The Determinants of Child Health Disparities: Evidence from Jordan

By Dr. Caroline Krafft[1]

This work was published as:
Caroline Krafft. 2021. "The Determinants of Inequality in Child Nutrition Status: Evidence from Jordan." Review of Development Economics.
doi: 10.1111/rode.12839

Prior Affiliation: Department of Applied Economics, University of Minnesota, 1994 Buford Ave, St. Paul, MN, 55108
Current Affiliation: Department of Economics, St. Catherine University, 2004 Randolph Avenue, St. Paul, MN, 55105. Email: cgkrafft@stkate.edu ORCID: 0000-0001-6906-9418

Abstract

Early childhood is the period when inequality originates and the intergenerational transmission of poverty and inequality begins. It is important to understand what drives inequality in early childhood 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; children from wealthy households grow normally while other children falter. This paper examines the determinants and mediators of health disparities in children's height and weight in Jordan, including parental health knowledge, food quantity and quality, health conditions, the health environment, and prenatal development. While this paper demonstrates

[1] **Acknowledgements**

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 2015 Annual Conference for valuable questions, comments, and suggestions.

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, and nutrition policies need to prioritize this period.

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

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

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 missteps 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[2] 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, Adair, Fall, et al., 2008), and ultimately lowers wages (Grantham-McGregor, Cheung, Cueto, et al., 2007; LaFave & Thomas, 2017). 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, that 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.

[2] The term "early childhood" lacks a single clear definition in the literature. The margins of early childhood are uncertain in both directions, 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 age windows as noted.

While numerous papers have examined the role of socio-economic status in child health inequality (e.g. Assaad, Krafft, Hassine, & Salehi-Isfahani, 2012; Monteiro, Benicio, Conde, et al., 2010; Wagstaff & Watanabe, 2000), there has been little research on the factors that mediate these socio-economic disparities. Such research is critically important to designing policies and programs to redress inequality. A large number of different factors, such as feeding practices or sanitation, 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.

To understand the determinants of child health inequality in Jordan, this paper uses Jordan's 2012 Jordan Population and Family Health Survey (JPFHS). While children in Jordan from high socio-economic status backgrounds experience a healthy pattern of growth, children from poorer backgrounds falter in their early growth. This clear differentiation in child health by socio-economic status makes Jordan an ideal case for studying the determinants of health disparities. Essentially, the differences between the rich and poor have the potential to fully illustrate the determinants that yield good or faltering early nutrition.

The findings of this paper demonstrate that 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, especially birth weight (a measure of fetal growth) play the largest role in mediating socio-economic disparities in child health. 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 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. Section 7 concludes the paper with a discussion of the policy implications of these findings.

2 Child Health and Nutrition

Anthropometric indicators are frequently used as measures of standards of living and well-being, since they are the product of multiple dimensions of the early environment (López-Alonso & Vélez-Grajales, 2015). Children’s early health in turn has long-lasting consequences. Height-for-age in the early years is the best predictor of adult human capital, with links to psycho-social development, health, education, and income (Dercon & Sánchez, 2013; Glewwe & Miguel, 2008; Victora, Adair, Fall, et al., 2008). Stunting, as a measure of inadequate height-for-age, has been linked with lower levels of 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, Adair, Fall, et al., 2008).

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, Adair, Fall, 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 socio-economic status (Currie & Moretti, 2007). Thus, understanding the roles of different factors in child health is critical to addressing not only contemporaneous inequality but also its intergenerational transmission.

The large number 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, resulting in low birth weight, has been identified as a key early factor in malnutrition, one that is often an outcome of maternal undernutrition or stunting (Dewey & Begum, 2011). Once children are born, feeding is a key target of interventions. There is a large body of literature showing that promoting exclusive breastfeeding can increase rates of breastfeeding. Although breastfeeding does have other health effects, such as reducing mortality, there is not clear evidence that breastfeeding will increase children's height and weight (Bhutta, Ahmed, Black, et al., 2008). Household food insecurity as well as intra-household distribution practices can drive nutrition inequality. Programs targeting complementary feeding have been demonstrated to increase children's height in both food secure and food insecure populations (Bhutta, Ahmed, Black, et al., 2008). Specific micronutrients can reduce malnutrition (Bhutta, Ahmed, Black, et al., 2008).

Conditional cash transfers that included maternal and infant health conditions have been shown to improve growth and reduce stunting. However, it is unclear if it is the health and nutrition conditions of the transfers or the increase in income that drives these effects (Gertler, 2004). Hygiene interventions, such as hand-washing, water quality, and sanitation, are also important for reducing diarrhea and thus improving nutrition outcomes (Bhutta, Ahmed, Black, et al., 2008). 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.

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; Dasgupta, 2016; Monteiro, Benicio, Conde, et al., 2010; Novak, 2014; Raju, Kim, Nguyen, & Govindaraj, 2019; Wagstaff & Watanabe, 2000). Generally, inequality in health outcomes is under-researched within the Middle East and North Africa region, which includes Jordan (Salehi-Isfahani, 2013). Globally, the mechanisms through which socio-economic factors impact child health have received limited attention, despite their important implications for child health.

3 Conceptual Framework

3.1 Child Health Production

The literature on the causes of child malnutrition (Bhutta, Ahmed, Black, et al., 2008; Black, Allen, Bhutta, et al., 2008) and the general health production function literature (Cebu Study Team, 1992; 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:

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

where a vector of health outputs, H (i.e. height, weight), is produced by the function $h()$, based on a series of vectors of health inputs including food, F, mother's 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 may be affected by socio-economic characteristics, S, such as education, wealth, and income. Additionally, S may shape the technology of the production function. An element of random genetic variation, v, also affects height and weight. When estimating the determinants of health, the unmeasured term v, random genetic variation, will also pick up any unobservable determinants.

3.2 Inequality

Inequality is both deplorable 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 an 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." Inequality in outcomes due to differing levels of effort is morally acceptable, as effort is, by definition, under an individual's control. 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 factors are under children's control. 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; de Barros, Ferreira, Vega, & Chanduvi, 2009), modifies Roemer's concept to consider inequality of opportunity only that inequality due to *observable* circumstances. Since not all circumstances are observable, or observed in survey data, inequality of opportunity measured based on observable circumstances is therefore a lower bound on true inequality of opportunity (Ferreira & Gignoux, 2011). 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. 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 the determinants of child health inequality, a method that 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 (two standard deviations (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 (two SD below the median of the healthy reference population in terms of weight-for-height) indicate rapid weight loss or acute temporary malnutrition (World Bank, 2006). Height-for-age thus is, in part, an accumulated history of weight over time. Weight-for-age and underweight (two 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). Z-scores do not, however, have a particularly intuitive interpretation in terms of inequality and would alter the inequality indices. Therefore, in this paper, z-scores are transformed back into height and weight measures in their natural units of centimeters and kilograms and standardized relative to the distribution of a single reference age and gender—in this case, a 24-month-old female child is used (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:

$$h_s = F_{\bar{a},\bar{x}}^{-1}\left(F_{a,x}(h)\right) \quad (2)$$

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

4.2 Inequality Decompositions

Assessing the shares of inequality attributable to different circumstances (distinguishing inequality of opportunity from the residual attributed to luck) requires 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 inequality as follows (Duclos & Araar, 2006):

$$\text{GE}(0) = \int_0^1 \left(ln(\mu) - ln(Q(p)\right)dp \quad (3)$$

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 (e.g. shortest to tallest heights), and *Q*(*p*) is the value of the continuous variable (height, weight) 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.

The GE(0) index is decomposed with a standardized distribution that eliminates all inequality due to circumstances (leaving only residual inequality due to luck). This approach is preferred because, as discussed below, child health and nutrition deteriorate 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. While both parametric and nonparametric methods can be used to decompose inequality of opportunity, examining only a few circumstances rapidly exhausts the possibilities for nonparametric decomposition. Since a large number of variables are of interest, parametric methods (OLS regressions) are used.

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, hereafter referred to as *M* (i.e. *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), this paper estimates both a "reduced form" model with just socio-economic status and a "structural" model that attempts to disentangle the effects of socio-economic mediators (as well as any additional effects they may have). Essentially, this approach assumes that *M* are a (linear) function of socio-economic status, *S*:

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

where γ is a vector of 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 or weight measures) can then be disentangled by estimating:

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

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

$$y_i = S_i(\alpha + \beta\gamma) + \eta_i\beta + \upsilon_i \quad (6)$$

which are readily estimated as:

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

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. Since variables are actively omitted, different permutations are checked to ensure that omitted variables and the order of additions are not driving results.

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

$$y_i = C_i\psi + \varepsilon_i \quad (8)$$

with the vector *C,* circumstances, be used as a generalization of (5) and (7). *C* includes *S* and can also include *M,* i.e. circumstances include socio-economic status and potentially mediators as well (depending on the specification). Then the estimated parameters, $\hat{\psi}$, are used to compute standardized distributions, $\widetilde{y_i}$, as (Ferreira & Gignoux, 2011):

$$\widetilde{y_i} = \bar{C}\hat{\psi} + \hat{\varepsilon}_i \tag{9}$$

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 $\widetilde{y_i}$ can be used to calculate inequality of opportunity, θ_r, residually as a share of total inequality (Ferreira & Gignoux, 2011):

$$\theta_r = 1 - {\mathrm{GE}_0(\{\widetilde{y_i}\})}\Big/{\mathrm{GE}_0(\{y_i\})} \tag{10}$$

The contribution of inequality of opportunity to overall inequality can thus be expressed 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, 2011):

$$\widetilde{y_i}^J = \bar{C}^J\hat{\psi}^J + C_i^{j\neq J}\psi^{j\neq J} + \hat{u}_i \tag{11}$$

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

$$\theta_r^J = 1 - {\mathrm{GE}_0\left(\{\widetilde{y_i}^J\}\right)}\Big/{\mathrm{GE}_0(\{y_i\})} \tag{12}$$

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 are tested for statistical significance by generating bootstrapped standard errors around the estimates.

5 Data

5.1 The Sample

This paper uses the 2012 JPFHS for Jordan, which is Jordan's version of the Demographic and Health Survey (DHS). This nationally-representative survey sampled 15,190 households (Department of Statistics (Jordan) & ICF International, 2013). 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 JPFHS 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 these 2,230 young children.

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. In subsequent specifications, this paper adds a number of potential mediators to the child health production function, such as parents' health knowledge or feeding practices. Table 1, in the appendix, lists in detail how individual variables are aggregated into categories. Two broad categories of socio-economic variables are considered, parents' education and "wealth and employment." 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). Geographic differences are examined, in terms of governorates, rural versus urban, refugee camps versus non-refugee areas, and *badia* (arid areas) versus non-*badia*. If geographic differences mediate socio-economic disparities, this may be due to differences in access to services such as sanitation, water, or health care. 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. Information on breastfeeding is incorporated into the category "food." In addition, the (categorical) frequency of feeding is incorporated. The frequency of feeding is a proxy for energy intake: 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). Food diversity and certain types of foods, such as protein, 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 aggregated 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). 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.

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 (World Bank, 2010). Although the entire history of episodes of illness is likely to drive current nutritional status, in the JPFHS 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 constitute the category of health conditions.

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 JPFHS samples in clusters of approximately 20 households, the local (cluster) level health environment is also measured in terms of the drinking water source, sewer connections, and wealth of other households.

Two final factors that are considered are mother's demographics and child's birth weight (as recalled by the mother). Mother's demographics incorporate the height of the mother, her age (categorically) and birth spacing in months (or a dummy for being part of the first birth). Mother's height (particularly her own stunting and malnutrition during childhood) has been shown to transmit across generations (Dewey & Begum, 2011). Mother's age and birth spacing, have been demonstrated to play an important role in infant health and nutrition outcomes (Dewey & Cohen, 2007; Kozuki, Lee, Silveira, et al., 2013).

Birth weight, particularly low versus normal birth weight, has been shown in other contexts to drive long-term health and nutrition outcomes (Bhutta, Ahmed, Black, et al., 2008; Black, Allen, Bhutta, et al., 2008; Black, Victora, Walker, et al., 2013; Dewey & Begum, 2011; Victora, Adair, Fall, 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. 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 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 (early, post-natal environment) are then added to the regressions to estimate how much of the socio-economic effects are mediated through these measures (how much the socio-economic status partial effects decrease after controlling for mediators). Lastly, mother's demographics and the child's birth weight (prenatal environment) 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. The rate of stunting is significantly higher than that expected in a healthy reference population (2.3% (World Health Organization, 2006)). 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.

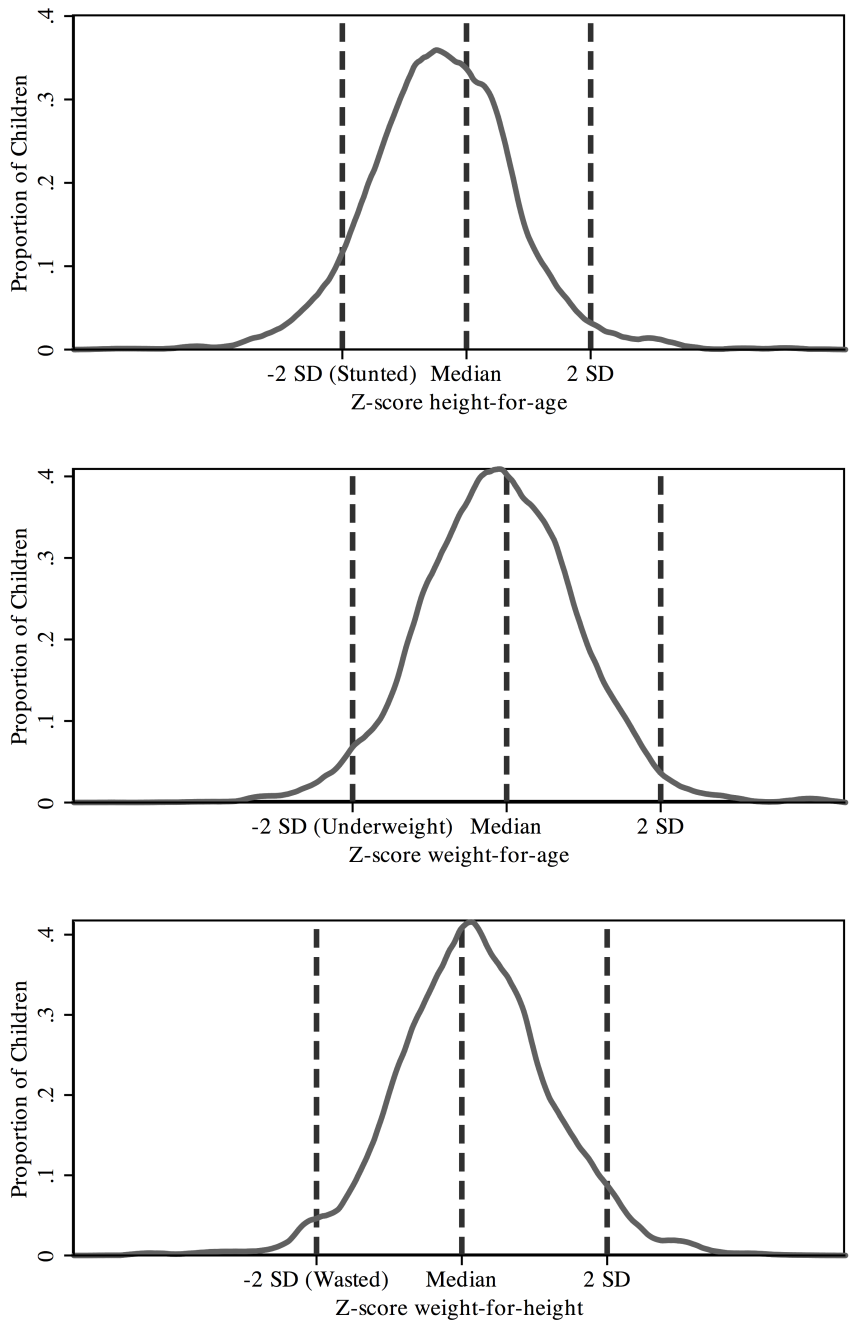

Figure 1. Distribution of Anthropometrics
Source: Author's calculations based on Jordan JPFHS 2012.
Notes: Kernel densities, using Epanechnikov kernel (bandwidth 0.4). Dashed lines show healthy reference population benchmarks.

Figure 2 shows the mean anthropometric outcomes by age in months and wealth quintile. Focusing first on overall patterns, 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 those for the reference population. Stunting, underweight, and wasting are relatively high at birth and decrease over the first 10 months 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.[3]

There are large differences in health and nutrition by socio-economic status in Jordan. Although breaking the data down by both child's age in months and wealth quintile is somewhat noisy, Figure 2 shows that children from less wealthy households have poorer nutrition outcomes. Only children from the richest quintile remain near the healthy reference median (a z-score of zero) for height-for-age 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 height-for-age and weight-for-age presented by poorer children in Jordan are similar to those seen throughout low and middle income countries (Shrimpton, Victora, de Onis, et al., 2001; Victora, de Onis, Hallal, Blössner, & Shrimpton, 2010). Although differences in weight-for-age are smaller, there is also a

[3] These differences by age in months are unlikely to be driven by cohort affects; the 2009 Jordanian JPFHS demonstrates similar patterns of nutrition by age in months.

clear socio-economic gradient in weight-for-age and being underweight. Weight-for-height, likely to measure transitory nutritional status, does not show such clear patterns.

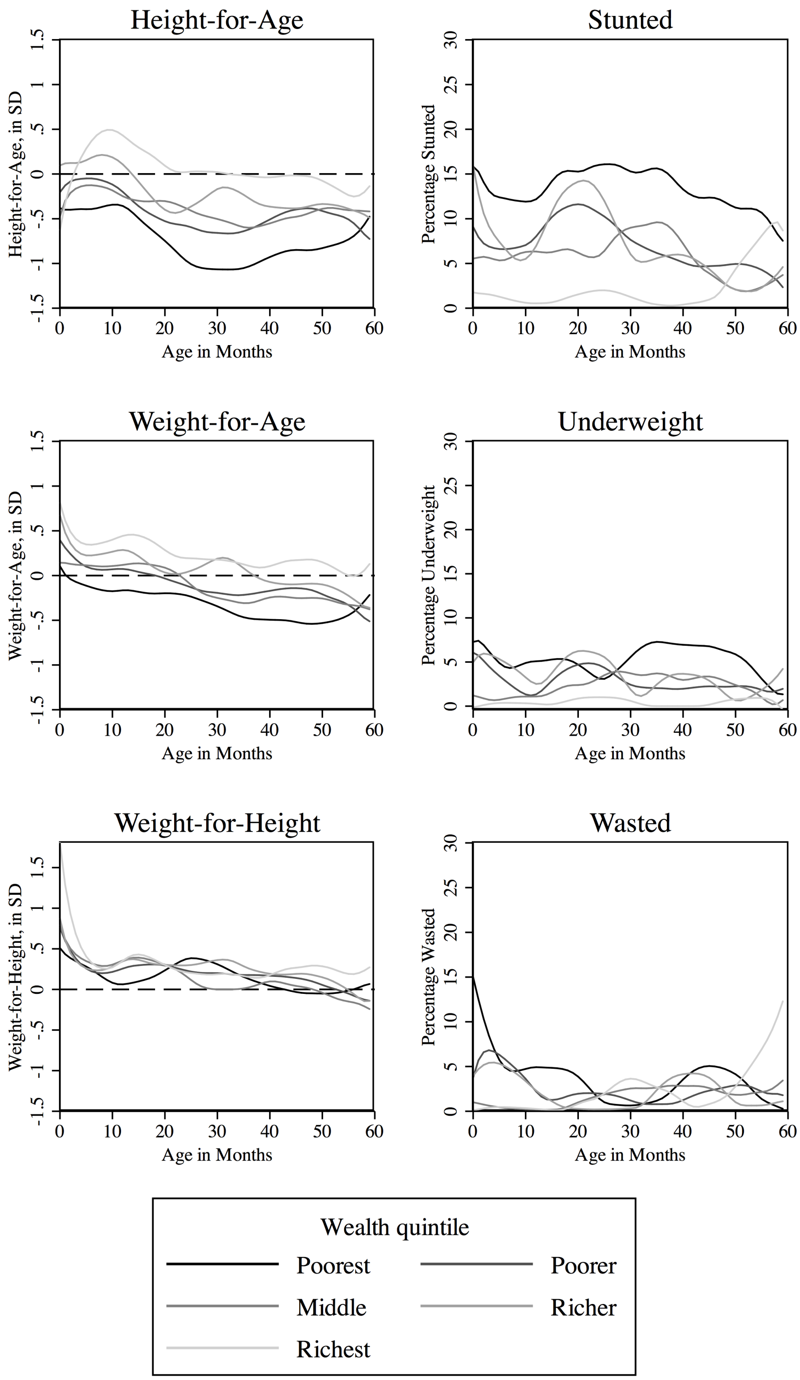

Figure 2. Anthropometrics by Age in Months and Wealth Quintile
Source: Author's calculations based on Jordan JPFHS 2012.
Notes: Lowess smoother (bandwidth 0.4).

Focusing on the youngest child under two, the sample for the inequality of opportunity analysis, there is a clear socio-economic gradient in nutrition by parents' education.[4] Children of secondary-educated parents show 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. 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. 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 inequality and malnutrition.

6.2 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

[4] Information on nutrition status by socio-economic characteristics is available in the appendix, Table 3.

after birth, and mediators preceding birth, by comparing the various analyses. Table 4 shows, for the analysis sample, the summary statistics for the different circumstances and covariates.

In the appendix, Table 5 (for height-for-age), Table 6 (for weight-for-age), and Table 7 (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 contribute to estimated inequality of opportunity. Since age can contribute to total inequality but does not contribute to inequality of opportunity, the proportion of inequality due to circumstances is likely to underestimate inequality of opportunity in children's long-term outcomes.

Figure 3 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 the appendix, Table 2. 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 as is 2.1% of weight-for-height. These measures are for models including socio-economic circumstances alone. If all variables were perfectly measured these socio-economic circumstances would have no explanatory power once mediators were added.

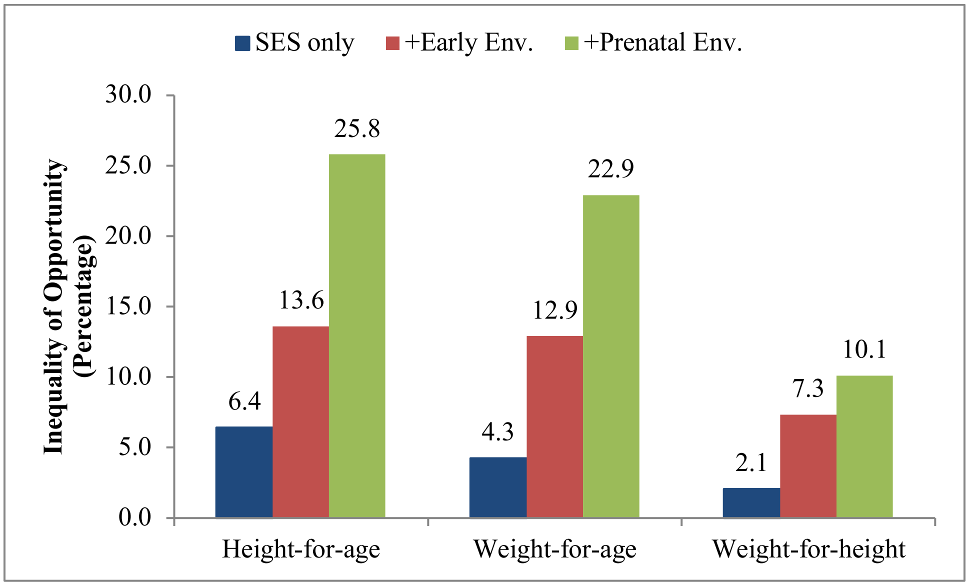

Figure 3. **Inequality of Opportunity in Anthropometrics by Specification, Youngest Child Under Two (Percentage of Total Inequality)**
Source: Author's calculations based on Jordan JPFHS 2012.

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 (measured) 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 25.8% 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 explained nutrition inequality is determined prior to birth. Second, the resulting level of inequality of opportunity, 25.8%, 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.

6.3 Mediators (Partial Effects) of Inequality in Child Health

A number of different factors mediate inequality of opportunity in child health. Figure 4 presents the partial effects for different categories of variables, in terms of shares of total inequality. Values underlying the figure are in the appendix, Table 2. 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% is due to parents' education.[5] Weight-for-age likewise shows a larger effect from wealth and employment than from education, but the opposite is true for weight-for-height. Adding the child's early environment reduces the impact of parents' education but has little or no effect on the wealth/employment effects for weight-for-age or height-for-age. Adding early environment reduces wealth/employment effects more than education effects for weight-for-height.

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

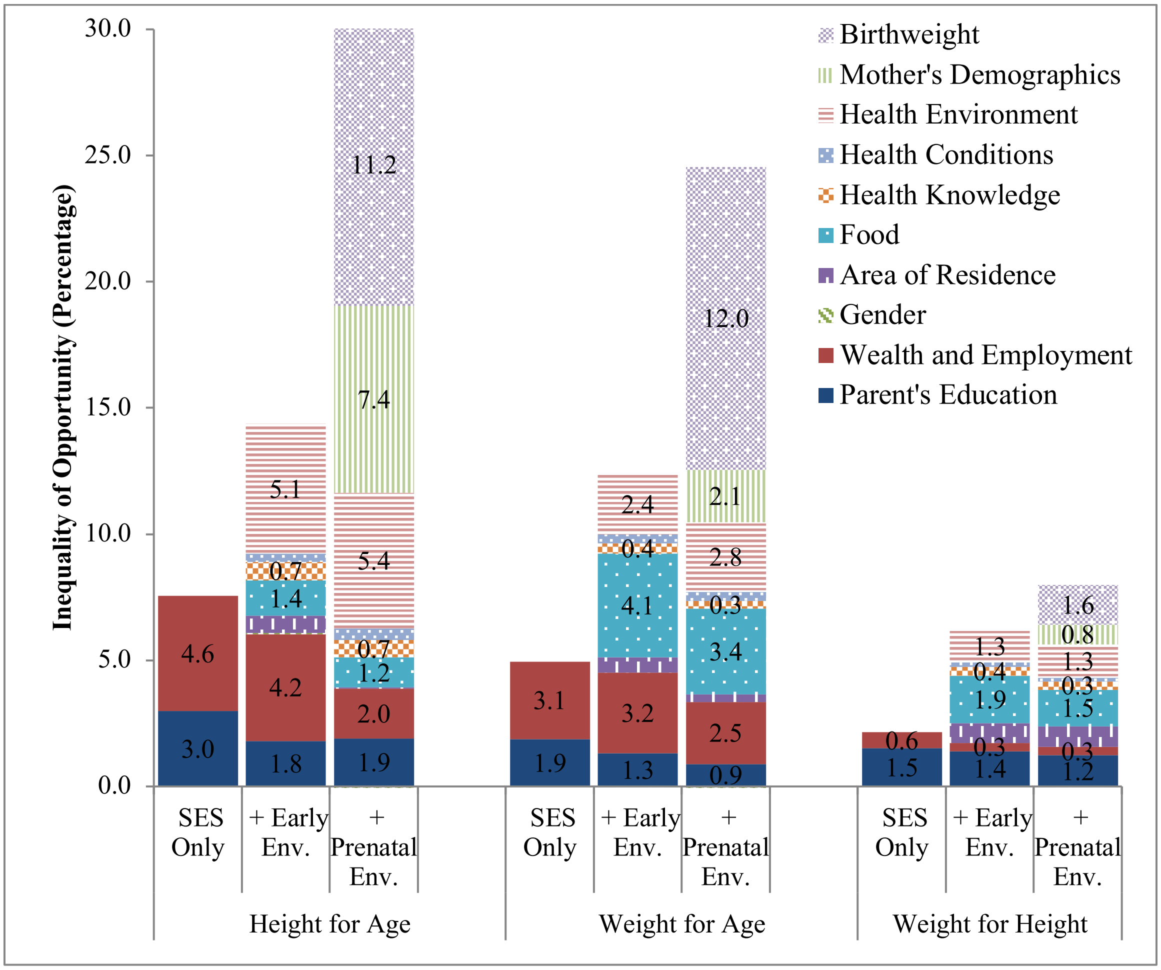

Figure 4. Partial Effects, Inequality of Opportunity in Anthropometrics by Specification, Youngest Child Under Two (Percentage of Total Inequality)
Source: Author's calculations based on Jordan JPFHS 2012.

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).[6] Thus, wealth and employment disparities are mediated primarily by prenatal development. Notably, there remain substantial disparities by socio-economic status even after

[6] 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.

the many variables included have been added. For example, even after adding the early environment and prenatal factors, 1.9% of inequality in height-for-age is attributable to parents' education and 2.0% is due to wealth and employment. Insufficiently precise measurements of other covariates, such as health knowledge, may contribute to these lingering effects, but they also suggest that there are other mediators not yet measured or accounted for that may contribute to socio-economic disparities.

A number of different individual partial effects within the prenatal and early environment 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. Around 3-4% of inequality in weight-for-age is related to feeding, and this is sometimes statistically significant across specifications. The smaller contributions of food and feeding to height may be because concurrent feeding affects weight, and the full history of feeding affects height, so effects on height are underestimated. 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 oral rehydration salts (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 5), 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 a household level.

The contributions of maternal demographics (age, height, and birth interval) are large and significant for height-for-age, where they contribute 7.4% 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 5), are a clear intergenerational transmission of long-term nutritional outcomes. Each additional centimeter in mother's height predicts an additional 0.136 centimeters of height for a 24-month old female, after accounting for other characteristics and age in months.

Much of children's nutrition is also driven by health and nutrition accumulated prior to birth; 11.2% 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). Each additional kilogram of birth weight predicts an additional 1.848 centimeters of height for a 24-month old female, after accounting for other characteristics. 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.

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 is crucially related to a number of different dimensions of human development. Thus, these early disparities in Jordan are likely to contribute to later inequalities, such as high inequality of opportunity in educational achievement in Jordan (Salehi-Isfahani, Belhaj Hassine, & Assaad, 2014).

A 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 mediate 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, 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, Lee, Angel, et al., 2013). In utero rainfall (and therefore nutrition) shocks have been shown to have a larger effect on long-term outcomes than shocks in the first two years of life (Abiona, 2017; 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 (Dubois, Kyvik, Girard, 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 disproportionate 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, 2011). Prenatal development tends to be more important than post-natal development for the formation of human capital, although both periods make important contributions.

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 globally. The large role of prenatal factors suggests that an important emphasis in health and nutrition interventions should be intervening before and during pregnancy (Black, Victora, Walker, et al., 2013). However, much of the current landscape of research, policy, and interventions places the greatest emphasis on development after birth as central to early childhood development (Bhutta, Ahmed, Black, et al., 2008; Black, Victora, Walker, et al., 2013; Horton, Shekar, McDonald, Mahal, & Brooks, 2010; World Bank, 2006, 2010), a phase that, while important, is relatively secondary, at least for the case at hand. These findings suggest that 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 (Leight, Glewwe, & Park, 2015; Portrait, van Wingerden, & Deeg, 2017). 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, Berngard, Krebs, et al., 2013). Calorie differences in early childhood have less explanatory power, explaining a maximum of 16% of height gaps for Guatemalan children (Griffen, 2016).

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 additional support for the health and nutrition of children with poor nutrition status at birth 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 inequality 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 typically 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 JPFHS for Jordan had unusually rich data, the factors included in this paper were measured imperfectly. Only the socio-economic links between one generation and the next could be assessed, but health and nutrition may be intergenerational across multiple generations, beyond parent-child links. Mediators were also measured imperfectly, for instance, data were 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. 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 critical outcomes.

Further research is needed in other countries to assess whether the pattern of predominant prenatal factors, which also has been found to occur in other contexts (Berngard, Berngard, Krebs, et al., 2013; Neumann & Harrison, 1994), is widespread. There is also insufficient research on the impact of nutrition interventions during pregnancy, but existing evidence shows such interventions can be effective, especially when mothers have poor nutritional status (Rasmussen & Habicht, 2010). Particularly if this pattern is common globally, future research needs to investigate interventions targeting maternal and fetal nutrition and health to assess how best to address these key drivers of child malnutrition and poor early development.

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Appendix: Additional Tables

Table 1. Categories of Variables

Category	Variables
Parents' education	Mother's education (6 categories), father's education (6 categories)
Wealth and employment	Household wealth factor (and square), 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 after birth (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 centimeters), birth interval (in months), first birth
Birth weight	Birth weight (in kilograms) and indicator if missing
Age in months (not a circumstance)	Categorically

Table 2. Inequality and Inequality of Opportunity in Child Anthropometry, Youngest Child Under Two Source: Author's calculations based on Jordan JPFHS 2012.

Outcome: Specification:	Height-for-age SES	Weight-for-age SES	Weight-for-height SES	Height-for-age + Early env.	Weight-for-age + Early env.	Weight-for-height + Early env.	Height-for-age + Prenatal env.	Weight-for-age + Prenatal env.	Weight-for-height + Prenatal env.
Total inequality	0.00133***	0.00865***	0.00541***	0.00133***	0.00865***	0.00541***	0.00133***	0.00865***	0.00541***
	(0.0000799)	(0.000536)	(0.000292)	(0.0000834)	(0.000527)	(0.000289)	(0.0000800)	(0.000552)	(0.000281)
Residual inequality	0.00124***	0.00828***	0.00529***	0.00115***	0.00754***	0.00501***	0.000987***	0.00667***	0.00486***
	(0.0000770)	(0.000529)	(0.000284)	(0.0000793)	(0.000474)	(0.000279)	(0.0000638)	(0.000433)	(0.000265)
Inequality of opportunity (share of total inequality)	0.0641**	0.0427**	0.0209	0.136***	0.129***	0.0733**	0.258***	0.229***	0.101***
	(0.0207)	(0.0162)	(0.0120)	(0.0306)	(0.0239)	(0.0241)	(0.0283)	(0.0251)	(0.0273)
Inequality of op. partial effects (share of total inequality)									
Parent's education	0.0300*	0.0188	0.0151	0.0180	0.0131	0.0139	0.0191	0.00883	0.0123
	(0.0131)	(0.0117)	(0.00950)	(0.0133)	(0.0131)	(0.0105)	(0.0129)	(0.0121)	(0.0116)
Wealth and employment	0.0456*	0.0307*	0.00634	0.0423*	0.0320	0.00328	0.0196	0.0246	0.00326
	(0.0214)	(0.0155)	(0.00992)	(0.0205)	(0.0163)	(0.0131)	(0.0246)	(0.0161)	(0.0135)
Gender				0.000571	-0.0000316	0.0000325	-0.00157	-0.00175	-0.000383
				(0.00303)	(0.00222)	(0.00194)	(0.00473)	(0.00345)	(0.00201)

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.
Area of residence				0.00670	0.00596	0.00773	0.000595	0.00315	0.00821
				(0.0109)	(0.00879)	(0.00814)	(0.0116)	(0.00802)	(0.00788)
Food				0.0140	0.0413*	0.0189	0.0118	0.0338	0.0145
				(0.0227)	(0.0161)	(0.0213)	(0.0194)	(0.0178)	(0.0219)
Health knowledge				0.00748	0.00396	0.00365	0.00694	0.00302	0.00338
				(0.00748)	(0.00555)	(0.00476)	(0.00694)	(0.00552)	(0.00505)
Health conditions				0.00328	0.00349	0.00154	0.00457	0.00372	0.00139
				(0.00621)	(0.00609)	(0.00438)	(0.00621)	(0.00548)	(0.00469)
Health environment				0.0513*	0.0238	0.0131	0.0537*	0.0277	0.0133
				(0.0242)	(0.0194)	(0.0148)	(0.0219)	(0.0171)	(0.0136)
Mother's demographics							0.0741***	0.0207	0.00783
							(0.0176)	(0.0124)	(0.0107)
Birth weight							0.112***	0.120***	0.0157
							(0.0231)	(0.0207)	(0.00925)
N	2111	2111	2111	2111	2111	2111	2111	2111	2111

Notes: *p<0.05; **p<0.01; ***p<0.001
Clustered bootstrapped standard errors in parentheses.

Table 3. 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/	-0.10	0.15	0.35	4.1	1.4	1.1	20.1

	Height-for-age (z-score)	Weight-for-age (z-score)	Weight-for-height (z-score)	Stunted (percentage)	Under-weight (percentage)	Wasted (percentage)	Percentage of Sample
managerial							
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 JPFHS 2012.

Table 4. Summary Statistics for Covariates, Youngest Child Under Two

	Mean	Standard deviation
Wealth		
Wealth score	6.720	1.140
Wealth score sq./100	0.465	0.165
Father's education		
No education	0.010	0.099
Elementary	0.089	0.285
Preparatory	0.178	0.382
Secondary	0.483	0.500
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 employment 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 occupation		
Did not work	0.103	0.303
Professional/technical/managerial	0.204	0.403
Clerical	0.070	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 occupation		
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
Governorate of residence		
Amman	0.353	0.478
Balqa	0.074	0.262
Zarqa	0.138	0.345
Madaba	0.029	0.167

	Mean	Standard deviation
Irbid	0.184	0.388
Mafraq	0.060	0.238
Jarash	0.040	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 initiation		
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	0.240
Other liquids within 3 days birth	0.666	0.472
Exclusively breastfed	0.055	0.229
Currently breastfed	0.525	0.500
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 +	0.160	0.367
Number liquids	2.395	1.190
Number grains	1.278	1.007
Number proteins	1.696	1.483
Number fruits and vegs.	0.759	0.821
Diarrhea		
None	0.738	0.440
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	9.601	0.753
Average cluster wealth factor sq./100	0.927	0.151
Cluster share of households not flushing to sewer	0.498	0.461
Cluster water		
Cluster share of households with bottled water	0.404	0.216
Cluster share of households with water piped in and treated	0.210	0.148
Cluster share of households with water piped in and not treated	0.300	0.230
Cluster share of households with other water source	0.086	0.195

	Mean	Standard deviation
Household Water		
Bottled	0.430	0.495
Piped to dwelling treated	0.218	0.413
Piped to dwelling not treated	0.280	0.449
Other	0.072	0.258
Flush to latrine/other	0.487	0.500
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 tuberculosis is curable	0.540	0.498
Know of oral rehydration salts	0.915	0.280
Exposure to family planning factor	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	0.160	0.367
40-44	0.068	0.252
45-49	0.003	0.053
Mother's height (in centimeters)	158.563	5.965
Birth spacing (in months)	37.348	18.484
First birth	0.205	0.404
Birth weight in kilograms	3.118	0.609
Birth weight in kilograms missing	0.008	0.088
N (Observations)	2,111	

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

Table 5. Regressions for Height-for-age (in Centimeters as a 24-month Female), Youngest Child Under Two

	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	2.850*	2.346*	0.941	0.717	1.225	0.930
	(1.110)	(1.146)	(1.097)	(1.131)	(1.052)	(1.079)
Wealth score sq./100	-15.492*	-11.396	-1.572	-0.230	-6.285	-4.510
	(7.476)	(7.886)	(7.446)	(7.721)	(7.116)	(7.415)
Father's education (none omit.)						
Elementary	0.748	0.895	0.578	0.574	0.617	0.836
	(1.187)	(1.164)	(1.106)	(1.029)	(1.061)	(0.968)
Preparatory	0.693	0.805	0.547	0.574	0.316	0.525
	(1.175)	(1.183)	(1.122)	(1.068)	(1.064)	(0.996)
Secondary	0.728	0.911	0.535	0.633	0.057	0.398
	(1.178)	(1.161)	(1.074)	(1.010)	(1.038)	(0.955)
Diploma	0.906	1.224	0.628	0.793	0.503	0.846
	(1.569)	(1.470)	(1.301)	(1.187)	(1.204)	(1.112)
University and above	1.844	2.076	1.839	1.862	1.241	1.500
	(1.318)	(1.290)	(1.179)	(1.110)	(1.136)	(1.051)
Mother's education (none omit.)						
Elementary	-0.534	-0.417	-1.285	-1.203	-2.248*	-2.058*
	(0.987)	(1.024)	(1.048)	(1.039)	(1.006)	(1.002)
Preparatory	-1.225	-1.113	-2.148*	-2.053*	-2.715**	-2.504**
	(0.990)	(1.031)	(1.035)	(1.030)	(0.971)	(0.967)
Secondary	-0.358	-0.388	-1.574	-1.679	-1.944*	-1.963*
	(0.905)	(0.940)	(0.967)	(0.963)	(0.919)	(0.915)
Diploma	0.550	0.531	-0.972	-1.078	-1.185	-1.302
	(0.998)	(1.016)	(1.077)	(1.074)	(1.018)	(1.011)
University and above	-0.445	-0.666	-1.845	-2.077*	-1.917	-2.122*
	(1.048)	(1.059)	(1.057)	(1.045)	(1.012)	(1.001)
Father's emp. status (none/absent omit.)						
Wage worker	-1.198	-1.196	-1.275*	-1.282*	-1.358*	-1.328*

	SES	SES and age/birth month	+ Early env.	+ Early env. and age/birth month	+ Prenatal env.	+ Prenatal env. and age/birth month
	(0.708)	(0.635)	(0.604)	(0.558)	(0.580)	(0.539)
Employer	-1.024	-0.935	-1.158	-0.866	-1.305	-1.007
	(1.072)	(0.969)	(0.983)	(0.910)	(0.881)	(0.805)
Self-employed	-1.068	-1.025	-1.123	-1.087	-1.423*	-1.321*
	(0.873)	(0.814)	(0.783)	(0.746)	(0.698)	(0.672)
Mother's employment status (none omit.)						
Wage worker	0.298	0.368	0.392	0.419	0.537	0.542
	(0.545)	(0.535)	(0.506)	(0.482)	(0.488)	(0.467)
Other work	1.757	1.911	1.881	2.213	1.584	1.779
	(2.033)	(1.985)	(1.979)	(1.897)	(1.795)	(1.734)
Father's occup. (professional omit.)						
Clerical	1.371	1.176	1.625*	1.358*	1.412	1.150*
	(0.946)	(0.754)	(0.811)	(0.630)	(0.719)	(0.578)
Sales	0.425	0.294	0.111	-0.031	-0.083	-0.173
	(0.706)	(0.670)	(0.694)	(0.697)	(0.605)	(0.612)
Agricultural	0.672	0.457	0.141	-0.250	0.404	0.037
	(0.852)	(0.788)	(0.790)	(0.767)	(0.776)	(0.735)
Household and domestic	-0.230	0.063	-0.282	-0.159	0.301	0.332
	(1.213)	(1.143)	(1.112)	(1.080)	(0.947)	(0.927)
Services	0.599	0.714	0.584	0.484	0.762	0.680
	(0.690)	(0.591)	(0.591)	(0.532)	(0.518)	(0.476)
Skilled manual	0.800	0.771	0.630	0.499	0.929	0.766
	(0.626)	(0.558)	(0.552)	(0.502)	(0.498)	(0.457)
Unskilled manual	1.191	1.334	0.703	0.829	1.023	1.170
	(1.017)	(0.946)	(0.965)	(0.968)	(0.853)	(0.866)
Mother's occup. (professional omit.)						
Other occupations	-0.611	-0.612	-0.555	-0.767	-0.631	-0.778
	(0.964)	(0.936)	(0.927)	(0.872)	(0.849)	(0.800)
Rural			-0.124	0.004	-0.030	0.038

	SES	SES and age/birth month	+ Early env.	+ Early env. and age/birth month	+ Prenatal env.	+ Prenatal env. and age/birth month
			(0.342)	(0.324)	(0.329)	(0.315)
Area of residence						
Balqa			0.359	0.451	0.295	0.323
			(0.575)	(0.540)	(0.549)	(0.505)
Zarqa			-0.151	-0.229	-0.459	-0.579
			(0.582)	(0.540)	(0.549)	(0.508)
Madaba			0.485	0.650	0.352	0.400
			(0.515)	(0.489)	(0.503)	(0.475)
Irbid			0.069	0.077	-0.218	-0.277
			(0.565)	(0.552)	(0.538)	(0.522)
Mafraq			-0.986*	-0.960*	-0.905*	-0.913*
			(0.496)	(0.475)	(0.438)	(0.421)
Jarash			-0.879	-0.798	-0.813	-0.810
			(0.537)	(0.501)	(0.503)	(0.468)
Ajlun			-0.501	-0.472	-0.655	-0.673
			(0.573)	(0.582)	(0.519)	(0.529)
Karak			0.398	0.462	0.165	0.148
			(0.652)	(0.616)	(0.616)	(0.579)
Tafiela			-0.292	-0.191	-0.415	-0.412
			(0.627)	(0.604)	(0.598)	(0.577)
Ma'an			-1.245*	-1.263*	-0.981	-1.082*
			(0.544)	(0.495)	(0.501)	(0.459)
Aqaba			-0.979	-1.027	-0.968	-1.024
			(0.679)	(0.677)	(0.660)	(0.657)
Camps			-0.079	-0.130	-0.284	-0.251
			(0.499)	(0.473)	(0.475)	(0.448)
Badia			0.236	0.325	0.505	0.576
			(0.520)	(0.506)	(0.449)	(0.432)
Female			0.195	0.147	0.679*	0.636*
			(0.293)	(0.277)	(0.278)	(0.264)
Breastfeeding init. (never omit.)						

	SES	SES and age/birth month	+ Early env.	+ Early env. and age/birth month	+ Prenatal env.	+ Prenatal env. and age/birth month
Immediately			1.321	1.613	0.523	0.816
			(1.056)	(0.997)	(0.960)	(0.911)
Within first hour			0.558	0.931	-0.080	0.283
			(1.030)	(0.916)	(0.941)	(0.833)
One hour			1.295	1.599	0.361	0.701
			(1.028)	(0.926)	(0.910)	(0.834)
2-24 hours			1.369	1.617	0.445	0.699
			(0.948)	(0.855)	(0.856)	(0.783)
One day			1.313	1.486	0.566	0.730
			(1.021)	(0.931)	(0.941)	(0.869)
Two days			1.765	2.323*	1.092	1.596
			(1.092)	(0.995)	(1.011)	(0.937)
3 or more days			0.666	0.912	0.199	0.354
			(1.010)	(0.932)	(0.912)	(0.863)
Other liquids within 3 days birth			-0.838*	-0.775*	-0.585	-0.553
			(0.344)	(0.334)	(0.311)	(0.298)
Exclusively breastfed			2.010**	2.034**	1.470*	1.578*
			(0.703)	(0.762)	(0.570)	(0.625)
Currently breastfed			0.759*	-0.173	0.501	-0.374
			(0.325)	(0.350)	(0.304)	(0.339)
Drank from bottle			1.188***	0.793*	1.022***	0.676*
			(0.346)	(0.326)	(0.300)	(0.283)
Feeding frequency						
Once			0.797	0.759	0.689	0.561
			(0.603)	(0.648)	(0.624)	(0.665)
Twice			1.458*	1.514*	1.463**	1.361*
			(0.589)	(0.660)	(0.541)	(0.612)
Three times			1.042	1.244	0.922	0.987
			(0.574)	(0.662)	(0.523)	(0.616)
Four +			0.812	0.900	0.878	0.882
			(0.622)	(0.728)	(0.567)	(0.662)

	SES	SES and age/birth month	+ Early env.	+ Early env. and age/birth month	+ Prenatal env.	+ Prenatal env. and age/birth month
No. Foods						
No. liquids			-0.119	-0.052	-0.121	-0.064
			(0.183)	(0.171)	(0.169)	(0.155)
No. grains			-0.090	0.025	-0.134	-0.038
			(0.192)	(0.181)	(0.177)	(0.167)
No. protein			0.226	0.392*	0.196	0.339*
			(0.175)	(0.173)	(0.151)	(0.150)
No. fruits and vegs.			-0.161	0.105	-0.102	0.129
			(0.238)	(0.216)	(0.184)	(0.181)
Diarrhea (none omit.)						
Yes but gone			0.115	-0.094	0.285	0.160
			(0.436)	(0.385)	(0.384)	(0.334)
Yes still			-0.920*	-1.283**	-0.823	-1.109*
			(0.461)	(0.467)	(0.446)	(0.452)
Fever/Cough (none omit.)						
Yes but gone			-0.388	-0.341	-0.339	-0.263
			(0.822)	(0.749)	(0.828)	(0.751)
Yes still			0.286	0.288	0.381	0.359
			(0.327)	(0.315)	(0.307)	(0.296)
Persons per room			-0.042	-0.072	0.013	-0.073
			(0.168)	(0.194)	(0.171)	(0.186)
Cluster wealth						
Average cluster wealth factor			11.306***	10.058**	10.106***	8.394**
			(3.211)	(3.394)	(2.867)	(2.981)
Average cluster wealth factor sq./100			-58.532***	-52.197**	-51.319***	-42.639**
			(15.776)	(16.697)	(14.118)	(14.742)
Cluster share of households not flushing to sewer			-2.397	-2.365	-1.591	-1.508
			(1.343)	(1.215)	(1.272)	(1.144)
Cluster water (bottled omit.)						

	SES	SES and age/birth month	+ Early env.	+ Early env. and age/birth month	+ Prenatal env.	+ Prenatal env. and age/birth month
Cluster share of households with water piped in and treated			-4.690**	-4.254**	-3.786**	-3.366*
			(1.546)	(1.431)	(1.383)	(1.304)
Cluster share of households with water piped in and not treated			-0.828	-0.869	-0.497	-0.546
			(0.907)	(0.922)	(0.824)	(0.841)
Cluster share of households with other water source			1.307	1.519	1.711	1.904*
			(1.003)	(1.075)	(0.906)	(0.937)
Household Sanitation (Sewer omit.)						
Flush to latrine/other			1.961	1.832	1.358	1.194
			(1.159)	(1.053)	(1.084)	(0.982)
Household Water (bottled omit.)						
Piped to dwelling treated			-0.049	-0.139	-0.018	-0.107
			(0.459)	(0.411)	(0.393)	(0.362)
Piped to dwelling not treated			-0.434	-0.350	-0.468	-0.453
			(0.360)	(0.350)	(0.327)	(0.315)
Other			-0.763	-0.862	-1.006	-1.137*
			(0.581)	(0.567)	(0.512)	(0.493)
Household members smoke			-0.177	-0.207	-0.064	-0.057
			(0.280)	(0.264)	(0.253)	(0.237)
Mother smokes cigarettes			-1.186	-0.764	-1.081*	-0.753
			(0.670)	(0.602)	(0.549)	(0.507)
Mother smokes nargile			0.372	0.310	0.001	-0.061
			(0.422)	(0.429)	(0.397)	(0.398)
Know TB is curable			0.213	0.274	0.091	0.159
			(0.308)	(0.280)	(0.268)	(0.240)
Know of ORS			-0.078	-0.059	0.102	0.023
			(0.455)	(0.409)	(0.451)	(0.400)
Exposure to family planning			0.262	0.179	0.256	0.172
			(0.165)	(0.160)	(0.151)	(0.142)

	SES	SES and age/birth month	+ Early env.	+ Early env. and age/birth month	+ Prenatal env.	+ Prenatal env. and age/birth month
Distance to health care problematic			-0.048	-0.019	0.005	0.055
			(0.300)	(0.279)	(0.296)	(0.265)
Mother's age (15-19 omit.)						
20-24					0.019	0.461
					(0.645)	(0.581)
25-29					-0.756	-0.074
					(0.608)	(0.571)
30-34					-0.435	0.319
					(0.663)	(0.614)
35-39					-0.584	0.056
					(0.697)	(0.695)
40-44					-0.921	-0.214
					(0.732)	(0.686)
45-49					-2.800*	-2.136
					(1.357)	(1.301)
Mother's height (in centimeters)					0.153***	0.136***
					(0.024)	(0.022)
Birth spacing (months)					0.022**	0.023**
					(0.008)	(0.007)
First birth					-0.147	-0.233
					(0.373)	(0.360)
Birth weight in kilograms					1.774***	1.848***
					(0.218)	(0.205)
Birth weight in kilograms missing					-4.967**	-4.630***
					(1.614)	(1.335)
Constant	72.982***	73.074***	25.783	30.996	1.593	11.461
	(3.854)	(4.001)	(16.243)	(17.077)	(15.465)	(15.645)
Age (months)	No	Yes	No	Yes	No	Yes
P-value (model)	0.000	0.000	0.000	0.000	0.000	0.000

	SES	SES and age/birth month	+ Early env.	+ Early env. and age/birth month	+ Prenatal env.	+ Prenatal env. and age/birth month
N(Observations)	2111	2111	2111	2111	2111	2111
R-squared	0.064	0.127	0.175	0.231	0.289	0.337
Adj. R-squared	0.053	0.107	0.142	0.192	0.256	0.299

Source: Author's calculations based on Jordan JPFHS 2012.
Notes: *p<0.05; **p<0.01; ***p<0.001
Clustered standard errors in parentheses.

Table 6. Regressions for Weight-for-age (in Kilograms as a 24-month Female), Youngest Child Under Two

	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	1.181**	0.884*	0.706	0.522	0.768	0.554
	(0.402)	(0.383)	(0.446)	(0.437)	(0.476)	(0.463)
Wealth score sq./100	-7.125**	-4.907	-3.399	-2.148	-4.467	-2.989
	(2.721)	(2.672)	(3.074)	(3.061)	(3.374)	(3.309)
Father's education (none omit.)						
Elementary	0.037	0.120	-0.150	-0.092	-0.085	0.028
	(0.362)	(0.332)	(0.302)	(0.273)	(0.300)	(0.289)
Preparatory	0.085	0.135	-0.138	-0.089	-0.128	-0.024
	(0.354)	(0.326)	(0.287)	(0.259)	(0.289)	(0.282)
Secondary	0.151	0.233	-0.067	-0.009	-0.144	-0.023
	(0.348)	(0.317)	(0.283)	(0.256)	(0.290)	(0.281)
Diploma	0.383	0.428	0.034	0.073	0.075	0.176
	(0.463)	(0.408)	(0.368)	(0.330)	(0.344)	(0.333)
University and above	0.255	0.300	0.047	0.063	-0.067	0.012
	(0.402)	(0.373)	(0.342)	(0.316)	(0.338)	(0.331)
Mother's education (none omit.)						
Elementary	0.213	0.216	-0.023	-0.007	-0.250	-0.238
	(0.309)	(0.308)	(0.289)	(0.290)	(0.287)	(0.280)
Preparatory	-0.329	-0.321	-0.501	-0.501	-0.592*	-0.586*
	(0.301)	(0.295)	(0.300)	(0.297)	(0.292)	(0.283)
Secondary	-0.167	-0.166	-0.390	-0.409	-0.483	-0.499
	(0.285)	(0.277)	(0.289)	(0.286)	(0.284)	(0.276)
Diploma	0.080	0.070	-0.225	-0.243	-0.280	-0.311
	(0.316)	(0.307)	(0.325)	(0.323)	(0.313)	(0.306)
University and above	0.096	0.046	-0.194	-0.245	-0.286	-0.363
	(0.340)	(0.322)	(0.314)	(0.310)	(0.309)	(0.302)
Father's emp. status (none/absent omit.)						
Wage worker	-0.395	-0.360	-0.308	-0.266	-0.412*	-0.368

	SES	SES and age/birth month	+ Early env.	+ Early env. and age/birth month	+ Prenatal env.	+ Prenatal env. and age/birth month
	(0.224)	(0.216)	(0.202)	(0.199)	(0.197)	(0.195)
Employer	-0.362	-0.355	-0.294	-0.240	-0.453	-0.413
	(0.349)	(0.319)	(0.323)	(0.300)	(0.305)	(0.280)
Self-employed	-0.407	-0.369	-0.328	-0.268	-0.501	-0.422
	(0.300)	(0.299)	(0.279)	(0.275)	(0.263)	(0.261)
Mother's employment status (none omit.)						
Wage worker	0.089	0.163	0.154	0.193	0.202	0.244
	(0.200)	(0.193)	(0.172)	(0.175)	(0.169)	(0.171)
Other work	0.080	0.227	0.215	0.372	0.192	0.339
	(0.453)	(0.496)	(0.481)	(0.510)	(0.421)	(0.457)
Father's occup. (professional omit.)						
Clerical	0.280	0.227	0.232	0.179	0.208	0.155
	(0.274)	(0.256)	(0.230)	(0.224)	(0.198)	(0.198)
Sales	0.354	0.249	0.241	0.133	0.274	0.176
	(0.286)	(0.266)	(0.267)	(0.262)	(0.243)	(0.241)
Agricultural	0.048	0.091	-0.225	-0.223	-0.037	-0.015
	(0.334)	(0.318)	(0.324)	(0.309)	(0.312)	(0.294)
Household and domestic	-0.088	-0.051	-0.239	-0.226	-0.053	-0.044
	(0.341)	(0.318)	(0.340)	(0.326)	(0.319)	(0.313)
Services	0.196	0.253	0.075	0.100	0.215	0.233
	(0.282)	(0.258)	(0.248)	(0.230)	(0.219)	(0.207)
Skilled manual	0.272	0.256	0.179	0.150	0.302	0.261
	(0.221)	(0.204)	(0.188)	(0.184)	(0.175)	(0.175)
Unskilled manual	0.261	0.291	0.133	0.157	0.259	0.270
	(0.311)	(0.286)	(0.266)	(0.245)	(0.243)	(0.229)
Mother's occup. (professional omit.)						
Other occupations	0.220	0.153	0.178	0.113	0.109	0.062
	(0.352)	(0.360)	(0.364)	(0.364)	(0.338)	(0.342)
Rural			-0.019	-0.005	0.002	0.003

	SES	SES and age/birth month	+ Early env.	+ Early env. and age/birth month	+ Prenatal env.	+ Prenatal env. and age/birth month
			(0.114)	(0.113)	(0.111)	(0.111)
Area of residence						
Balqa			0.236	0.238	0.202	0.194
			(0.191)	(0.183)	(0.180)	(0.170)
Zarqa			0.077	0.061	-0.015	-0.034
			(0.190)	(0.179)	(0.180)	(0.169)
Madaba			0.227	0.239	0.170	0.158
			(0.185)	(0.181)	(0.178)	(0.172)
Irbid			0.037	0.031	-0.058	-0.100
			(0.191)	(0.191)	(0.185)	(0.184)
Mafraq			0.081	0.087	0.123	0.122
			(0.159)	(0.159)	(0.152)	(0.152)
Jarash			0.032	0.037	0.057	0.038
			(0.212)	(0.202)	(0.205)	(0.198)
Ajlun			0.301	0.313	0.253	0.258
			(0.223)	(0.219)	(0.217)	(0.213)
Karak			0.320	0.349	0.224	0.246
			(0.212)	(0.200)	(0.210)	(0.201)
Tafiela			0.246	0.270	0.218	0.228
			(0.256)	(0.249)	(0.245)	(0.238)
Ma'an			-0.312	-0.304	-0.262	-0.252
			(0.208)	(0.194)	(0.180)	(0.167)
Aqaba			0.286	0.238	0.299	0.234
			(0.240)	(0.236)	(0.251)	(0.242)
Camps			0.050	0.011	0.003	-0.017
			(0.171)	(0.165)	(0.165)	(0.159)
Badia			-0.070	-0.080	-0.005	-0.024
			(0.173)	(0.171)	(0.158)	(0.155)
Female			-0.011	-0.004	0.158	0.166
			(0.105)	(0.099)	(0.101)	(0.097)
Breastfeeding init. (never omit.)						

	SES	SES and age/birth month	+ Early env.	+ Early env. and age/birth month	+ Prenatal env.	+ Prenatal env. and age/birth month
Immediately			-0.211	-0.182	-0.547	-0.521
			(0.417)	(0.406)	(0.394)	(0.382)
Within first hour			-0.432	-0.346	-0.632	-0.558
			(0.408)	(0.379)	(0.381)	(0.358)
One hour			-0.173	-0.142	-0.514	-0.479
			(0.399)	(0.378)	(0.381)	(0.363)
2-24 hours			-0.169	-0.178	-0.520	-0.527
			(0.388)	(0.367)	(0.373)	(0.356)
One day			0.027	0.029	-0.335	-0.331
			(0.402)	(0.384)	(0.381)	(0.368)
Two days			0.029	0.062	-0.299	-0.293
			(0.405)	(0.386)	(0.390)	(0.375)
3 or more days			-0.421	-0.384	-0.586	-0.571
			(0.386)	(0.371)	(0.368)	(0.355)
Other liquids within 3 days birth			-0.254	-0.230	-0.136	-0.128
			(0.131)	(0.127)	(0.115)	(0.113)
Exclusively breastfed			0.883***	0.702**	0.735**	0.579**
			(0.247)	(0.246)	(0.223)	(0.209)
Currently breastfed			0.255*	0.116	0.191	0.072
			(0.124)	(0.130)	(0.115)	(0.121)
Drank from bottle			0.295*	0.223*	0.235*	0.171
			(0.121)	(0.113)	(0.113)	(0.107)
Feeding frequency						
Once			-0.057	-0.061	-0.079	-0.084
			(0.199)	(0.223)	(0.179)	(0.201)
Twice			0.148	0.062	0.194	0.091
			(0.230)	(0.244)	(0.200)	(0.220)
Three times			-0.125	-0.224	-0.159	-0.267
			(0.260)	(0.272)	(0.231)	(0.247)
Four +			-0.248	-0.323	-0.179	-0.258
			(0.258)	(0.282)	(0.225)	(0.253)

	SES	SES and age/birth month	+ Early env.	+ Early env. and age/birth month	+ Prenatal env.	+ Prenatal env. and age/birth month
No. Foods						
No. liquids			0.023	0.041	0.021	0.037
			(0.067)	(0.063)	(0.063)	(0.059)
No. grains			-0.016	-0.004	-0.039	-0.032
			(0.065)	(0.064)	(0.062)	(0.059)
No. protein			0.152*	0.162*	0.129*	0.130*
			(0.064)	(0.064)	(0.059)	(0.058)
No. fruits and vegs.			0.032	0.045	0.061	0.067
			(0.074)	(0.077)	(0.068)	(0.073)
Diarrhea (none omit.)						
Yes but gone			0.028	-0.051	0.080	0.017
			(0.157)	(0.142)	(0.151)	(0.136)
Yes still			-0.370*	-0.476**	-0.322*	-0.417*
			(0.163)	(0.163)	(0.161)	(0.163)
Fever/Cough (none omit.)						
Yes but gone			-0.005	-0.036	0.079	0.075
			(0.295)	(0.296)	(0.277)	(0.284)
Yes still			0.091	0.119	0.105	0.134
			(0.123)	(0.117)	(0.120)	(0.115)
Persons per room			0.036	0.009	0.018	-0.014
			(0.058)	(0.058)	(0.055)	(0.055)
Cluster wealth						
Average cluster wealth factor			3.813**	3.311*	3.350**	2.809*
			(1.316)	(1.318)	(1.297)	(1.293)
Average cluster wealth factor sq./100			-19.580**	-17.068**	-16.989**	-14.251*
			(6.479)	(6.512)	(6.454)	(6.486)
Cluster share of households not flushing to sewer			-0.584	-0.506	-0.202	-0.122
			(0.376)	(0.358)	(0.348)	(0.329)
Cluster water (bottled omit.)						

	SES	SES and age/birth month	+ Early env.	+ Early env. and age/birth month	+ Prenatal env.	+ Prenatal env. and age/birth month
Cluster share of households with water piped in and treated			-0.748	-0.701	-0.455	-0.437
			(0.536)	(0.509)	(0.505)	(0.484)
Cluster share of households with water piped in and not treated			-0.194	-0.155	-0.146	-0.091
			(0.356)	(0.351)	(0.338)	(0.326)
Cluster share of households with other water source			0.354	0.492	0.381	0.532
			(0.391)	(0.377)	(0.370)	(0.354)
Household Sanitation (Sewer omit.)						
Flush to latrine/other			0.854**	0.717*	0.528	0.395
			(0.311)	(0.302)	(0.286)	(0.277)
Household Water (bottled omit.)						
Piped to dwelling treated			-0.008	0.030	0.019	0.054
			(0.144)	(0.145)	(0.139)	(0.141)
Piped to dwelling not treated			-0.148	-0.121	-0.175	-0.164
			(0.125)	(0.120)	(0.118)	(0.116)
Other			-0.213	-0.239	-0.282	-0.324
			(0.235)	(0.225)	(0.212)	(0.207)
Household members smoke			-0.006	-0.026	0.028	0.014
			(0.097)	(0.098)	(0.090)	(0.090)
Mother smokes cigarettes			-0.108	-0.038	-0.108	-0.041
			(0.254)	(0.232)	(0.230)	(0.212)
Mother smokes nargile			-0.001	-0.003	-0.074	-0.074
			(0.213)	(0.211)	(0.208)	(0.207)
Know TB is curable			0.019	0.049	-0.032	0.004
			(0.105)	(0.100)	(0.098)	(0.092)
Know of ORS			-0.303	-0.271	-0.302*	-0.260
			(0.155)	(0.147)	(0.153)	(0.145)
Exposure to family planning			0.082	0.067	0.080	0.062
			(0.063)	(0.066)	(0.059)	(0.059)

	SES	SES and age/birth month	+ Early env.	+ Early env. and age/birth month	+ Prenatal env.	+ Prenatal env. and age/birth month
Distance to health care problematic			-0.043	-0.052	-0.036	-0.046
			(0.115)	(0.110)	(0.109)	(0.103)
Mother's age (15-19 omit.)						
20-24					0.121	0.058
					(0.239)	(0.239)
25-29					0.299	0.300
					(0.240)	(0.245)
30-34					0.085	0.093
					(0.265)	(0.265)
35-39					0.292	0.251
					(0.277)	(0.280)
40-44					0.179	0.118
					(0.288)	(0.297)
45-49					-0.969	-0.968
					(0.499)	(0.593)
Mother's height (in centimeters)					0.031***	0.027**
					(0.009)	(0.008)
Birth spacing (months)					0.002	0.001
					(0.003)	(0.003)
First birth					0.096	0.120
					(0.150)	(0.147)
Birth weight in kilograms					0.759***	0.774***
					(0.078)	(0.074)
Birth weight in kilograms missing					-1.127*	-1.150*
					(0.539)	(0.471)
Constant	7.116***	7.712***	-9.426	-6.559	-14.387*	-10.611
	(1.340)	(1.299)	(6.389)	(6.363)	(6.218)	(6.156)
Age (months)	No	Yes	No	Yes	No	Yes
P-value (model)	0.001	0.000	0.000	0.000	0.000	0.000

	SES	SES and age/birth month	+ Early env.	+ Early env. and age/birth month	+ Prenatal env.	+ Prenatal env. and age/birth month
N(Observations)	2111	2111	2111	2111	2111	2111
R-squared	0.046	0.093	0.143	0.176	0.242	0.271
Adj. R-squared	0.034	0.072	0.109	0.134	0.207	0.230

Source: Author's calculations based on Jordan JPFHS 2012.
Notes: *p<0.05; **p<0.01; ***p<0.001
Clustered standard errors in parentheses.

Table 7. Regressions for Weight-for-height (in Kilograms as a 24-month Female), Youngest Child Under Two

	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	0.345	0.180	0.413	0.271	0.406	0.253
	(0.388)	(0.378)	(0.420)	(0.414)	(0.429)	(0.422)
Wealth score sq./100	-2.266	-1.080	-2.403	-1.419	-2.300	-1.212
	(2.746)	(2.710)	(2.979)	(2.949)	(3.066)	(3.024)
Father's education (none omit.)						
Elementary	-0.170	-0.131	-0.299	-0.238	-0.247	-0.187
	(0.257)	(0.256)	(0.218)	(0.214)	(0.200)	(0.200)
Preparatory	-0.084	-0.089	-0.262	-0.224	-0.199	-0.149
	(0.249)	(0.249)	(0.207)	(0.204)	(0.195)	(0.196)
Secondary	-0.020	-0.006	-0.186	-0.159	-0.142	-0.112
	(0.249)	(0.252)	(0.206)	(0.205)	(0.198)	(0.201)
Diploma	0.094	0.060	-0.154	-0.159	-0.080	-0.068
	(0.306)	(0.305)	(0.248)	(0.247)	(0.228)	(0.232)
University and above	-0.195	-0.218	-0.396	-0.389	-0.354	-0.342
	(0.290)	(0.293)	(0.247)	(0.245)	(0.232)	(0.235)
Mother's education (none omit.)						
Elementary	0.444	0.429	0.445	0.432	0.451	0.413
	(0.283)	(0.278)	(0.251)	(0.249)	(0.248)	(0.245)
Preparatory	-0.012	-0.012	0.076	0.051	0.119	0.074
	(0.234)	(0.229)	(0.232)	(0.230)	(0.232)	(0.231)
Secondary	-0.066	-0.074	0.014	0.002	0.014	-0.014
	(0.226)	(0.218)	(0.227)	(0.226)	(0.225)	(0.224)
Diploma	-0.004	-0.007	0.079	0.069	0.071	0.052
	(0.244)	(0.237)	(0.249)	(0.248)	(0.243)	(0.242)
University and above	0.279	0.263	0.322	0.306	0.262	0.215
	(0.254)	(0.244)	(0.247)	(0.243)	(0.248)	(0.247)
Father's emp. status (none/absent omit.)						
Wage worker	-0.071	-0.037	0.021	0.069	-0.054	-0.014

	SES	SES and age/birth month	+ Early env.	+ Early env. and age/birth month	+ Prenatal env.	+ Prenatal env. and age/birth month
	(0.170)	(0.173)	(0.156)	(0.158)	(0.151)	(0.152)
Employer	-0.119	-0.132	-0.032	-0.030	-0.141	-0.155
	(0.229)	(0.240)	(0.209)	(0.222)	(0.211)	(0.219)
Self-employed	-0.158	-0.102	-0.047	0.032	-0.138	-0.055
	(0.213)	(0.218)	(0.197)	(0.197)	(0.191)	(0.190)
Mother's employment status (none omit.)						
Wage worker	-0.003	0.045	-0.003	0.030	0.007	0.046
	(0.190)	(0.178)	(0.188)	(0.178)	(0.182)	(0.175)
Other work	-0.365	-0.248	-0.250	-0.168	-0.195	-0.094
	(0.247)	(0.238)	(0.283)	(0.253)	(0.279)	(0.261)
Father's occup. (professional omit.)						
Clerical	-0.065	-0.071	-0.162	-0.162	-0.137	-0.139
	(0.254)	(0.222)	(0.221)	(0.204)	(0.206)	(0.186)
Sales	0.184	0.097	0.154	0.066	0.228	0.136
	(0.214)	(0.213)	(0.203)	(0.205)	(0.198)	(0.199)
Agricultural	-0.197	-0.108	-0.353	-0.267	-0.236	-0.136
	(0.243)	(0.236)	(0.237)	(0.227)	(0.241)	(0.234)
Household and domestic	-0.036	-0.088	-0.228	-0.239	-0.195	-0.191
	(0.313)	(0.319)	(0.335)	(0.331)	(0.326)	(0.328)
Services	-0.038	-0.004	-0.159	-0.106	-0.075	-0.031
	(0.165)	(0.158)	(0.161)	(0.153)	(0.147)	(0.140)
Skilled manual	0.019	0.006	-0.025	-0.028	0.026	0.018
	(0.142)	(0.144)	(0.137)	(0.143)	(0.133)	(0.138)
Unskilled manual	-0.127	-0.112	-0.133	-0.125	-0.099	-0.110
	(0.226)	(0.250)	(0.217)	(0.251)	(0.218)	(0.245)
Mother's occup. (professional omit.)						
Other occupations	0.307	0.248	0.257	0.232	0.214	0.195
	(0.272)	(0.280)	(0.274)	(0.272)	(0.258)	(0.261)
Rural			-0.016	-0.030	-0.015	-0.028

	SES	SES and age/birth month	+ Early env.	+ Early env. and age/birth month	+ Prenatal env.	+ Prenatal env. and age/birth month
			(0.097)	(0.094)	(0.095)	(0.092)
Area of residence						
Balqa			0.167	0.153	0.150	0.143
			(0.150)	(0.145)	(0.149)	(0.145)
Zarqa			0.111	0.115	0.101	0.111
			(0.130)	(0.128)	(0.128)	(0.128)
Madaba			0.080	0.042	0.067	0.033
			(0.152)	(0.152)	(0.150)	(0.148)
Irbid			0.058	0.049	0.042	0.016
			(0.161)	(0.159)	(0.159)	(0.155)
Mafraq			0.346**	0.344**	0.384**	0.383**
			(0.121)	(0.118)	(0.125)	(0.122)
Jarash			0.262	0.250	0.278	0.262
			(0.158)	(0.150)	(0.157)	(0.149)
Ajlun			0.468**	0.469**	0.468**	0.474**
			(0.165)	(0.162)	(0.167)	(0.164)
Karak			0.272	0.285	0.244	0.269
			(0.191)	(0.179)	(0.191)	(0.180)
Tafiela			0.326	0.333	0.338	0.356
			(0.217)	(0.213)	(0.216)	(0.211)
Ma'an			0.014	0.028	0.002	0.038
			(0.174)	(0.166)	(0.168)	(0.158)
Aqaba			0.484*	0.456*	0.509*	0.468*
			(0.204)	(0.195)	(0.207)	(0.194)
Camps			0.082	0.042	0.085	0.047
			(0.146)	(0.135)	(0.142)	(0.133)
Badia			-0.143	-0.171	-0.145	-0.179
			(0.126)	(0.121)	(0.128)	(0.124)
Female			-0.029	-0.011	0.017	0.036
			(0.082)	(0.079)	(0.081)	(0.079)
Breastfeeding init. (never omit.)						

	SES	SES and age/birth month	+ Early env.	+ Early env. and age/birth month	+ Prenatal env.	+ Prenatal env. and age/birth month
Immediately			-0.430	-0.472*	-0.560*	-0.604*
			(0.239)	(0.230)	(0.245)	(0.236)
Within first hour			-0.414	-0.414	-0.450	-0.457
			(0.251)	(0.239)	(0.249)	(0.241)
One hour			-0.372	-0.406	-0.476*	-0.512*
			(0.231)	(0.224)	(0.238)	(0.229)
2-24 hours			-0.369	-0.433*	-0.483*	-0.544*
			(0.212)	(0.208)	(0.219)	(0.216)
One day			-0.119	-0.160	-0.282	-0.318
			(0.226)	(0.215)	(0.216)	(0.210)
Two days			-0.250	-0.337	-0.399	-0.497*
			(0.272)	(0.247)	(0.260)	(0.241)
3 or more days			-0.503	-0.501*	-0.551*	-0.544*
			(0.268)	(0.252)	(0.263)	(0.250)
Other liquids within 3 days birth			0.015	0.016	0.064	0.057
			(0.100)	(0.096)	(0.095)	(0.091)
Exclusively breastfed			0.364	0.148	0.343	0.131
			(0.265)	(0.258)	(0.259)	(0.248)
Currently breastfed			0.148	0.185	0.152	0.196*
			(0.099)	(0.099)	(0.092)	(0.095)
Drank from bottle			0.070	0.078	0.049	0.054
			(0.087)	(0.086)	(0.086)	(0.085)
Feeding frequency						
Once			-0.401*	-0.351	-0.387*	-0.318
			(0.196)	(0.214)	(0.191)	(0.206)
Twice			-0.366	-0.415	-0.330	-0.361
			(0.200)	(0.224)	(0.193)	(0.217)
Three times			-0.555*	-0.645**	-0.559**	-0.630**
			(0.222)	(0.241)	(0.210)	(0.229)
Four +			-0.594**	-0.639**	-0.551**	-0.583*
			(0.212)	(0.237)	(0.200)	(0.227)

	SES	SES and age/birth month	+ Early env.	+ Early env. and age/birth month	+ Prenatal env.	+ Prenatal env. and age/birth month
No. Foods						
No. liquids			0.061	0.064	0.061	0.062
			(0.048)	(0.045)	(0.046)	(0.043)
No. grains			-0.003	-0.013	-0.015	-0.025
			(0.052)	(0.048)	(0.050)	(0.046)
No. protein			0.093*	0.075*	0.078*	0.057
			(0.037)	(0.036)	(0.035)	(0.035)
No. fruits and vegs.			0.038	0.004	0.051	0.016
			(0.065)	(0.062)	(0.064)	(0.061)
Diarrhea (none omit.)						
Yes but gone			-0.007	-0.036	-0.003	-0.035
			(0.089)	(0.085)	(0.092)	(0.088)
Yes still			-0.197	-0.224	-0.174	-0.208
			(0.134)	(0.127)	(0.131)	(0.124)
Fever/Cough (none omit.)						
Yes but gone			0.005	-0.048	0.070	0.034
			(0.225)	(0.226)	(0.203)	(0.208)
Yes still			0.000	0.024	-0.002	0.028
			(0.095)	(0.091)	(0.097)	(0.091)
Persons per room			0.030	0.006	0.001	-0.015
			(0.045)	(0.046)	(0.048)	(0.051)
Cluster wealth						
Average cluster wealth factor			0.658	0.375	0.507	0.298
			(1.316)	(1.291)	(1.306)	(1.319)
Average cluster wealth factor sq./100			-3.369	-1.967	-2.644	-1.592
			(6.609)	(6.530)	(6.580)	(6.708)
Cluster share of households not flushing to sewer			0.088	0.157	0.240	0.303
			(0.241)	(0.240)	(0.238)	(0.240)
Cluster water (bottled omit.)						

	SES	SES and age/birth month	+ Early env.	+ Early env. and age/birth month	+ Prenatal env.	+ Prenatal env. and age/birth month
Cluster share of households with water piped in and treated			0.426	0.382	0.511	0.446
			(0.362)	(0.369)	(0.359)	(0.363)
Cluster share of households with water piped in and not treated			-0.050	-0.020	-0.074	-0.028
			(0.307)	(0.300)	(0.300)	(0.287)
Cluster share of households with other water source			-0.100	0.015	-0.159	-0.030
			(0.419)	(0.407)	(0.403)	(0.386)
Household Sanitation (Sewer omit.)						
Flush to latrine/other			0.350	0.235	0.195	0.089
			(0.194)	(0.194)	(0.194)	(0.199)
Household Water (bottled omit.)						
Piped to dwelling treated			-0.053	0.004	-0.034	0.020
			(0.127)	(0.122)	(0.127)	(0.124)
Piped to dwelling not treated			-0.015	-0.003	-0.038	-0.026
			(0.122)	(0.114)	(0.118)	(0.110)
Other			-0.023	-0.034	-0.030	-0.049
			(0.239)	(0.221)	(0.234)	(0.215)
Household members smoke			0.039	0.023	0.045	0.024
			(0.087)	(0.085)	(0.083)	(0.080)
Mother smokes cigarettes			0.182	0.170	0.171	0.176
			(0.180)	(0.179)	(0.186)	(0.181)
Mother smokes nargile			-0.084	-0.086	-0.065	-0.065
			(0.182)	(0.172)	(0.179)	(0.170)
Know TB is curable			-0.041	-0.025	-0.069	-0.050
			(0.095)	(0.091)	(0.094)	(0.090)
Know of ORS			-0.300*	-0.260	-0.334*	-0.264*
			(0.136)	(0.137)	(0.132)	(0.131)
Exposure to family planning			0.020	0.023	0.019	0.019
			(0.051)	(0.050)	(0.048)	(0.048)

	SES	SES and age/birth month	+ Early env.	+ Early env. and age/birth month	+ Prenatal env.	+ Prenatal env. and age/birth month
Distance to health care problematic			-0.031	-0.043	-0.034	-0.051
			(0.091)	(0.084)	(0.088)	(0.082)
Mother's age (15-19 omit.)						
20-24					0.101	-0.046
					(0.201)	(0.216)
25-29					0.402*	0.257
					(0.203)	(0.220)
30-34					0.133	-0.019
					(0.216)	(0.229)
35-39					0.369	0.194
					(0.219)	(0.234)
40-44					0.453	0.247
					(0.251)	(0.269)
45-49					-0.185	-0.354
					(0.343)	(0.440)
Mother's height (in centimeters)					-0.007	-0.007
					(0.008)	(0.007)
Birth spacing (months)					-0.004	-0.005*
					(0.002)	(0.002)
First birth					0.133	0.171
					(0.137)	(0.135)
Birth weight in kilograms					0.292***	0.290***
					(0.076)	(0.073)
Birth weight in kilograms missing					-0.044	-0.140
					(0.336)	(0.336)
Constant	10.697***	11.114***	7.312	9.244	8.268	10.091
	(1.265)	(1.263)	(5.928)	(5.943)	(6.208)	(6.338)
Age (months)	No	Yes	No	Yes	No	Yes
P-value (model)	0.320	0.007	0.000	0.000	0.000	0.000

	SES	SES and age/birth month	+ Early env.	+ Early env. and age/birth month	+ Prenatal env.	+ Prenatal env. and age/birth month
N(Observations)	2111	2111	2111	2111	2111	2111
R-squared	0.023	0.077	0.097	0.138	0.127	0.168
Adj. R-squared	0.011	0.056	0.061	0.094	0.087	0.120

Source: Author’s calculations based on Jordan JPFHS 2012.
Notes: *p<0.05; **p<0.01; ***p<0.001
Clustered standard errors in parentheses.