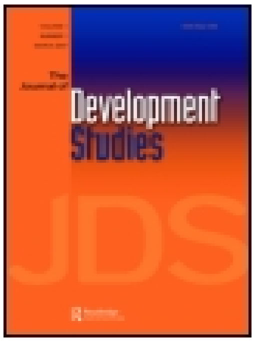


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# Early Childhood Nutrition, Parental Growth Perceptions and Educational Aspirations in Rural Burkina Faso

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ABSTRACT *Early childhood nutrition can have long-term impacts on human capital outcomes. Besides direct biological effects, parents' perceptions of exogenous nutrition shocksimpacts and their adjustments in subsequent investments, can amplify these direct effects on long-run outcomes. Understanding and anticipating parental perceptions and responses can improve the design of policies aimed at improving child nutrition. Using a randomised trial providing nutrition supplementation to children from 9 to 18 months old in Burkina Faso, we investigate how parental growth perceptions and educational aspirations respond to this positive shock when these children grow to 3–5 years old. We find that the intervention significantly increases parents rating their child's physical and cognitive development as 'Very good'. We find no significant impact on educational aspirations on average, but the intervention increases the probability that parents report that they would allow a girl to pursue post-secondary education by 13.4 percentage points (22.2%); if the household belongs to the poorest quantile in the sample, then this probability increases by 16.3 percentage points (37.2%). These heterogeneous effects suggest that early childhood nutrition interventions may stimulate complementary investments in human capital by parents that could amplify the direct effects and further enable disadvantaged children to catch up.*

## 1. Introduction

Recent research shows that even relatively mild shocks of various sorts in early life – including both prenatal and postnatal events – can have life-long consequences (see Almond, Currie, & Duque, 2018; Currie & Almond, 2011 for reviews of this broad literature.) Among the wide range of environmental factors that can have lasting effects on a child's physical and cognitive trajectory, diet and nutritional quality in the first 18–24 months of life are critical. Empirical evidence highlighting the importance of early childhood nutrition comes from studies of the effects of breastfeeding on infants' cognitive development (Fitzsimons & Vera-Hernández, 2013) and nutrition supplementation programs (Grantham-McGregor, Powell, Walker, & Himes, 1991; Maluccio et al., 2009; Pollitt et al., 1993).[1] In a recent randomised nutrition trial conducted in Burkina Faso, on which we base our study, researchers find that providing small-quantity lipid-based nutrient supplements (LNS) along with diagnosis and treatment (as needed) for diarrhoea, fever and malaria to children for 9 months, from 9 to 18 months of age, brings significant

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improvement in their anthropometric measures, health and cognitive development indicators at 18 months of age (Hess et al., 2015; Prado et al., 2017). These early life improvements can have lifelong effects that are transformational. For instance, an early childhood nutrition intervention in Guatemala has been shown to increase women's years of schooling by 1.2 grades, improve cognitive abilities for both men and women (Maluccio et al., 2009), and result in 46 per cent higher wages for men a quarter century after it ended (Hoddinott, Maluccio, Behrman, Flores, & Martorell, 2008).

To understand how educational and other adult outcomes are influenced by a child's rearing environment and to improve the design of policies and programs aimed at improving these long-term outcomes, it is important to examine how parents respond to early childhood shocks in their subsequent human capital investments, which can either amplify or offset the direct biological effects of these shocks. Such parental responses can be particularly important in developing country contexts – the more prevalent are market and government failures, the more critical resource allocation within the household becomes. Existing studies span developing and developed countries. Yi, Heckman, Zhang, and Conti (2015) find evidence of parents' human capital investments reinforcing exogenous variations in early childhood nutrition, looking at health and education investments at age of 10–11 years in China; Adhvaryu and Nyshadham (2016) also find improved vaccination and breastfeeding behaviour in response to an iodine supplementation program in Tanzania. In contrast, Breining, Daysal, Simonsen, and Trandafir (2015) and Akee, Simeonova, Costello, and Copeland (2018) find evidence of parents' investments compensating exogenous variations in early childhood nutrition in Denmark and the U.S., respectively. Interestingly, Hsin (2012) find heterogeneous results in mothers' time investment in children of 12 years old or younger in the U.S. – college-educated mothers compensate for low birth weight by investing more in children while less educated mothers are more likely to focus their scarce time on their higher birth weight children. In sum, existing evidence suggests considerable and potentially important heterogeneity in parental responses: Poor parents may be more prone to allocate their limited resources to children with pre-existing advantages or positive health shocks, thereby amplifying these direct effects, while non-poor parents may be more likely to try to compensate for pre-existing deficits or negative health shocks by investing more in children with diminished potential.

Our study contributes to this literature on parental responses by focusing on the outcome variables of parents' reported educational aspirations for their children, while exploiting exogenous variations in early childhood nutrition induced by the large-scale nutrition supplementation program in Burkina Faso mentioned above (Hess et al., 2015).[2] While the treated infants received LNS delivered at home, as well weekly home visits and illness screening and treatment (as needed) from 9 to 18 months of age, in the control villages, LNS were available when the child was older (18–27 months), parents were required to collect their LNS supplies at local health clinic, and there were no home visits or illness diagnosis and treatment. Returning to the rural villages included in this original study 25–43 months after the original intervention ended, we revisited a sub-sample of the program families when the program children were 3–5 years of age, and collected data on parents' growth perceptions and educational aspirations.

We conjecture that the documented growth difference between treated and control children at 18 months of age in Hess et al. (2015) persists during our follow-up visits, because the late intervention is lesser than the original intervention, and the timing matters. In the nutrition and neuroscience literature, researchers have identified a sensitive period between conception and age 2 years (first 1000 days) for child development, and generally speaking, the existing evidence indicates that, the earlier the nurturing environment improvement is provided, the stronger the benefit on child physical and cognitive growth of previously deprived children (Black, Pérez-Escamilla, & Fernandez Rao, 2015; Black et al., 2017; Wachs, Georgieff, Cusick, & McEwen, 2014). We hypothesise that such a growth difference leads to treatment effects in parents' growth perceptions and educational aspirations. Indeed, in a study using household data also from rural Burkina Faso, Akresh, Bagby, de Walque, and Kazianga (2012) find that negative nutrition shocks in the first 1000 days because of the variations in local weather, lead to a lower rate of school enrolment but those after the first 1000 days do not.

In our paper, we focus on the outcome variable of parents' educational aspirations, to discuss whether parents' responses are reinforcing or compensating the exogenous shift in child development because of the nutrition intervention; we also elicit parental growth perceptions as a potential intermediate variable. In our survey, we first elicit parents' perceptions of how well their children have developed so far, both physically and cognitively, using a 5-point rating scale of '1-Very poor', '2-Poor', '3-Average', '4-Good', or '5-Very good'. Then, we elicit parents' educational aspirations by asking them the minimum years of schooling they *want* their children to complete, and the maximum years of schooling they would *allow*.[3]

We find that parents of treated children are 8.3 percentage points (pp; 33.2%) and 9.2 pp (36.7%) more likely to rate their children as physically and cognitively developing 'very good', respectively. These estimated treatment effects on parental perceptions are driven disproportionately by responses of non-poor parents and still exist even after controlling for anthropometric measures at 18 months of age, suggesting that parents may be perceiving additional dimensions of child development. As for parental educational aspirations, we find no significant average treatment effect but substantial heterogeneity. The treatment effect is significantly greater for girls than for boys and greater for poor than non-poor households. In particular, the treatment increased the likelihood that a parent reported that they would *allow* a girl to complete more than 13 years of schooling (equivalent to pursue post-secondary education) by 13.4 pp (20.8%). It also increased the reported likelihood by 16.3 pp (37.2%) if the family belonged to the lowest quantile of the sample. These significant treatment effects in educational aspirations among subgroups of households support that parents reinforce exogenous variations in early childhood nutrition among poor and disadvantaged populations, while they cannot be explained by differences in parental growth perceptions, or aspirations for children, women or the households in general. The heterogeneous effects imply that early childhood nutrition interventions can be progressive as poor parents respond more, and they can help close the gender gap in parental investments, which has been shown to contribute to the gender gap in health and cognitive outcomes (Baker & Milligan, 2016; Bharadwaj & Lakdawala, 2013).

The current paper speaks to two major gaps in the broader literature that links child health and development to human capital outcomes, as discussed in a recent review by Almond et al. (2018). First, as put by Almond et al. (2018, p. 1), 'we still know relatively little about the interval [...]', or," middle years", '[...] between [...] early life and adulthood'. While studies tracking affected infants or cohorts over decades to study the impact into adulthood (Dahl, Løken, Mogstad, & Salvanes, 2016; Hoynes, Schanzenbach, & Almond, 2016; Isen, Rossin-Slater, & Walker, 2017; Maluccio et al., 2009) are of great importance, we also need to assess *current* or *recent* policies within a reasonable amount of time, so that we can learn whether it would be feasible to identify problems or opportunities and perhaps introduce further interventions in the medium-term. If we consider a dynamic model of human capital formation and parental investments (Almond et al., 2018; Currie & Almond, 2011; Heckman, 2007; Strauss & Thomas, 2007) with multiple periods (Heckman, 2007), the intermediate periods are relevant when there is dynamic complementarity – that is, existing capacities in one period can influence the productivity of investments in the next period.

Almost all existing research studying the parental responses to early childhood circumstances on later outcomes focuses on academic outcomes after children enter school (Almond, Mazumder, & Ewijk, 2015; Bharadwaj, Løken, & Neilson, 2013; Black, Devereux, & Salvanes, 2007; Figlio, Guryan, Karbownik, & Roth, 2014); parental responses prior to children entering school, which provides a readily observable investment decision, are rarely studied. We view our study of parental perceptions of child development and educational aspirations in pre-school ages (3–5 years) as an effort to draw researchers' and policy makers' attention to these neglected but foundational years. While eliciting parental perceptions of childhood development helps understand parents' awareness of and ability to discern subtle but important child growth patterns, measuring parents' educational aspirations provides an indicator regarding parents' educational investment intentions that could determine their real education investments in the future.

Second, it has not been well-understood whether parental responses in human capital investment decisions are driven by their preferences or by the constraints they face, such as available production technologies, resources and information (Currie & Almond, 2011). Distinguishing behavioural responses due to preferences from those associated with constraints can inform policy in specific and useful ways. Because 'if many parents are constrained in their investments [...]' or information, 'then social investments may have an important impact on parents' choices by changing the productivity and cost of their own investments' (Almond et al., 2018, p. 31). In the current paper, we find heterogeneous parental responses consistent with the prior literature. In theory, the reinforcing tendencies of poor parents can be either due to differences in their preferences compared to non-poor parents, or different human capital production functions and associated returns to human capital investments they face. Empirically, we find heterogeneous effects on educational aspirations in the maximum years of schooling parents reported that they would *allow*, but not in the minimum years of schooling parents reported that they would *want*, which is consistent with differential constraints driving these heterogeneous effects.

In terms of information constraints, our paper also implicitly addresses how well parents can discern the relative growth and development of their child. We find that parental perceptions of child development qualitatively reflect the impact of the micro-nutrient supplementation intervention, which has been documented to improve objective measures of physical, cognitive and linguistic development (Hess et al., 2015; Prado et al., 2017). As previous research has discussed different types of information gaps parents face, such as information on children's academic performance at school (Dizon-Ross, 2018), information on the return to early childhood investments (Cunha, Elo, & Culhane, 2013), and information on the return to education (Jensen, 2010), which indicate the need to help parents make more informed choices about investments in their children, our study adds a new aspect to this emerging literature.

## 2. The iLiNS project in Burkina Faso and our follow-up study

The International Lipid-Based Nutrient Supplements (iLiNS) Project was conducted from April 2010 to July 2012 in rural communities of the Dandé Health District in south-western Burkina Faso.[4] The trial was randomised at the two levels of village and concession. Thirty-four villages were stratified by selected indicators such as population size, proximity to road and Bobo-Dioulasso (the major city nearby), and health clinic affiliation. Then, within strata, computer-generated assignments randomly selected 25 villages into the treatment group and the remaining 9 villages serve as the control group. The eligible infants were recruited at the age of 9 months. Now randomised at the level of concession, a housing structure in which several interrelated families resided together, those in the treatment group were allocated to one of the following treatment arms from 9 to 18 months of age: (1) Free provision and home delivery of small-quantity lipid-based nutrient supplements (SQ-LNS) without zinc, and placebo tablet (LNS-Zn0); (2) SQ-LNS with 5 mg zinc, and placebo tablet (LNS-Zn5); (3) SQ-LNS with 10 mg zinc, and placebo tablet (LNS-Zn10); (4) SQ-LNS without zinc, and 5 mg zinc tablet (LNS-TabZn5). Participating households were not aware of which treatment arm they belong to. In addition, the treated infants also received weekly home visits which included free screening and treatment of diarrhoea, malaria and fever during the treatment period (when the study children were from 9 to 18 months of age.) In contrast, infants in the control group received none of the supplements or treatments from 9 to 18 months of age, but they were offered SQ-LNS at a later stage, from 18 to 27 months of age. However, the delivery method differed: Parents in the control cohort were offered to pick up LNS at the nearest health center during the follow up period, but many did not do that. So many children in the control may not ever have gotten LNS or a very limited amount. Also, no home visits or illness diagnosis and treatment were provided. In other words, the treatment groups and the control group differ in the timing and extent of the intervention.

The project enrolled 3220 children, with 2435 randomly assigned to one of the 4 treatment groups and 785 to the control group. By the final visit of the main project when study children were 18 months old, the attrition rate was 19.5 per cent and 15.2 per cent for the treatment groups and the control group, respectively. The research team organised several rounds of data collection. A baseline survey provided basic socio-economic characteristics of the household and each parent, which was conducted at recruitment. Study children's anthropometric measures were taken at the recruit, 3 months after, 6 months after, and 9 months after. Based on these measures, Hess et al. (2015) found that the intervention had significant treatment effects on children's growth: Among other indicators, the weight-for-height z-score (WHZ score) and height-for-age z-score (HAZ score) were significantly greater for treated children compared to those in the control group at 18 months of age, with no significant difference among the 4 intervention groups. The research team also collected data on household income and expenditure using standard household survey questionnaire modules during the treatment period. The income and expenditure survey was conducted with a random sub-sample of 535 households in total (399 households from the treatment groups and 136 households from the control group).

For the follow-up project, we restricted our revisit to these 535 households included in the income and expenditure survey. The main research objective of the follow-up project involved a lab-in-the-field experiment on the intra-household aspect of these study households. Both the mother and father of the study child participated in the experiment and answered the follow-up survey. As the lab-in-the-field experiment was quite time-consuming, we limited our revisit to a sub-sample of 22 villages (14 treatment villages and 8 control villages) out of the 34 villages due to budget constraints. We excluded villages where we conducted our focus groups and the pretest for the lab-in-the-field experiment, as well as several remote villages with very few study households in the sub-sample of the 535 households. From December 2013 to January 2014, we revisited 231 households, with 179 evenly split in the treatment arms and 52 in the control group. We provide an overall time-line of the Burkina iLiNS project and our follow-up study in Figure A1. Even though we were not too worried about selective attritions given the sampling strategy of our follow-up survey, we conducted a balance check between our sub-sample of 231 households and all other households in the Burkina iLiNS project whose data are available. As shown in the last three columns of Table 1, households in our sub-sample were not statistically different from those not included in the current paper in key social-economic characteristics collected at the baseline or during the original treatment period, except that children in our sub-sample were slightly younger, and the households were less likely to be polygamous.

## 3. Data

We first present summary statistics of the outcome variables. Figure 1 plots parents' perceptions of their children's development in ratings on a five-point scale. Distributions of the ratings for physical and cognitive development are highly correlated (the Pearson's correlation coefficient is 0.41), and for both ratings, the mode is '4-Good', and '1-Very poor' and '2-Poor' are both quite rare. Figure 2 presents the distributions of minimum and maximum years of education parents reported that they will *want* and *allow* for their children, respectively. In Burkina Faso, the education system consists of 6-year primary school, 4-year junior high school, 3-year senior high school and then university. There are also junior high-level vocational schools offering 2 to 3-year professional training for specific occupations. As the histogram shows, the minimum years of schooling parents reported that they would *want* are clustered at 6 years, 10 years and 13 years, which indicate graduation from primary school, junior high school and senior high school, respectively. In contrast, the maximum years of schooling parents reported that they would *allow* for their children are clustered at 10 years, 13 years, and 14–16 years, indicating graduation from junior high school, senior high school and beyond, respectively.

**Table 1.** Balance test of baseline characteristics

| Variable | Control (C) | Treated (T) | p-value | Our Sub-sample | Others | p-value |
|---|---|---|---|---|---|---|
| Child is a girl | 0.385 | 0.503 | 0.135 | 0.476 | 0.494 | 0.686 |
| | (0.068) | (0.038) | | (0.033) | (0.029) | |
| Age of the child | 3.582 | 3.549 | 0.642 | 3.562 | 3.638 | 0.006 |
| | (0.062) | (0.034) | | (0.03) | (0.007) | |
| Polygamy | 0.385 | 0.330 | 0.464 | 0.346 | 0.427 | 0.017 |
| | (0.068) | (0.035) | | (0.031) | (0.009) | |
| Daily expenditure | 0.795 | 1.033 | 0.068 | 0.979 | 1.013 | 0.681 |
| | (0.100) | (0.064) | | (0.057) | (0.055) | |
| Asset index | −0.249 | 0.136 | 0.013 | 0.049 | −0.004 | 0.439 |
| | (0.135) | (0.073) | | (0.065) | (0.018) | |
| Mother is Mossi | 0.308 | 0.603 | 0.000 | 0.537 | 0.549 | 0.726 |
| | (0.065) | (0.037) | | (0.033) | (0.009) | |
| Mother is Bobo | 0.423 | 0.179 | 0.000 | 0.229 | 0.215 | 0.614 |
| | (0.069) | (0.029) | | (0.028) | (0.007) | |
| Father is Mossi | 0.308 | 0.626 | 0.000 | 0.55 | 0.552 | 0.94 |
| | (0.065) | (0.036) | | (0.033) | (0.009) | |
| Father is Bobo | 0.404 | 0.173 | 0.000 | 0.225 | 0.209 | 0.563 |
| | (0.069) | (0.028) | | (0.028) | (0.007) | |
| Age of mother | 29.9 | 30.3 | 0.746 | 30.2 | 29.9 | 0.614 |
| | (0.900) | (0.507) | | (0.441) | (0.123) | |
| Age of father | 38.1 | 39.2 | 0.448 | 39.0 | 39.4 | 0.534 |
| | (1.202) | (0.747) | | (0.639) | (0.192) | |
| Schooling of mother | 0.423 | 0.803 | 0.186 | 0.717 | 0.594 | 0.289 |
| | (0.204) | (0.143) | | (0.12) | (0.031) | |
| Schooling of father | 2.096 | 1.388 | 0.108 | 1.548 | 1.363 | 0.313 |
| | (0.459) | (0.196) | | (0.184) | (0.05) | |
| Mother is a farmer | 0.962 | 0.816 | 0.010 | 0.848 | n.a. | n.a. |
| | (0.027) | (0.029) | | (0.024) | n.a. | |
| Father is a farmer | 0.942 | 0.827 | 0.039 | 0.853 | n.a. | n.a. |
| | (0.033) | (0.028) | | (0.023) | n.a. | |
| HAZ (9 moths) | −1.078 | −1.046 | 0.846 | −1.053 | n.a. | n.a. |
| | (0.158) | (0.078) | | (0.070) | n.a. | |
| WHZ (9 moths) | −0.887 | −0.825 | 0.706 | −0.839 | n.a. | n.a. |
| | (0.173) | (0.072) | | (0.068) | n.a. | |
| HAZ (18 moths) | −1.493 | −1.363 | 0.484 | −1.394 | n.a. | n.a. |
| | (0.172) | (0.087) | | (0.078) | n.a. | |
| WHZ (18 moths) | −0.738 | −0.628 | 0.464 | −0.654 | n.a. | n.a. |
| | (0.156) | (0.069) | | (0.064) | n.a. | |
| *N* | 52 | 179 | | 231 | Varies[5] | |

*Notes*: Daily expenditure per capita is calculated based on the income and consumption module in the baseline survey, and is measured in U.S. dollars. Asset index is calculated based on the asset module in the baseline survey, and is increasing in the total value of the household asset, and ranges from −1.795 to 2.607. Mossi and Bobo are the two major ethnicities in the study area, but there are also other ethnicities, which serves the omitted category when using as RHS variables in regressions.

In our follow-up survey, we also collected data on general aspirations with three questions: (1) ‘Do you think that children of your village will be stronger, healthier and smarter in future?’ (2) ‘Do you think women deserve a higher position in the household and in society?’ (3) ‘Do you think that your household will be better off in future?’ Figure 3 presents answers to these three questions, showing that most parents ‘5-Strongly agree’, ‘4-Agree’, or ‘3-Slightly agree’ with these statements. We provide summary statistics of outcome variables on perceptions and aspirations dividing the sample into subgroups in Table A1.

Next, we conduct a balance check of the randomisation with respect to key socio-economic characteristics of the household and its members, and the 9-months Height-for-Age Z-score (HAZ) and Weight-

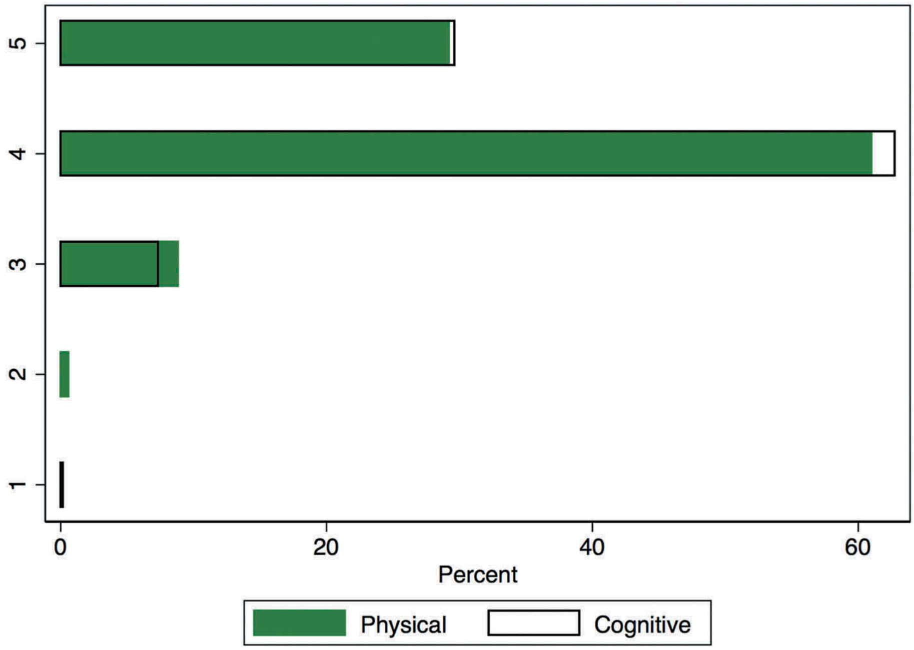


**Figure 1.** Histogram of parental perceptions of children's development.

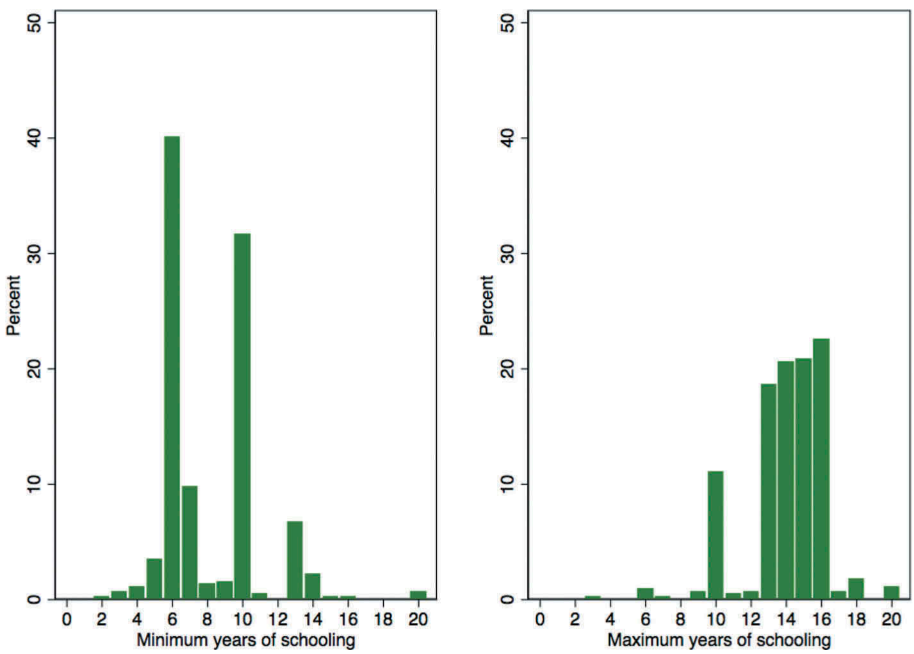


**Figure 2.** Histogram of parental educational aspirations.

for-Height Z-score (WHZ) for the focus child. We also compare the 18-months anthropometric measures between the treated and control households, which are outcome variables of the intervention. Even though the randomisation process was rigorously conducted and was unlikely to be corrupted, by chance, the

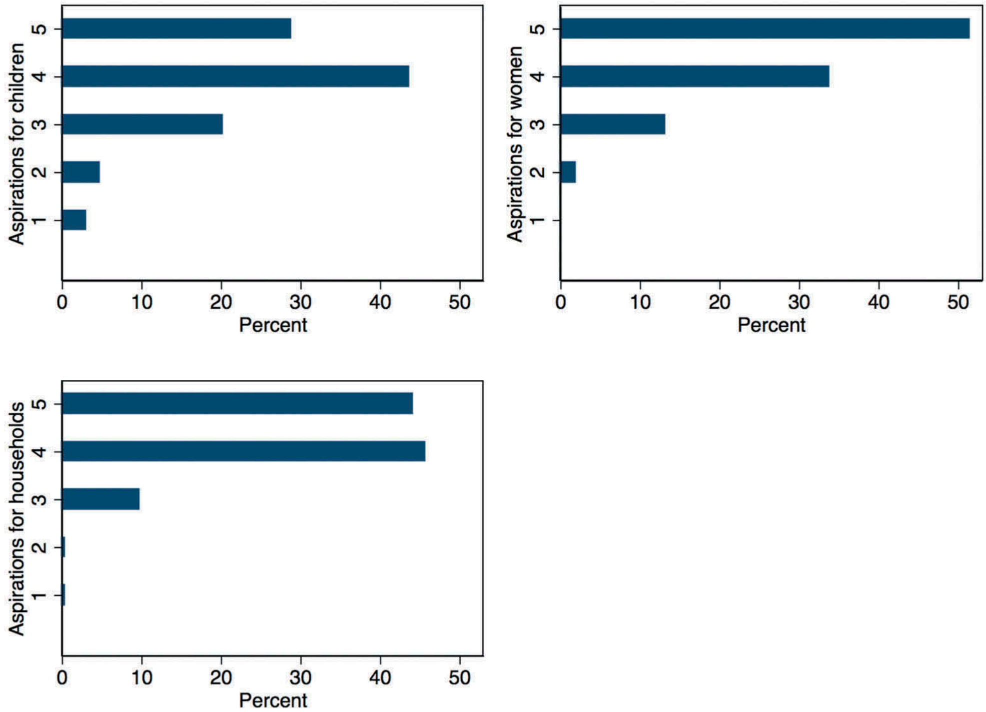


**Figure 3.** Histogram of parental general aspirations.

randomisation turns out to have produced imbalanced groups. As shown in the first three columns of Table 1, the treated households have higher levels of income and wealth, and the treated parents are more likely to be Mossi, and less likely to be a farmer.[6] Nevertheless, we control for these baseline covariates in the regression analysis. Note that the anthropometric measures of the study children are very similar when the intervention begins, while they are slightly higher for the treated children when the intervention ends. Though such a difference in anthropometric measures in the end-line is not statistically significant as reported in Table 1, the treatment effect in the 18-month HAZ is significant once controlling for the 9-month HAZ (see Table 6), while the treatment effect in the 18-month WHZ is still not statistically significant after controlling for the 9-month WHZ.

## 4. Results

Our empirical results mainly come from regressing our outcome variables of interest, such as parental perceptions and aspirations, on the treatment dummy, with and without control variables. Since according to Hess et al. (2015), there is no significant difference in child growth outcomes within the different treatment arms, we use the single dummy indicating treatment status in general.[7] We pool mothers and fathers' answers together, add the parent gender as a control variable, and use standard errors clustered at the village level, which should be more robust than clustering at the household level. We first present results on parental perceptions of physical and cognitive development in Table 2. As the ratings are ordinal categories, we adopt an ordered Logit regression, and both the coefficient of the treatment dummy directly from the ordered Logit regression, and the marginal treatment effects on the probability of the parent reporting each rating category. Results on parental perceptions of children's physical and cognitive development are shown in columns (1)–(2) and (3)–(4), respectively. While columns (1) and (3) are results without any controls, for columns (2) and (4), we add control variables including all those in Table 1 as well as the gender of the parent.[8]

**Table 2.** Ordered logit regression on parental perception of child growth

| | (I) | (II) | (III) | (IV) | (V) | (VI) |
|---|---|---|---|---|---|---|
| | Physical | Physical | Physical | Physical | Cognitive | Cognitive |
| Treated | 0.379* | 0.420* | 0.222 | 0.347** | 0.580*** | 0.462** |
| | (0.202) | (0.233) | (0.164) | (0.175) | (0.142) | (0.214) |
| HAZ (18 months) | | | 0.050 | 0.059 | | |
| | | | (0.125) | (0.135) | | |
| WHZ (18 months) | | | 0.442*** | 0.417** | | |
| | | | (0.172) | (0.182) | | |
| *Marginal treatment effect:* | | | | | | |
| 'Very poor' | −0.000818 | | −0.001 | −0.003 | | −0.00101 |
| | (0.000913) | | (0.001) | (0.002) | | (0.000921) |
| 'Poor' | −0.00243* | −0.00275 | −0.002 | −0.00125 | | |
| | (0.00129) | (0.00179) | (0.001) | (0.00120) | | |
| 'Average' | −0.0300* | −0.0325* | −0.018 | −0.027** | −0.0392*** | −0.0306** |
| | (0.0167) | (0.0184) | (0.013) | (0.014) | (0.0108) | (0.0147) |
| 'Good' | −0.0447* | −0.0477* | −0.025 | −0.038* | −0.0792*** | −0.0602** |
| | (0.0246) | (0.0275) | (0.020) | (0.021) | (0.0210) | (0.0289) |
| 'Very good' | 0.0779* | 0.0830* | 0.045 | 0.068** | 0.120*** | 0.0918** |
| | (0.0413) | (0.0460) | (0.034) | (0.035) | (0.0297) | (0.0426) |
| Controls | No | Yes | No | Yes | No | Yes |
| *N* | 462 | 452 | 368 | 359 | 462 | 452 |

*Notes*: [a]Controls in columns (II) and (IV) include all variables in Table 1 plus the gender of the parent. [b]Standard errors clustered at village level in parentheses. [c]***Significant level at the 1 per cent level. [d]**Significant level at the 5 per cent level. [e]*Significant level at the 10 per cent level.

Over the columns, we can see that the intervention significantly increases how well these children have developed in the eyes of their parents. This estimated effect for cognitive development is more statistically significant than the effect for physical development. Note that adding control variables does not change the estimated coefficients qualitatively, which relieves our concern of the sample imbalance between the treated and control households. On average, the nutrition intervention increases the likelihood of the parent reporting the child's physical development as 'Very good' by 8.3 pp (or 33.2% compared to the sample mean of control households), meanwhile decreases the likelihood of reporting 'Good' by 4.8 pp (or 7.9%), the likelihood of reporting 'Average' by 3.3 pp (or 24.5%) and 'Poor' by 0.3 pp (or 31.3%). For cognitive development perception, the intervention increases the likelihood of reporting:Very good" by 9.2 pp (or 41.6%), decreased the likelihood of reporting 'Good' and 'Average' by 3.1 pp (or 4.7%) and 6 pp (or 48%), respectively.

Per columns (III) and (IV), adding HAZ and WHZ measured at 18 months old as control variables reduces these point estimates for perceptions of physical development and reduces the sample size considerably, but the fact that parents of treated children still perceive better physical outcomes (at least in with full control variables in column (IV)) suggests that they are perceiving different dimensions of physical growth, or, perhaps, are prone to placebo effects that magnify their perceptions beyond the measured growth effects. In both columns, the WHZ score is positively correlated with physical perceptions, suggesting that parents are at least in part detecting measurable physical growth differences.

To investigate the heterogeneous treatment effects on parental perceptions, in three separate regressions, we added an interaction term of the intervention dummy and the gender of the parent, the intervention dummy and the gender of the child, and the intervention dummy and the household asset index. We find no significant heterogeneous treatment effects between mothers and fathers, or between sons and daughters. As reported in Table 3, there are significant heterogeneous treatment effects along different levels of household asset index. Similar to the structure in Table 2, we have

**Table 3.** Heterogeneous treatment effect on parental perceptions over asset index

| | (I) | (II) | (III) | (IV) |
|---|---|---|---|---|
| | Physical | Physical | Cognitive | Cognitive |
| Treated | 0.484** | 0.498** | 0.690*** | 0.580*** |
| | (0.236) | (0.250) | (0.156) | (0.195) |
| Asset index | −0.380** | −0.413** | −0.416 | −0.506** |
| | (0.172) | (0.169) | (0.257) | (0.252) |
| Treated X Asset index | 0.345* | 0.434** | 0.522* | 0.604** |
| | (0.208) | (0.180) | (0.297) | (0.263) |
| **Marginal treatment effect:** | | | | |
| *Asset index above median* | | | | |
| 'Very poor' | −0.00245 | | −0.00376 | −0.00339 |
| | (0.00272) | | (0.00399) | (0.00346) |
| 'Poor' | −0.00723* | −0.00814 | | |
| | (0.00429) | (0.00501) | | |
| 'Average' | −0.0815** | −0.0874** | −0.106** | −0.0958** |
| | (0.0410) | (0.0398) | (0.0485) | (0.0434) |
| 'Good' | −0.0448** | −0.0529*** | −0.0909*** | −0.0890*** |
| | (0.0181) | (0.0117) | (0.0248) | (0.0219) |
| 'Very good' | 0.136*** | 0.148*** | 0.201*** | 0.188*** |
| | (0.0465) | (0.0424) | (0.0466) | (0.0474) |
| *Asset index below median* | | | | |
| 'Very poor' | −0.000500 | | −0.000675 | −0.000316 |
| | (0.000782) | | (0.000680) | (0.000434) |
| 'Poor' | −0.00149 | −0.00127 | | |
| | (0.00149) | (0.00166) | | |
| 'Average' | −0.0183 | −0.0147 | −0.0205 | −0.00948 |
| | (0.0215) | (0.0212) | (0.0142) | (0.0148) |
| 'Good' | −0.0232 | −0.0131 | −0.0293 | −0.00939 |
| | (0.0319) | (0.0309) | (0.0298) | (0.0285) |
| 'Very good' | 0.0435 | 0.0291 | 0.0504 | 0.0192 |
| | (0.0548) | (0.0532) | (0.0440) | (0.0434) |
| Controls | No | Yes | No | Yes |
| *N* | 462 | 452 | 462 | 452 |

*Notes*: [a]Controls in columns (II) and (IV) include all variables in Table 1 plus the gender of the parent. [b]Standard errors clustered at village level in parentheses. [c]***Significant level at the 1 per cent level. [d]**Significant level at the 5 per cent level. [e]*Significant level at the 10 per cent level.

four columns, and we first report the estimated coefficients directly from the ordered Logit model and then marginal effects for different sub-samples. We can see that a general pattern across columns is that the treatment dummy is significantly positive, the asset index is significantly negative, and the interaction term is significantly positive. This means that in the control group, relatively wealthier households have lower parental perceptions, while the treatment effect is higher among the relatively wealthier households – therefore, in the treatment group, there is no difference between households of different wealth levels in perceptions. As the asset index ranges from −1.795 to 2.607, the marginal treatment effects are statistically significant for the relatively wealthier half of the sample, but not significant for the poorer half. For the wealthier half of the sample, the intervention increased parents' probability to rate their children's physical development as 'Very good' by 14.8 pp (or 75.9% compared to the sample mean of control households belonging to the poorer half), decreased the probability of rating 'Good' and 'Average' by 5.29 pp (or 8.2%) and 8.74 pp (or 61.1 percentage), respectively. The change in these parents' rating of their child's cognitive development is similar, with Very good increased by 18.8 pp (or 112.8%), 'Good' and 'Average' decreased by 8.9 pp (or 14.4%) and 9.58 pp (or 44.7%), respectively.

**Table 4.** Ordered Logit regression on parents' educational aspirations for the child

| | Max (I) | Max (II) | Min (III) | Min (IV) |
|---|---|---|---|---|
| ***Panel A*** *Average effect:* | | | | |
| Treated | 0.326 | 0.165 | −0.113 | −0.383 |
| | (0.205) | (0.241) | (0.270) | (0.255) |
| ***Panel B*** *Heterogeneous effect over gender of the child:* | | | | |
| | Max | Max | Min | Min |
| Treated | 0.00901 | −0.173 | −0.157 | −0.501 |
| | (0.228) | (0.249) | (0.348) | (0.370) |
| Girl | −0.865*** | −0.766*** | −0.420 | −0.453 |
| | (0.205) | (0.248) | (0.262) | (0.280) |
| Treated X Girl | 0.783** | 0.760** | 0.166 | 0.280 |
| | (0.305) | (0.302) | (0.300) | (0.361) |
| *Marginal effect:* | | | | |
| | Girl | | Boy | |
| | Max | Max | Max | Max |
| ≤ 10 years | −0.120*** | −0.0809* | −0.000977 | 0.0170 |
| | (0.0423) | (0.0440) | (0.0247) | (0.0249) |
| > 10, ≤13 years | −0.0695*** | −0.0528* | −0.000918 | 0.0158 |
| | (0.0262) | (0.0272) | (0.0232) | (0.0240) |
| >13 years | 0.189*** | 0.134* | 0.00189 | −0.0327 |
| | (0.0635) | (0.0688) | (0.0479) | (0.0487) |
| ***Panel C*** *Heterogeneous effect over household wealth:* | | | | |
| | Max | Max | Min | Min |
| Treated | 0.208 | 0.0883 | −0.175 | −0.359 |
| | (0.238) | (0.252) | (0.263) | (0.249) |
| Asset index | 0.413*** | 0.384*** | 0.0858 | 0.0681 |
| | (0.135) | (0.138) | (0.121) | (0.114) |
| Treated X Asset index | −0.402*** | −0.412*** | 0.194 | 0.225 |
| | (0.148) | (0.157) | (0.153) | (0.148) |
| *Marginal effect:* | | | | |
| | Poorest 10% | | Poorest 25% | |
| | Max | Max | Max | Max |
| ≤ 10 years | −0.126*** | −0.0986* | −0.103*** | −0.0812* |
| | (0.0427) | (0.0527) | (0.0370) | (0.0460) |
| 10, ≤13 years | −0.0726*** | −0.0646** | −0.0638*** | −0.0527* |
| | (0.0234) | (0.0290) | (0.0226) | (0.0273) |
| >13 years | 0.199*** | 0.163** | 0.167*** | 0.134* |
| | (0.0611) | (0.0798) | (0.0558) | (0.0719) |
| Controls | No | Yes | No | Yes |
| *N* | 454 | 452 | 454 | 452 |

*Notes*: [a]Controls in columns (II) and (IV) include all variables in Table 1 plus the gender of the parent. [b]Standard errors clustered at village level in parentheses. [c]***Significant level 0.01; **Significant level 0.05; *Significant level 0.1.

Next, we conducted similar analyses as above examining how outcomes of parents' educational aspirations are influenced by the randomised treatment status. We generated discrete categorical variables based on the years of schooling parents reported that they would *want* or *allow*, given the information on the education system and the distributions as in Figure 2. In Panel A of Table 4, we report the coefficients for the treatment dummy from the ordered Logit regression without adding any interaction terms. None of the coefficients is statistically significant across columns. Then, we run the three separate regressions with interaction terms as mentioned in the previous paragraph, and find no significant heterogeneous treatment effects across mothers and fathers, but significant heterogeneity across gender of the child, and the household asset index. We report the estimated coefficients from the ordered-Logit model as well as marginal effects for subgroups in Panel B and C of Table 4, respectively. The nutrition intervention significantly increased the probability of the parent allowing a girl to pursue post-secondary education by 13.4 pp (or 22.2%, compared to sample mean of control girls), with a 5.3 pp (or 21.2%) and 8.9 pp (or 61.7%) decrease in only allowing up to finish junior high school and finishing senior high school, respectively. Such results are consistent with parents reinforcing instead of compensation exogenous variations in early childhood nutrition and growth. Also, note that without the intervention, the average maximum education parents reported that they would *allow* for girls (the likelihood of 'greater than 14 years' for control girls is 55.1%, with standard error 0.066) are lower than that for boys (71.5% with s.e. of 0.037), but due to the heterogeneous treatment effect, in the treated households, girls (67% with s.e. of 0.035) are able to catch up with boys (68.4% with s.e. of 0.032) in their parents' educational aspirations.

In Panel C, we can see that the treatment effect is significantly greater for poorer households. The intervention makes parents in households in the poorest quantile 16.3 pp (or 37.2%, compared to the sample mean of control households belonging to the poorest quantile) more likely to allow their children pursue post-secondary education, with decreases in the likelihood of only allowing lower educations by 9.86 pp (or 39.4%) and 6.46 pp (or 20.7%), respectively. Again, the treatment has made up the gap in the maximum years between the poorest 10 per cent households and the rest of the sample.[9]

To further understand treatment effects in educational aspirations, we include the two variables of parental growth perceptions, and then three variables of general aspirations as controls for the sub-samples of girls, and households with asset index below the median level, respectively. As Table 5 shows, adding perceptions or general aspirations does not change the treatment effects in maximum educational aspirations, either economically or statistically. Also, note that across sub-samples and columns, parental perceptions of physical growth are negatively correlated with their maximum educational aspirations, while parental perceptions of cognitive growth are positively correlated with their maximum educational aspirations.[10] Moreover, the variable of aspiration for children is positively correlated with maximum educational aspirations for girls. In fact, we find no significant treatment effects in general aspiration variables, except that the intervention increases the likelihood of girls' parents to *strongly agreeing* with that the household will be better off in the future by 13.1 pp (or 37.8%, compared to the sample mean of girls' parents in control households), with decreases in the likelihood of *agreeing* or *slightly agreeing* by 7.4 pp (or 14.5%) and 5.1 pp (or 41.7%), respectively.

## 5. Conclusion and discussion

In conclusion, we find that an early childhood nutrition intervention in rural Burkina Faso significantly increases children's physical and cognitive development level as perceived by their parents at 3–5 years of age. In addition, we find that the treatment effect in parental perceptions comes mostly from the relatively wealthier parents. The treatment effect in parental perceptions of physical growth cannot be explained by adding anthropometric measures at 18 months of age (the latest measures available) as extra control variables in the regression, suggesting that parents are either picking up real but different dimensions of physical development, or subject to a placebo effect and made more optimistic by the intervention. Nevertheless, parental perceptions of physical growth at 3–5 years of age correlate positively with the weight-for-height z-score (WHZ score) at 18 months of age, suggesting that parental perceptions are at least to some extent grounded in objective growth levels.

More important, the intervention increases the maximum years of schooling parents report that they would *allow* for girls, and for children in relatively poorer households regardless of gender. Such a result suggests that parents' intentions of human capital investments, as measured by their educational aspirations, reinforce exogenous variations in early childhood nutrition, at least for certain sub-

**Table 5.** Adding variables of perceptions and general aspirations to explain treatment effects in educational aspirations

| | Max (I) | Max (II) | Max (III) | Max (IV) | Max (V) | Max (VI) |
|---|---|---|---|---|---|---|
| ***Panel A*** *Restricted to sub-sample of girls:* | | | | | | |
| Treated | 0.804*** | 0.697** | 0.821*** | 0.728* | 0.798** | 0.726* |
| | (0.269) | (0.345) | (0.294) | (0.383) | (0.320) | 0.408 |
| Physical perceptions | | | −0.407* | −0.622** | −0.407* | −0.600** |
| | | | (0.221) | (0.278) | 0.230 | 0.284 |
| Cognitive perceptions | | | 0.631*** | 0.661** | 0.545** | 0.562** |
| | | | (0.231) | (0.270) | (0.234) | (0.266) |
| Aspiration children | | | | | 0.275** | 0.295* |
| | | | | | (0.130) | (0.161) |
| Aspiration women | | | | | 0.125 | 0.083 |
| | | | | | (0.135) | (0.170) |
| Aspiration households | | | | | 0.272 | 0.239 |
| | | | | | (0.290) | (0.326) |
| *N* | 216 | 213 | 216 | 213 | 216 | 213 |
| ***Panel B*** *Restricted to sub-sample of households with asset index below median:* | | | | | | |
| Treated | 0.498** | 0.410 | 0.575** | 0.503* | 0.527* | 0.483* |
| | (0.232) | (0.303) | (0.261) | (0.294) | (0.270) | (0.288) |
| Physical perceptions | | | −0.651** | −0.788** | −0.718** | −0.859** |
| | | | (0.311) | (0.373) | (0.321) | (0.384) |
| Cognitive perceptions | | | 0.699*** | 0.779*** | 0.642*** | 0.740*** |
| | | | (0.203) | (0.269) | (0.209) | (0.277) |
| Aspiration children | | | | | 0.179 | 0.074 |
| | | | | | (0.125) | (0.154) |
| Aspiration women | | | | | 0.237 | 0.225 |
| | | | | | (0.162) | (0.175) |
| Aspiration households | | | | | 0.125 | 0.211 |
| | | | | | (0.171) | (0.247) |
| *N* | 234 | 231 | 234 | 231 | 234 | 231 |
| Controls | No | Yes | No | Yes | No | Yes |

*Notes*: Controls in columns (II) and (IV) include all variables in Table 1 plus the gender of the parent. Standard errors clustered at village level in parentheses. ***Significant level 0.01; **significant level 0.05; *significant level 0.1.

samples. We also find that the treatment increases parents' aspirations of a better future for the household, but only when the treated child is a girl. The treatment effects in educational aspirations for girls and relatively poor households cannot be explained by shifts in general aspirations or changes in parental growth perceptions.

Some of these results seem counterintuitive. The fact that adding parents' perceptions to the regression does not explain the treatment effect in educational aspirations, does not necessarily reject the hypothesis that the educational aspiration results are driven by changes in parental perceptions. We conjecture that the seemingly counterintuitive result may arise as a result of the subjective nature of the perception measures – they may not be well suited for inter-personal comparisons. We also find that parents from relatively wealthy households give lower ratings for their children's development (Table 3); this may be because that wealthier parents have higher standards or a different reference group compared to poorer parents (Wang, Puentes, Behrman, & Cunha, 2018).[11]

The finding that there is no significant treatment effect in parental perceptions, but a significant treatment effect in educational aspirations for relatively poor households, and an opposite pattern exists for wealthier household, also seems a bit puzzling. In fact, we find that the intervention

**Table 6.** Treatment effects in HAZ scores 18 months of age

| | (I) | (II) | (III) | (IV) |
|---|---|---|---|---|
| | HAZ (18 months) | HAZ | HAZ | HAZ |
| Treated | 0.230*** | 0.265*** | 0.225*** | 0.261*** |
| | (0.0785) | (0.0842) | (0.0721) | (0.0841) |
| HAZ (9 months) | 0.896*** | 0.887*** | 0.897*** | 0.888*** |
| | (0.0467) | (0.0499) | (0.0464) | (0.0500) |
| Asset Index | | | 0.0198 | 0.0497 |
| | | | (0.0872) | (0.0850) |
| Treated × Asset Index | | | −0.0232 | −0.0264 |
| | | | (0.107) | (0.109) |
| Controls | No | Yes | No | Yes |
| *N* | 183 | 178 | 183 | 178 |

*Notes*: [a]Controls in columns (II) and (IV) include all variables in Table 1. [b]Standard errors clustered at village level in parentheses. [c]***Significant level 0.01; **significant level 0.05; *significant level 0.1.

improved the 18 months-old objective measures of child growth (Height-for-Age Z-scores) in our sample, regardless of the wealth level (see Table 6).[12] To reconcile these results, we consider several alternative explanations: First, it is possible that poor parents did perceive improvements in child development, but the overall shifts in their perceptions were moderate, thus were too subtle to be detected by the self-reported perceptions measures with a rough 5-point scale. If it is the case that even a moderate shift in parents' perceptions leads to a significant boost in their educational aspirations, then this suggests that early childhood nutrition interventions may help break the aspiration trap of poverty (Dalton, Ghosal, & Mani, 2016; Lybbert & Wydick, 2018). It is also possible that the result is driven by the subjective nature of the perception measures as discussed in the previous paragraph. The intervention may have shifted upwards poor parents' standards or their reference group when evaluating how well their children have developed, which results in no treatment effect in their reported ratings while they, in fact, have perceived improvements in their children's growth.

Alternatively, the empirical pattern can also arise if poor parents did not perceive the improved development in their children, but the nutrition intervention itself directly uplifts their education aspirations, possibly because the intervention – not only the nutrition supplementation but also the weekly home visits and the illness diagnosis and treatment (as needed) – made them pay more attention to their children and their human capital accumulation. This seems plausible especially given the result that treatment effects in educational aspirations stay the same even after controlling for parents' perceptions. Nevertheless, if it is true that poor parents were less able to perceive children's improved development, it may be because of the cognitive burden poverty levies on the poor (Mani, Mullainathan, Shafir, & Zhao, 2013).

Besides the main results, we also find some interesting patterns in our data that are suggestive of underlying characteristics of household decision-making. For example, we find a negative correlation between educational aspirations and parental perceptions of physical growth, and a positive correlation between educational aspirations and parental perceptions of cognitive growth. This seems to be consistent with a model of rational educational investment decisions, in which physical growth increases the opportunity cost of education (as farming needs manual labour in the study area), while cognitive growth potentially increases the return to education (as smarter children probably do better at school and earn more with high education).

Our empirical evidence also seems to be consistent with son preference when it comes to parents' educational aspirations and suggests that the nutrition intervention may be able to close this gender gap. The heterogeneous treatment effects can stem from the parents' believed return to education, as a function of the child's gender, ability, and the interaction of the two. For example, if parents believe that returns to education for boys are not that different whether he is physically strong or not, smart or not, while they believe that sending a physically strong or smart girl to school gives much higher return than sending a less strong or smart girl to school, then parental responses to early childhood nutrition shocks in educational aspirations can arise only for girls but not for boys, as we observe in our data. The result suggests that an early childhood nutrition intervention without targeting female infants may have women-empowering effects through the channel of parental responses in education. The heterogeneous treatment effects across wealth levels are in line with the diverging empirical patterns between developing and developed countries in the literature, and that between college uneducated and educated mothers in the U.S. as in Hsin (2012) – parents reinforce positive exogenous shocks in child endowment if they are in poor socio-economic conditions. In our context, this suggests that early childhood nutrition interventions can bring greater benefits to children in poorer households as the subsequent parental investments in these households may be more likely to amplify the biological effects.

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## Disclosure statement

No potential conflict of interest was reported by the authors.

## Data Availability Statement

Data is available upon requests.

## Notes

1. Linnemayr and Alderman (2011) also examine nutritional supplementation for pregnant women and 0 to 3-year-old children in Senegal and find that supplementation has a significant effect on the development outcomes of toddlers only if it is taken during mothers' pregnancy.
2. Our study differs from most of the existing research in the previous paragraph on parental responses to exogenous changes mentioned in early childhood circumstances in that we do not investigate the impacts on siblings of the program children, as we do not have data on the siblings. We are aware that the terms of reinforce and compensate come from previous studies looking at families with multiple children, and a main component of parents' preferences they consider is inequity aversion versus the desire to maximise the total productivity of the offspring. However, in this paper, we borrow the terms, and instead consider the trade-off between the program child's human capital and parent's own consumption and/or other investments.
3. These short elicitation questions were added to an add-on project of the nutrition trial, which was a lab-in-the-field experiment studying intra-household cooperation between spouses.
4. The nutrition supplementation was provided to the households in the sub-sample used in the current chapter from June 2010 to November 2011.
5. Similar imbalance also exists in the full sample of the Burkina iLiNS project.
6. We tried using four treatment status dummies instead of one, and we also found no significantly different treatment effects among the different treatment arms.
7. There is no significant difference in mothers' and fathers' ratings in our regression.
8. The likelihood of greater than 14 years for control poor (i.e., poorest 10%), treated poor, control non-poor (i.e., richest 90%) and treated non-poor are 52.4 per cent (with standard error 0.059), 67 per cent (0.035), 68.3 per cent (0.048) and 67.5 per cent (0.027), respectively.
9. We tried including these two perceptions variables non-linearly as well, but most of time adding the quadratic simply makes the coefficients on the perception variables insignificant.
10. However, we do not find a significant correlation between the objective measures of child-growth either 18 months or 9 months of age, and the asset index variable. This is a bit puzzling if, as argued here, relatively wealthier parents with more resources also have stronger preferences for child growth. The explanation may have something to do with the fact that even these relatively wealthier households in our sample face serious constraints and are therefore largely unable to translate their slightly larger asset base into real growth outcomes.
11. We also have data on Weight-for-Height Z-scores for our sample, but we find no significant treatment effect in the WHZ scores either on average or for the poor and non-poor halves separately.
12. The number of observations varies for different variables, ranging from 308 to 3,038, due to the fact that some of the variables were collected from all households participating in the broader iLiNS study while some were only collected of a random subset of these households. Missing data with some variables introduces another layer of variation in these samples sizes.

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## Appendix A. Additional Tables and Figures

**Table A1.** Summary statistics of outcome variables by subgroups of households

| | | | | *Boys* | | | | | | *Girls* | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Control** | **Perceptions** | 1 | 2 | 3 | 4 | 5 | **Perceptions** | 1 | 2 | 3 | 4 | 5 |
| | Physical | 0% | 1.56% | 10.94% | 62.5% | 25% | Physical | 0% | 0% | 17.5% | 57.5% | 25% |
| | Cognitive | 0% | 0% | 14.06% | 65.62% | 20.31% | Cognitive | 0% | 0% | 10% | 65% | 25% |
| | **Aspirations** | 1–6 | 7–10 | 11–13 | ≥14 | | **Aspirations** | 1–6 | 7–10 | 11–13 | ≥14 | |
| | Min | 48.44% | 35.93% | 10.94% | 4.68% | | Min | 52.5% | 45% | 2.5% | 0% | |
| | Max | 0% | 7.81% | 23.44% | 68.75% | | Max | 2.5% | 20% | 30% | 47.5% | |
| | N = 64 | | | | | | N = 40 | | | | | |
| **Treatment** | **Perceptions** | 1 | 2 | 3 | 4 | 5 | **Perceptions** | 1 | 2 | 3 | 4 | 5 |
| | Physical | 0% | 1.15% | 5.75% | 60.92% | 32.18% | Physical | 0% | 0% | 9.09% | 61.36% | 29.55% |
| | Cognitive | 0% | 0% | 6.9% | 62.64% | 30.46% | Cognitive | 0.57% | 0% | 4.55% | 61.93% | 32.95% |
| | **Aspirations** | 1–6 | 7–10 | 11–13 | ≥14 | | **Aspirations** | 1–6 | 7–10 | 11–13 | ≥14 | |
| | Min | 39.65% | 50.57% | 6.89% | 2.87% | | Min | 47.73% | 40.91% | 6.25% | 5.13% | |
| | Max | 0.57% | 12.63% | 16.08% | 70.68% | | Max | 1.71% | 10.8% | 20.46% | 67.05% | |
| | N = 174 | | | | | | N = 176 | | | | | |
| | | | | *Above Median Wealth* | | | | | | *Below Median Wealth* | | |
| **Control** | **Perceptions** | 1 | 2 | 3 | 4 | 5 | **Perceptions** | 1 | 2 | 3 | 4 | 5 |
| | Physical | 0% | 2.38% | 14.29% | 64.29% | 19.05% | Physical | 0% | 0% | 12.9% | 58.06% | 29.03% |
| | Cognitive | 0% | 0% | 21.43% | 61.9% | 16.67% | Cognitive | 0% | 0% | 6.45% | 67.74% | 25.81% |
| | **Aspirations** | 1–6 | 7–10 | 11–13 | ≥14 | | **Aspirations** | 1–6 | 7–10 | 11–13 | ≥14 | |
| | Min | 47.72% | 45.24 | 4.76% | 2.38% | | Min | 51.6% | 35.48% | 9.68% | 3.23% | |
| | Max | 0% | 7.14% | 23.81% | 69.05% | | Max | 1.61% | 16.13% | 27.42% | 54.83% | |
| | N = 42 | | | | | | N = 62 | | | | | |
| **Treatment** | **Perceptions** | 1 | 2 | 3 | 4 | 5 | **Perceptions** | 1 | 2 | 3 | 4 | 5 |
| | Physical | 0.54% | 0% | 7.53% | 59.68% | 32.26% | Physical | 0% | 1.16% | 7.56% | 62.79% | 28.49% |
| | Cognitive | 0% | 0% | 3.76% | 61.83% | 34.41% | Cognitive | 0.58% | 0% | 8.14% | 62.21% | 29.07% |
| | **Aspirations** | 1–6 | 7–10 | 11–13 | ≥14 | | **Aspirations** | 1–6 | 7–10 | 11–13 | ≥14 | |
| | Min | 37.1% | 51.61% | 8.07% | 3.24% | | Min | 51.16% | 29.07% | 5.23% | 4.65% | |
| | Max | 1.08% | 10.76% | 17.75% | 70.43% | | Max | 1.74% | 12.79% | 18.6% | 66.86% | |
| | N = 186 | | | | | | N = 172 | | | | | |

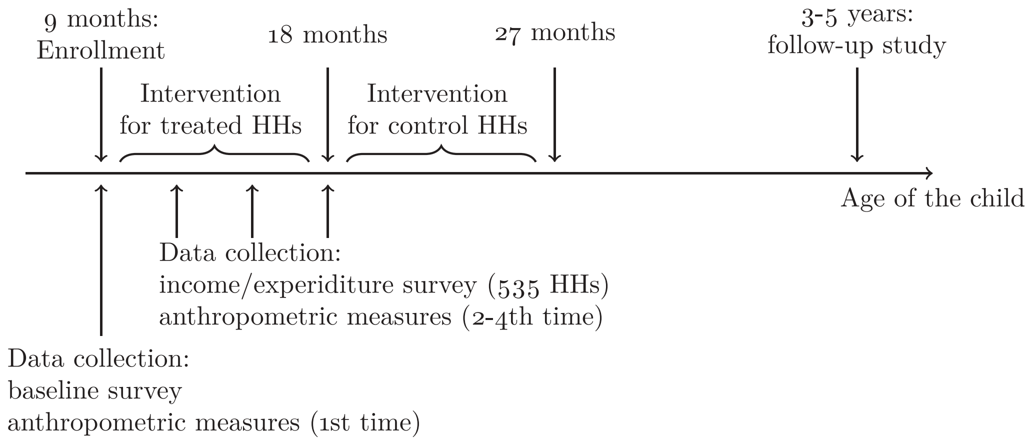


**Figure A1.** Time-line of the Burkina iLiNS project and our follow-up study.