998). *Equality of Opportunity*. Cambridge, MA: Harvard University Press.

Roemer, J. E. (2014). Economic Development as Opportunity Equalization. *The World Bank Economic Review*, *28*(2), 189–209.

Rosenzweig, M. R., & Schultz, T. P. (1983). Estimating a Household Production Function: Heterogeneity, the Demand for Health Inputs, and Their Effects on Birth Weight. *Journal of Political Economy*, *91*(5), 723.

Shrimpton, R., Victora, C. G., de Onis, M., Lima, R. C., Blössner, M., & Clugston, G. (2001). Worldwide Timing of Growth Faltering: Implications for Nutritional Interventions. *Pediatrics*, *107*(5), e75.

Spears, D. (2013). *How Much International Variation in Child Height Can Sanitation Explain? World Bank Policy Research Working Paper No. 6351*. Washington, DC.

Strauss, J., & Thomas, D. (1998). Health, Nutrition, and Economic Development. *Journal of Economic Literature*, *36*(2), 766–817.

Towne, B., Guo, S., Roche, A. F., & Siervogel, R. M. (1993). Genetic Analysis of Patterns of Growth in Infant Recumbent Length. *Human Biology*, *65*(6), 977–989.

Ulijaszek, S. J. (2001). Secular Trends in Growth: The Narrowing of Ethnic Differences in Stature. *Nutrition Bulletin*, *26*, 43–51.

Ulijaszek, S. J., & Kerr, D. A. (1999). Anthropometric Measurement Error and the Assessment of Nutritional Status. *British Journal of Nutrition, 82*(3), 165–177.

UNICEF. (2014). *The State of the World's Children 2014 in Numbers: Every Child Counts: Revealing disparities, advancing children's rights*. New York, NY: UNICEF.

Victora, C. G., Adair, L., Fall, C., Hallal, P. C., Martorell, R., Richter, L., & Sachdev, H. S. (2008). Maternal and Child Undernutrition: Consequences for Adult Health and Human Capital. *Lancet*, *371*(9609), 340–57.

Victora, C. G., de Onis, M., Hallal, P. C., Blössner, M., & Shrimpton, R. (2010). Worldwide Timing of Growth Faltering: Revisiting Implications for Interventions. *Pediatrics*, *125*(3), e473–e480.

Wagstaff, A., van Doorslaer, E., & Watanabe, N. (2003). On Decomposing the Causes of Health Sector Inequalities with an Application to Malnutrition Inequalities in Vietnam. *Journal of Econometrics*, *112*, 207–223.

Wagstaff, A., & Watanabe, N. (2000). *Socioeconomic Inequalities in Child Malnutrition in the Developing World*. *World Bank Policy Research Working Paper No. 2434*. Washington, DC.

Wamani, H., Tylleskär, T., Astrøm, A. N., Tumwine, J. K., & Peterson, S. (2004). Mothers' Education but Not Fathers' Education, Household Assets or Land Ownership Is the Best Predictor of Child Health Inequalities in Rural Uganda. *International Journal for Equity in Health*, *3*(9), 1–8.

World Bank. (2006). *Repositioning Nutrition as Central to Development: A Strategy for Large-Scale Action*. Washington, DC: World Bank.

World Bank. (2010). *What Can We Learn from Nutrition Impact Evaluations? Lessons from a Review of Interventions to Reduce Child Malnutrition in Developing Countries*. Washington, DC.

World Bank. (2012). *Arab Republic of Egypt - Inequality of Opportunity in Access to Basic Services among Egyptian Children*. Washington, DC: World Bank.

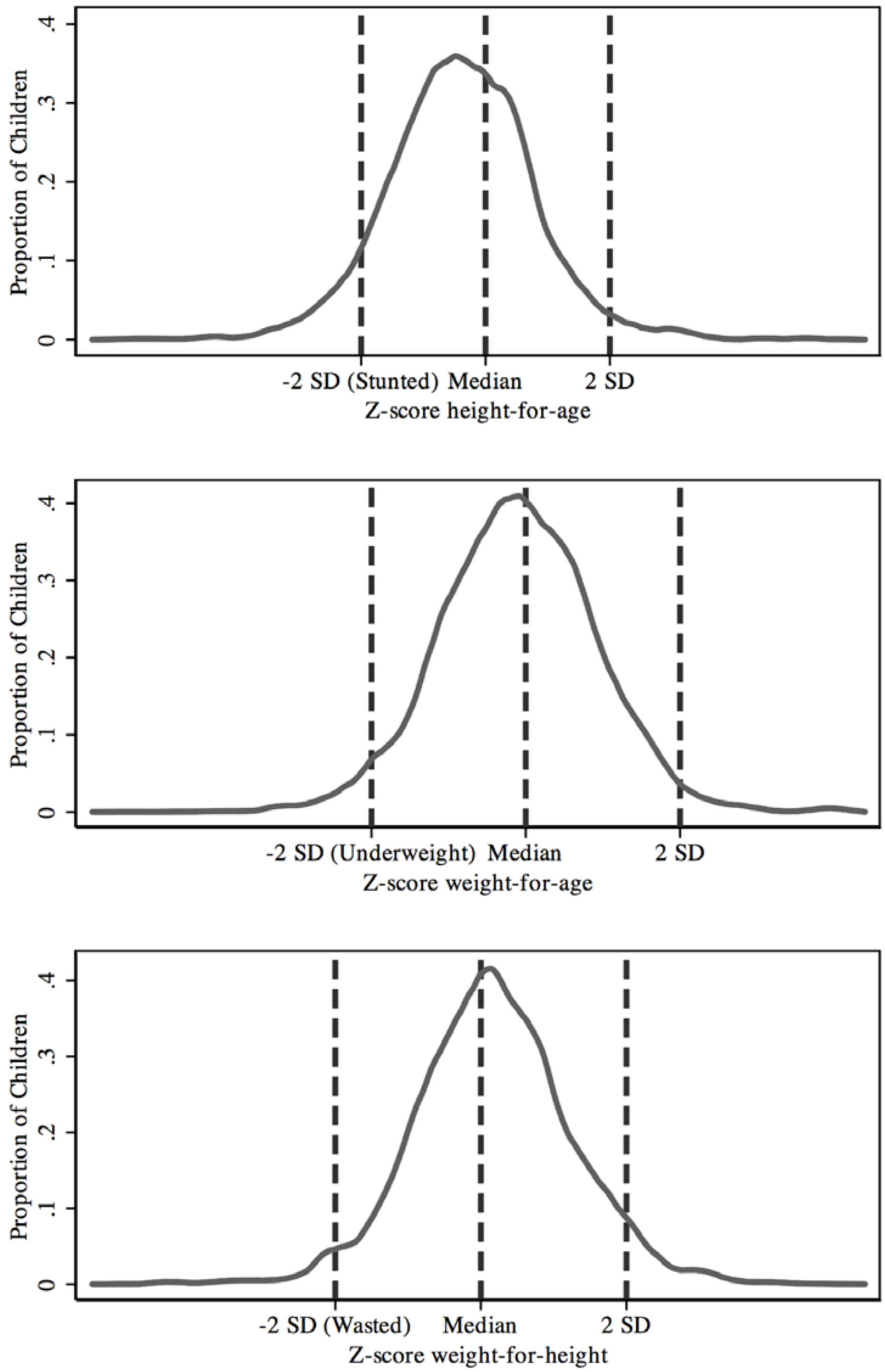
World Health Organization. (2005). *Guiding Principles for Feeding Non-Breastfed Children 6-24 Months of Age*. Geneva, Switzerland: WHO Press.

World Health Organization. (2006). *WHO Child Growth Standards: Length/height-for-Age, Weight-for-Age, Weight-for-Length, Weight-for-Height and Body Mass Index-for-Age: Methods and Development*. Geneva, Switzerland.

World Health Organization. (2008). *Indicators for Assessing Infant and Young Child Feeding Practices*. Geneva, Switzerland: WHO Press.

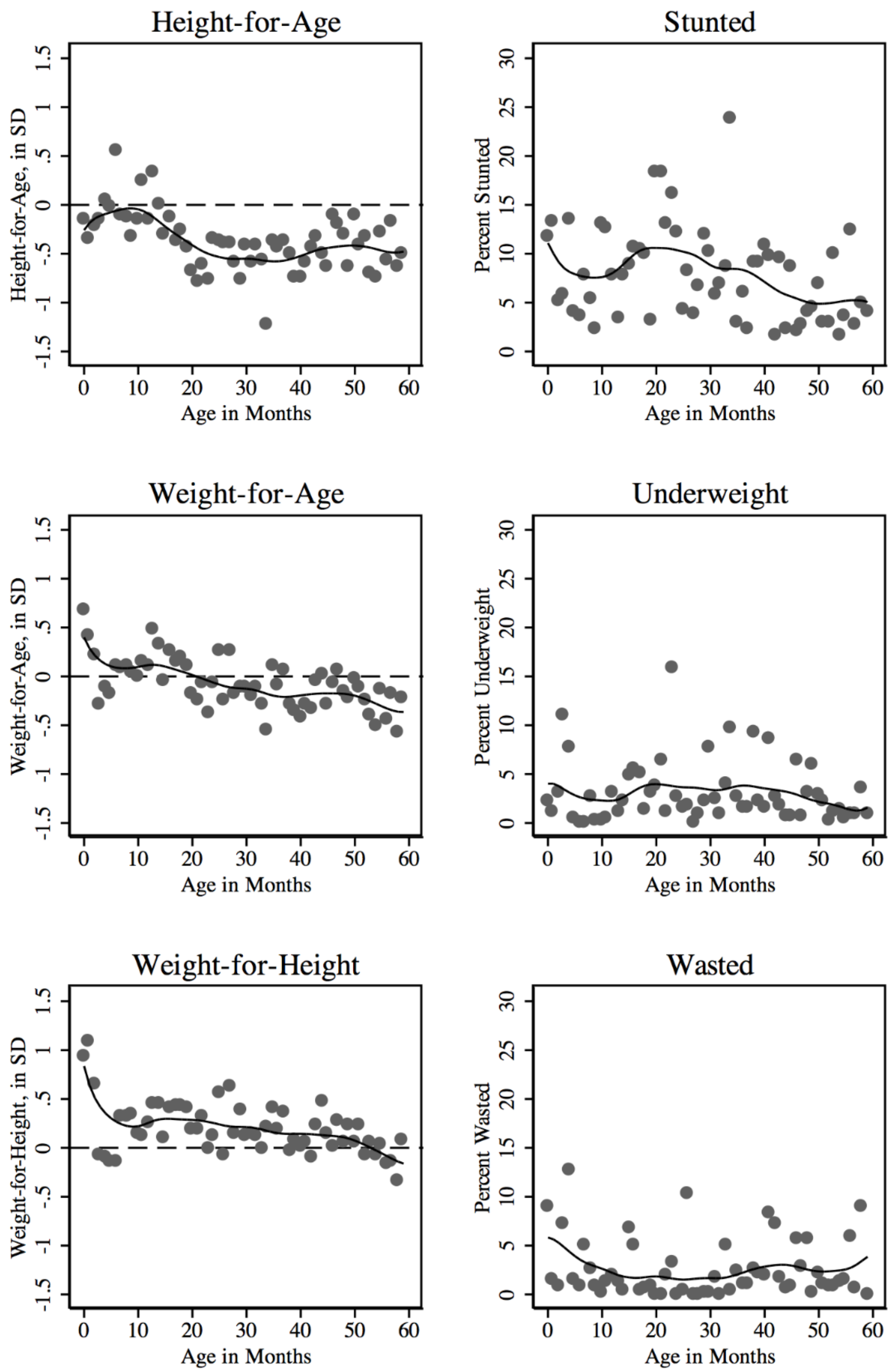
Zere, E., & McIntyre, D. (2003). Inequities in under-Five Child Malnutrition in South Africa. *International Journal for Equity in Health, 2*(7), 1–10.

Figure 1: Distribution of Anthropometrics



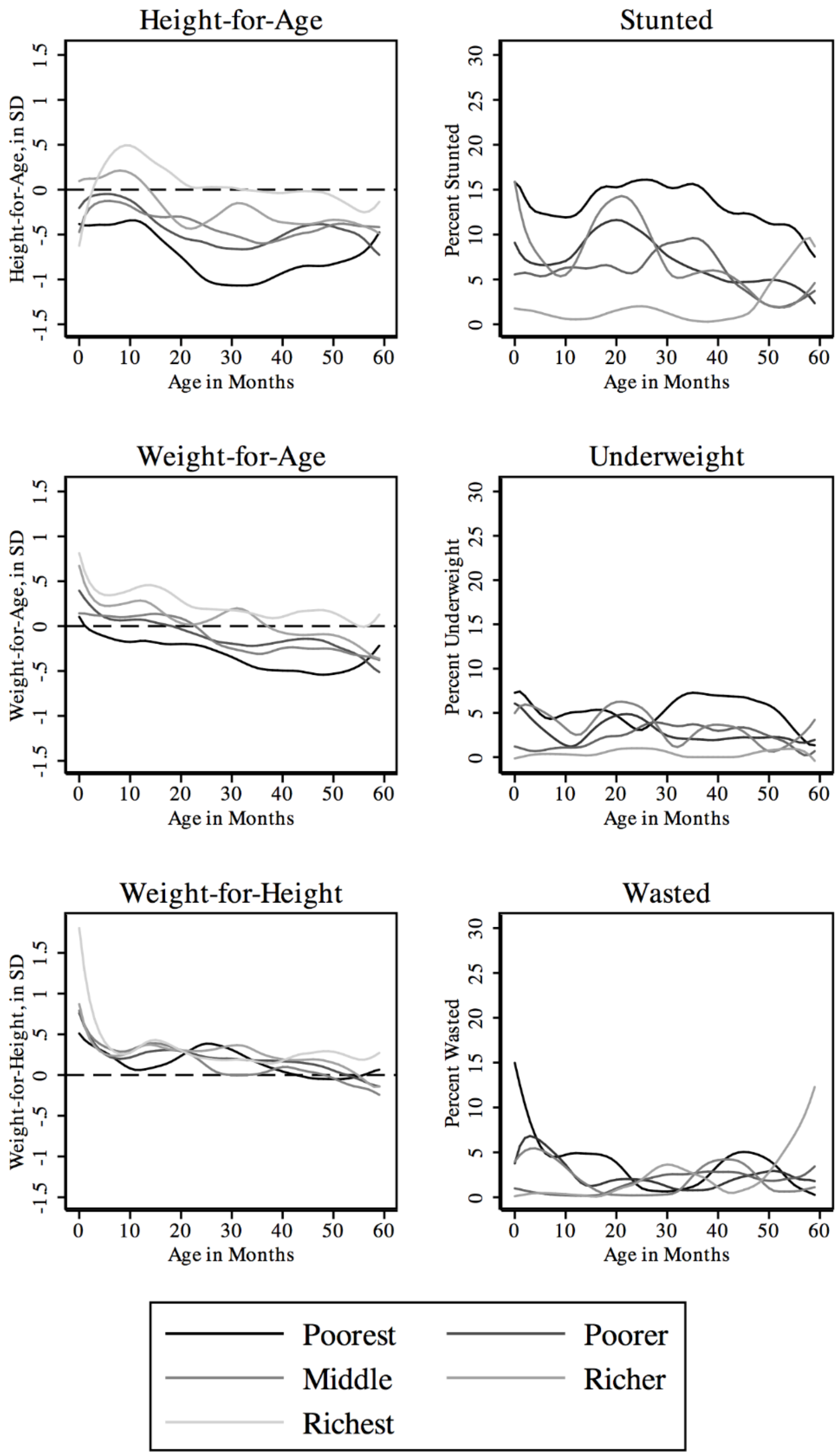
Notes: Kernel densities, using Epanechnikov kernel (bandwidth 0.4).
Source: Author's calculations based on Jordan DHS 2012.

Figure 2: Anthropometrics by Age in Months



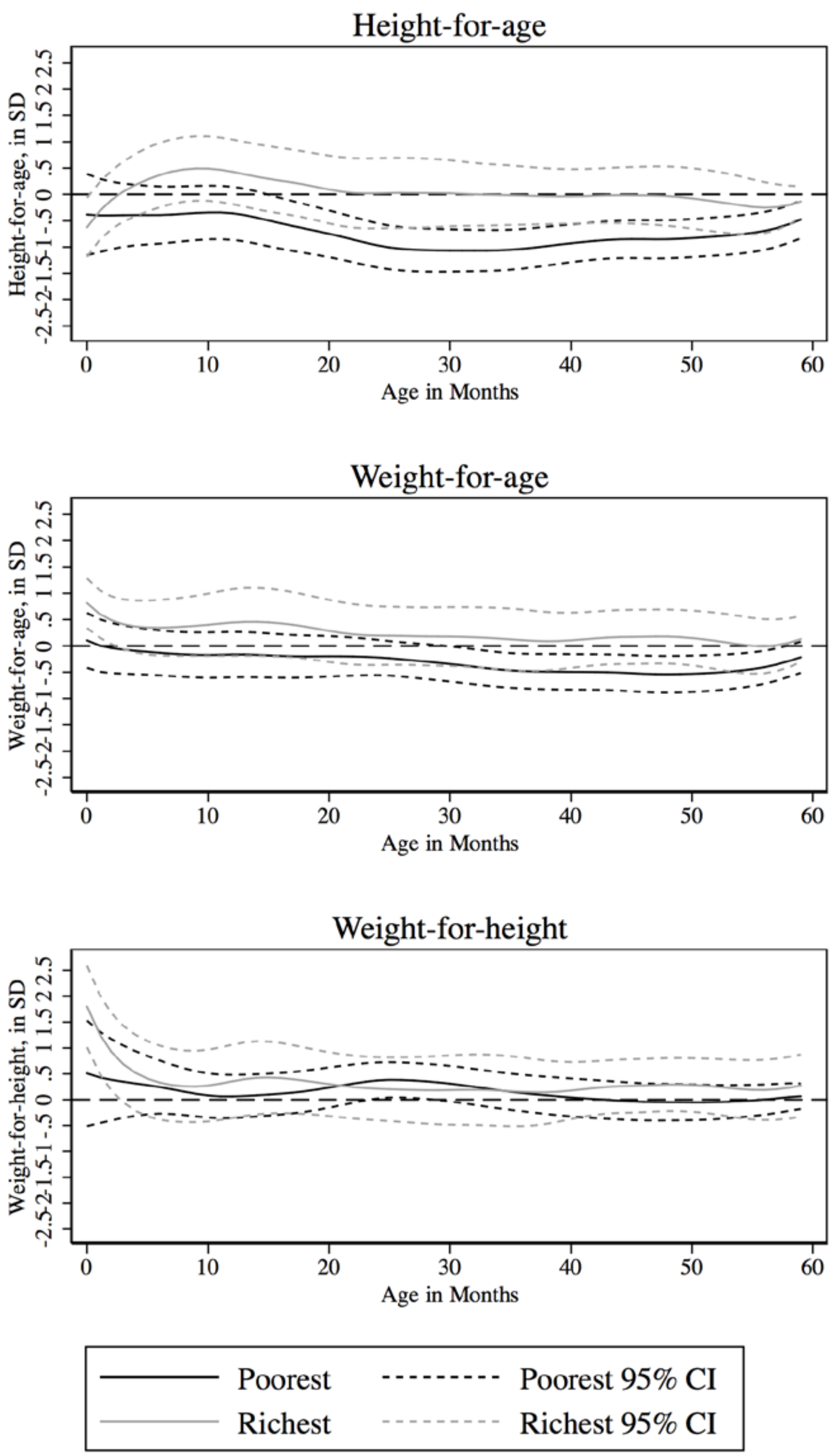
Notes: Lowess smoother (bandwidth 0.4).
Source: Author's calculations based on Jordan DHS 2012.

Figure 3: Anthropometrics by Age in Months and Wealth Quintile



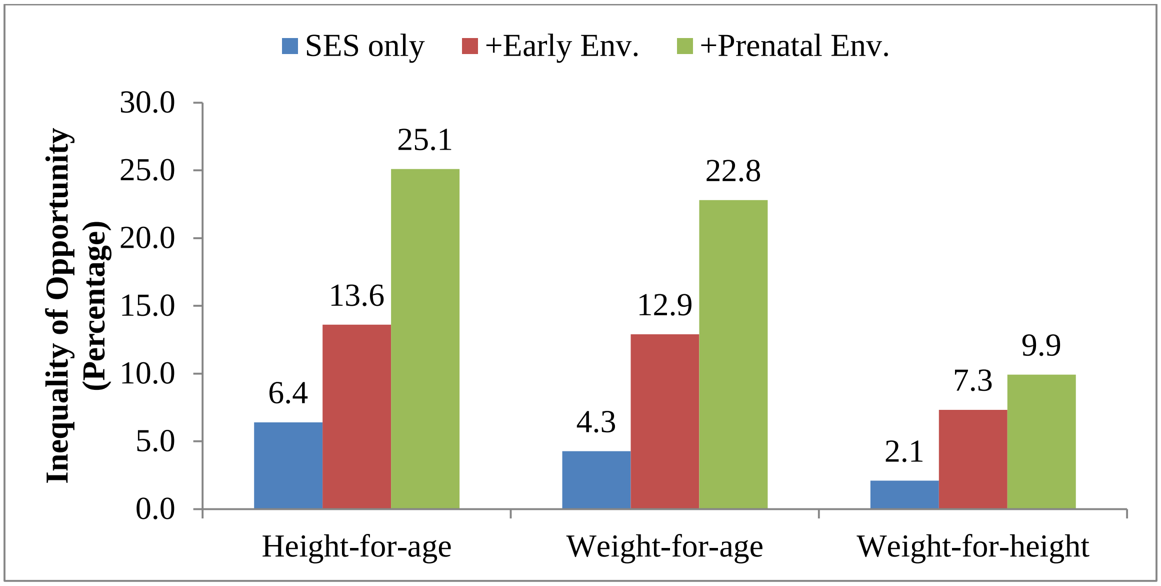
Notes: Lowess smoother (bandwidth 0.4)
Source: Author's calculations based on Jordan DHS 2012

Figure 4: Anthropometrics by Age in Months, Richest and Poorest Wealth Quintiles and Confidence Intervals



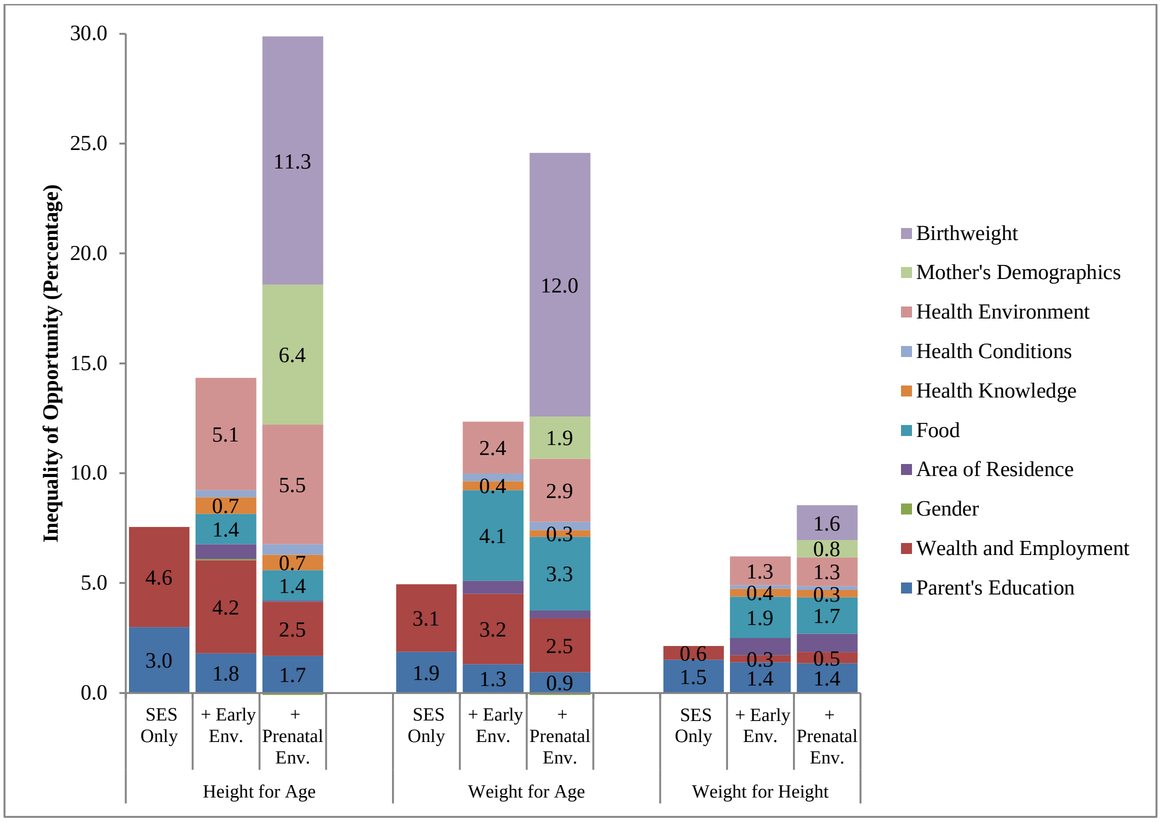
Notes: Lowess smoother (bandwidth 0.4). The 95% confidence intervals are constructed using the standard errors for the means at each month.
Source: Author's calculations based on Jordan DHS 2012

Figure 5: Inequality of Opportunity in Anthropometrics by Specification, Youngest Child under Two (Percentage of Total Inequality)



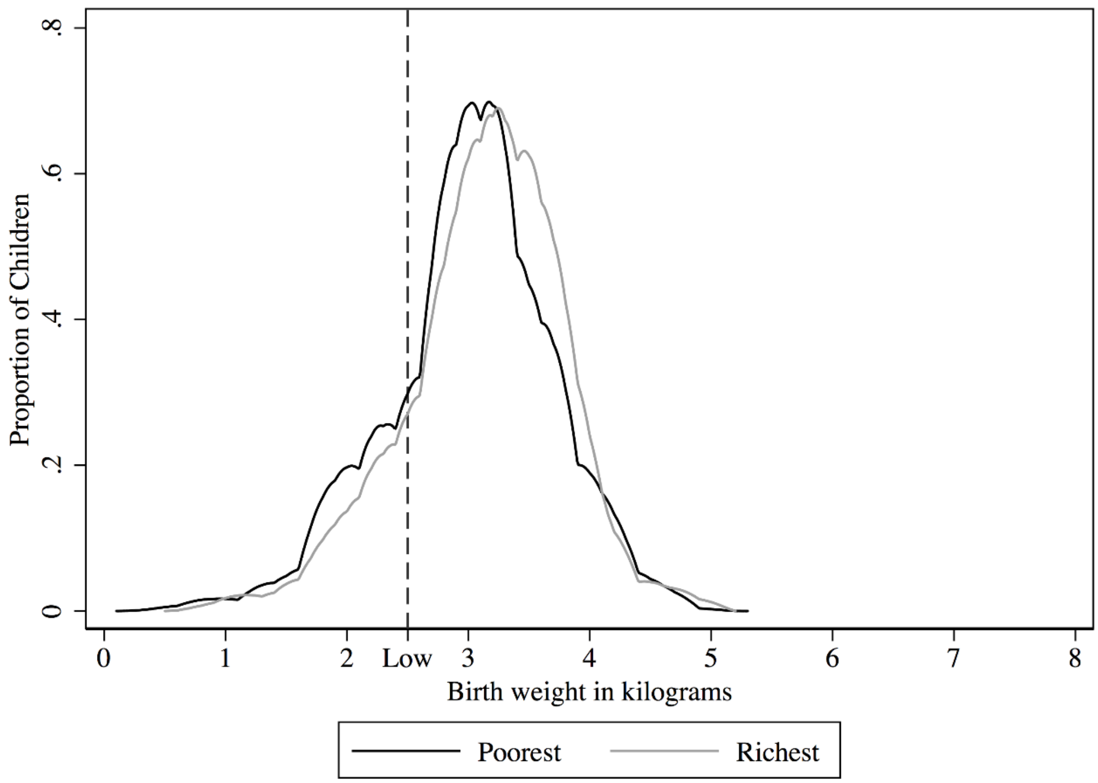
Source: Author's calculations based on Jordan DHS 2012.

Figure 6: Partial Effects, Inequality of Opportunity in Anthropometrics by Specification, Youngest Child under Two (Percentage of Total Inequality)



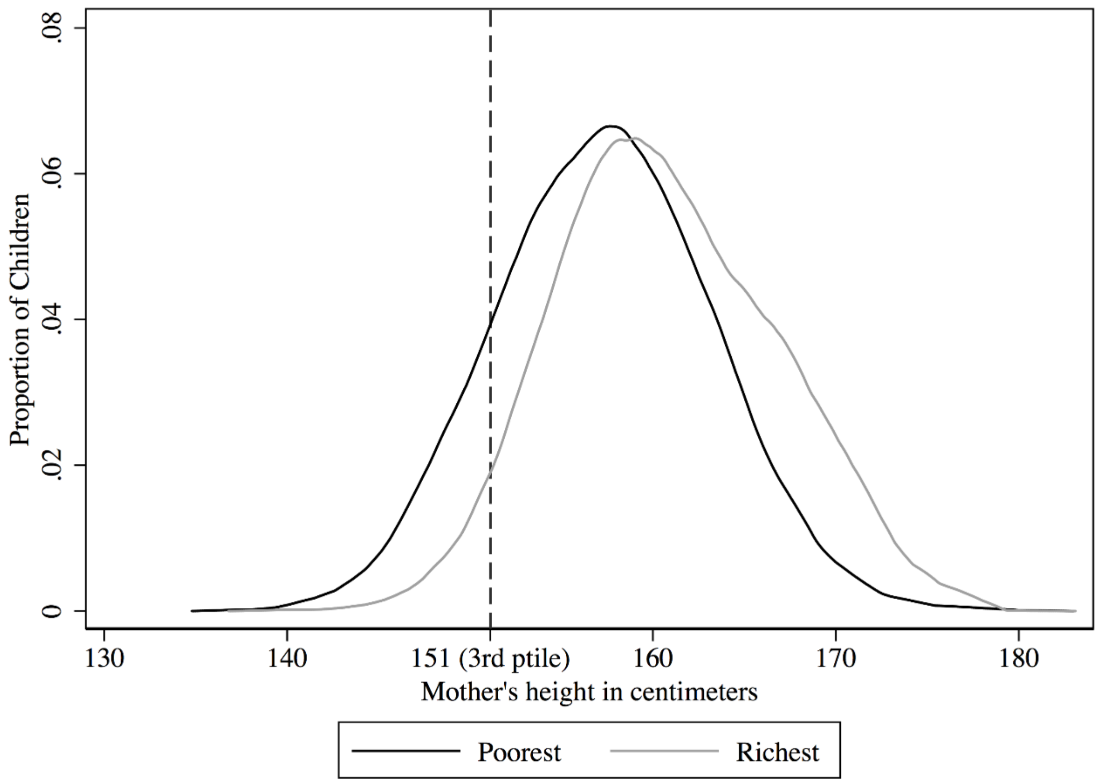
Source: Author's calculations based on Jordan DHS 2012.

Figure 7: Distribution of Birth weights (in Kilograms), Poorest versus Richest Wealth Quintile



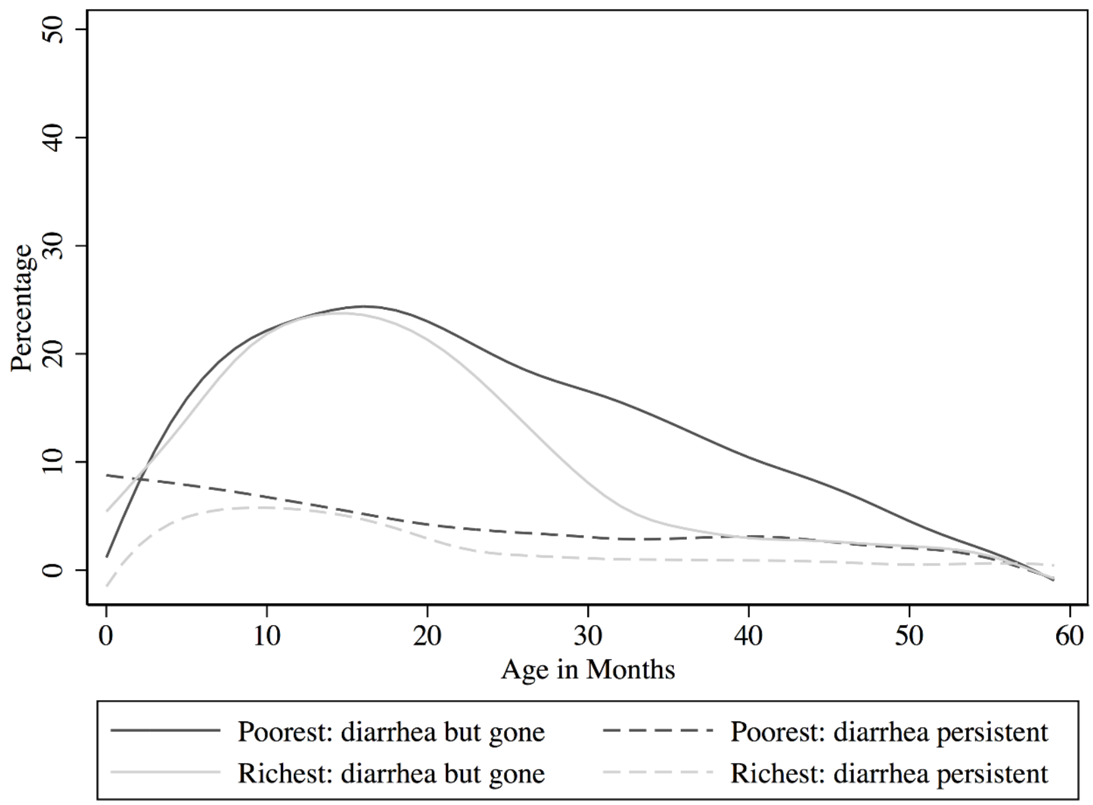
Notes: Kernel densities, using Epanechnikov kernel (bandwidth 0.4). Low birth weight defined as less than 2.5 kilograms.
Source: Author's calculations based on Jordan DHS 2012.

Figure 8: Distribution of Mother's Height (in Centimeters), Poorest versus Richest Wealth Quintile



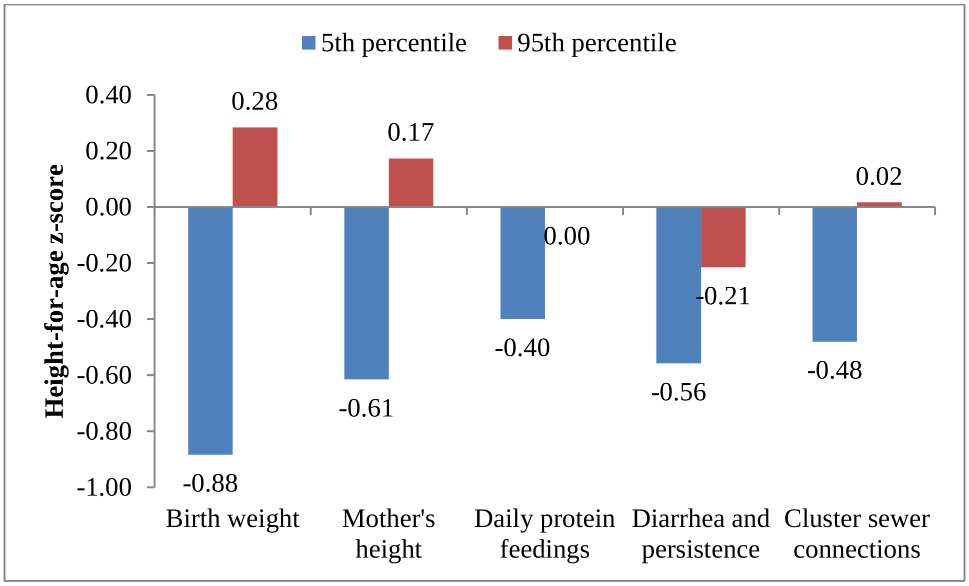
Notes: Kernel densities, using Epanechnikov kernel (bandwidth 5). Mother's height below 3rd percentile if less than 151.1112 per CDC growth charts for a 20-year-old female (Centers for Disease Control, 2001).
Source: Author's calculations based on Jordan DHS 2012.

Figure 9: Diarrhea in the Past Two Weeks and Persistence by Age in Months, Richest and Poorest Wealth Quintiles



Notes: Lowess smoother (bandwidth 0.6).
Source: Author's calculations based on Jordan DHS 2012.

Figure 10: Simulations of Height-for-age Z-scores (Shift from 5th to 95th Percentiles for Selected Covariates)



Notes: Based on regressions for height-for-age, specification including prenatal environment and age in months (Table 4). All other characteristics as observed except the one being simulated. Shifts from 5th to 95th percentiles are: birth weight of 2 kg to 4 kg, mother's height of 149.4 to 168.2, number of proteins from zero to four, diarrhea from persistent to none, cluster sewage connection from none to all.
Source: Author's calculations based on Jordan DHS 2012.

Table 1: Categories of Variables

Category	Variables
Parent's education	Mother's education (6 categories), father's education (6 categories)
Wealth and employment	Household wealth factor (and square), father's employment status, mother's employment status (3 categories), father's employment status (4 categories), father's occupation (8 categories), mother's occupation (2 categories)
Gender	Female
Geography	Governorate (12 categories), rural, refugee camps, badia (arid areas)
Food	Breastfeeding initiation (8 categories), currently breastfed, exclusively breastfed, fed with a bottle, frequency of feeding, number of liquids fed, number of grains fed, number of fruits/leafy vegetables fed, number of proteins fed
Health knowledge	Mother knows tuberculosis is curable, mother knows oral rehydration salts (ORS), factor for family planning knowledge
Health conditions	Diarrhea and persistence (3 categories), fever/cough and persistence (3 categories)
Health environment	Household level: Drinking water source (4 categories), sewage connection, distance to health facilities is a big problem, mother smokes cigarettes, mother smokes nargile (hookah), household members smoke, persons per room Cluster level: Share drinking water source (4 categories), share sewage connection, wealth of other households (and square)
Mother's demographics	Mother's age at birth (7 categories), mother's height (in cm.)
Birth weight	Birth weight (in kg.) and indicator if missing
Age in months (not a circumstance)	Categorically

Table 2: Anthropometrics by Socio-Economic Status, Youngest Child under Two

	Height-for-age (z-score)	Weight-for-age (z-score)	Weight-for-height (z-score)	Stunted (percent-age)	Under-weight (percent-age)	Wasted (percent-age)	Percent-age of Sample
Father's Education							
No education	-0.91	-0.28	0.32	19.6	2.3	0.0	1.0
Elementary	-0.45	-0.13	0.17	12.6	5.5	4.1	8.9
Preparatory	-0.45	-0.13	0.20	16.5	5.4	3.7	17.4
Secondary	-0.23	0.07	0.29	7.8	3.2	2.4	48.7
Diploma	-0.22	0.21	0.49	13.2	3.1	1.1	7.9
University and above	0.11	0.20	0.27	4.3	1.4	1.4	16.0
Mother's Education							
No education	-0.55	-0.23	0.11	12.9	6.3	1.0	1.4
Elementary	-0.48	0.13	0.58	12.2	1.5	0.9	5.7
Preparatory	-0.61	-0.11	0.30	17.8	3.4	1.8	14.1
Secondary	-0.27	-0.03	0.19	9.8	5.2	3.6	46.2
Diploma	0.13	0.17	0.18	5.2	2.2	2.4	12.0
University and above	-0.03	0.24	0.43	5.8	0.8	1.1	20.7
Wealth quintile							
Poorest	-0.62	-0.24	0.20	16.7	5.0	4.2	23.6
Poorer	-0.26	0.02	0.24	9.8	3.9	4.7	22.7
Middle	-0.27	0.09	0.32	7.6	2.1	0.4	22.1
Richer	-0.03	0.22	0.34	10.2	5.2	1.6	17.5
Richest	0.24	0.27	0.28	0.7	0.2	0.3	14.0
Father's Employment Status							
Not present/not working	-0.34	0.01	0.30	14.1	1.8	2.7	9.9
Wage worker	-0.25	0.05	0.29	9.3	3.2	1.9	69.4
Employer	-0.07	0.05	0.15	10.7	7.3	4.3	8.8
Self-employed	-0.23	0.07	0.24	7.6	3.6	4.4	11.8
Mother's Employment Status							
Not working	-0.29	0.01	0.25	10.1	3.9	2.6	86.1
Wage worker	0.06	0.29	0.41	7.1	1.0	1.8	13.1
Other work	0.12	0.15	0.11	13.3	0.8	0.0	0.9
Father's Occupation							
Did not work	-0.34	0.01	0.30	14.1	1.8	2.7	9.9
Professional/technical /managerial	-0.10	0.15	0.35	4.1	1.4	1.1	20.1
Clerical	0.00	0.13	0.24	9.6	4.5	1.8	7.0
Sales	-0.23	0.12	0.35	11.7	2.7	2.7	11.4
Agricultural	-0.53	-0.27	0.05	5.2	3.0	1.0	1.6
Household and domestic	-0.77	-0.35	0.19	20.8	8.3	0.0	1.3
Services	-0.29	-0.01	0.24	10.1	3.5	1.5	15.9
Skilled manual	-0.27	0.01	0.24	10.6	5.5	3.9	29.7
Unskilled manual	-0.36	-0.10	0.11	12.6	1.9	4.8	3.1
Mother's Occupation							
Not working	-0.29	0.01	0.25	10.1	3.9	2.6	86.1
Professional/technical /managerial	0.18	0.31	0.36	4.1	0.9	1.8	11.3
Other occupations	-0.42	0.18	0.52	22.2	1.0	1.1	2.6
Total	-0.24	0.04	0.27	9.7	3.5	2.5	100.0
N	2,230	2,230	2,230	2,230	2,230	2,230	2,230

Source: Author’s calculations based on Jordan DHS 2012

Table 3: Summary Statistics for Covariates, Analysis Sample

	Mean	Standard deviation
Wealth		
Wealth Score	58.287	9.886
Wealth Score Sq./100	34.95	12.404
Father's education		
No education	0.01	0.099
Elementary	0.089	0.285
Preparatory	0.178	0.382
Secondary	0.483	0.5
Diploma	0.079	0.269
University and above	0.161	0.368
Mother's education		
No education	0.014	0.116
Elementary	0.058	0.234
Preparatory	0.137	0.344
Secondary	0.464	0.499
Diploma	0.121	0.327
University and above	0.205	0.404
Father's emp. status		
Not present/not working	0.103	0.303
Wage worker	0.691	0.462
Employer	0.085	0.279
Self-employed	0.121	0.326
Mother's employment status		
Not working	0.864	0.342
Wage worker	0.127	0.333
Other work	0.009	0.092
Father's occup.		
Did not work	0.103	0.303
Professional/technical/managerial	0.204	0.403
Clerical	0.07	0.256
Sales	0.109	0.312
Agricultural	0.016	0.125
Household and domestic	0.014	0.117
Services	0.155	0.362
Skilled manual	0.296	0.457
Unskilled manual	0.033	0.179
Mother's occup.		
Not working	0.864	0.342
Professional/technical/managerial	0.111	0.315
Other occupations	0.024	0.154
Rural	0.209	0.407
Camps	0.043	0.202
Badia	0.083	0.276
Gov. of residence		
Amman	0.353	0.478
Balqa	0.074	0.262
Zarqa	0.138	0.345
Madaba	0.029	0.167
Irbid	0.184	0.388
Mafraq	0.06	0.238
Jarash	0.04	0.196
Ajlun	0.025	0.157
Karak	0.045	0.208
Tafiela	0.015	0.123
Ma'an	0.019	0.136
Aqaba	0.016	0.127
Female	0.447	0.497
Breastfeeding init.		
Not breastfed	0.053	0.224
Immediately	0.129	0.336
Within first hour	0.065	0.247
One hour	0.176	0.381
2-24 hours	0.339	0.473
One day	0.121	0.326
Two days	0.056	0.229
3 or more days	0.061	0.24

	Mean	Standard deviation
Other liquids within 3 days birth	0.666	0.472
Exclusively breastfed	0.055	0.229
Currently breastfed	0.525	0.5
Drank from bottle	0.571	0.495
Feeding frequency		
None	0.207	0.405
Once	0.104	0.306
Twice	0.212	0.409
Three times	0.316	0.465
Four +	0.16	0.367
No. liquids	2.395	1.19
No. grains	1.278	1.007
No. protein	1.696	1.483
No. fruits and vegs.	0.759	0.821
Diarrhea		
None	0.738	0.44
Yes but gone	0.194	0.395
Yes still	0.068	0.251
Fever/Cough		
None	0.657	0.475
Yes but gone	0.029	0.166
Yes still	0.314	0.464
Persons per room	1.792	0.929
Average cluster wealth factor	95.14	7.465
Average cluster wealth factor sq./100	91.073	14.863
Cluster share of households not flushing to sewer	0.498	0.461
Cluster water		
Cluster share of households with bottled water	0.406	0.214
Cluster share of households with water piped in and treated	0.211	0.147
Cluster share of households with water piped in and not treated	0.299	0.229
Cluster share of households with other water source	0.085	0.194
Household Water		
Bottled	0.43	0.495
Piped to dwelling treated	0.218	0.413
Piped to dwelling not treated	0.28	0.449
Other	0.072	0.258
Flush to latrine/other	0.487	0.5
Household members smoke	0.639	0.481
Mother smokes cigarettes	0.066	0.248
Mother smokes nargile	0.088	0.284
Distance to health care problematic	0.307	0.462
Know TB is curable	0.54	0.498
Know of ORS	0.915	0.28
Exposure to family planning	0.033	0.793
Mother's age		
15-19	0.031	0.172
20-24	0.186	0.389
25-29	0.291	0.455
30-34	0.261	0.439
35-39	0.16	0.367
40-44	0.068	0.252
45-49	0.003	0.053
Mother's height (in cm.)	158.563	5.965
Birth weight in kg	3.118	0.609
Birth weight in kg missing	0.008	0.088
N (Observations)	2,111	

Source: Author’s calculations based on Jordan DHS 2012.

Table 4: Regressions for Height-For-Age (in cm. as a 24-month female)

	SES	SES and age/birth month	+ Early Env.	+ Early Env. and age/birth month	+ Prenatal Env.	+ Prenatal Env. and age/birth month
Wealth						
Wealth Score	0.329*	0.270**	0.108	0.082	0.144	0.110
	(0.132)	(0.083)	(0.128)	(0.132)	(0.122)	(0.126)
Wealth Score Sq./100	-0.206*	-0.151*	-0.021	-0.003	-0.080	-0.055
	(0.103)	(0.066)	(0.101)	(0.104)	(0.095)	(0.099)
Father's education (none omit.)						
Elementary	0.748	0.895	0.576	0.571	0.426	0.652
	(1.203)	(1.004)	(1.111)	(1.075)	(1.101)	(1.054)
Preparatory	0.693	0.805	0.544	0.571	0.183	0.402
	(1.195)	(0.993)	(1.132)	(1.101)	(1.116)	(1.081)
Secondary	0.728	0.911	0.532	0.630	-0.111	0.234
	(1.210)	(0.990)	(1.113)	(1.081)	(1.107)	(1.066)
Diploma	0.906	1.224	0.623	0.789	0.418	0.756
	(1.598)	(1.049)	(1.347)	(1.255)	(1.276)	(1.213)
University and above	1.844	2.076*	1.836	1.860	1.026	1.285
	(1.335)	(1.049)	(1.206)	(1.159)	(1.190)	(1.140)
Mother's education (none omit.)						
Elementary	-0.534	-0.417	-1.284	-1.203	-2.206*	-2.047*
	(0.932)	(0.892)	(1.059)	(1.050)	(1.022)	(1.008)
Preparatory	-1.225	-1.113	-2.147*	-2.053	-2.554*	-2.353*
	(0.989)	(0.853)	(1.089)	(1.088)	(1.032)	(1.026)
Secondary	-0.358	-0.388	-1.572	-1.677	-1.829	-1.864
	(0.897)	(0.839)	(1.024)	(1.025)	(0.978)	(0.976)
Diploma	0.550	0.531	-0.971	-1.079	-1.081	-1.224
	(0.987)	(0.881)	(1.101)	(1.108)	(1.067)	(1.066)
University and above	-0.445	-0.666	-1.841	-2.074	-1.899	-2.143*
	(1.017)	(0.883)	(1.102)	(1.097)	(1.050)	(1.045)
Father's emp. status (none/absent omit.)						
Wage worker	-1.198	-1.196**	-1.272*	-1.279*	-1.436*	-1.406*
	(0.739)	(0.429)	(0.631)	(0.579)	(0.607)	(0.561)
Employer	-1.024	-0.935	-1.156	-0.865	-1.462	-1.191
	(1.065)	(0.581)	(0.966)	(0.903)	(0.874)	(0.807)
Self-employed	-1.068	-1.025	-1.117	-1.083	-1.517*	-1.409*
	(0.869)	(0.526)	(0.785)	(0.729)	(0.752)	(0.703)
Mother's employment status (none/absent omit.)						
Wage worker	0.298	0.368	0.385	0.413	0.487	0.489
	(0.564)	(0.354)	(0.529)	(0.501)	(0.507)	(0.485)
Other work	1.757	1.911	1.877	2.211	1.524	1.740
	(2.089)	(1.072)	(2.023)	(1.935)	(1.814)	(1.727)
Father's occup. (professional omit.)						
Clerical	1.371	1.176*	1.622*	1.355*	1.358*	1.100
	(0.854)	(0.460)	(0.767)	(0.604)	(0.686)	(0.565)
Sales	0.425	0.294	0.110	-0.032	-0.016	-0.111
	(0.694)	(0.437)	(0.646)	(0.626)	(0.601)	(0.589)
Agricultural	0.672	0.457	0.141	-0.250	0.507	0.155
	(0.855)	(0.820)	(0.775)	(0.764)	(0.744)	(0.719)
Household and domestic	-0.230	0.063	-0.281	-0.158	0.220	0.226
	(1.236)	(0.846)	(1.172)	(1.120)	(1.032)	(1.003)
Services	0.599	0.714	0.582	0.482	0.750	0.660
	(0.689)	(0.384)	(0.589)	(0.536)	(0.517)	(0.479)
Skilled manual	0.800	0.771*	0.627	0.497	0.934	0.777
	(0.624)	(0.372)	(0.549)	(0.503)	(0.486)	(0.454)
Unskilled manual	1.191	1.334*	0.699	0.826	0.978	1.112
	(0.970)	(0.616)	(0.930)	(0.896)	(0.814)	(0.825)
Mother's occup. (professional omit.)						
Other occupations	-0.611	-0.612	-0.548	-0.762	-0.545	-0.713
	(0.924)	(0.702)	(0.908)	(0.855)	(0.860)	(0.801)
Rural			-0.124	0.004	-0.022	0.046
			(0.358)	(0.339)	(0.337)	(0.325)
Area of residence (Amman omit.)						
Balqa			0.358	0.451	0.268	0.300
			(0.566)	(0.530)	(0.529)	(0.497)
Zarqa			-0.150	-0.228	-0.413	-0.510
			(0.585)	(0.548)	(0.550)	(0.520)

	SES	SES and age/birth month	+ Early Env.	+ Early Env. and age/birth month	+ Prenatal Env.	+ Prenatal Env. and age/birth month
Madaba			0.493	0.657	0.472	0.516
			(0.556)	(0.538)	(0.537)	(0.519)
Irbid			0.069	0.077	-0.207	-0.282
			(0.515)	(0.501)	(0.497)	(0.481)
Mafraq			-0.986	-0.959	-0.856	-0.860
			(0.550)	(0.548)	(0.524)	(0.524)
Jarash			-0.876	-0.796	-0.713	-0.710
			(0.557)	(0.525)	(0.517)	(0.486)
Ajlun			-0.498	-0.469	-0.563	-0.581
			(0.591)	(0.579)	(0.547)	(0.536)
Karak			0.399	0.463	0.204	0.183
			(0.625)	(0.586)	(0.606)	(0.569)
Tafiela			-0.294	-0.192	-0.372	-0.369
			(0.674)	(0.645)	(0.654)	(0.625)
Ma'an			-1.242*	-1.261*	-0.918	-1.011
			(0.623)	(0.596)	(0.576)	(0.557)
Aqaba			-0.983	-1.030	-0.997	-1.059
			(0.725)	(0.726)	(0.711)	(0.711)
Camps			-0.078	-0.128	-0.255	-0.227
			(0.487)	(0.463)	(0.461)	(0.438)
Badia			0.236	0.325	0.465	0.528
			(0.537)	(0.528)	(0.513)	(0.507)
Female			0.195	0.146	0.686**	0.640*
			(0.285)	(0.270)	(0.261)	(0.250)
Breastfeeding init. (never omit.)						
Immediately			1.322	1.614	0.581	0.856
			(1.042)	(0.995)	(0.943)	(0.900)
Within first hour			0.557	0.930	0.029	0.382
			(1.022)	(0.930)	(0.924)	(0.840)
One hour			1.295	1.599	0.370	0.691
			(1.029)	(0.948)	(0.908)	(0.842)
2-24 hours			1.372	1.620	0.459	0.690
			(0.954)	(0.880)	(0.854)	(0.787)
One day			1.313	1.486	0.565	0.704
			(1.014)	(0.938)	(0.915)	(0.846)
Two days			1.764	2.322*	1.088	1.553
			(1.090)	(1.005)	(0.988)	(0.917)
3 or more days			0.663	0.909	0.314	0.450
			(1.050)	(0.968)	(0.948)	(0.883)
Other liquids within 3 days birth			-0.841**	-0.778*	-0.567	-0.539
			(0.322)	(0.317)	(0.295)	(0.289)
Exclusively breastfed			2.013**	2.036**	1.399*	1.468*
			(0.687)	(0.733)	(0.594)	(0.642)
Currently breastfed			0.761*	-0.172	0.585*	-0.282
			(0.307)	(0.335)	(0.288)	(0.324)
Drank from bottle			1.190***	0.795*	0.987**	0.638*
			(0.353)	(0.320)	(0.321)	(0.292)
Feeding frequency						
Once			0.797	0.759	0.805	0.708
			(0.641)	(0.678)	(0.613)	(0.643)
Twice			1.459*	1.513*	1.535**	1.465*
			(0.580)	(0.657)	(0.547)	(0.604)
Three times			1.042	1.244	1.018	1.114
			(0.566)	(0.667)	(0.542)	(0.622)
Four +			0.810	0.897	0.967	1.005
			(0.640)	(0.750)	(0.598)	(0.687)
No. Foods						
No. liquids			-0.118	-0.052	-0.121	-0.065
			(0.192)	(0.174)	(0.176)	(0.158)
No. grains			-0.092	0.024	-0.137	-0.045
			(0.190)	(0.176)	(0.178)	(0.164)
No. protein			0.226	0.392*	0.178	0.322*
			(0.153)	(0.155)	(0.140)	(0.143)
No. fruits and vegs.			-0.159	0.107	-0.122	0.107
			(0.244)	(0.217)	(0.216)	(0.198)
Diarrhea (none omit.)						
Yes but gone			0.117	-0.092	0.253	0.127

	SES	SES and age/birth month	+ Early Env.	+ Early Env. and age/birth month	+ Prenatal Env.	+ Prenatal Env. and age/birth month
			(0.389)	(0.364)	(0.356)	(0.330)
Yes still			-0.922	-1.285**	-0.824	-1.106*
			(0.482)	(0.493)	(0.457)	(0.463)
Fever/Cough (none omit.)						
Yes but gone			-0.388	-0.341	-0.286	-0.200
			(0.790)	(0.699)	(0.838)	(0.748)
Yes still			0.287	0.290	0.409	0.395
			(0.324)	(0.302)	(0.291)	(0.274)
Persons per room			-0.041	-0.072	-0.031	-0.117
			(0.182)	(0.202)	(0.175)	(0.186)
Local Env. (Cluster Chars.)						
Average cluster wealth factor			1.141**	1.015**	1.097***	0.939**
			(0.356)	(0.343)	(0.309)	(0.307)
Average cluster wealth factor sq./100			-0.596***	-0.532**	-0.561***	-0.481**
			(0.180)	(0.173)	(0.156)	(0.155)
Cluster share of households not flushing to sewer			-2.520	-2.488*	-1.712	-1.601
			(1.307)	(1.192)	(1.242)	(1.130)
Cluster share of households with water piped in and treated			-4.952**	-4.493**	-3.934**	-3.540**
			(1.516)	(1.413)	(1.403)	(1.330)
Cluster share of households with water piped in and not treated			-0.862	-0.908	-0.348	-0.394
			(1.002)	(0.980)	(0.975)	(0.945)
Cluster share of households with other water source			1.382	1.603	1.834	2.048*
			(0.996)	(1.050)	(0.965)	(0.973)
Household Water (bottled omit.)						
Piped to dwelling treated			0.225	0.109	0.231	0.122
			(0.460)	(0.412)	(0.411)	(0.377)
Piped to dwelling not treated			-0.386	-0.300	-0.484	-0.469
			(0.365)	(0.363)	(0.351)	(0.346)
Other			-0.831	-0.942	-1.087*	-1.234*
			(0.594)	(0.615)	(0.540)	(0.545)
Household Sanitation (Sewer omit.)						
Flush to latrine/other			2.086	1.957	1.464	1.270
			(1.107)	(1.026)	(1.048)	(0.968)
Household members smoke			-0.178	-0.209	-0.044	-0.036
			(0.280)	(0.268)	(0.258)	(0.249)
Mother smokes cigarettes			-1.188	-0.766	-0.974	-0.640
			(0.668)	(0.620)	(0.534)	(0.507)
Mother smokes nargile			0.374	0.312	0.005	-0.068
			(0.443)	(0.453)	(0.412)	(0.414)
Know TB is curable			0.212	0.273	0.071	0.140
			(0.295)	(0.274)	(0.280)	(0.260)
Know of ORS			-0.077	-0.058	0.044	-0.031
			(0.503)	(0.460)	(0.479)	(0.433)
Exposure to family planning			0.262	0.179	0.280	0.197
			(0.186)	(0.172)	(0.166)	(0.153)
Distance to health care problematic			-0.049	-0.020	0.027	0.074
			(0.309)	(0.286)	(0.290)	(0.265)
Mother's age (15-19 omit.)						
20-24					0.053	0.522
					(0.604)	(0.539)
25-29					-0.613	0.118
					(0.580)	(0.534)
30-34					-0.182	0.634
					(0.600)	(0.565)
35-39					-0.128	0.592
					(0.620)	(0.601)
40-44					-0.351	0.433
					(0.678)	(0.640)
45-49					-2.017	-1.304
					(1.391)	(1.398)
Mother's height (in cm.)					0.152***	0.135***
					(0.024)	(0.023)
Birth weight in kg					1.806***	1.884***

	SES	SES and age/birth month	+ Early Env.	+ Early Env. and age/birth month	+ Prenatal Env.	+ Prenatal Env. and age/birth month
					(0.217)	(0.208)
Birth weight in kg missing					-4.812**	-4.502***
					(1.638)	(1.338)
Constant	72.982***	73.074***	25.740	30.953	-1.803	7.250
	(3.912)	(2.611)	(17.263)	(16.895)	(15.880)	(15.701)
Age (months)	No	Yes	No	Yes	No	Yes
P-value (model)	0.000	0.000	0.000	0.000	0.000	0.000
N(Observations)	2111	2111	2111	2111	2111	2111
R-squared	0.064	0.127	0.175	0.231	0.282	0.330
Adj. R-squared	0.053	0.107	0.142	0.192	0.251	0.292

Source: Author’s calculations based on Jordan DHS 2012

Table 5: Regressions for Weight-For-Age (in kg. as a 24-month female)

	SES	SES and age/birth month	+ Early Env.	+ Early Env. and age/birth month	+ Prenatal Env.	+ Prenatal Env. and age/birth month
Wealth						
Wealth Score	0.136**	0.102***	0.081	0.060	0.088	0.064
	(0.046)	(0.030)	(0.049)	(0.049)	(0.053)	(0.051)
Wealth Score Sq./100	-0.095**	-0.065**	-0.045	-0.029	-0.059	-0.040
	(0.036)	(0.024)	(0.040)	(0.040)	(0.044)	(0.042)
Father's education (none omit.)						
Elementary	0.037	0.120	-0.150	-0.093	-0.114	0.003
	(0.370)	(0.362)	(0.319)	(0.304)	(0.319)	(0.315)
Preparatory	0.085	0.135	-0.138	-0.089	-0.146	-0.039
	(0.359)	(0.358)	(0.307)	(0.290)	(0.312)	(0.307)
Secondary	0.151	0.233	-0.067	-0.010	-0.165	-0.039
	(0.359)	(0.357)	(0.306)	(0.291)	(0.311)	(0.307)
Diploma	0.383	0.428	0.033	0.072	0.066	0.169
	(0.476)	(0.379)	(0.396)	(0.366)	(0.371)	(0.361)
University and above	0.255	0.300	0.046	0.062	-0.088	-0.001
	(0.412)	(0.379)	(0.359)	(0.345)	(0.351)	(0.349)
Mother's education (none omit.)						
Elementary	0.213	0.216	-0.022	-0.007	-0.248	-0.233
	(0.307)	(0.322)	(0.299)	(0.303)	(0.295)	(0.293)
Preparatory	-0.329	-0.321	-0.500	-0.501	-0.578*	-0.574*
	(0.289)	(0.308)	(0.302)	(0.298)	(0.293)	(0.285)
Secondary	-0.167	-0.166	-0.389	-0.408	-0.474	-0.494
	(0.272)	(0.303)	(0.290)	(0.286)	(0.284)	(0.277)
Diploma	0.080	0.070	-0.225	-0.243	-0.257	-0.287
	(0.306)	(0.318)	(0.323)	(0.319)	(0.315)	(0.310)
University and above	0.096	0.046	-0.193	-0.245	-0.272	-0.348
	(0.327)	(0.319)	(0.323)	(0.319)	(0.315)	(0.311)
Father's emp. status (none/absent omit.)						
Wage worker	-0.395	-0.360*	-0.308	-0.266	-0.416*	-0.369*
	(0.221)	(0.155)	(0.205)	(0.198)	(0.192)	(0.186)
Employer	-0.362	-0.355	-0.294	-0.240	-0.460	-0.413
	(0.364)	(0.210)	(0.340)	(0.310)	(0.311)	(0.281)
Self-employed	-0.407	-0.369	-0.327	-0.267	-0.512*	-0.429
	(0.294)	(0.190)	(0.272)	(0.260)	(0.256)	(0.247)
Mother's employment status (none/absent omit.)						
Wage worker	0.089	0.163	0.153	0.192	0.200	0.244
	(0.201)	(0.128)	(0.175)	(0.177)	(0.176)	(0.176)
Other work	0.080	0.227	0.215	0.372	0.164	0.312
	(0.451)	(0.387)	(0.474)	(0.512)	(0.419)	(0.460)
Father's occup. (professional omit.)						
Clerical	0.280	0.227	0.231	0.178	0.195	0.142
	(0.248)	(0.166)	(0.224)	(0.213)	(0.199)	(0.195)
Sales	0.354	0.249	0.240	0.133	0.272	0.172
	(0.285)	(0.158)	(0.260)	(0.252)	(0.236)	(0.232)
Agricultural	0.048	0.091	-0.225	-0.223	-0.036	-0.019
	(0.330)	(0.296)	(0.322)	(0.307)	(0.313)	(0.296)
Household and domestic	-0.088	-0.051	-0.238	-0.225	-0.048	-0.033
	(0.344)	(0.305)	(0.350)	(0.337)	(0.328)	(0.324)
Services	0.196	0.253	0.074	0.100	0.208	0.227
	(0.286)	(0.139)	(0.252)	(0.235)	(0.227)	(0.215)
Skilled manual	0.272	0.256	0.179	0.150	0.295	0.253
	(0.224)	(0.134)	(0.200)	(0.190)	(0.177)	(0.171)
Unskilled manual	0.261	0.291	0.132	0.157	0.258	0.271
	(0.319)	(0.222)	(0.289)	(0.270)	(0.261)	(0.254)
Mother's occup. (professional omit.)						
Other occupations	0.220	0.153	0.180	0.114	0.138	0.090
	(0.347)	(0.253)	(0.355)	(0.361)	(0.338)	(0.346)
Rural			-0.019	-0.005	0.005	0.006
			(0.122)	(0.122)	(0.115)	(0.116)
Area of residence (Amman omit.)						
Balqa			0.236	0.237	0.191	0.183
			(0.205)	(0.200)	(0.191)	(0.187)
Zarqa			0.076	0.061	-0.022	-0.046
			(0.201)	(0.193)	(0.187)	(0.181)
Madaba			0.228	0.240	0.175	0.158

	SES	SES and age/birth month	+ Early Env.	+ Early Env. and age/birth month	+ Prenatal Env.	+ Prenatal Env. and age/birth month
			(0.204)	(0.200)	(0.195)	(0.190)
Irbid			0.037	0.031	-0.052	-0.093
			(0.198)	(0.198)	(0.191)	(0.191)
Mafraq			0.081	0.087	0.120	0.116
			(0.171)	(0.173)	(0.168)	(0.168)
Jarash			0.033	0.038	0.063	0.039
			(0.207)	(0.204)	(0.196)	(0.194)
Ajlun			0.302	0.314	0.261	0.262
			(0.222)	(0.218)	(0.215)	(0.211)
Karak			0.320	0.349	0.227	0.248
			(0.222)	(0.216)	(0.217)	(0.213)
Tafiela			0.246	0.270	0.213	0.220
			(0.261)	(0.255)	(0.250)	(0.242)
Ma'an			-0.312	-0.304	-0.259	-0.252
			(0.203)	(0.200)	(0.184)	(0.183)
Aqaba			0.285	0.238	0.295	0.230
			(0.239)	(0.235)	(0.233)	(0.230)
Camps			0.051	0.011	0.005	-0.017
			(0.177)	(0.175)	(0.167)	(0.164)
Badia			-0.070	-0.080	-0.005	-0.023
			(0.167)	(0.169)	(0.159)	(0.160)
Female			-0.011	-0.004	0.160	0.168
			(0.105)	(0.099)	(0.098)	(0.094)
Breastfeeding init. (never omit.)						
Immediately			-0.211	-0.182	-0.546	-0.525
			(0.402)	(0.389)	(0.376)	(0.361)
Within first hour			-0.432	-0.347	-0.630	-0.562
			(0.407)	(0.380)	(0.381)	(0.356)
One hour			-0.173	-0.142	-0.521	-0.489
			(0.404)	(0.384)	(0.376)	(0.356)
2-24 hours			-0.168	-0.178	-0.526	-0.536
			(0.383)	(0.363)	(0.360)	(0.341)
One day			0.027	0.029	-0.335	-0.332
			(0.402)	(0.382)	(0.375)	(0.358)
Two days			0.029	0.062	-0.290	-0.284
			(0.404)	(0.386)	(0.384)	(0.367)
3 or more days			-0.421	-0.385	-0.571	-0.560
			(0.395)	(0.378)	(0.373)	(0.357)
Other liquids within 3 days birth			-0.255*	-0.230*	-0.132	-0.124
			(0.114)	(0.112)	(0.104)	(0.103)
Exclusively breastfed			0.884***	0.702**	0.724***	0.569**
			(0.232)	(0.230)	(0.204)	(0.193)
Currently breastfed			0.256*	0.116	0.192	0.068
			(0.112)	(0.121)	(0.108)	(0.117)
Drank from bottle			0.295*	0.223	0.237*	0.175
			(0.129)	(0.120)	(0.120)	(0.112)
Feeding frequency						
Once			-0.057	-0.061	-0.062	-0.061
			(0.211)	(0.224)	(0.185)	(0.201)
Twice			0.148	0.062	0.203	0.107
			(0.215)	(0.231)	(0.195)	(0.214)
Three times			-0.125	-0.224	-0.149	-0.251
			(0.226)	(0.242)	(0.209)	(0.226)
Four +			-0.248	-0.323	-0.168	-0.241
			(0.246)	(0.270)	(0.223)	(0.249)
No. Foods						
No. liquids			0.023	0.041	0.020	0.037
			(0.070)	(0.066)	(0.066)	(0.062)
No. grains			-0.016	-0.004	-0.036	-0.029
			(0.061)	(0.060)	(0.058)	(0.057)
No. protein			0.152*	0.162**	0.127*	0.128*
			(0.061)	(0.061)	(0.057)	(0.057)
No. fruits and vegs.			0.032	0.045	0.059	0.066
			(0.076)	(0.077)	(0.073)	(0.075)
Diarrhea (none omit.)						
Yes but gone			0.029	-0.051	0.079	0.017
			(0.155)	(0.147)	(0.148)	(0.139)

	SES	SES and age/birth month	+ Early Env.	+ Early Env. and age/birth month	+ Prenatal Env.	+ Prenatal Env. and age/birth month
Yes still			-0.371*	-0.477**	-0.323*	-0.419**
			(0.162)	(0.161)	(0.161)	(0.161)
Fever/Cough (none omit.)						
Yes but gone			-0.005	-0.036	0.073	0.064
			(0.324)	(0.316)	(0.311)	(0.309)
Yes still			0.092	0.120	0.105	0.133
			(0.123)	(0.118)	(0.115)	(0.111)
Persons per room			0.037	0.009	0.008	-0.025
			(0.063)	(0.063)	(0.058)	(0.056)
Local Env. (Cluster Chars.)						
Average cluster wealth factor			0.385**	0.334**	0.337**	0.277*
			(0.123)	(0.124)	(0.126)	(0.126)
Average cluster wealth factor sq./100			-0.199**	-0.174**	-0.172**	-0.142*
			(0.061)	(0.061)	(0.063)	(0.063)
Cluster share of households not flushing to sewer			-0.614	-0.532	-0.219	-0.135
			(0.377)	(0.367)	(0.346)	(0.334)
Cluster share of households with water piped in and treated			-0.787	-0.738	-0.446	-0.422
			(0.571)	(0.552)	(0.542)	(0.527)
Cluster share of households with water piped in and not treated			-0.202	-0.161	-0.131	-0.079
			(0.378)	(0.373)	(0.353)	(0.345)
Cluster share of households with other water source			0.376	0.520	0.422	0.585
			(0.405)	(0.397)	(0.389)	(0.377)
Household Water (bottled omit.)						
Piped to dwelling treated			0.035	0.070	0.042	0.072
			(0.155)	(0.148)	(0.142)	(0.138)
Piped to dwelling not treated			-0.137	-0.112	-0.172	-0.161
			(0.133)	(0.130)	(0.122)	(0.121)
Other			-0.232	-0.266	-0.306	-0.356
			(0.236)	(0.226)	(0.221)	(0.211)
Household Sanitation (Sewer omit.)						
Flush to latrine/other			0.884**	0.744*	0.536	0.397
			(0.318)	(0.314)	(0.293)	(0.287)
Household members smoke			-0.006	-0.026	0.034	0.019
			(0.099)	(0.096)	(0.093)	(0.090)
Mother smokes cigarettes			-0.108	-0.038	-0.113	-0.052
			(0.248)	(0.229)	(0.217)	(0.199)
Mother smokes nargile			-0.001	-0.003	-0.074	-0.075
			(0.205)	(0.204)	(0.198)	(0.196)
Know TB is curable			0.019	0.049	-0.033	0.003
			(0.106)	(0.102)	(0.100)	(0.096)
Know of ORS			-0.302	-0.271	-0.309	-0.264
			(0.171)	(0.163)	(0.172)	(0.161)
Exposure to family planning			0.082	0.067	0.084	0.065
			(0.070)	(0.069)	(0.064)	(0.063)
Distance to health care problematic			-0.043	-0.053	-0.030	-0.040
			(0.117)	(0.113)	(0.110)	(0.105)
Mother's age (15-19 omit.)						
20-24					0.084	0.011
					(0.231)	(0.237)
25-29					0.247	0.230
					(0.229)	(0.236)
30-34					0.030	0.014
					(0.240)	(0.246)
35-39					0.248	0.177
					(0.244)	(0.252)
40-44					0.143	0.048
					(0.257)	(0.270)
45-49					-0.957	-0.992
					(0.496)	(0.588)
Mother's height (in cm.)					0.030***	0.026**
					(0.009)	(0.008)
Birth weight in kg					0.761***	0.774***
					(0.076)	(0.075)
Birth weight in kg missing					-1.119*	-1.143*

	SES	**SES and age/birth month**	**+ Early Env.**	**+ Early Env. and age/birth month**	**+ Prenatal Env.**	**+ Prenatal Env. and age/birth month**
					(0.542)	(0.473)
Constant	7.116***	7.712***	-9.435	-6.569	-14.146*	-10.102
	(1.335)	(0.942)	(5.905)	(5.958)	(5.979)	(5.998)
Age (months)	No	Yes	No	Yes	No	Yes
P-value (model)	0.001	0.000	0.000	0.000	0.000	0.000
N(Observations)	2111	2111	2111	2111	2111	2111
R-squared	0.046	0.093	0.143	0.176	0.241	0.271
Adj. R-squared	0.034	0.072	0.109	0.134	0.207	0.230

Source: Author's calculations based on Jordan DHS 2012

Table 6: Regressions for Weight-For-Height (in kg. as a 24-month female)

	SES	SES and age/birth month	+ Early Env.	+ Early Env. and age/birth month	+ Prenatal Env.	+ Prenatal Env. and age/birth month
Wealth						
Wealth Score	0.040	0.021	0.048	0.031	0.046	0.028
	(0.046)	(0.024)	(0.050)	(0.049)	(0.051)	(0.050)
Wealth Score Sq./100	-0.030	-0.014	-0.032	-0.019	-0.031	-0.017
	(0.038)	(0.019)	(0.041)	(0.040)	(0.042)	(0.041)
Father's education (none omit.)						
Elementary	-0.170	-0.131	-0.299	-0.238	-0.227	-0.162
	(0.253)	(0.292)	(0.228)	(0.226)	(0.224)	(0.228)
Preparatory	-0.084	-0.089	-0.261	-0.224	-0.183	-0.132
	(0.246)	(0.288)	(0.220)	(0.217)	(0.219)	(0.222)
Secondary	-0.020	-0.006	-0.185	-0.159	-0.120	-0.084
	(0.243)	(0.288)	(0.210)	(0.210)	(0.213)	(0.218)
Diploma	0.094	0.060	-0.153	-0.159	-0.067	-0.051
	(0.302)	(0.305)	(0.258)	(0.254)	(0.251)	(0.252)
University and above	-0.195	-0.218	-0.396	-0.389	-0.320	-0.299
	(0.285)	(0.305)	(0.256)	(0.253)	(0.249)	(0.252)
Mother's education (none omit.)						
Elementary	0.444	0.429	0.445	0.432	0.444	0.414
	(0.278)	(0.259)	(0.255)	(0.254)	(0.254)	(0.253)
Preparatory	-0.012	-0.012	0.077	0.051	0.092	0.046
	(0.238)	(0.248)	(0.237)	(0.236)	(0.238)	(0.237)
Secondary	-0.066	-0.074	0.014	0.002	-0.006	-0.034
	(0.234)	(0.244)	(0.234)	(0.231)	(0.234)	(0.231)
Diploma	-0.004	-0.007	0.079	0.069	0.068	0.054
	(0.255)	(0.256)	(0.263)	(0.258)	(0.261)	(0.256)
University and above	0.279	0.263	0.322	0.305	0.272	0.234
	(0.268)	(0.257)	(0.264)	(0.260)	(0.263)	(0.260)
Father's emp. status (none/absent omit.)						
Wage worker	-0.071	-0.037	0.021	0.068	-0.039	0.005
	(0.168)	(0.125)	(0.156)	(0.156)	(0.150)	(0.150)
Employer	-0.119	-0.132	-0.032	-0.030	-0.108	-0.109
	(0.259)	(0.169)	(0.250)	(0.242)	(0.243)	(0.237)
Self-employed	-0.158	-0.102	-0.047	0.032	-0.125	-0.039
	(0.223)	(0.153)	(0.209)	(0.205)	(0.200)	(0.197)
Mother's employment status (none/absent omit.)						
Wage worker	-0.003	0.045	-0.002	0.031	0.018	0.060
	(0.197)	(0.103)	(0.194)	(0.184)	(0.187)	(0.180)
Other work	-0.365	-0.248	-0.250	-0.168	-0.207	-0.109
	(0.254)	(0.312)	(0.282)	(0.254)	(0.271)	(0.251)
Father's occup. (professional omit.)						
Clerical	-0.065	-0.071	-0.161	-0.161	-0.137	-0.138
	(0.245)	(0.134)	(0.218)	(0.190)	(0.206)	(0.179)
Sales	0.184	0.097	0.154	0.066	0.208	0.117
	(0.222)	(0.127)	(0.218)	(0.214)	(0.211)	(0.208)
Agricultural	-0.197	-0.108	-0.353	-0.267	-0.262	-0.170
	(0.238)	(0.238)	(0.239)	(0.222)	(0.237)	(0.222)
Household and domestic	-0.036	-0.088	-0.228	-0.239	-0.169	-0.153
	(0.317)	(0.246)	(0.336)	(0.333)	(0.329)	(0.332)
Services	-0.038	-0.004	-0.159	-0.106	-0.078	-0.032
	(0.168)	(0.112)	(0.160)	(0.156)	(0.151)	(0.148)
Skilled manual	0.019	0.006	-0.025	-0.028	0.017	0.008
	(0.150)	(0.108)	(0.147)	(0.148)	(0.140)	(0.141)
Unskilled manual	-0.127	-0.112	-0.132	-0.125	-0.088	-0.094
	(0.238)	(0.179)	(0.236)	(0.264)	(0.237)	(0.260)
Mother's occup. (professional omit.)						
Other occupations	0.307	0.248	0.257	0.232	0.221	0.204
	(0.276)	(0.204)	(0.271)	(0.270)	(0.262)	(0.262)
Rural			-0.016	-0.030	-0.014	-0.027
			(0.106)	(0.104)	(0.103)	(0.102)
Area of residence (Amman omit.)						
Balqa			0.167	0.153	0.147	0.139
			(0.162)	(0.155)	(0.158)	(0.152)
Zarqa			0.111	0.115	0.082	0.084
			(0.144)	(0.140)	(0.140)	(0.137)
Madaba			0.080	0.042	0.041	0.003

	SES	SES and age/birth month	+ Early Env.	+ Early Env. and age/birth month	+ Prenatal Env.	+ Prenatal Env. and age/birth month
			(0.161)	(0.159)	(0.157)	(0.156)
Irbid			0.057	0.048	0.045	0.024
			(0.163)	(0.158)	(0.162)	(0.156)
Mafraq			0.346*	0.344*	0.368**	0.363**
			(0.136)	(0.134)	(0.137)	(0.134)
Jarash			0.261	0.250	0.258	0.237
			(0.166)	(0.161)	(0.164)	(0.160)
Ajlun			0.468**	0.468**	0.452**	0.454**
			(0.165)	(0.162)	(0.163)	(0.160)
Karak			0.272	0.285	0.237	0.261
			(0.196)	(0.187)	(0.194)	(0.186)
Tafiela			0.326	0.334	0.322	0.337
			(0.215)	(0.209)	(0.212)	(0.206)
Ma'an			0.014	0.028	-0.011	0.019
			(0.158)	(0.155)	(0.154)	(0.150)
Aqaba			0.485*	0.456*	0.512*	0.473*
			(0.211)	(0.202)	(0.206)	(0.197)
Camps			0.082	0.042	0.080	0.041
			(0.147)	(0.143)	(0.143)	(0.140)
Badia			-0.143	-0.171	-0.135	-0.166
			(0.137)	(0.136)	(0.134)	(0.132)
Female			-0.029	-0.011	0.018	0.036
			(0.083)	(0.080)	(0.082)	(0.079)
Breastfeeding init. (never omit.)						
Immediately			-0.430	-0.472*	-0.574*	-0.618**
			(0.230)	(0.220)	(0.233)	(0.224)
Within first hour			-0.414	-0.414	-0.476	-0.486*
			(0.252)	(0.239)	(0.249)	(0.240)
One hour			-0.372	-0.406	-0.485*	-0.520*
			(0.226)	(0.218)	(0.225)	(0.219)
2-24 hours			-0.369	-0.433*	-0.492*	-0.550**
			(0.207)	(0.202)	(0.210)	(0.206)
One day			-0.119	-0.160	-0.282	-0.312
			(0.231)	(0.219)	(0.225)	(0.217)
Two days			-0.250	-0.337	-0.388	-0.478*
			(0.273)	(0.248)	(0.259)	(0.240)
3 or more days			-0.502	-0.500*	-0.565*	-0.559*
			(0.262)	(0.251)	(0.261)	(0.250)
Other liquids within 3 days birth			0.015	0.016	0.064	0.057
			(0.097)	(0.094)	(0.094)	(0.091)
Exclusively breastfed			0.364	0.148	0.350	0.149
			(0.263)	(0.249)	(0.256)	(0.243)
Currently breastfed			0.148	0.185	0.132	0.169
			(0.094)	(0.099)	(0.091)	(0.097)
Drank from bottle			0.070	0.078	0.060	0.067
			(0.095)	(0.093)	(0.093)	(0.092)
Feeding frequency						
Once			-0.401	-0.351	-0.400*	-0.334
			(0.207)	(0.203)	(0.203)	(0.200)
Twice			-0.366	-0.415*	-0.340	-0.373
			(0.189)	(0.206)	(0.186)	(0.207)
Three times			-0.555**	-0.645**	-0.574**	-0.648**
			(0.197)	(0.214)	(0.193)	(0.212)
Four +			-0.594**	-0.639**	-0.563**	-0.599**
			(0.206)	(0.226)	(0.200)	(0.223)
No. Foods						
No. liquids			0.061	0.064	0.060	0.061
			(0.049)	(0.046)	(0.048)	(0.045)
No. grains			-0.003	-0.013	-0.011	-0.020
			(0.051)	(0.048)	(0.049)	(0.046)
No. protein			0.093*	0.075*	0.080*	0.059
			(0.037)	(0.035)	(0.036)	(0.035)
No. fruits and vegs.			0.038	0.004	0.054	0.021
			(0.065)	(0.062)	(0.064)	(0.061)
Diarrhea (none omit.)						
Yes but gone			-0.007	-0.036	0.004	-0.027
			(0.102)	(0.099)	(0.101)	(0.098)

	SES	SES and age/birth month	+ Early Env.	+ Early Env. and age/birth month	+ Prenatal Env.	+ Prenatal Env. and age/birth month
Yes still			-0.196	-0.224	-0.175	-0.211
			(0.134)	(0.127)	(0.131)	(0.124)
Fever/Cough (none omit.)						
Yes but gone			0.005	-0.048	0.050	0.008
			(0.259)	(0.261)	(0.239)	(0.244)
Yes still			0.000	0.024	-0.009	0.017
			(0.099)	(0.094)	(0.096)	(0.091)
Persons per room			0.030	0.006	0.002	-0.014
			(0.048)	(0.048)	(0.049)	(0.050)
Local Env. (Cluster Chars.)						
Average cluster wealth factor			0.066	0.038	0.030	0.000
			(0.140)	(0.141)	(0.139)	(0.141)
Average cluster wealth factor sq./100			-0.034	-0.020	-0.016	-0.001
			(0.072)	(0.073)	(0.072)	(0.073)
Cluster share of households not flushing to sewer			0.094	0.166	0.257	0.317
			(0.217)	(0.218)	(0.214)	(0.216)
Cluster share of households with water piped in and treated			0.449	0.402	0.555	0.500
			(0.414)	(0.408)	(0.417)	(0.410)
Cluster share of households with water piped in and not treated			-0.054	-0.023	-0.102	-0.062
			(0.321)	(0.312)	(0.309)	(0.300)
Cluster share of households with other water source			-0.105	0.015	-0.156	-0.021
			(0.390)	(0.382)	(0.384)	(0.375)
Household Water (bottled omit.)						
Piped to dwelling treated			-0.078	-0.018	-0.075	-0.020
			(0.134)	(0.130)	(0.132)	(0.130)
Piped to dwelling not treated			-0.013	-0.002	-0.027	-0.015
			(0.125)	(0.120)	(0.120)	(0.115)
Other			-0.018	-0.036	-0.027	-0.052
			(0.235)	(0.226)	(0.235)	(0.225)
Household Sanitation (Sewer omit.)						
Flush to latrine/other			0.344	0.226	0.174	0.070
			(0.181)	(0.182)	(0.179)	(0.184)
Household members smoke			0.039	0.023	0.045	0.023
			(0.088)	(0.085)	(0.084)	(0.082)
Mother smokes cigarettes			0.182	0.170	0.138	0.137
			(0.177)	(0.169)	(0.179)	(0.170)
Mother smokes nargile			-0.084	-0.087	-0.065	-0.063
			(0.174)	(0.162)	(0.171)	(0.161)
Know TB is curable			-0.041	-0.025	-0.065	-0.046
			(0.090)	(0.088)	(0.088)	(0.086)
Know of ORS			-0.300*	-0.260	-0.326*	-0.254
			(0.137)	(0.137)	(0.142)	(0.138)
Exposure to family planning			0.020	0.023	0.017	0.016
			(0.060)	(0.056)	(0.058)	(0.054)
Distance to health care problematic			-0.031	-0.043	-0.034	-0.051
			(0.090)	(0.087)	(0.088)	(0.084)
Mother's age (15-19 omit.)						
20-24					0.056	-0.106
					(0.205)	(0.219)
25-29					0.313	0.143
					(0.195)	(0.212)
30-34					0.014	-0.174
					(0.208)	(0.225)
35-39					0.209	-0.013
					(0.202)	(0.220)
40-44					0.272	0.015
					(0.234)	(0.253)
45-49					-0.373	-0.589
					(0.306)	(0.374)
Mother's height (in cm.)					-0.007	-0.008
					(0.008)	(0.007)
Birth weight in kg					0.285***	0.282***
					(0.071)	(0.071)
Birth weight in kg missing					-0.076	-0.166

	SES	SES and age/birth month	+ Early Env.	+ Early Env. and age/birth month	+ Prenatal Env.	+ Prenatal Env. and age/birth month
					(0.316)	(0.308)
Constant	10.697***	11.114***	7.318	9.252	9.379	11.651
	(1.298)	(0.759)	(6.258)	(6.380)	(6.416)	(6.548)
Age (months)	No	Yes	No	Yes	No	Yes
P-value (model)	0.448	0.000	0.000	0.000	0.000	0.000
N(Observations)	2111	2111	2111	2111	2111	2111
R-squared	0.023	0.077	0.097	0.138	0.124	0.163
Adj. R-squared	0.011	0.056	0.061	0.094	0.085	0.116

Source: Author’s calculations based on Jordan DHS 2012

Table 7: Inequality and Inequality of Opportunity in Child Anthropometry, Youngest Child Under Two

Outcome:	**Height-for-age**	**Weight-for-age**	**Weight-for-height**	**Height-for-age**	**Weight-for-age**	**Weight-for-height**	**Height-for-age**	**Weight-for-age**	**Weight-for-height**
Specification:	**SES**	**SES**	**SES**	**+ Early Env.**	**+ Early Env.**	**+ Early Env.**	**+ Prenatal Env.**	**+ Prenatal Env.**	**+ Prenatal Env.**
Total Inequality	0.00133***	0.00865***	0.00541***	0.00133***	0.00865***	0.00541***	0.00133***	0.00865***	0.00541***
	(0.0000873)	(0.000518)	(0.000288)	(0.0000837)	(0.000521)	(0.000271)	(0.0000884)	(0.000522)	(0.000306)
Residual Inequality	0.00124***	0.00828***	0.00529***	0.00115***	0.00754***	0.00501***	0.000996***	0.00668***	0.00487***
	(0.0000811)	(0.000502)	(0.000283)	(0.0000740)	(0.000456)	(0.000262)	(0.0000612)	(0.000434)	(0.000266)
Inequality of Opportunity (Share of Total Inequality)	0.0641***	0.0427**	0.0209	0.136***	0.129***	0.0733**	0.251***	0.228***	0.0992***
	(0.0193)	(0.0158)	(0.0134)	(0.0300)	(0.0217)	(0.0233)	(0.0298)	(0.0254)	(0.0274)
Inequality of Op. Partial Effects (Share of Total Inequality)									
Parent's education	0.0300*	0.0188	0.0151	0.0181	0.0131	0.0139	0.0169	0.00943	0.0135
	(0.0147)	(0.0122)	(0.0105)	(0.0152)	(0.0125)	(0.0106)	(0.0138)	(0.0123)	(0.0111)
Wealth and Employment	0.0456*	0.0307*	0.00634	0.0423*	0.0320*	0.00329	0.0246	0.0245	0.00506
	(0.0199)	(0.0149)	(0.0107)	(0.0199)	(0.0143)	(0.0130)	(0.0229)	(0.0156)	(0.0128)
Gender				0.000570	-0.0000325	0.0000325	-0.00161	-0.00182	-0.000399
				(0.00243)	(0.00198)	(0.00176)	(0.00403)	(0.00305)	(0.00192)
Area of residence				0.00669	0.00596	0.00773	0.000501	0.00368	0.00842
				(0.00983)	(0.00816)	(0.00808)	(0.0102)	(0.00844)	(0.00782)
Food				0.0139	0.0413*	0.0189	0.0139	0.0334*	0.0165
				(0.0224)	(0.0165)	(0.0212)	(0.0208)	(0.0160)	(0.0212)
Health Knowledge				0.00748	0.00397	0.00365	0.00701	0.00310	0.00340
				(0.00809)	(0.00640)	(0.00577)	(0.00724)	(0.00602)	(0.00531)
Health Conditions				0.00328	0.00349	0.00154	0.00480	0.00376	0.00177
				(0.00608)	(0.00588)	(0.00457)	(0.00633)	(0.00584)	(0.00512)
Health Environment				0.0511*	0.0237	0.0131	0.0545**	0.0287	0.0131
				(0.0222)	(0.0204)	(0.0143)	(0.0190)	(0.0170)	(0.0140)
Mother's Demographics							0.0635***	0.0192	0.00783
							(0.0172)	(0.0112)	(0.00876)

Outcome:	Height-for-age	Weight-for-age	Weight-for-height	Height-for-age	Weight-for-age	Weight-for-height	Height-for-age	Weight-for-age	Weight-for-height
Specification:	**SES**	**SES**	**SES**	**+ Early Env.**	**+ Early Env.**	**+ Early Env.**	**+ Prenatal Env.**	**+ Prenatal Env.**	**+ Prenatal Env.**
Birth Weight							0.113*** (0.0211)	0.120*** (0.0207)	0.0158 (0.00881)
N	2111	2111	2111	2111	2111	2111	2111	2111	2111

Source: Author's calculations based on Jordan DHS 2012.