# The Melancholic Childhood
## Causes and Consequences of Malnutrition on Psychosocial Competencies. Evidence from Indian Adolescents

**PRELIMINARY DRAFT**

THARSHINI THANGAVELU [*]

October 4, 2017

### Abstract

This paper quantifies the impact of malnutrition on psychosocial abilities (such as aspiration, self-efficacy and self-esteem) using an instrumental variable approach. Using Young Lives panel data from Andhra Pradesh in India and subjective and objective self-reported drought variable as an instrument, the results suggests that adolescents face an increased degradation in self-efficacy. Although, the coefficients for aspiration and self-esteem share the same sign as the self-efficacy, yet they came out to be non-significant. This paper contributes to a literature which so far has mostly focused on the long-term consequences of climatic shocks.

*Keywords: Psychosocial Competences, Malnutrition, Drought Shock, India.*
*JEL classification: I14, I15, I25, Q31, Q51*

# 1 Introduction

In this paper, I ask whether malnutrition affects children's psychosocial competencies (also referred to as non-cognitive or socio-emotional competencies) such as aspiration, self-efficacy and self-esteem (also known as agency or mastery) in Andhra Pradesh [1], India. The crucial role of malnutrition for children's subsequent cognitive and non-cognitive development has received considerable attention in many fields. In the economic literature there is, however, little consensus concerning the impact of malnutrition on children's non-cognitive competencies. The objective is to study whether malnutrition [2] in childhood matters for children's subsequent psychosocial competencies, and whether different causes of malnutrition have different consequences on psychosocial competencies. The main contribution of this paper is to exploit a plausibly exogenous shock in income, a deficient rainfall level, to examine the effect of different causes of malnutrition on psychosocial competencies outcomes for children in Andhra Pradesh, studied in the Young Lives (throughout I refer to this survey as the YL) longitudinal panel data. Two different drought variables are employed as instruments [3] for malnutrition to capture the casual impact, using the fact that droughts are as good as randomly assigned (quasi-experimental) given the geographical location of the child. Psychosocial competencies are receiving increasing attention in the study of child inequality and poverty in developing economies. Research is still ongoing to understand the channels through which malnutrition affects the children's psychosocial competencies. Therefore, it is important to refine our understanding of how experiences with food insecurity causing malnutrition may affect children's development of psychosocial skills because impairments can persist into adulthood and undermine other related learning skills such as classroom based learning outcomes [4]. The demand for understanding the psychosocial behavior aspect of human capital formation has mainly been investigated by Heckman et al. (2006) andCunha et al. (2010) who emphasized on augmenting human capital formation with psychosocial skills. It is important to comprehend the role played by psychosocial skills not only due to future prospects in terms of learning skills, well-being and labor market outcome but because one need to understand the underlying structure to the poor child health in order

---

[1] See figure 1 over Andhra Pradesh

[2] Malnutrition describes a nutritional status of an individual having a deficiency, imbalance of nutritions which results in adverse effects on body composition. The deviation from adequate and optimal nutritional input in infants and children and in adulthood is commonly referred to as being undernourished. Both malnutrition and undernutrition are commonly used synonymously, as is the case in this paper. In addition to it's deterioration effect on such as muscle and bone, cardiovascular and respiratory, gastrointestinal, immunity and tissue repair, endocrine, reductive adaptation and re-feeding syndrome it also has physical consequences and psychosocial effects, such as apathy, depression, anxiety and self-neglect (Shetty, 2006), (Saunders et al., 2011) and (Macallan, 2005).

[3] To briefly mention some of the events applied as exogenous variation in previous research are; famine (Almond, 2006), civil or armed conflicts (Tranchant et al., 2014), exposure to radioactive emission (Almond et al., 2009), ramadan fasting (Almond and Mazumder, 2011) and government intervention such as iodine supplementation (Field et al., 2009), hookworm and malaria eradication programs and extreme climatic shocks (Miguel et al., 2004), all have been used to capture the causal relationship between early life condition (utero) and adulthood life outcomes.

[4] For more reference in this topic see e.g. (Gertler et al., 2013); (Heckman and Rubinstein, 2001); (Heckman et al., 2006); (Heckman, 2007); (Cunha and Heckman, 2009); (Almlund et al., 2011); (Borghans et al., 2011); (Yi et al., 2015).

to break the cycle of poverty. In a situation, where a child face difficulties already in early state, beyond household budget constraint such as insufficient of quality time spent by parents, resources allocated into early child development may all have a negative impact Barker et al. (2012). Consequently, from an economic perspective children have a crucial role as assets and to become economic productive individuals to contribute to economic well-being.

In India, despite high economic growth, the rural households [5] and children are left behind. The overall well-being of the children is largely being neglected. Because of this imbalance, rural households still rely largely on subsistence farming and self-insurance, and are exposed to extremely high levels of income risk that not even risk coping mechanisms can eliminate (Dercon, 2001). Consequently, they face substantial fluctuations in their purchasing power over real goods and services during years that are crucial for the children's human capital accumulation. There are two main types of shocks that can affect children in their early development, which can have consequences for their acquisition of psychosocial skills in later years income and disease shocks. Households dependent on agricultural production are much more vulnerable to climatic shocks relative to other households, and since agriculture is predominantly rain-fed in India, their income is highly sensitive to erratic monsoon rainfall. In recent years, droughts and other climatic shocks have been a common phenomenon in India. The dependence on rainfall makes the rural households vulnerable, indicating that a negative rainfall shock in a given year will result in reduced agricultural production, in turn leading to food insecurity and income shocks [6]. In the YL dataset, households are to a large living in rural areas. As a result, households living in districts where climatic shocks occur are likely to be adversely affected. At present, the consequences of climatic shocks in diverse social science fields are discussed at different scientific forums about public policies needed to decrease the number of adverse climatic incidents in the poor livelihoods (Akresh, 2016) (Hanna and Oliva, 2016) and (Zivin and Shrader, 2016).

This paper unfolds in the following way. Section 2 reviews recent evidence from economics and psychology that documents the importance of psychosocial competencies. This is followed by section 3, which sets out the analytical framework, followed in section 4 by description of data employed. After describing the data available to me, I describe the empirical framework in section 5. I present the paper's core empirical findings in section 6. While section 7 presents

---

[5]     There is large variation of how a households in rural communities acquire purchasing power. The most common way is still labor earnings, home production and wealth of all kinds.

[6]     There is ample evidence from developing countries that validates that shocks to household income have a large impact on the nutritional input on children, see e.g. (Adams et al., 2003) and (Fletcher and Wolfe, 2016). First, the climatic shocks, along with price shocks and parental employment shocks, could lead to unexpected negative income shocks, which will reduce children's food consumption (and thus reduce child growth) in utero and in early childhood, and may also reduce parental time and the quality of that time due to increases in parental working hours and reductions on parental health. Second, climatic shocks and environmental fluctuations could also worsen the disease environment through increased water contamination or vector borne illnesses, which could directly impair child's health and thus slow their physical and neurological development. Noteworthy, the nutritional status is associated beyond only food availability, other various contributors are equally important such as diet quality, sanitation, water supplies, breast-feeding practices and treatment of childhood diarrhea, vaccination and vitamin A supplementation. In a broader context, children's nutrition is both cause and consequence of health conditions, household income and living standards.

robustness checks. A final section summarizes the findings and provides recommendations for future research.

## 2   Background on Children's Psychosocial Competencies and Malnutrition

**Empirical findings on the effect of psychosocial competencies in developed and developing countries**

The earliest empirical research on psychosocial skills emphasize on the labor market, schooling and health outcomes. Nevertheless, it is only recently that psychosocial skills are investigated through the lens of formation of human capital [7]. Given this evidence, it is astonishing to see that economist have turned their attention to the effects of non-cognitive traits only in the last decades. The psychological research suggests at least two mechanism by which non-cognitive skills influences children's future outcomes. Firstly, the parents own self-worth spillover to children. Secondly, economic hardship affects the course of children's development through its influence on family structure rather than directly undermining parents sense of efficacy to promote their children's competencies and to protect them from risky environments that can compromise successful development (Bandura et al., 2001). While in sociology, much of the early research illustrate a broader aspect of human capital formation where both cognitive and non-cognitive skills are justified as crucial instrument for labor market success (Farkas, 2003).

More recently, researchers have been able to establish a naïve relationship by means of econometric model. Much of this newer research uses data from high-income countries and confirms the suggested evidence that non-cognitive abilities – motivation, self-efficacy and self-esteem plays a substantial role. The neglect of psychosocial skills in analysing earnings, schooling and other life outcomes is in part due to the lack of reliable means of measurements. Indeed, there is no single, identified, dominant factor for psychosocial skills that is equivalent to the psychometrics, which both summarizes intelligence tests and their effects as well as the scores of achievement tests. In reality, it is unlikely that one will ever find such an instrument, given the diversity of character traits that fall into the category of psychosocial skills. Much of the evidence is derived from self-reported assessments of persistence, self-esteem, self-efficacy, optimism and the like, and these may be as much of a consequence as a cause of the measures being investigated. In developed countries, the empirical evidence illustrates that there are positive returns to psychosocial competencies in the labor market such as they offer better job opportunities, better wages as well as educational outcomes for children of all ages. Beginning primarily with work by Heckman and Rubinstein (2001) who study the general education degree (GED) recipient [8].

---

[7]   Historically, in sociology and psychology literatures have given non-cognitive and cognitive skills equally predictive power for many labor market and social outcomes (see, for example McClelland, 1965: Barrick and Mount, 1991; Hogan and Holland, 2003).

[8]   GED is 7 and-a-half hour achievement test that high school drop-outs may take to certify that they are

The study illuminate an interesting aspect about production of human capital. The evidence shows that GED recipients and high school graduates scores, on average equal the cognitive test whereas, they only have earnings equal to those of high school drop-outs. The explanation for the latter outcome being that GED recipients bearing poor psychosocial skills. This lack causes them to be less successful in the military, the labor force and in personal relationship. With this evidence from labor market outcomes, there is an interest in understanding whether educational attainments and health are directly affected. The Perry Preschool Program, Heckman et al. (2009) [9] show that participants in the program performed far better than non-participants in almost all area of schooling and of work and social life. Much of earliest research tried to establish the determinants of cognitive and non-cognitive abilities on social and economic success are mainly using data from the United States, such as Heckman et al. (2006), Cunha and Heckman (2008), Borghans et al. (2011), Heckman and Kautz (2012). Later, similar pattern is found in several other high-income countries, including Germany (Coneus et al., 2012), United Kingdom (Heineck, 2007), Sweden (Lindqvist and Vestman, 2011),(Grönqvist et al., 2010).

In spite of what has been studied, more recent research tries to understand the determinants of psychosocial skills, such as the causes of discrepancies in psychosocial outcomes. There are in fact very few evidence in economic literature that focus on understanding the determinants of psychosocial competencies. This omission is important because psychosocial skills, as mentioned, are likely to play a crucial role in predicting wide range of important adult outcomes. That being said, using a recent US panel data, Fletcher and Wolfe (2016) show the importance of household income in the formation and evolution of psychosocial skills in childhood. The findings suggests an important divergence in psychosocial skills based on family income that accumulates over time and does not seem to be explained by children's health status differences. The result is not surprising, previous research has shown that low-income households are frequently associated with stress, health shocks and limited access to health care, credit market and information (Dupas, 2011) and (Dupas, 2013). The results are equally applicable to high and low-income countries. Other similar, yet important results can be found in Eren and Oxbeklik (2013) who shows that non-cognitive ability is beneficial to young U.S men at the lower quantiles.

While in developing countries, there has been less investigation about psychosocial skills due to data availability. Despite the limitation, there are few studies looking into the effect of

---

equivalent to high school graduates.

[9]  The Perry Preschool Program, is an intensive, two-year preschool program for highly disadvantaged children that ran between 1962-1967 in United States.

malnutrition [10] on psychosocial outcomes [11]. The existing literature has found negative relationship between malnutrition and psychosocial skills, albeit the evidence were often based on simple correlation studies, hence did not speak to a causal mechanism of malnutrition on psychosocial skills. Dercona and Sanchez (2013) investigates across four YL (Ethiopia, India, Peru and Vietnam) developing countries. In line with my paper, the result for India indicates that school aspiration, self-esteem and self-efficacy are positively correlated with HAZ. This relationship is not comparable to the high-income countries, because the concept of malnutrition has a different nuance. Yet, a study by Howard (2011) investigates the relationship between food insecurity at home and non-cognitive competencies. His results show significant negative development effects for children with food insecurity at home. Meanwhile, Dercon and Singh (2013), document gender gaps across numerous indicators. Among others, they show that poor non-cognitive abilities could be a channel for continuity in gender bias through poorer labor market outcomes. Yet, unlike the two studies just discussed, Krishnan and Krutikova (2013) shows strong explanatory power on self-esteem and self-efficacy from an intervention conducted in urban India [12].

Although the result is only suggestive, it indicates that intervention has been effective in reaching out to deprived children in urban India to increase psychosocial skills. This does not necessarily imply that the intervention rewards children in ways other than increasing their skills; since the psychosocial competencies cover only some aspect of skills, other skills may be picked up by years of schooling or other institutional setting of the child. Further, many of the children included in the intervention are pro-poor which certainly causes additional problems. Chong et al. (2016) investigates iron deficiency on schooling attainment and level of aspiration in Peru. The study argue that iron supplementation significantly increases students level of aspiration. Put differently, household's access to nutrition overtime such as calorie intake or iron deficiency implies that households are vulnerable towards adverse food or price shock. Hence, it remains unclear whether it is really malnutrition that drive these results. Nonetheless, no clear empirical evidence on the effect of malnutrition on psychosocial abilities among Indian adolescents, to

---

[10] In economic literature, child malnutrition is measured by height or weight. Height is in fact an important predictor of future outcomes. It is also strongly heritable, implying that the height of children tends to resemble the height of their parents. Nevertheless, a child that has experienced a deprivation can still catch up the height curve by improving the health and nutritional conditions. The height of a child measures the accumulative experience since birth capturing an early childhood experience of deprivation. For more on the subject see; Tarozzi and Mahajan (2007), Case and Paxson (2008b), Case and Paxson (2008a), Tarozzi (2008) Deaton and Arora (2009), Jayachandran and Kuziemko (2011) and Jayachandran and Pande (2015) offers more detailed overview of elements that influence height and weight and that of policies that have demonstrated to be effective in catching up or ameliorating the long-term consequences of low height and birth weight. Almond and Currie (2011) generate knowledge about fetal origins hypothesis.

[11] In low-income countries, the adverse effect of malnutrition has been extensively studied, mostly connecting to cognitive skills (See Glewwe and King (2001); Bobonis et al. (2006); Paxson and Schady (2007); Field et al. (2009); Chong et al. (2016) for an excellent review.

[12] The intervention is called *The Akansha intervention*, implemented by a NGO which goes under the same name as the intervention, active in Bombay, India. It has been active the past 18 years with objective of raising awareness and improve psychosocial competencies among disadvantaged children. The program includes 10 level, taught daily for three hours after school. The first 7 levels are to give children tools to build up solid psychosocial skills, while the last 3 levels are mainly devoted to prepare for a job and build up life skills.

author's knowledge, exists in earlier literature. Therefore, it remains an open and an under-investigated question.

## Why are Psychosocial Competencies important?

A related and relevant question is why psychosocial abilities are important and whether they matter, in addition to cognitive skills ? Psychosocial abilities are important because they casually affect the development of children's capabilities. In fact, the investments in capabilities are relatively more productive at some stages of children's live cycle than other (Cunha and Heckman, 2009). Much of the evidence concerning child development suggests that investments at different stages of life cycle are vital to the formation of different types of abilities. This is because skills acquired in one stage affect both initial capacities and the technology of learnings at the next stage. Consequently, parental inputs have different effects at different stages of the child's life cycle. Cunha and Heckman (2008) suggests some evidence that non-cognitive skills promote formation of cognitive skills, however the reverse does not hold. One explanation may be that non-cognitive skills are malleable and the effects of investments are more persistent in the late childhood, whereas cognitive skills have higher rate of return during early stage of childhood. The economic literature suggest at least three mechanism by which high quality nurture might affect psychosocial abilities. The enhancing factors related to psychosocial skills are health, early childhood education including teaching characteristics. The children's environment such as family and contextual characteristics (social class, poverty, housing, culture) have a large impact on psychosocial skills (Fletcher and Wolfe, 2016). The environmental aspect of human development is well articulated in Zivin and Shrader (2016) acknowledging that environments and experiences are encountered in a cumulative fashion, starting from the prenatal period throughout the early childhood years. Another postulated explanation to the importance role of psychosocial abilities is the need to address non-cognitive skills in the education policy. Since non-cognitive skills are developed during late childhood and throughout children's school year (i.e. adolescents), the development of these skills are dependent on several factors, such as parental investment, the impact of school environment that either drive or inhibit children's development.

## Suggested pathways through which malnutrition could affect Psychosocial Competencies?

Only recently have theories commenced to address the negative association between malnutrition and psychosocial abilities. Consequently, the mechanism that underlie this relationship is still not well understood. The existing evidence on pathways linking malnutrition and psychosocial skills comes mainly from medical research; siblings and twin studies; studies of shocks to the early-life environment, which offer the possibility of examining outcomes through the lens of natural experiments; and observational studies. One hypothesis is that the effect of malnutrition

on mental development is limited food intake, compromising the child's active exploration and learning curve, which leads to mental deficiencies. Therefore, both adequate nutrition and good health appear to be important for child development. The empirical results on this theory tend to conflict. Some studies find that malnutrition accompanies (sometimes causes) poor health. As a result, detailed information about the social experiences, education and health of individuals are required in order to understand the underlying pathways. This implies, that malnutrition have multiple faces. In reality it occurs in conjunction with other forms of deprivation such as the less-fed individual is more likely to have the fewest social and economic resources. This indicates that influences of social and educational environment are equally important. Furthermore, biological channels have also been identified as an influential factor on both malnutrition and psychosocial competencies over a broad range of the population. It is, however, unclear precisely how genetic and environmental factors interact in operating these biological channels. The gene endowments together with health at birth, mother's health at birth as well as conception and fetal development impacts the child's future health. Given that many elements have an adverse affect on child health, influencing child's self-esteem, level of aspiration and self-efficacy. As discussed, previous contribution attempts to distinguish the role of environment and socio-economic status as determinants of psychosocial competencies. While more recent work tries to disentangle the gap in malnutrition. Leight et al. (2014), analyses the impact of early childhood shocks, proxied by rainfall shocks in a poor, rural province in China, on the development of cognitive and psychosocial skills over time. The results are somewhat promising; it is possible to reverse the negative impact of early deprivation conditions (due to weather shocks) on the development of children's cognitive skills. Hence, there is a clear justification for making compensatory investments that can help children to catch up. However, the study gives very little evidence of the impact of weather shocks on subsequent psychosocial skills at any age.

# 3    Conceptual Framework

## 3.1    Motivating Theory

Theoretically there are two broad reasons why drought on malnutrition may affect children's psychosocial competencies. In this section, I briefly discuss the mechanism. The underlying economic framework rest on (Grossman, 1972),(Grossman, 2003) and (Maccini and Yang, 2009) [13]. Let us start from a simplistic health production function illustrating the value of child health to the household. The health of the child can be seen as an intrinsic value entering as a welfare of the household into the health production function. The health of the child $i$ at time $t$,

---

[13]    Evidently, previous literature in this subject is large, yet, how psychosocial competencies is affected by climatic shock is still narrow, hence, increasing understanding is crucial to disentangle the economic consequences of climate change. In addition, we have still very few evidence on which policies that best reduces the effects of climate change in relation to health.

$H_{it}$[14] is a function of an initial health endowment $H_0$, a vector of health inputs $I_t$ such as food consumption in terms of nutritional inputs affecting the child after time 0 and up until time $t$. $H_{t-1}$, is the child's previous period health status, including the initial health endowments. Other health determinants of importance include time-invariant demographic characteristics $X_i$ such as birth order, gender, caste, caregiver's level of education; time varying observable $Z_{it}$ such as age, recent economic shocks, socio-economic status, community characteristics $V_t$ such as availability and access to village infrastructure as well as the disease environment. $U_{it}$ it is a vector of unobserved attributes of the child, parents, households and community that affect the child's health status. The function allows for the possibility of interaction effects among its arguments.

$$H_{it} = h(H_{t-1}, I_t, X_i, Z_{it}, V_t, Uit) \tag{1}$$

Equation 1 establish a full conceptual framework where the aspect of climate shock is incorporated in a systematic way. Contrary to early work by Becker and Tomes (1986), childhood consists of many period. It is crucial to; at least, distinguish between early and late childhood. Psychosocial skills are measured in the late childhood and malnutrition is captured in early childhood. Human capital, in the form of psychosocial skills and abilities depends on parental characteristics, initial endowments and investments. Thus, it is the current human capital that I estimate empirically which is the outcome of initial endowments of the child, home environment, and all prior investments in the child's human capital. I do not observe the arguments of the health production function; instead, my results identify the reduced form relationship between climatic shock and malnutrition in early childhood and psychosocial outcomes observed in late childhood.

A brief word is also in order regarding the mechanism behind climatic shock. The Indian agriculture relies mostly on rain-fed water supply. This implies that erratic or deficient rainfall will have a negative impact on rural livelihoods due to crop failure and thereby on the agricultural income, as this is derived from crop sales [15]. Therefore, when households experience crop failure, the income declines. Moreover, if the crop failure is widespread this will often lead to higher food prices, making it difficult for the household to supplement its food intake[16].

---

[14]    This health stock is perceived as an utility to the child acting as an input into a variety of other goods and stocks. Importantly, health will be a key input into human capital accumulation. A standard assumption is that a child must be well enough to go to school, to work, hence requires a minimum health stock of $H(min)$, beyond this, variation in the stock of psychosocial competencies will affect the child's ability to learn and participate at school and acquire human capital.

[15]    In Mullainathan and Shafir (2013), the rural household's scarcity is evoked, highlighting on farmers' spending pattern in pre and post harvest period. The authors explain how quickly scarcity can establish a negative constraint in the household. A typical Indian farmer starts to spend in pre-harvest period with expectation of positive harvest. This implies that the wage rate of a farmer, contrary to a labor worker, is not smooth across time, instead, the salary arrives as a stock variable penetrating the households' purchasing power exclusively in post harvest period.

[16]    The food scarcity encounter farmers with unfavourable decision making due to uninsured income, lack of crop or weather insurance and low social safety net which may tax the non-cognitive skills and ability in the household.

In addition, credit constraints limit the household's ability to smooth consumption over time, making its nutrition and health vulnerable to economic shocks [17]. Further, droughts can also worsen the disease environment in the affected communities, affecting child nutrition by reducing the affected children's capacity to take in and sustain essential nutrients from food. To the extent that parents cannot entirely prevent or perfectly ameliorate these effects of child illness, drought shock will have an additional negative impact on the child's nutritional status through the disease channel. However, the evidence of drought impacts on the disease environment is ambiguous. A drought shock can have a negative effect when e.g. availability and quality of household drinking water is adversely affected. In this situation, households are without any power to prevent or ameliorate the negative effects on their children's health. On the other hand, a positive effect could appear from the reduction of water-borne diseases [18]. There is an intimate connection between these two effects, on one hand the combined impact of negative income effect and negative disease effect due to drought on child health is unambiguous, while the impact resulting from the interaction of negative income effect and positive disease effect will have on health outcomes is unclear. Nevertheless, there is evidence suggesting that income effect on health dominate the disease effect during drought shocks (Tiwari and Jacoby, 2013) and (Kumar et al., 2014). This is the essential argument underpinning the belief that drought shocks can have a negative impact on children's psychosocial competencies through its effect on children's nutritional trajectory.

# 4    Data and Descriptive Evidence

The paper uses what may be the best available longitudinal data on children living in low-income countries, the Young Lives (YL) dataset. This enables me to investigate the development of determinants of psychosocial competencies of young children by examining the effects of negative exogenous climatic shocks on child nutrition in Andhra Pradesh, India. Using the longitudinal data, I look at the effects of climatic shocks in terms of droughts on nutrition and the subsequent impacts on young children's psychosocial skills.

## 4.1    Data overview - Young Lives Study

My analysis is based on Young Lives study, a national cohort panel study on poverty and child well-being conducted in Ethiopia, India (Andhra Pradesh), Peru and Vietnam. In the younger cohort, YL follows 2,000 children in each country from age 6 - 17.9 month [19] until they are

---

[17]    In many remote areas in developing economies, the households are spatially dispersed with weak transport infrastructure, thus markets for food staples may not be well integrated creating a friction.

[18]    On the contrarty an excess rainfall will lead to diarrheal diseases but also vector-born diseases such as malaria and dengue (Zivin and Shrader, 2016).

[19]    Age in completed months is estimated by taking age of the child in days, that is, date of interview minus date of birth and dividing this number by 365/12, the number of days per month. The final number is rounded up to one decimal point.

15 years old and in the older cohort, YL follows 1,000 children in each country from age 8 until they have reached their early adulthood of 22 years of age 24 . The caregiver (often a biological parent of the child) and, when the child is old enough, both the caregiver and the child are interviewed every three to four years with a quantitative survey. The YL provides rich information, not only on the households' material and social circumstances, but also on their perspectives on their lives and their aspirations for the future. The YL survey adopts a so-called sentinel site surveillance system. It consists of a multi-stage, purposive and random sampling to select the two cohorts of children. This methodology randomised the selection of households within a study site while the sites themselves were chosen on the basis of predetermined criteria. To ensure the sustainability of the YL data and for resurveying purposes, a number of well-defined sites were chosen. The survey is divided into three sections: a child, a household and a community questionnaire which are to be completed for each sentinel site at every data collection round.

The children and their households are enrolled in the sample during a total period of 15 years through a two-stage process. In each country, 20 sentinel sites are chosen; within each sentinel site, approximately 100 children aged 6-17.9 months and 50 children aged 7.5 years and their households are randomly selected through the enrolment procedure. The enrolment visit is the first visit by the field research assistant (FRA) to the households and the form is designed to find whether there is an eligible child in the household and to identify the primary caregiver of the child which is usually the child's mother. The household questionnaire includes elements of location information, household composition, pregnancy, delivery and breastfeeding, child care, child health, caregiver's background, caregiver's psychosocial well- being, livelihoods and time allocation, economic changes, socio-economic status, social capital, tracking details and anthropometry [20]. The community questionnaire, unlike the child or the household survey, is intended to act as a cross-validation of information between multiple qualified informants to get the most accurate information about the characteristics of the environment in which the children live. This implies that the community level survey does not reflect the opinion of inhabitants but tries to collect and corroborate the information collected. Therefore, a selection of informants with key position in the community are interviewed. These key informants are municipal/commune leaders, government officials, village headmen, child health nurses, headmasters, leaders of women's groups and religious leaders [21].

YL is well positioned to contribute a strong understanding of contemporary child inequalities and their impact on children's lives [22]. The longitudinal dataset gives an opportunity to follow

---

[20] Special trainees were responsible for collection of anthropometry so called anthropometrics for measuring length and weight of the index child. I use of the World Health Organizations definition for constructing the measures of weight- for-age and height-for-age z-score standard deviation. The z-score measurement is among the most used to measure child health in empirical works. For more detail about the measurement see Appendix B.2

[21] The community level survey collects informations in the following areas: general characteristics of the locality, social environment, access to services, economy, local prices and access to services relevant for children such as educational and health services. Overall, the specific areas are the same across waves, but can deviate for certain waves in some of the areas.

[22] Charles Dickinson (May 30, 1780-1806) novel Oliver Twist in which the author, in a brilliant way illustrates

the same child throughout their childhood. The longitudinal dataset gives an opportunity to follow the same child throughout their childhood. Thus, it is a powerful dataset which allows me to track changes over the life course, as well as looking for causes and consequences of events or circumstances. In addition, dynamic relationships and possibilities to elicit heterogeneity among the subjects adds to the large benefits of working with panel data since dynamic relationships can only be studied with repeated observations. Likewise, the main concern with panel data is the level of attrition, fortunately, the YL dataset has relatively low attrition rates [23]. In order to test my hypothesis I will mainly need to study the older cohort. Therefore, to conduct my analysis I have merged all three questionnaires of the first two waves into one dataset so that I follow every child from the start of the baseline year 2002 until the second wave when the children are 12 years old, in the year 2006. Thus, all children and their household characteristics as well as the community in which they live are accurately captured in the final dataset.

## 4.2 Sample descriptives

Table 1 provides summary statistics for the sample showing data on basic child, parental and socioeconomic characteristics. In child characteristics, I have included gender, first language, caste and religion. Since, all of the mentioned characteristics are time-invariant variables, they are taken as fixed as from wave I in the survey, except the information on the child's first language which was collected from wave II. Therefore, most missing values in variables are explained by attrition. In my sample, the average child was 12 years old in 2006 with an average weight of 31 kg and average height of 141.48 cm. Similarly, caregivers' average age is 34 and on average fathers have higher levels of education than mothers. Moreover, the average size of the family is five members, and the household head is, on average, 40 years old and has 3 years of education.

**Child malnutrition** In addition to child characteristics, I have child health and nutritional variables consisting of anthropometric information and constructed measures for malnutrition. The key variable of interest is anthropometric information [24], which includes z-scores [25] for WAZ and HAZ , which indicates whether a child exhibits chronic malnutrition. These two

---

the children's position in the society, the value and emotional struggle the young children undergo and their venue into the future life is nearly predetermined by birth. In the same perspective as Dickinson, the YL dataset is making it possible to quantifying the children's value, hence, adding value to the policy research forums. In a color full way the children's lives and their well-being in the $21^{th}$ century can be illustrated.

[23] In YL, the level of attrition is relatively low due to efforts made by FRA's when the YL program was implemented. The field worker were told to give solid background information about the YL study to all participants concerning the importance of remaining in the study throughout all 15 years.

[24] The validity of anthropometric reference is debatable, nevertheless, until today there are no alternative measurements which describes more accurately early childhood growth in low income countries. The mentioned measurements are well established in the field of epidemiology and became to be recognized in economics late 1980's.

[25] The z-scores were estimated using WHO reference table. For each combination of gender and age in months, the WHO provides the distribution of these measures for a reference population of children from Brazil, Ghana, India, Norway, Oman and the United States without health or environmental constraints to growth and who were given recommended nutrition and health inputs (WHO Multi centre Growth Reference Study Group, 2006)

measurements are the most common to employ to illustrate child health status in low-income countries. In most empirical works, data on child health is compared with the WHO reference table in order to make appropriate comparisons across different children's health. The z-scores for a specific child's weight and height show how many standard deviations these are above or below the median of the reference population. A z-score of 0 means that the weight or height is equal to the median of the reference population, while, a z-score of -1 indicates that the child is 1 standard deviation below the reference-population median for his or her gender and age. If a child has, a HAZ of -2, it is considered to have long-term health problem, called stunting; a WAZ of -2 indicates wasting [26]. Since HAZ yields long-term and WAZ yields short-term health problem of the child [27], I am able to observe the cumulative nutritional impact of the child. This reveals child's historical nutritional input over time. The average HAZ for children in the sample is -1.557 and average WAZ is -1.903, indicating that they experience nutritional deficiency both in the short and long term. As health is treated as a stock variable, yielding a cumulative health status, it implies that WAZ, a short-term measure gives information about children's wasting status. While HAZ is the long-term health status yielding children's historical nutritional intake. In my estimation (see equation 2 below), I include HAZ and WAZ from wave I when children are at the age of 7 to 8. Figure 2 show histograms with corresponding raw scores for short and long-term malnutrition. It confirms previous evidence that on average children in the sample show wasting and stunting [28]. Table 2 describes the nutritional differences across gender. The nutritional structure is similar between the two gender groups; however, there is a difference in wasting; girls are more likely to have low weight in relation to their height compared to their peer boys. Consequently, girls are in higher degree malnourished in short-term than boys. Further, table 3 gives an indication of whether children living in drought prone districts are more likely to be malnourished relative to children living in non-drought area. The differences are not large, but children are more malnourished in drought prone districts.

**Measurements of psychosocial competencies** I follow a similar approach as Dercona and Sanchez (2013) and Dercona and Krishnan (2009) to construct indicators to approximate children's psychosocial competencies. The three dimensions studied in this paper are survey-based indicators of self-efficacy, self-esteem and (educational) aspiration. Contrary to Dercona and Sanchez (2013), I treat the aspiration variable as upward mobility which generates a better understanding over children's ability to state and aspire for higher educational achievement. I am, following the same definition used in Chong et al. (2016) who provides a novel evidence on health and aspiration. The study shows that improvements in one's health can lead to im-

---

[26]  The percentage of children with a low height for age (stunting) reflects the cumulative effects of under-nutrition and infections since and even before the birth. Therefore, HAZ can be used to interpret as an indication of poor environmental conditions or long-term restriction of a child's growth potential. While, the percentage of children who have low weight for age (underweight) can reflect *wasting* indicating low weight for height which indicates acute weight loss, *stunting* or both. Thus, *underweight* is a composite indicator and may therefore be difficult to interpret.

[27]  stunting and wasting are terminology used by epidemiologist to capture health status of a child.

[28]  I elaborate with WAZ in my estimations to study whether the short-term health is also affected by drought.

provement in aspiration of future mobility. In YL, the level of aspiration is captured by asking children what level of education she/he would like to achieve if there were no constraints on their ability to attend school. The responses are measured in years of education that the child would like to complete. Figure 3 show histograms over psychosocial competencies, standardized to have mean 0 and variance 1 for each of the personality traits. Table 5 describes the statements and the corresponding raw average scores used to construct each of the outcome indicators. The average scores rely upon the degree of agreement with each of the statements, measured on a 4-point Likert scale that ranges from strong agreement to strong disagreement. The average educational aspiration is 13, which corresponds to post-secondary level studies. For the analysis, I have, based on what children answered in response to the statements, created individual average scores for self-efficacy and self-esteem, see Table 6 for an overview.

**Sever illness** This is a dummy variable which measures whether the mother has been severely ill between the the [29]. Severe illness in a household creates negative shocks. An illness is an idiosyncratic household shock, positively correlated with drought for the reasons discussed earlier see Table 4. Mothers are normally the primary caregivers, but a mother who experiences severe illness during the crucial age of the child is less likely to fulfil her task. The YL sample indicates that severe illness is also one of the main adverse shocks experienced by the households.

## 4.3 Climatic Shocks and Instruments for Child Malnutrition

In addition to childhood and household variables, the individual questionnaire also includes questions on a range of negative economic, physical and social events that might have affected household members in the last four years, between wave I and wave II. Although the shocks can be multiple, I have mainly focused on drought in Andhra Pradesh in order to capture the consequences of drought on households well-being, as it is part of my hypothesis. A climatic shock can strain economic, physical and moral resources of households. Further, among all types of natural disaster, drought is the most reported across households and communities in Andhra Pradesh. I use drought events that occurred in districts where the children live. The self-reported drought events were collected both at household and community level for each YL child. The responses from these different agents are denoted as subjective and objective drought variables, respectively [30]. The objective community drought variable takes the value 1 if interviewed community drought affected their villages between the two waves, 0 otherwise.

---

[29] In the YL survey data households were asked whether they had experienced, between year 2002 and 2006 any big events or changes that decreased the welfare of the household such as severe illness or injury. The corresponding answer is a binary response, either yes or no.

[30] In Wave II - the subjective measurement was extracted from the question that was posed to the households across districts in Andhra Pradesh. The question is the following: Have you experienced drought in the last four years? This question implies whether households experienced drought since wave I in year 2002. At the community level, the objective drought measurement was extracted in the same way as the subjective drought measurement. The question posed is ; in the last four years, has any natural disaster happened in this locality? Following options were given; volcanic eruption, cyclone/tornado/hurricane, drought, avalanche/mud slide, earthquake.

The self-reported subjective household measure is also defined as 1 if a drought is reported and 0 otherwise, but is bound to incorporate an element of vulnerability to drought in addition to that of pure exposure.

Figure 4 plots the occurrence of droughts across districts in Andhra Pradesh. As can be observed, the differences are quite small in the prevalence of droughts as measured at the community level and at the household level, respectively. Anantapur and Mababubnagar are the two districts that experienced the most droughts between year 2002-2006 which translates into high proportions of affected households. Table 7 describes the distribution of drought impacts according to household's self-reported drought, 43.64 % of the households reported that the drought affected their own household and some others in the same village, while 30.55 % reported that all households in the village were affected by the drought. Drought patterns vary across the three regions and districts of the state. In Table 8, I picture the drought exposure across the districts for households (column 1), who was affected (column 2-5) and rural households (column 6). According to the households subjective drought variable, drought is very prevalent in Anantapur and Mahbubnagar, with 46 and 29 percent of the households reporting having suffered from drought. Except for these districts, other districts illustrate quite homogeneous patterns in exposure to drought. The number of drought prevalence at community level is equivalent to household level. The main advantage of having both subjective and objective measurements of drought is the possibility of comparison between the two variables and to validate that drought actually did occur in the community. The column 2-5 shows who was affected by drought in each districts. In district West Godavari, Srikakulam and Hyderabad, it was mainly households that was affected by the drought shock. While in districts Kadapa and Anantapur it was households and others in the villages. In Karimnagar, all households in the villages and in Mahboobnagar village and beyond were affected by drought shock. Figure 5 illustrates the discrepancy between short and long-term malnutrition on the two drought measurements according to child's gender. Unexpectedly, irrespective of drought and nutritional measurements, the male children are more malnourished conditioned on drought. For the subjective drought measure, however, female children show the lowest value for malnourishment in the long-term health status. Moreover, the median short-termed malnourishment lies around -2 z-score while long-termed malnourishment show an improvement in both gender's health status. In the non-drought affected group, the male child show quite similar nutritional pattern as for the female child. Thus, the YL sample yields some indication of non-conventional gender differences in nutritional pattern conditioned on climatic exposer.

# 5    Empirical Framework

My goal is to investigate whether prevalence of low psychosocial competencies in adolescents in Andra Pradesh is determined by past nutritional inputs trajectory, I intend to study how children's psychosocial competencies are affected by malnutrition in different geographical units

experiencing climatic shock across Andhra Pradesh. I combine the panel data on child anthropometrics, psychosocial competencies and other socioeconomic variables provided by the YL dataset. This will enable me to estimate the effect of malnutrition on children's psychosocial competencies. The analysis is carried out in two steps to make the identification strategy clean. I will start by illustrating a simple intuition behind the direct effect of malnutrition and drought on psychosocial competencies. The direct effect will eventually provide me with set of useful benchmark estimates that I will use to compare with the impact of the interaction between malnutrition and drought and between severe illness and drought. Hence, the main hypotheses that this paper provides is to test whether there is a mechanism linking child malnutrition to psychosocial competencies. In this line, my aim is to comprehend in depth and capture the indirect effect of malnutrition by instrumenting drought with malnutrition in Andhra Pradesh. I argue that, in communities with high incidence of rainfall will experience adversely by a climatic shock. Consequently, children in those districts are more likely to experience shortage or lack of nutritional input periodically. This claim is supported by the cumulative malnutrition measurement. Accordingly, as the HAZ captures children's past long-term nutritional inputs, this channel will capture the impact of indirect effect.

## 5.1 Direct effect of malnutrition and drought on children's psychosocial competencies

The structural equation that I wish to estimate is as follows:

$$PSY_{ihd,t} = \beta_1 Nnutrition_{ihd,t-1} + \beta_2 I_h td + \beta_3 X_{ihd,t} + \epsilon_{ihd,t} \qquad (2)$$

where $PSY_{ihd,t}$ is the outcome variable, psychosocial competencies of child $i$, in household $h$, in district $d$ at time $t$. $Nutrition_{ihd,t-1}$ is the HAZ and WAZ of all children included in the sample, measured at time $t$–1 (in 2002). $I_{hd}$ is binary variable indicating 1 if the mother in household $h$ in district $d$ have experienced severe illness in the last four years before the survey wave II, in time $t$ (in 2006), 0 otherwise. Severe illness is an idiosyncratic household shock and one of the most common shock experienced by households in developing countries. In YL data, 6.43 % of the mothers in the households suffered severe illness who did not experience a drought, while when a drought occurred the number more than doubles to 15.63 % [31]. In fact, there is a valid reason to believe that the relationship between severe illness and drought is expected to be positive. First and foremost, it is expected that severe illness have an adverse impact on household resources by exacerbating their material poverty, assets and weakening their bargaining position [32]. Secondly,

---

[31] The equivalent numbers for objective drought are 8% and and 11.2 % respectively .

[32] Severe illness and injury in households have both direct costs for prevention care and cure, as well as opportunity cost in terms of lost income. Yet, the lion's share of the cost of illness is lost income and therefore not necessarily healthcare expenditures. Further, timing and duration, frequency of illness also affect its impact. Small farms and households are experiencing illness during the slack agricultural season are better off than during peak season because it leads to heavy loss of income associated with reduced labour supply and productivity which can result into costly private informal coping mechanism such as

the drought amplifies the illness even further by its impact on the household well-being such as physical and moral resources of the households. Thus, both shocks create an insecurity and a simultaneous vulnerability on households health status. This, implies that non-inclusion of the variable would probably give me an overestimation of the effect of drought which is not desirable if it can be avoided. $\beta_3 X_{ihd,t}$ is a vector of relevant child, household and district level characteristics which are considered to be predetermined in the model and $\epsilon_{ihd,t}$ is an i.i.d error term.

The theoretical literature on this subject predicts that $\beta_1 > 0$, which indicates that children who are malnourished in wave I are expected to have lower psychosocial competencies relative to their peers. As established in previous section, drought have a cumulative effect on both child nutritional input and on the outcome variables. The assumption behind this model is that I am identifying the effect of malnutrition conditional on observable individual and household controls from wave I when children are 8 years old. I am imposing the standard error to be clustered at district level when estimating equation 2 to correct for the fact that the errors are not i.i.d. Moreover, the fact that I am observing the same child repeatedly helps me to rule out cross-sectional confounders that could correlate with malnutrition and explain psychosocial outcomes. Throughout the paper, I estimate equation 2 by OLS as a baseline and reference for comparing other estimates, always including malnutrition. For several reasons that will be made clear in the later sections, malnutrition can be expected to correlate with important characteristics of drought, either observable or unobservable, that can have a direct impact on the outcomes of interest. A strong concern in estimating equation 2 by OLS is thus, that it may yield biased estimates of the effects of malnutrition. In particular, the risk of picking up reverse causation is likely: that malnutrition could be affected by other shocks than drought. In other words, I risk misinterpreting the effects if lower psychosocial competencies of early adolescents lead to malnutrition, rather than malnutrition leading to lower psychosocial competencies, malnutrition and psychosocial competencies are both affected by other factors . Although I do not have any evidence that this is the case, it seems plausible that family investment decisions, including external environment, are affected by accessibility to food, prevalence of health care services and social norms. It can be assumed that societies benefit more from healthy adolescents. Therefore, without the ability to quantify the relative importance of these effects, OLS estimates risk yielding limited information about the causal effect of malnutrition on psychosocial competencies. To overcome these issues related to omitted variables and to consistently estimate parameters, I propose an identification strategy exploiting households' and communities' self-reported drought variables in the YL dataset. The remainder of the section presents the instrumental variables strategy in more detail.

---

informal borrowing, selling assets, transfers from their families and social support networks. Gertler and Gruber (2002) studies the impact of severe illness on household resources. The results indicate that there are significant economic costs associated with major illness and to prevent the lost, public policy such as consumption insurance can enhance the welfare of the household.

## 5.2 Identification Strategy and challenges

There is no clear consensus among researchers about the impact of climatic shocks on children's health status. Nonetheless, there is general agreement that marginalized populations [33] are more vulnerable to drought. Given these facts, estimating the equation 2 using OLS would not be enough to retrieve the causal impact of growing up in districts with high prevalence of drought on children's psychosocial competencies. These estimations will have high tendency to overestimate the true impact of drought if children in drought affected districts are poorer, even without being exposed to drought. In order to disentangle and address this potential endogeneity bias problem, I instrument malnutrition with presence of climatic shock (drought) across districts in Andhra Pradesh. The regression differs from the structural model because of the correlation between the error term and the endogenous variable, producing inconsistency in the structural equation. In order to disentangle and address this potential endogeneity bias problem, I instrument malnutrition with presence of climatic shock (drought) across districts in Andhra Pradesh. The regression differs from the structural model because of the correlation between the error term and the endogenous variable, producing inconsistency in the structural equation[34]. With this in mind, the instrument variable requires three conditions to be satisfied; the instrument should be as good as randomly assigned from the perspective of the individual child, the instrument must be able to explain a sizeable variation of the potentially endogenous variable (malnutrition, in this case) and it must influence the outcome variables (i.e. psychosocial competencies) only by its effect on the endogenous variable. The first condition is clearly met; drought shocks are as good as random from the perspective of the individual child or household. The second condition, that the instrument should be associated with malnutrition, is clearly also met. Weather deviations from the norm, especially deviations below the norm, affect production negatively and reduce household income; as argued previously, such deviations can also contribute to negative health shocks that affect nutrition. Lastly, the exclusion restriction assumption can be violated if there are other channels through which drought shocks might affect children's psychosocial competencies, rather than through the effects on malnutrition. For instance, since weather variation is negatively associated with agricultural income, there could be also effects through income. I address this concern by proxying household income with a wealth index. Given that these three conditions are fulfilled, the IV produces an asymptotically unbiased estimate wherein I am better off than evidence produced by equation 2.

### Endogeneity and IV approach

As explained above, I use an IV approach where I instrument malnutrition with drought shock where I adapt self-reported drought variables at household and community level. I estimate the

---

[33]   The wealthy can recover losses in one year, but poor people, who have no money, will never recover.

[34]   The technique of IV is the standard prescription for correcting cases as the one that I experience, hence a solution for rebuilding the structural parameters. This requires me to find instrumental variables that are correlated with the endogenous variable but uncorrelated with the error term, given the feasibility, the IV regression will yield consistent estimate of $\beta$.

first stage regression as:

$$Nutrition_{ihd,t-1} = \gamma_1 Shocks_{ihd} + \gamma_2 I_{hd} + \gamma_3 X_{ihd,t} + \epsilon_{ihd,t} \qquad (3)$$

where $Nutrition_{ihd,t-1}$ is the HAZ and WAZ, estimated separately for child $i$ living in household $h$ in district $d$. $Shocks_{ihd}$ is shocks experienced by children in the different time scale as explained earlier. Because drought shocks are constructed to capture stochastic variation with respect to fixed district characteristics, the coefficient of interest $\gamma_1$, is estimated without bias.

# 6 Empirical Evidence

Before investigating the link between the instrument and malnutrition, I verify the story from the direct effect, thereafter I lay out the mechanisms that tries to capture the causal effect. My approach is predicated on the notion that the malnutrition leads children to have lower psychosocial competencies. Consequently, the first set of results attempt to show this impact.

## 6.1 Direct Effect

Table 9 and 10 presents the results from the OLS specification in equation 2. It summarizes the direct relationship between the short-term and long-term malnutrition on psychosocial competencies among early adolescent children. To keep the presentation simple, the coefficients of Aspiration, Self-esteem and Self-efficacy are given in columns (1), (2) and (3), respectively. Since psychosocial competencies and malnutrition are standardized variables with mean 0 and variance 1, this indicates that marginal effects can be interpreted in terms of proportion of the standard deviation of the outcomes explained by WAZ and HAZ. The results in Table 10 indicate that the short-term health status of children, as measured by WAZ, has no impact on their psychosocial competencies. Results for the covariates indicate that gender affects aspiration. To some extent; the fact that girls show lower levels of aspiration in a patriarchal society is not surprising. Furthermore, the YL sample is pro-rural, primarily sampling rural areas where traditions and norms are still maintained. When controlling for caregivers' level of education, the evidence suggests that a child's level of aspiration is to a high degree influenced by their domestic environment. In YL sample, caregivers with secondary level of education have a positive impact on aspiration levels of early adolescents compared to caregivers with none or lower level of education. Not surprisingly, wealth has a positive and statistically significant impact on children's level of aspiration. In addition, living in a large family has a negative impact on self-esteem; as the number of family members increases, the self-esteem of the child decreases the number of family member crowds out the expected positive input that increasing number of family member possess (i.e. help within the family such as taking care of the siblings, farming

and monetary contribution to the household.) to the cost of well-being of the child [35]. Thus, household size have a negative impact on children's self-esteem on both short and long-term health of early adolescents, they are neglected and do not reach the level of attention needed which amplifies into lower self-esteem. Moreover, children living in Rayalaseem and Telangana show a lower self-esteem compared to their peers in Coastal Andhra. The third psychosocial competencies, self-efficacy, shows somewhat unexpected results. Contrary to the results for aspiration, and somewhat counter-intuitively, the impact of wealth and caregivers' level of education on children's self-efficacy is actually negative. Astonishingly, the internal environment, caregivers' level of education and wealth which have a positive effect on the level of aspiration while it has an adverse effect on self-efficacy. The higher the level of education in the household and therefore, on average higher wealth, the lower is the children's self-efficacy. This is seemingly counter-intuitive, influenced by disagreement or fail to interpret correctly which can be associated with self-efficacy being one's own system of beliefs over their cognitive functioning. Therefore it can be a reflection of a two-way path. Children from a relatively higher level of education in the household, aspire higher level of education for themselves. At the same time, they show a lower degree of self-efficacy. These two elements seem to contradict each other, in fact, they are not. The lower self-efficacy generates from the lack of faith in a specific action, hence, not lack of faith in your *self*. Further, children living in rural area have relatively lower self-efficacy compared to children in urban area. This result can be a cause of multiple dimension, though, the most relevant in this context would be that children in urban area are more exposed to, through the external and to some extend to internal environment that demands them to seek for higher aims and values. Certainly, rural adolescents are time constrained and less exposed to the modern society, thus more likely to be outsiders and their future plans and vision is short-lived.

(Insert Table 10)

Is there a discrepancy in children's short and long-term health status on psychosocial competencies? The results in Table 11 for the impact of long-term health status are quite similar to those for short- term health status. The chief difference is that long-term health status has a positive effect on early adolescents' level of aspiration, implying that less malnourished children are more likely to report to aim for higher education level. A one standard deviation increase in HAZ, increases children's level of aspiration by 9.6% and is statistically significant at the 1 % level. Arguably, the result predicts the same pattern as in the conventional literature in economics about human capital that malnourished children have lower cognitive skills. This capitalize a vicious cycle, if my "window" of aspiration is determined solely by individuals who populate by low aspired individual, the more likely am I also to comply to the norm. This indicates that children's environment is an element that have a positive effect for the development of aspiration. Therefore, an internal environment such as caregivers' level of education and wealth status of the households are factors that are likely to have positive impact because

---

[35] $\dfrac{d(Self-esteem)}{d(family)} > 0 \dfrac{d^2(Self-esteem)}{d(family)^2} < 0$

caregivers with higher education are also more likely to have higher level of aspiration which will create a positive spillover effect within the households.

(Insert Table 11)

## 6.2 Mechanism

**First Stage Results: Does Drought Affect Malnutrition?** The first stage results document short and long-term malnutrition instrumented with self-reported drought shock. It verifies whether the endogenous variable is associated to the instrument variable, whether there is a first stage relationship. To see how controlling for drought shock affect malnutrition, column (1), (2) and (3) in Table 11 reports subjective drought for HAZ. The results are in line with the conceptual model - children's health deteriorate more in response to an additional drought shock. In terms of magnitude, the estimates show that HAZ is reduced by, on average, 19.1% of a standard deviation relative to the reference population for children who have been exposed to a drought shock; this is statistically significant at the 5% level. This is consistent with the theory that adverse climate have an adverse effect on children's malnutrition. Results for self-esteem and self-efficacy, where samples are slightly different due to slight differences in missing variables, the results are almost identical. Therefore, the subjective drought is a strong predictor of child malnutrition measured as HAZ. However, the result is only valid when instrumenting subjective drought to the long-term health status, HAZ. The coefficients for WAZ (reported in Table 14 in the Appendix) are not significantly different from zero which indicates, somewhat surprisingly, that subjective drought have no impact on children's short-term health status. Similar results apply when estimating the impact of objective drought on HAZ and WAZ. Furthermore, the first stage gives an indication that subjective drought shocks, as reported by households themselves, have adverse impacts on children's health, while objective drought shocks, as reported at the community level, do not.

Insert Table 12

**Second Stage Results: Does Drought Affect Early Adolescents Psychosocial Competencies?** Table 12 reports the main results, those from the second stage of the 2SLS equation. Among the three psychosocial competencies studied, self-efficacy is the only competence that is affected by subjective drought. Table 12, column 3 shows a positive and statistically significant coefficient at 1% level. The result is intuitive; on average children who are malnourished possess lower levels of self-efficacy. Elaborating further the result, the self-efficacy component in early adolescents are fragile to stunting. Therefore, this study confirms, in addition to what previous literature has suggested, that stunted children have lower school attainment, that psychosocial problems are also a consequence of malnourishment in early childhood [36]. Although the coefficients for aspiration and self-esteem have the same sign as that for self-efficacy, they are not

---

[36]    The results are consistent with many theories such as parental investment, parental information, sorting and peer effects, household credit constraints, preference formation and genetics.

statistically significant. Overall, the standard errors for the 2SLS coefficient estimates are larger than the corresponding OLS coefficient estimates. This suggests that the observed association between malnutrition and early adolescence's psychosocial competencies is not driven by omitted variables such as family background and other characteristics that are not observed in the model but might potentially affect the outcome variables through the chosen instrument [37].

<center>Insert Table 13</center>

# 7 Robustness Checks

## 7.1 Sensitivity of estimation

An important aspect in interpreting IV estimates is investigation of internal validity, i.e. examining the sensitivity of estimates to violations of key identifying assumptions. Therefore, one crucial issue in YL data is measurement of psychosocial skills, which was done using average responses to sets of questions for each of the three outcome variables. Using principal components of these sets of responses rather than average responses gives very similar results.

## 7.2 Heterogeneous Effects by Gender

The main result reported the pooled YL sample. In this section, I check for whether there exist discrepancy in psychosocial skills by gender. In order to test this hypothesis, I employ the same estimation process as in Section 6.2 but split the sample according to gender. The results are reported in Appendix A, Table 19. The overall results for both genders are largely similar to those for the pooled sample, although the smaller group sizes, not surprisingly, give weaker statistical significance in general. There is some weak evidence that adverse effect of climatic shocks on psychosocial competencies may be slightly larger for boys, though the estimated coefficient on the psychosocial competencies is insignificant in all cases except for one; self-efficacy. The first stage regression in Panel B illustrates that the subjective drought, is somewhat weak instrument; nevertheless, the coefficient in the first stage estimation shows the expected sign, that is, the subjective drought have an adverse impact on HAZ. With that being said, plausible interpretation of the result would likely be that boys in the YL sample have worst self- efficacy, mainly generating from high level of malnutrition. This result is not astonishing, a low level of self-efficacy can produce depression and anxiety. This holds from the fact that individual are partly product of their environment. Therefore, belief on one's self-efficacy have power to shape the course of children's lives through influencing choices of activities and environment. These concepts broadly captures the development trajectory during

---

[37] The estimation was also produced for the short-term malnutrition, WAZ. However, the results report that WAZ have no impact on psychosocial competencies, see table 15. The 2SLS result for objective drought show similar result, neither on short-term (WAZ) nor on long-term(HAZ) have impact on children's psychosocial competencies. See Tables 17 and 19 in the Appendix.

adolescent life. Further, self-efficacy is correlated to an individual's sense of agency or able to conduct her own life. In psychology, this is related to how individuals perceive their effort, whether the achievements are purely luck or intervention of others.

Insert Table 20


## 7.3 Drought and the agricultural sector

In Tables 21 - 22, I address concerns regarding the omission of potentially important determinants to circumvent drought shock, such as household revenue from agricultural activity, agriculture production of paddy rice. I also check for the impact of formal and informal insurance mechanisms. However, I should express the concern regarding over-controlling problem in weather regression, where I cannot be sure that these additional controls are indeed exogenous.


Table 21 presents reduced-form estimates of the relationship between self-reported subjective drought and rice production as well as revenues from agricultural activity transformed in natural logarithm. The agricultural sector constitutes the principal channel through which drought can impact health outcomes. In Andhra Pradesh, most households are involved in rural activity, mainly engaged in cropping activities. In the sample, the paddy rice is the most common crop cultivated by the rural households in Andhra Pradesh. It also requires a sufficient amount of precipitation level. Assuming that, if a drought shock puts into vigorous action this will be reflected in the production of paddy rice. Table 21, column (1) presents the reduced-form estimates of the relationship between the severity of drought and paddy rice production, while column (2) presents revenue from agricultural activity. The paddy rice production is a binary variable comparing those households who cultivates rice in relation to households cultivating other crops. The results show that drought can have a negative impact on paddy rice production. Living in the most drought affected district compared to living in the least drought-affected districts is associated with approximately 20 percent decrease in paddy rice production for subjective drought. This indicates that for the average rural household in the sample, the drought shock have an adverse effect on rice production and revenue from agricultural activity. Although, the results are not statistically significant, the sign of the coefficient are found to be same as in the well established literature such as Lohmann and Lechtenfeld (2015), and Fichera and Savage (2015). The control variables; education and age of the household head show an anticipated evidence. The level of education of the household head have a positive and statistically significant impact on crop revenue, while the same does not hold true for production of paddy rice. Production of crops demand labor capacity, thus, as the level of education of the household head increases, evidently, the amount of time spent in agricultural activity decreases. The result shows the trade off in the human capital investment between the two dependent variable.

## 7.4 Drought and the coping mechanism

The reason for examining households revenue is to understand how individual cope with fluctuations in their incomes which in turn have an adverse impact on household food consumption. This assumption is largely acknowledged by the fact that rural household's consumption budget is skewed towards food consumption. In addition, the majority of individuals in poor, rural settings are engaged in agriculture (in YL sample, Wave II 73 % lives in rural area), thus their livelihoods are often subject to great uncertainty from weather and natural disasters, from sickness and from fluctuations in the prices of their crops. Table 22 presents regression results for coping strategies; asset and social network. Asset describes whether household's vulnerability to drought depends on the economic position. Previous evidence points out that households from higher income distribution are more likely to smooth out negative consumption effects of drought by selling of assets . Table 22, column (1), reveal statistically significant evidence for differential drought-related health effects by ownership of asset. The column (2) show results for what role informal social network can have on drought. Social network refers to the question if households had a problem, is there someone who would help out, therefore, it is treated as a binary variable. However, the results does not reveal statistically significant evidence on social network. This indicates that network that is available in the community does not outweigh the amount of damage from drought. Remember that droughts are covariate shocks, thus, even a strong network within community or at village level can seldom fully provide assistance to disasters.

## 8 Caveats and Conclusions

Psychosocial competencies; aspiration, self-efficacy and self-esteem are so called *"soft skills"* that together with education *"hard skills"* are leading determinants of economic growth, employment and earnings in modern knowledge-based economics. There is a large literature on the effect of education on the overall economy; however, far fewer papers have studied the importance of psychosocial competencies. In this paper, I have tried to narrow the gap of children's psychosocial competencies and its determinants by employing a climatic shock, which act as an exogenous variation in the empirical strategy. Education together with psychosocial competencies are two key inputs in the learning production function, therefore understanding what drives children's low psychosocial competencies has relevant policy implications. This paper contributes to the literature that investigates how climatic shock through malnutrition influence on early adolescents psychosocial competencies in low-income countries, where children are largely left behind. Although, it is a much-studied question whether climate shocks have an impact on children's live. To my knowledge, this is the first paper to look at self-reported droughts and psychosocial competencies of early Indian adolescents. I explore the link between malnutrition at age 8 living in Andhra Pradesh, India and their early psychosocial competencies at 12 years old. The question is of particular interest in this context: first because India is

experiencing a large economic growth where the middle-income group is increasing and second because despite the growth, it still remains one of the world's unfavourable place for children to grow up. Previous hypotheses state that the rate of stunting and wasting in India are in larger extent inferior to their counterparts in sub-Saharan Africa. In contrast to what Dercona and Sanchez (2013) provides, my paper explores a causal link between malnutrition and early adolescent's psychosocial competencies. My estimation shows that for the average household in the sample who reported to have experienced drought shock between years 2002-2006, the children are malnourished which is consistent with the general results found in the literature. While, the results from IV estimation provides me with somewhat interesting results. Malnutrition of children have a negative and statistically significant effect on early adolescents self-efficacy; however, the result reports no association for children's malnutrition having impact on their educational aspiration nor on self-esteem. Although, the coefficient have the correct sign it is, nevertheless, not statistically significant. This is, certainly not conclusive, measuring psychosocial competencies is non-trivial challenge, and it is possible that the failure to detect a significant effect partially is a reflection of measurement issues. Further, the results presented give some new evidence and are to certain extent plausible, yet it suffers from few data related drawbacks. In particular, the self-reported droughts demand for some caution when interpreting the results since it comes with limited geographical variation. More to, the YL sample only covers one state in India, therefore, the commonality of generalizability to the results should be made with clear assumptions about the extent to which rural households behave similarly in other contexts. Finally, child malnutrition and its impact on both short and long term, rest, a complex development policy challenge addressing for coordinated policy response on various levels such as expanding basic health care facilities, water quality and sanitation but more crucially early age intake of essential nutrition.

# References

Adams, P., Hurd, M. D., McFadden, D., Merrill, A., and Ribeiro, T. (2003). Healthy, wealthy, and wise? tests for direct causal paths between health and socioeconomic status. *Journal of Econometrics*, 112(1):3 – 56.

Ahmed, H. (2015). Rainfall shocks and children's well-being in India.

Akresh, R. (2016). Climate change, conflict, and children. *The Future of Children*, 26(1):51–71.

Almlund, M., Duckworth, A. L., Heckman, J., and Kautz, T. (2011). Chapter 1 - personality psychology and economics1. In Eric A. Hanushek, S. M. and Woessmann, L., editors, *Handbook of The Economics of Education*, volume 4 of *Handbook of the Economics of Education*, pages 1 – 181. Elsevier.

Almond, D. (2006). Is the 1918 influenza pandemic over? long-term effects of in utero influenza exposure in the post-1940 us population. *Journal of Political Economy*, 114(4):672–712.

Almond, D. and Currie, J. (2011). Killing me softly: The fetal origins hypothesis. *Journal of Economic Perspectives*, 25(3):153–72.

Almond, D., Edlund, L., and Palme, M. (2009). Chernobyl's subclinical legacy: prenatal exposure to radioactive fallout and school outcomes in sweden. *Quarterly Journal of economics*, 124(4):1729–1772.

Almond, D. and Mazumder, B. A. (2011). Health capital and the prenatal environment: the effect of ramadan observance during pregnancy. *American Economic Journal: Applied Economics*, 3(4):56–85.

Bandura, A., Barbaranelli, C., Caprara, G. V., and Pastorelli, C. (2001). Self-efficacy beliefs as shapers of children's aspirations and career trajectories. *Child development*, 72(1):187–206.

Barker, D., Lampl, M., Roseboom, T., and Winder, N. (2012). Resource allocation in utero and health in later life. *Placenta*, 33:e30–e34.

Becker, G. S. and Tomes, N. (1986). Human capital and the rise and fall of families. *Journal of labor economics*, 4(3, Part 2):S1–S39.

Bobonis, G. J., Miguel, E., and Puri-Sharma, C. (2006). Anemia and school participation. *The Journal of Human Resources*, 41(4):692–721.

Borghans, L., Golsteyn, B. H., Heckman, J., and Humphries, J. E. (2011). Identification problems in personality psychology. *Personality and Individual Differences*, 51(3):315 – 320. Special Issue on Personality and Economics.

Case, A. and Paxson, C. (2008a). Height, health, and cognitive function at older ages. *American Economic Review*, 98(2):463–467.

Case, A. and Paxson, C. (2008b). Stature and status: Height, ability, and labor market outcomes. *Journal of political Economy*, 116(3):499–532.

Chong, A., Cohen, I., Field, E., Nakasone, E., and Torero, M. (2016). Iron deficiency and schooling attainment in Peru. *American Economic Journal: Applied Economics*, 8(4):222–55.

Coneus, K., Laucht, M., and Reub, K. (2012). The role of parental investments for cognitive and noncognitive skill formation. evidence for the first 11 years of life. *Economics & Human Biology*, 10(2):189 – 209.

Cortina, J. M. (1993). What is coefficient alpha? an examination of theory and applications. *Journal of Applied Psychology*, 78(1):98.

Cunha, F. and Heckman, J. J. (2008). Formulating, identifying and estimating the technology of cognitive and noncognitive skill formation. *Journal of Human Resources*, 43(4):738–782.

Cunha, F. and Heckman, J. J. (2009). The economics and psychology of inequality and human development. *Journal of the European Economic Association*, 7(2-3):320–364.

Cunha, F., Heckman, J. J., and Schennach, S. M. (2010). Estimating the technology of cognitive and noncognitive skill formation. *Econometrica*, 78(3):883–931.

Deaton, A. and Arora, R. (2009). Life at the top: the benefits of height. *Economics & Human Biology*, 7(2):133–136.

Dercon, S. (2001). Assessing vulnerability. *Publication of the Jesus College and CSAE, Department of Economics, Oxford University.*

Dercon, S. and Singh, A. (2013). From nutrition to aspirations and self-efficacy: Gender bias over time among children in four countries. *World Development*, 45:31–50.

Dercona, S. and Krishnan, P. (2009). Poverty and the psychosocial competencies of children: Evidence from the young lives sample in four developing countries. *Children, Youth and Environments*, 19(2):138–169.

Dercona, S. and Sanchez, A. (2013). Height in mid childhood and psychosocial competencies in late childhood: evidence from four developing countries. *Economics and Human Biology*, 11(4):426–432.

Dupas, P. (2011). Health behavior in developing countries. *Annual Review of Economics*, 3(1):425–449.

Dupas, P. (2013). Why don't the poor save more? evidence from health savings. *American Economi*, vol.103(4):pages 1138–71.

Eren, O. and Oxbeklik, S. (2013). The effect of noncognitive ability on the earnings of young men: A distributional analysis with measurement error correction. *Labour E*, 24:293–304.

Farkas, G. (2003). Cognitive skills and noncognitive traits and behaviors in stratification processes. *Annual review of sociology*, pages 541–562.

Fichera, E. and Savage, D. (2015). Income and health in Tanzania. an instrumental variable approach. *World Development*, 66:500–515.

Field, E., Robles, O., and Torero, M. (2009). Iodine deficiency and schooling attainment in tanzania. *American Economic Journal: Applied Economics*, 1(4):140–169.

Fletcher, J. M. and Wolfe, B. (2016). The importance of family income in the formation and evolution of non-cognitive skills in childhood. *Economics of Education Review*, 54:143 – 154.

Gertler, P. and Gruber, J. (2002). Insuring consumption against illness. *American Economic Review*, 92(1):51–70.

Gertler, P., Heckman, J., Pinto, R., Zanolini, A., Vermeersch, C., Walker, S., Chang, S. M., and Grantham-McGregor, S. (2013). Labor market returns to early childhood stimulation: a 20-year followup to an experimental intervention in Jamaica.

Glewwe, P. and King, E. M. (2001). The impact of early childhood nutritional status on cognitive development: Does the timing of malnutrition matter? *The World Bank Economic Review*, 15(1):81–113.

Grönqvist, E., Öckert, B., and Vlachos, J. (2010). The intergenerational transmission of cognitive and non-cognitive abilities. IFAU.

Grossman, M. (1972). On the concept of health capital and the demand for health. *Journal of Political Economy*, 80(2):223–255.

Grossman, M. (2003). Household production and health. *Review of Economics of the Household*, 1(4):331–342.

Hanna, R. and Oliva, P. (2016). Implications of climate change for children in developing countries. *The Future of Children*, 26(1):115–132.

Heckman, J. J. (2007). The economics, technology and neuroscience of human capability formation. Working Paper 13195, National Bureau of Economic Research.

Heckman, J. J. and Kautz, T. (2012). Hard evidence on soft skills. *Labour Economics*, 19(4):451 – 464. European Association of Labour Economists 23rd annual conference, Paphos, Cyprus, 22-24th September 2011.

Heckman, J. J., Malofeeva, L., Pinto, R., and Savelyev, P. (2009). The effect of the perry preschool program on the cognitive and non-cognitive skills of its participants.

Heckman, J. J. and Rubinstein, Y. (2001). The importance of noncognitive skills: Lessons from the ged testing program. *American Economic Review*, 91(2):145–149.

Heckman, J. J., Stixrud, J., and Urzua, S. (2006). The effects of cognitive and noncognitive abilities on labor market outcomes and social behavior. *Journal of Labor Economics*, 24(3):411 – 482.

Heineck, G. (2007). Does it pay to be nice? personality and earnings in the UK. LASER Discussion Paper.

Howard, L. L. (2011). Does food insecurity at home affect non-cognitive performance at school? a longitudinal analysis of elementary student classroom behavior. *Economics of Education Review*, 30(1):157 – 176.

Jayachandran, S. and Kuziemko, I. (2011). Why do mothers breastfeed girls less than boys? evidence and implications for child health in India. *Quarterly Journal of Economics*, 126(3):1485–1538.

Jayachandran, S. and Pande, R. (2015). Why are indian children so short?

Krishnan, P. and Krutikova, S. (2013). Non-cognitive skill formation in poor neighbourhoods of urban India. *Labour Economics*, 24:68 – 85.

Kumar, S., Molitor, R., and Vollmer, S. (2014). Children of drought: Rainfall shocks and early child health in rural India. *Working paper*.

Leight, J., Glewwe, P., and Park, A. (2014). The impact of early childhood shocks on the evolution of cognitive and non-cognitive skills. *Unpublished manuscript*.

Lindqvist, E. and Vestman, R. (2011). The labor market returns to cognitive and noncognitive ability: Evidence from the swedish enlistment. *American Economic Journal: Applied Economics*, 3(1):101–128.

Lohmann, S. and Lechtenfeld, T. (2015). The effect of drought on health outcomes and health expenditure in rural Vietnam. *World Development*, 72:432–448.

Macallan, D. (2005). Malnutrition and infection. *Medicine*, 33(3):14–16.

Maccini, S. and Yang, D. (2009). Under the weather: Health, schooling, and economic consequences of early-life rainfall. *American Economic Review*, 99(3):1006–1026.

Miguel, E., Satyanath, S., and Sergenti, E. (2004). Economic shocks and civil conflict: An instrumental variables approach. *Journal of Political Economy*, 112(4):725–753.

Mullainathan, S. and Shafir, E. (2013). *Scarcity: Why having too little means so much*. Macmillan.

Paxson, C. and Schady, N. (2007). Cognitive development among young children in ecuador the roles of wealth, health, and parenting. *Journal of Human resources*, 42(1):49–84.

Saunders, J., Smith, T., and Stroud, M. (2011). Malnutrition and undernutrition. *Medicine*, 39(1):45–50.

Shetty, P. (2006). Malnutrition and undernutrition. *Medicine*, 34(12):524–529.

Tarozzi, A. (2008). Growth reference charts and the nutritional status of indian children. *Economic and Human Biology*, 6(3):455–468.

Tarozzi, A. and Mahajan, A. (2007). Child nutrition in India in the nineties. *Economic Development and Cultural Change*, 55(3):pp. 441–486.

Tiwari, S. and Jacoby, H. G. (2013). Monsoon babies: rainfall shocks and child nutrition in Nepal.

Tranchant, J.-P., Justino, P., Müller, C., et al. (2014). Political violence, drought and child malnutrition: Empirical evidence from Andhra Pradesh, India.

Yi, J., Heckman, J. J., Zhang, J., and Conti, G. (2015). Early health shocks, intra-household resource allocation and child outcomes. *Economic Journal*, 125(588):F347–F371.

Zivin, J. G. and Shrader, J. (2016). Temperature extremes, health, and human capital. *The Future of Children*, pages 31–50.

**Figures and Tables**



Figure 1: Andrah Pradesh is a state in South east of India. The YL data includes 7 districts with 20 anonymised villages. Its distinguishing features can be categorized into three agro-climatic regions; Coastal Andhra, Rayalseema and Telangan where YL dataset captures the interregional variations. Its sub-ecological zones across the communities are described mainly by costal and inland plan. The two states; Andhra Pradesh and Telangana were united until June 2014, after Telangana, the north-western part of Andhra Pradesh bifurcated to form a new state. Both together accounted for the fifth largest population in India.

Table 1: Demographic Summary Statistics

| Sample Characteristics | | | | |
|---|---|---|---|---|
| **Child Characteristics** | Mean (Std.dev) | Min | Max | Obs |
| Age | 12.370 (0.339) | 11.57 | 13.14 | 928 |
| Height-for-age Z (wave I ) | - 1.557 (1.026) | -5.60 | 2.01 | 970 |
| Weight-for-age Z (wave I ) | - 1.903 (0.980) | -3-99 | 2.35 | 969 |
| Height (cm) | 141.484 (7.586) | 101.20 | 172.20 | 928 |
| Weight (kg) | 31.607 (6.517) | 15.60 | 62.20 | 928 |
| BMI [ calculated BMI = weight/height 2 ] | 15.670 (2.233) | 11.06 | 33.39 | 928 |
| BMI for age Z-score | -1.483 (1.230) | -5.37 | 3.04 | 928 |
| | | | | |
| **Household Characteristics** | | | | |
| Caregiver's age | 34.885 (6.241) | 20 | 74 | 927 |
| Caregiver's education | 1.501 (.795) | 1 | 3 | 926 |
| Mother's age | 34.666 (5.646) | 24 | 64 | 915 |
| Mother's level of education | 2.332 (3.857) | 0 | 15 | 893 |
| Father's age | 40.791 (6.339) | 28 | 70 | 883 |
| Father's level of education | 4.028(4.962) | 0 | 15 | 830 |
| Age of household head | 42.506 (9.655) | 24 | 94 | 928 |
| Household head's level of education | 3.886 (5.153) | 0 | 28 | 924 |
| Household size (members in the family) | 5.199 (1.832) | 2 | 22 | 928 |
| | | | | |
| Housing quality index | .550 (.276) | .015 | 1 | 928 |
| Consumer durables index | .234 (.197) | 0 | .89 | 928 |
| Access to electricity | .896 (.304) | 0 | 1 | 928 |
| Drinking quality | .952 (.212) | 0 | 1 | 928 |
| Sanitation quality | .339 (.473) | 0 | 1 | 928 |
| Cooking fuel quality | .266 (.442) | 0 | 1 | 928 |
| Housing services index | .613 (.250) | 0 | 1 | 928 |
| Wealth index | .464 (.197) | .007 | .92 | 928 |

Notes: Data drawn from Wave II (unless otherwise noted) of the Young Lives survey for Andhra Pradesh, India. The sample includes older children who are present in both waves. The 2002 and 2006 waves account for 73% and 92% of the observations, respectively. Standard errors are in parentheses. Source: Author's calculations based on the YL dataset.
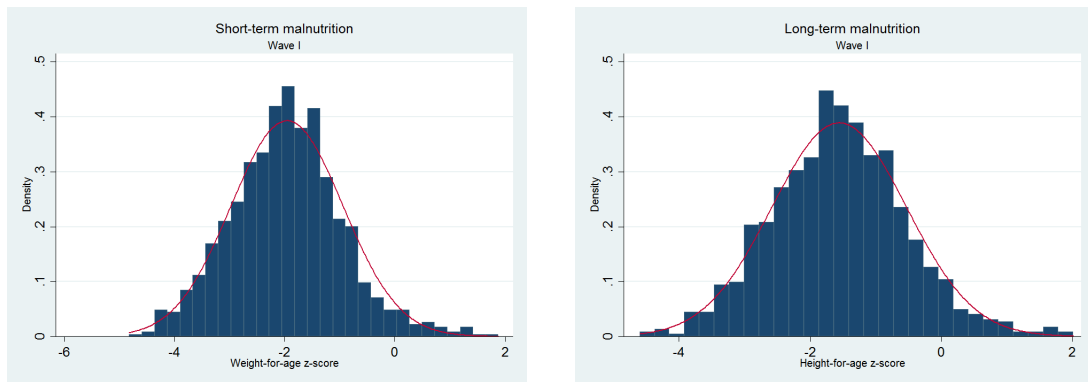


Figure 2: Notes: The histogram shows the density of short-term (weight-for-age z-score) and long-term (height-for-age z-score) malnutrition for YL children in year 2002, wave I. The immediate observation from the histogram of the raw data is that the sample includes children with very high wasting and stunting. Extreme values (defined as WAZ $\leq -4$, WAZ$\geq 2$ and HAZ $\leq -5$) are excluded in the analysis. Source: Author's calculations based on the YL dataset.

Table 2: Descriptive statistics for HAZ and WAZ

|  | All children | Gender | |
|---|---|---|---|
|  |  | Girls | Boys |
| Height-for-age | -1.561 (1.035) | -1.526 (1.057) | -1.596 (1.013) |
| Stunted (%) | 34 | 17 | 17 |
| Weight-for-age | -1.911 (.996) | -1.886 (.956) | -1.939 (1.039) |
| Wasted (%) | 48 | 23 | 25 |

Notes: Based on children aged 7-8 years old. Stunted refers to children whose height-for-age z-scores were more than 2 standard deviations below the median height of the international reference group of children of the same age. A similar definition based on the weight-for-age z-score is used to define wasting. Source: Author's calculations based on the YL dataset.

Table 3: Nutritional Indicators across Drought and Non-drought affected Districts

|  | Height-for-age z-score | Weight-for-age z-score |
|---|---|---|
| *Average* |  |  |
| Children living in: |  |  |
| Drought - affected Districts | -1.740 (1.066) | -2.035 (.981) |
| Non-Drought affected Districts | -1.481 (0.999) | -1.849 (.975) |

Notes: The calculation is based on the subjective drought variable in relation to the average nutritional status when children are of 8 years old. The values are mean differences across the groups. Source: Author's calculations based on the YL dataset, Wave I (year 2002).

Table 4: Correlation study of Severe illness and Drought Shock

|  | Severe illness of Mother |
|---|---|
| Drought subjective | 0.1452* |
| Drought objective | 0.0541 |

Notes: Correlation study between severe illness of mothers and self-reported droughts. The severe illness of mothers are reported in the survey conditional on having experienced it between wave I and II. Source: Author's calculations based on Young Lives Survey dataset.

**Histograms of Psychosocial Competencies**
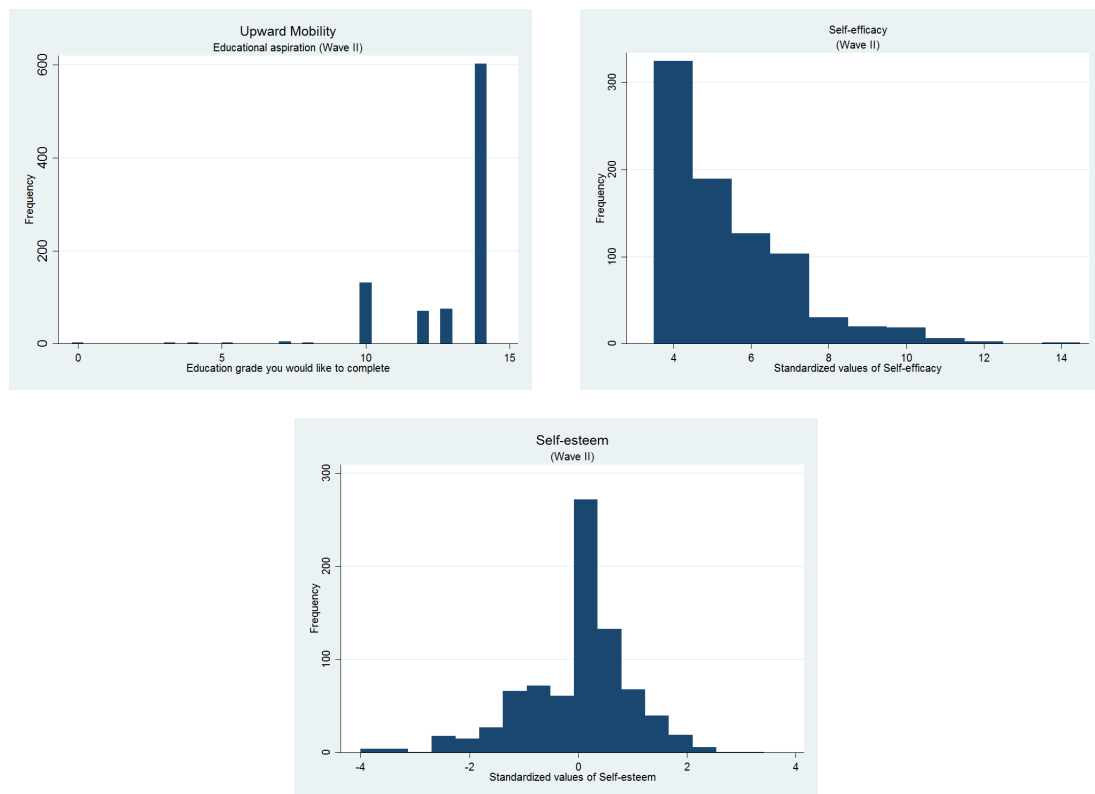


Figure 3: Notes: Histograms of psychosocial competencies when YL children are age of 12 years old. All measurement indices are standardized to have mean 0 and variance 1 in each of the personality traits; Upward mobility (Aspiration), Self-esteem and Self-efficacy. Source: Author's calculations based on the YL dataset, Wave II (year 2006).

Table 5: Psychosocial statements with raw scores

| Measurements of Psychosocial traits | | |
|---|---|---|
| Characteristics | Statement | Mean Score |
| Self-esteem | I feel proud to show my friends or other visitors where I live | 1.30 (.652) |
| | I am ashamed of my clothes$^a$ | 3.67 (.760) |
| | I feel proud of the job done by the head of household | 1.33 (.687) |
| | I am often embarrassed because I do not have the right books, | |
| | pencils or other equipment for school$^a$ | 3.28 (1.09) |
| | I am proud of my achievements at school | 1.52 (.767) |
| | I am worried that I don't have the correct uniform | 3.53 (.915) |
| Self-efficacy | If I try hard I can improve my situation in life | 1.14 (.421) |
| | Other people in my family make all the decisions$^a$ | |
| | about how I spend my time | 1.68 (.957) |
| | I like to make plans for my future studies and work | 1.46 (.781) |
| | If I study hard at school I will be rewarded by a better job in future | 1.20 (.536) |
| Educational aspiration | | |
| (Upward mobility) | Imagine you had no constrains and could stay at school as long as you liked, | |
| | what level of formal education would you like to complete? | 13.06 (1.67) |

Notes: The score indicates the extent to which the respondent agrees with each statement. Mean score is on a scale from 1 to 4 ( 1 - strongly disagree, 2 - disagree, 3 - agree , 4 - strongly agree). The reverse score is presented for the negative statements, indicated by $a$. Standard errors in brackets. Source: Author's calculations based on the YL dataset, Wave II (year 2006).

Table 6: Measurements of Psychosocial traits

| Psychosocial index | Mean | Std |
|---|---|---|
| Grade Aspiration (Upward mobility) | 13.067 | (1.675) |
| Self-efficacy | 1.351 | (0.107) |
| Self-esteem | 2.445 | (0.384) |

Notes: The mean indicates the mean of total sum of responses for each of the psychosocial competencies. See Table 5 for detailed computational sequence for each psychosocial index. Source: Author's calculations based on the YL dataset - Wave II (2006).
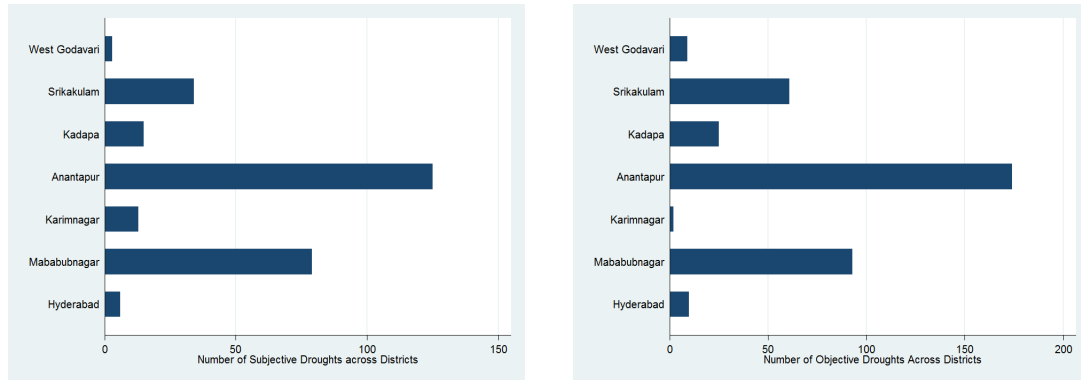


Figure 4: Notes: Number of subjective and objective droughts across seven districts in Andhra Pradesh. Households' and communities self-reported drought between years 2002-2006. Source: Author's calculations based on the YL dataset - Wave II (2006).

Table 7: Who Was Affected by Drought (Subjective)

| Who was affected by drought | Frequency | Percent (%) |
|---|---|---|
| Only affected my household | 39 | 14.18 |
| Affected my household and some other in this village | 120 | 43.64 |
| Affected all household in this village | 84 | 30.55 |
| Affected this village and other village | 32 | 11.64 |

Notes: Households' self-reported drought measurement. Source: Author's calculation based on the YL dataset - Wave II (2006).
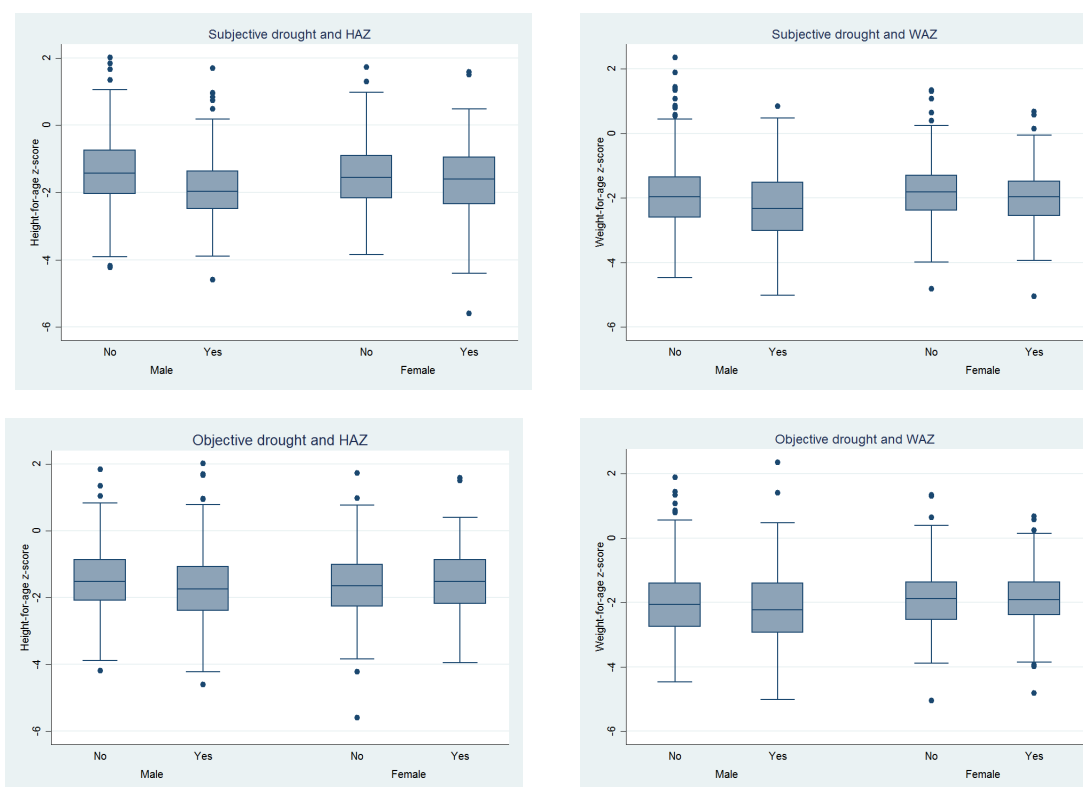
Figure 5: Notes: Gender differences in malnourishment and in drought experience, Andhra Pradesh - Young Lives survey dataset. Source: Author's calculations based on the YL dataset.

Table 8: Exposure of Rural Households to Drought in Andhra Pradesh, year 2002-2006

| District | % of households who suffered from drought (Household survey) | Who was affected (%) | | | | % of rural villages which suffered from drought ( Community survey) |
|---|---|---|---|---|---|---|
| | | Household only | Household and others in villages | All households in villages | Village and beyond | |
| *Region: Costal Andhra* | | | | | | |
| West Godavari | 1 | 5.1 | 0.8 | 0 | 0 | 2.4 |
| Srikakulam | 13 | 43.6 | 8.4 | 4.9 | 9.4 | 16.5 |
| | | | | | | |
| *Region: Rayalaseem* | | | | | | |
| Kadapa | 6 | 0 | 6.7 | 6.1 | 3.1 | 6.8 |
| Anantapur | 46 | 20.5 | 60.5 | 53.7 | 0 | 47 |
| | | | | | | |
| *Region: Telangana* | | | | | | |
| Karimnagar | 5 | 0 | 5 | 8.5 | 0 | 0.5 |
| Mahboobnagar | 29 | 23.1 | 16.8 | 26.8 | 87.5 | 25.1 |
| | | | | | | |
| *Region: State Capital* | | | | | | |
| Hyderabad | 2 | 7.7 | 2.5 | 0 | 0 | 2.7 |
| | | | | | | |
| Whole sample | 30 | 14 | 44 | 30 | 12 | 47 |

Notes: The distribution of drought exposure on rural household in Andhra Pradesh. The sample consists of YL child from older cohort present in the two waves 2002-2006. The Column (1) yields the number of droughts in each district from the total number of droughts in Andhra Pradesh derived from the subjective drought variable. Last row describes the number of droughts in Andhra Pradesh from whole sample (affected and non-affected drought households). The columns (2) - (5) yields the number of droughts in Andhra Pradesh and its distribution across four different response catagories. Column (6) yields percentage of rural villages suffered from drought derived from the objective drought variable. Source: Author's calculation based on the YL dataset.
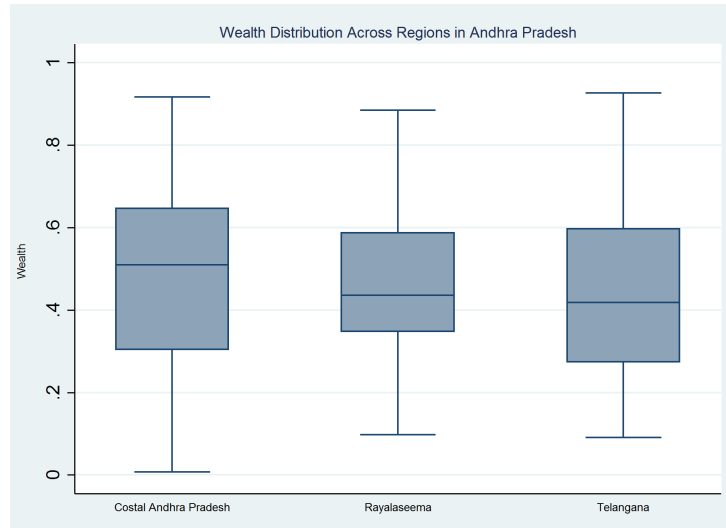
Figure 6: Notes: The Box plots illustrates the wealth distribution across the three different regions in Andhra Pradesh. Source: Author's calculation based on the YL dataset.

Table 9: Correlation between psychosocial competencies and nutrition

| Psychosocial competencies | HAZ | WAZ | Wealth | Illness |
|---|---|---|---|---|
| Aspiration | 0.108 | 0.128 | 0.167 | 0.002 |
| Self-esteem | 0.071 | 0.114 | 0.093 | 0.023 |
| Self-efficacy | 0.002 | 0.08 | -0.067 | -0.044 |

Notes: The Table describes the correlation matrix across the three psychosocial competencies. It gives a general description of the relationship between three psychosocial competencies and main explanatory variable which is valuable for understanding their magnitude and interrelation. Source: Author's calculations based on Young Lives Survey dataset.

Table 10: Direct effect: Does Malnutrition(WAZ) Affect Children's Psychosocial Competencies?

| Variables | (1) Aspiration | (2) Self-esteem | (3) Self-efficacy |
|---|---|---|---|
| WAZ | 0.0548 | 0.0567 | 0.0818 |
| | (0.0582) | (0.0788) | (0.0550) |
| Gender: Female | -0.455*** | 0.258 | -0.0681 |
| | (0.112) | (0.158) | (0.113) |
| Child's age in years | 0.133 | -0.0950 | 0.278 |
| | (0.165) | (0.245) | (0.182) |
| Mother severe ill | 0.0523 | 0.210 | -0.236 |
| | (0.181) | (0.244) | (0.199) |
| HH size between 9-12 | 0.252 | -0.568 | -0.0624 |
| | (0.233) | (0.448) | (0.256) |
| HH size > 13 | 0.239 | -1.503* | 0.170 |
| | (0.500) | (0.840) | (0.498) |
| Child's ethnicity, ST | 0.174 | -0.160 | 0.301 |
| | (0.206) | (0.352) | (0.224) |
| Child's ethnicity, BC | -0.138 | 0.229 | 0.0910 |
| | (0.160) | (0.209) | (0.151) |
| Child's first language, other local languages | -0.176 | 0.0538 | 0.219 |
| | (0.149) | (0.234) | (0.185) |
| Caregiver's relationship to child, other relatives | -0.567 | 0.427 | 0.0796 |
| | (0.357) | (0.473) | (0.304) |
| Caregiver's education level, elementary | 0.137 | -0.0289 | -0.241 |
| | (0.169) | (0.255) | (0.168) |
| Caregiver's education level, secondary | 0.680*** | 0.231 | -0.663*** |
| | (0.133) | (0.213) | (0.154) |
| Region: Rayalaseema | -0.00762 | -0.923*** | 0.0965 |
| | (0.137) | (0.212) | (0.165) |
| Region: Telangana | -0.101 | -1.272*** | -0.163 |
| | (0.146) | (0.189) | (0.130) |
| Site: Rural | 0.0853 | 0.381 | -0.677*** |
| | (0.161) | (0.253) | (0.178) |
| Wealth | 0.998*** | 0.808 | -1.042*** |
| | (0.353) | (0.565) | (0.382) |
| Constant | 11.19*** | 15.67*** | 3.255 |
| | (2.106) | (3.036) | (2.308) |
| Observations | 839 | 806 | 816 |
| R-squared | 0.078 | 0.085 | 0.054 |

Notes: The estimation results report the direct effect estimated by OLS. The robust standard errors are presented in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 11: Direct effect: Does Malnutrition (HAZ) Affect Children's Psychosocial Competencies?

| Variables | (1) Aspiration | (2) Self-esteem | (3) Self-efficacy |
|---|---|---|---|
| HAZ | 0.0963* | 0.105 | 0.0801 |
| | (0.0548) | (0.0785) | (0.0597) |
| Gender: Female | -0.443*** | 0.270* | -0.0465 |
| | (0.112) | (0.158) | (0.112) |
| Child's age in years | 0.160 | -0.0670 | 0.284 |
| | (0.164) | (0.245) | (0.181) |
| Mother severe ill | 0.0498 | 0.204 | -0.235 |
| | (0.182) | (0.244) | (0.198) |
| HH size between 9-12 | 0.252 | -0.569 | -0.0472 |
| | (0.231) | (0.448) | (0.255) |
| HH size > 13 | 0.221 | -1.520* | 0.149 |
| | (0.504) | (0.836) | (0.499) |
| Child's ethnicity, ST | 0.178 | -0.153 | 0.310 |
| | (0.206) | (0.354) | (0.224) |
| Child's ethnicity, BC | -0.138 | 0.231 | 0.0880 |
| | (0.160) | (0.208) | (0.151) |
| Child's first language, other local languages | -0.151 | 0.0796 | 0.214 |
| | (0.147) | (0.234) | (0.186) |
| Caregiver's relationship to child, other relatives | -0.540 | 0.456 | 0.0892 |
| | (0.357) | (0.472) | (0.303) |
| Caregiver's education level, elementary | 0.170 | 0.00757 | -0.249 |
| | (0.167) | (0.254) | (0.169) |
| Caregiver's education level, secondary | 0.675*** | 0.226 | -0.665*** |
| | (0.134) | (0.212) | (0.154) |
| Region: Rayalaseema | 0.00836 | -0.905*** | 0.0925 |
| | (0.135) | (0.212) | (0.163) |
| Region: Telangana | -0.0906 | -1.259*** | -0.180 |
| | (0.144) | (0.188) | (0.129) |
| Site: Rural | 0.102 | 0.399 | -0.684*** |
| | (0.160) | (0.252) | (0.178) |
| Wealth | 0.983*** | 0.786 | -1.039*** |
| | (0.349) | (0.564) | (0.382) |
| Constant | 10.88*** | 15.35*** | 3.142 |
| | (2.080) | (3.023) | (2.298) |
| Observations | 838 | 805 | 815 |
| R-squared | 0.081 | 0.085 | 0.054 |

Notes: The estimation results report the direct effect estimated by OLS. The robust standard errors are presented in parentheses. *** $p<0.01$, ** $p<0.05$, * $p<0.1$

Table 12: First Stage: Effects of Subjective Drought Shock on Child Malnutrition (HAZ)

| First stage: Drought shock on Child Malnutrition (HAZ) Outcome variables | (1) Aspiration | (2) Self-esteem | (3) Self-efficacy |
|---|---|---|---|
| Subjective drought (self-reported) | -0.191** | -0.202** | -0.176** |
| | (0.0865) | (0.0881) | (0.0874) |
| Gender: Female | -0.105 | -0.120* | -0.103 |
| | (0.0681) | (0.0691) | (0.0685) |
| Child's age in years | -0.216** | -0.223** | -0.187* |
| | (0.104) | (0.106) | (0.105) |
| Mother ill | 0.0332 | 0.0715 | 0.00574 |
| | (0.118) | (0.120) | (0.117) |
| HH size between 9-12 | 0.147 | 0.130 | 0.151 |
| | (0.184) | (0.184) | (0.190) |
| HH size > 13 | 0.0545 | 0.0217 | 0.0274 |
| | (0.374) | (0.372) | (0.371) |
| Child's ethnicity, ST | -0.0809 | -0.139 | -0.122 |
| | (0.138) | (0.138) | (0.138) |
| Child's ethnicity, BC | 0.0323 | 0.0150 | 0.0177 |
| | (0.0912) | (0.0931) | (0.0922) |
| Child's first language, other local languages | 0.0115 | -0.00371 | -0.0208 |
| | (0.0962) | (0.0966) | (0.0970) |
| Caregiver's relationship to child, other relatives | -0.460** | -0.497*** | -0.440** |
| | (0.194) | (0.190) | (0.200) |
| Caregiver's education level, elementary | -0.0784 | -0.0831 | -0.0865 |
| | (0.108) | (0.110) | (0.109) |
| Caregiver's education level, secondary | 0.222** | 0.203** | 0.209** |
| | (0.0984) | (0.100) | (0.0990) |
| Region: Rayalaseema | -0.351*** | -0.340*** | -0.342*** |
| | (0.0944) | (0.0953) | (0.0949) |
| Region: Telangana | -0.139 | -0.132 | -0.105 |
| | (0.0870) | (0.0885) | (0.0878) |
| Site: Rural | -0.0413 | -0.0391 | -0.0475 |
| | (0.107) | (0.110) | (0.108) |
| Wealth | 0.621** | 0.664*** | 0.618** |
| | (0.243) | (0.246) | (0.244) |
| Constant | 1.051 | 1.159 | 0.713 |
| | (1.293) | (1.321) | (1.304) |
| | | | |
| Observations | 838 | 805 | 815 |
| R-squared | 0.097 | 0.100 | 0.093 |
| IV F-stat | 4.882 | 5.244 | 4.070 |
| Durbin pval | 0.768 | 0.992 | 0.003 |

Notes: The first stage regression of the endogenous variable height-for-age z-score on the instrument variable, subjective drought measurement for each of the three psychosocial competencies. Standard errors in parentheses with significance level *** p<0.01, ** p<0.05, * p<0.1

Table 13: 2SLS: Does Subjective Drought Affect Early Psychosocial Development

| 2SLS<br>Outcome variables | (1)<br>Aspiration | (2)<br>Self-esteem | (3)<br>Self-efficacy |
|---|---|---|---|
| HAZ | -0.121 | 0.114 | 2.421* |
|  | (0.746) | (0.982) | (1.404) |
| Gender: Female | -0.465*** | 0.271 | 0.184 |
|  | (0.135) | (0.191) | (0.238) |
| Child's age in years | 0.116 | -0.0651 | 0.686* |
|  | (0.228) | (0.313) | (0.382) |
| Mother ill | 0.0492 | 0.204 | -0.174 |
|  | (0.193) | (0.269) | (0.332) |
| HH size between 9-12 | 0.278 | -0.570 | -0.336 |
|  | (0.317) | (0.425) | (0.563) |
| HH size > 13 | 0.229 | -1.520* | 0.115 |
|  | (0.616) | (0.836) | (1.051) |
| Child's ethnicity, ST | 0.162 | -0.151 | 0.579 |
|  | (0.233) | (0.336) | (0.424) |
| Child's ethnicity, BC | -0.135 | 0.231 | 0.0873 |
|  | (0.150) | (0.208) | (0.260) |
| Child's first language, other local languages | -0.149 | 0.0796 | 0.267 |
|  | (0.159) | (0.217) | (0.277) |
| Caregiver's relationship to child, other relatives | -0.645 | 0.461 | 1.149 |
|  | (0.479) | (0.660) | (0.851) |
| Caregiver's education level, elementary | 0.156 | 0.00821 | -0.0685 |
|  | (0.184) | (0.256) | (0.328) |
| Caregiver's education level, secondary | 0.723*** | 0.225 | -1.150*** |
|  | (0.231) | (0.300) | (0.404) |
| Region: Rayalaseema | -0.0816 | -0.901** | 1.033* |
|  | (0.342) | (0.449) | (0.620) |
| Region: Telangana | -0.128 | -1.257*** | 0.140 |
|  | (0.191) | (0.256) | (0.311) |
| Site: Rural | 0.0823 | 0.399 | -0.465 |
|  | (0.185) | (0.257) | (0.326) |
| Wealth | 1.130* | 0.779 | -2.590** |
|  | (0.641) | (0.892) | (1.158) |
| Constant | 11.07*** | 15.34*** | 1.895 |
|  | (2.221) | (3.112) | (3.762) |
| Observations | 838 | 805 | 815 |
| R-squared | 0.065 | 0.085 | - |

Notes: The 2SLS equation of malnutrition measured as height-for-age z-score on psychosocial competencies. Standard errors in parentheses with significance level *** p<0.01, ** p<0.05, * p<0.1

# Appendix A

Table 14: First stage: Subjective Drought Shock on Children's Malnutrition (WAZ)

| First stage: Drought shock on Child Malnutrition (WAZ) Outcome variables | (1) Aspiration WAZ | (2) Self-esteem WAZ | (3) Self-efficacy WAZ |
|---|---|---|---|
| Sujective drought (self-reported) | -0.0944 | -0.117 | -0.109 |
| | (0.0856) | (0.0880) | (0.0871) |
| Gender: Female | 0.152** | 0.131* | 0.146** |
| | (0.0672) | (0.0690) | (0.0682) |
| Child's age in years | -0.0685 | -0.109 | -0.0661 |
| | (0.103) | (0.106) | (0.104) |
| Mother ill | -0.000847 | 0.0194 | 0.00181 |
| | (0.117) | (0.120) | (0.117) |
| HH size between 9-12 | 0.280 | 0.273 | 0.316* |
| | (0.182) | (0.184) | (0.189) |
| HH size > 13 | -0.218 | -0.246 | -0.235 |
| | (0.369) | (0.372) | (0.370) |
| Child's ethnicity, ST | 0.0284 | -0.0278 | -0.0157 |
| | (0.136) | (0.138) | (0.138) |
| Child's ethnicity, BC | 0.00471 | -0.0211 | -0.0169 |
| | (0.0902) | (0.0931) | (0.0919) |
| Child's first language, other local languages | -0.0245 | -0.0320 | -0.0149 |
| | (0.0947) | (0.0962) | (0.0963) |
| Caregiver's relationship to child, other relatives | -0.291 | -0.395** | -0.328 |
| | (0.191) | (0.190) | (0.199) |
| Caregiver's education level, elementary | -0.0954 | -0.0928 | -0.0898 |
| | (0.106) | (0.109) | (0.109) |
| Caregiver's education level, secondary | 0.225** | 0.212** | 0.200** |
| | (0.0972) | (0.100) | (0.0987) |
| Region: Rayalaseema | -0.418*** | -0.401*** | -0.403*** |
| | (0.0932) | (0.0953) | (0.0946) |
| Region: Telangana | -0.325*** | -0.305*** | -0.292*** |
| | (0.0859) | (0.0884) | (0.0873) |
| Site: Rural | -0.102 | -0.0973 | -0.106 |
| | (0.105) | (0.110) | (0.107) |
| Wealth | 0.650*** | 0.707*** | 0.683*** |
| | (0.240) | (0.246) | (0.243) |
| Constant | -1.208 | -0.684 | -1.221 |
| | (1.278) | (1.319) | (1.299) |
| | | | |
| Observations | 837 | 806 | 816 |
| R-squared | 0.109 | 0.110 | 0.106 |
| IV F-stat | 1.216 | 1.774 | 1.566 |
| Durbin p-value | 0.766 | 0.965 | 0.003 |

Notes: The first stage regression of the endogenous variable weight-for-age z-score on the instrument variable, objective drought measurement for each of the three psychosocial competencies. Standard errors in parentheses with significance level *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table 15: 2SLS: Does Subjective Drought Affect Early Psychosocial Development

| 2SLS<br>Outcome variables | (1)<br>Aspiration | (2)<br>Self-esteem | (3)<br>Self-efficacy |
|---|---|---|---|
| WAZ | -0.396 | 0.131 | 3.929 |
| | (1.556) | (1.691) | (3.312) |
| Gender: Female | -0.377 | 0.248 | -0.640 |
| | (0.266) | (0.275) | (0.567) |
| Child's age in years | 0.116 | -0.0875 | 0.496 |
| | (0.200) | (0.292) | (0.470) |
| Mother ill | 0.0434 | 0.210 | -0.167 |
| | (0.200) | (0.267) | (0.485) |
| HH size between 9-12 | 0.372 | -0.588 | -1.210 |
| | (0.521) | (0.601) | (1.259) |
| HH size > 13 | 0.136 | -1.484 | 1.103 |
| | (0.724) | (0.942) | (1.730) |
| Child's ethnicity, ST | 0.191 | -0.158 | 0.345 |
| | (0.238) | (0.314) | (0.572) |
| Child's ethnicity, BC | -0.137 | 0.231 | 0.197 |
| | (0.154) | (0.216) | (0.390) |
| Child's first language, other local languages | -0.188 | 0.0562 | 0.280 |
| | (0.167) | (0.223) | (0.402) |
| Caregiver's relationship to child, other relatives | -0.705 | 0.458 | 1.370 |
| | (0.572) | (0.807) | (1.384) |
| Caregiver's education level, elementary | 0.0952 | -0.0226 | 0.0807 |
| | (0.229) | (0.284) | (0.528) |
| Caregiver's education level, secondary | 0.780** | 0.215 | -1.427* |
| | (0.386) | (0.424) | (0.774) |
| Region: Rayalaseema | -0.208 | -0.891 | 1.790 |
| | (0.715) | (0.773) | (1.504) |
| Region: Telangana | -0.251 | -1.248** | 1.033 |
| | (0.549) | (0.585) | (1.089) |
| Site: Rural | 0.0292 | 0.390 | -0.160 |
| | (0.264) | (0.324) | (0.622) |
| Wealth | 1.302 | 0.753 | -3.777 |
| | (1.128) | (1.363) | (2.559) |
| Constant | 10.47*** | 15.73*** | 8.390 |
| | (2.988) | (3.258) | (6.955) |
| Observations | 837 | 806 | 816 |
| R-squared | 0.012 | 0.084 | - |

Notes: The 2SLS equation of malnutrition measured as weight-for-age z-score on psychosocial competencies. Standard errors in parentheses with significance level *** $p<0.01$, ** $p<0.05$, * $p<0.1$

Table 16: First stage: Objective Drought Shock on Children's Malnutrition

| First stage: Drought shock on Child Malnutrition (WAZ) Outcome variables | (1) Aspiration WAZ | (2) Self-esteem WAZ | (3) Self-efficacy WAZ |
|---|---|---|---|
| Objective drought (self-reported) | -0.118 | -0.117 | -0.109 |
| | (0.0861) | (0.0880) | (0.0871) |
| Gender: Female | 0.151** | 0.131* | 0.146** |
| | (0.0677) | (0.0690) | (0.0682) |
| Child's age in years | -0.0836 | -0.109 | -0.0661 |
| | (0.104) | (0.106) | (0.104) |
| Mother ill | 0.0129 | 0.0194 | 0.00181 |
| | (0.117) | (0.120) | (0.117) |
| HH size between 9-12 | 0.290 | 0.273 | 0.316* |
| | (0.183) | (0.184) | (0.189) |
| HH size > 13 | -0.207 | -0.246 | -0.235 |
| | (0.372) | (0.372) | (0.370) |
| Child's ethnicity, ST | 0.0202 | -0.0278 | -0.0157 |
| | (0.137) | (0.138) | (0.138) |
| Child's ethnicity, BC | -0.0131 | -0.0211 | -0.0169 |
| | (0.0908) | (0.0931) | (0.0919) |
| Child's first language, other local languages | -0.0161 | -0.0320 | -0.0149 |
| | (0.0954) | (0.0962) | (0.0963) |
| Caregiver's relationship to child, other relatives | -0.282 | -0.395** | -0.328 |
| | (0.193) | (0.190) | (0.199) |
| Caregiver's education level, elementary | -0.0903 | -0.0928 | -0.0898 |
| | (0.107) | (0.109) | (0.109) |
| Caregiver's education level, secondary | 0.225** | 0.212** | 0.200** |
| | (0.0979) | (0.100) | (0.0987) |
| Region: Rayalaseema | -0.411*** | -0.401*** | -0.403*** |
| | (0.0940) | (0.0953) | (0.0946) |
| Region: Telangana | -0.337*** | -0.305*** | -0.292*** |
| | (0.0865) | (0.0884) | (0.0873) |
| Site: Rural | -0.0931 | -0.0973 | -0.106 |
| | (0.106) | (0.110) | (0.107) |
| Wealth | 0.700*** | 0.707*** | 0.683*** |
| | (0.241) | (0.246) | (0.243) |
| Constant | -1.039 | -0.684 | -1.221 |
| | (1.286) | (1.319) | (1.299) |
| Observations | 839 | 806 | 816 |
| R-squared | 0.112 | 0.110 | 0.106 |
| IV F-stat | 1.894 | 1.774 | 1.566 |
| Durbin pval | 0.794 | 0.965 | 0.003 |

Notes: The first stage regression of the endogenous variable weight-for-age z-score on the instrument variable, objective drought measurement for each of the three psychosocial competencies. Standard errors in parentheses with significance level *** p<0.01, ** p<0.05, * p<0.1

Table 17: 2SLS: Does Objective Drought Affect Early Psychosocial Development

| 2SLS<br>Outcome variables | (1)<br>Aspiration | (2)<br>Self-esteem | (3)<br>Self-efficacy |
|---|---|---|---|
| WAZ | -0.257 | 0.131 | 3.929 |
| | (1.217) | (1.691) | (3.312) |
| Gender: Female | -0.407* | 0.248 | -0.640 |
| | (0.219) | (0.275) | (0.567) |
| Child's age in years | 0.110 | -0.0875 | 0.496 |
| | (0.195) | (0.292) | (0.470) |
| Mother ill | 0.0494 | 0.210 | -0.167 |
| | (0.195) | (0.267) | (0.485) |
| HH size between 9-12 | 0.338 | -0.588 | -1.210 |
| | (0.454) | (0.601) | (1.259) |
| HH size > 13 | 0.171 | -1.484 | 1.103 |
| | (0.676) | (0.942) | (1.730) |
| Child's ethnicity, ST | 0.182 | -0.158 | 0.345 |
| | (0.231) | (0.314) | (0.572) |
| Child's ethnicity, BC | -0.145 | 0.231 | 0.197 |
| | (0.154) | (0.216) | (0.390) |
| Child's first language, other local languages | -0.181 | 0.0562 | 0.280 |
| | (0.161) | (0.223) | (0.402) |
| Caregiver's relationship to child, other relatives | -0.659 | 0.458 | 1.370 |
| | (0.483) | (0.807) | (1.384) |
| Caregiver's education level, elementary | 0.111 | -0.0226 | 0.0807 |
| | (0.205) | (0.284) | (0.528) |
| Caregiver's education level, secondary | 0.750** | 0.215 | -1.427* |
| | (0.318) | (0.424) | (0.774) |
| Region: Rayalaseema | -0.148 | -0.891 | 1.790 |
| | (0.568) | (0.773) | (1.504) |
| Region: Telangana | -0.212 | -1.248** | 1.033 |
| | (0.457) | (0.585) | (1.089) |
| Site: Rural | 0.0470 | 0.390 | -0.160 |
| | (0.229) | (0.324) | (0.622) |
| Wealth | 1.227 | 0.753 | -3.777 |
| | (0.978) | (1.363) | (2.559) |
| Constant | 10.83*** | 15.73*** | 8.390 |
| | (2.572) | (3.258) | (6.955) |
| Observations | 839 | 806 | 816 |
| R-squared | 0.046 | 0.084 | - |

Notes: The reduced form equation of malnutrition measured as weight-for-age z-score on psychosocial competencies. Standard errors in parentheses with significance level *** $p<0.01$, ** $p<0.05$, * $p<0.1$

Table 18: First stage: Objective Drought Shock on Children's Malnutrition (HAZ)

| First stage: Drought shock on Child Malnutrition (HAZ) Outcome variables | (1) Aspiration HAZ | (2) Self-esteem HAZ | (3) Self-efficacy HAZ |
|---|---|---|---|
| Objective drought (self-reported) | 0.0450 | 0.0134 | 0.0294 |
| | (0.0846) | (0.0861) | (0.0859) |
| Gender: Female | -0.101 | -0.109 | -0.0918 |
| | (0.0734) | (0.0744) | (0.0737) |
| Child's age in years | -0.237** | -0.261** | -0.206* |
| | (0.112) | (0.114) | (0.113) |
| Mother ill | 0.0237 | 0.0670 | -0.000837 |
| | (0.123) | (0.125) | (0.123) |
| HH size between 9-12 | 0.0673 | 0.0491 | 0.0678 |
| | (0.197) | (0.196) | (0.203) |
| HH size > 13 | 0.0901 | 0.0654 | 0.0737 |
| | (0.403) | (0.401) | (0.400) |
| Child's ethnicity, ST | -0.120 | -0.188 | -0.161 |
| | (0.146) | (0.147) | (0.147) |
| Child's ethnicity, BC | -0.0113 | -0.0299 | -0.0265 |
| | (0.0975) | (0.0984) | (0.0979) |
| Child's first language, other local languages | 0.150 | 0.142 | 0.119 |
| | (0.107) | (0.107) | (0.108) |
| Caregiver's relationship to child, other relatives | -0.479** | -0.524*** | -0.460** |
| | (0.200) | (0.196) | (0.207) |
| Caregiver's education level, elementary | -0.0836 | -0.0765 | -0.0875 |
| | (0.115) | (0.117) | (0.117) |
| Caregiver's education level, secondary | 0.184* | 0.165 | 0.167 |
| | (0.107) | (0.109) | (0.107) |
| Region: Rayalaseema | -0.531*** | -0.516*** | -0.506*** |
| | (0.104) | (0.105) | (0.104) |
| Region: Telangana | -0.220** | -0.201** | -0.166* |
| | (0.0952) | (0.0965) | (0.0957) |
| Site: Rural | -0.0513 | -0.0446 | -0.0549 |
| | (0.119) | (0.121) | (0.119) |
| Wealth | 0.797*** | 0.850*** | 0.795*** |
| | (0.258) | (0.261) | (0.258) |
| Constant | 1.255 | 1.579 | 0.902 |
| | (1.397) | (1.427) | (1.408) |
| Observations | 718 | 691 | 699 |
| R-squared | 0.103 | 0.108 | 0.098 |
| IV F-stat | 0.283 | 0.0244 | 0.118 |
| Durbin p-value | 0.610 | 0.640 | 0.001 |

Notes: First stage regression of the endogenous variable height-for-age z-score on the instrument variable, objective drought measurement for each of the three psychosocial competencies. Standard errors in parentheses with *** $p<0.01$, ** $p<0.05$, * $p<0.1$

Table 19: 2SLS: Does Objective Drought Affect Early Psychosocial Development

| 2SLS<br>Outcome variables | (1)<br>Aspiration | (2)<br>Self-esteem | (3)<br>Self-efficacy |
|---|---|---|---|
| HAZ | -1.509 | 6.931 | -15.63 |
| | (4.368) | (45.58) | (45.53) |
| Gender: Female | -0.688 | 1.088 | -1.476 |
| | (0.477) | (4.985) | (4.339) |
| Child's age in years | -0.220 | 1.708 | -2.892 |
| | (1.091) | (12.01) | (9.736) |
| Mother ill | 0.0747 | -0.221 | -0.273 |
| | (0.307) | (3.214) | (1.914) |
| HH size between 9-12 | 0.398 | -0.906 | 1.176 |
| | (0.567) | (2.741) | (4.614) |
| HH size > 13 | 0.263 | -1.943 | 1.205 |
| | (1.024) | (4.168) | (7.147) |
| Child's ethnicity, ST | 0.00987 | 1.170 | -2.318 |
| | (0.650) | (8.748) | (7.940) |
| Child's ethnicity, BC | -0.135 | 0.427 | -0.381 |
| | (0.231) | (1.527) | (1.950) |
| Child's first language, other local languages | 0.0271 | -0.704 | 2.173 |
| | (0.717) | (6.552) | (5.795) |
| Caregiver's relationship to child, other relatives | -1.388 | 3.949 | -7.109 |
| | (2.143) | (23.91) | (21.12) |
| Caregiver's education level, elementary | 0.0611 | 0.437 | -1.633 |
| | (0.447) | (3.553) | (4.334) |
| Caregiver's education level, secondary | 0.949 | -0.925 | 1.983 |
| | (0.844) | (7.587) | (7.806) |
| Region: Rayalaseema | -0.811 | 2.558 | -7.626 |
| | (2.250) | (23.25) | (22.52) |
| Region: Telangana | -0.565 | 0.0862 | -2.668 |
| | (0.971) | (9.148) | (7.599) |
| Site: Rural | 0.0823 | 0.549 | -1.401 |
| | (0.321) | (2.052) | (2.811) |
| Wealth | 2.465 | -5.105 | 11.70 |
| | (3.551) | (38.82) | (36.45) |
| Constant | 12.81* | 4.760 | 16.46 |
| | (6.630) | (73.80) | (48.64) |
| Observations | 718 | 691 | 699 |
| R-squared | - | - | - |

Notes: The reduced form equation of malnutrition measured as height-for-age z-score on psychosocial competencies. Standard errors in parentheses with significance level *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

# Robustness checks

## Table 20: Heterogenous Effects by Gender : Male

### Panel A: Subjective Drought and short-term malnutrition (WAZ)

| | Aspiration | | Self-esteem | | Self-efficacy | |
|---|---|---|---|---|---|---|
| | First stage | 2SLS | First stage | 2SLS | First stage | 2SLS |
| Subjective drought shock | -0.0942 | | -0.126 | | -0.116 | |
| | (0.122) | | (0.126) | | (0.125) | |
| WAZ | | -0.746 | | -0.624 | | 3.299 |
| | | (2.158) | | (2.306) | | (3.769) |
| Control variables | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 406 | 406 | 388 | 388 | 397 | 397 |
| R-squared | 0.144 | - | 0.146 | 0.028 | 0.142 | - |
| IV F - stat | 0.598 | | 1.006 | | 0.869 | |
| Durbin p-val | 0.677 | | 0.768 | | 0.0479 | |

### Panel B: Subjective Drought and long-term malnutriton (HAZ)

| | Aspiration | | Self-esteem | | Self-efficacy | |
|---|---|---|---|---|---|---|
| | First stage | 2SLS | First stage | 2SLS | First stage | 2SLS |
| Sujective drought shock | -0.319*** | | -0.346*** | | -0.309** | |
| | (0.123) | | (0.126) | | (0.125) | |
| HAZ | | -0.0597 | | -0.0120 | | 1.229* |
| | | (0.541) | | (0.779) | | (0.729) |
| Control variables | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 423 | 423 | 404 | 404 | 412 | 412 |
| R-squared | 0.118 | 0.070 | 0.135 | 0.097 | 0.120 | - |
| IV F - stat | 6.754 | | 7.592 | | 6.087 | |
| Durbin p-val | 0.857 | | 0.917 | | 0.0683 | |

### Panel C: Objective Drought and short-term malnutrition (WAZ)

| | Aspiration | | Self-esteem | | Self-efficacy | |
|---|---|---|---|---|---|---|
| | First stage | 2SLS | First stage | 2SLS | First stage | 2SLS |
| Objective drought shock | 0.0610 | | 0.00471 | | 0.0623 | |
| | (0.124) | | (0.128) | | (0.128) | |
| WAZ | | -3.100 | | 121.4 | | -7.291 |
| | | (6.993) | | (3,216) | | (15.16) |
| Control variables | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 351 | 351 | 337 | 337 | 344 | 344 |
| R-squared | 0.130 | | 0.130 | | 0.126 | |
| IV F - stat | 0.241 | | 0.00136 | | 0.237 | |
| Durbin p-val | 0.288 | | 0.0459 | | 0.0200 | |

### Panel D: Objective Drought and long-term malnutriton (HAZ)

| | Aspiration | | Self-esteem | | Self-efficacy | |
|---|---|---|---|---|---|---|
| | First stage | 2SLS | First stage | 2SLS | First stage | 2SLS |
| Objective drought shock | -0.0980 | | -0.130 | | -0.118 | |
| | (0.126) | | (0.129) | | (0.129) | |
| HAZ | | 1.800 | | -3.278 | | 4.186 |
| | | (2.848) | | (3.898) | | (4.590) |
| Control variables | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 366 | 366 | 351 | 351 | 357 | 357 |
| R-squared | 0.101 | | 0.117 | | 0.102 | |
| IV F - stat | 0.601 | | 1.015 | | 0.828 | |
| Durbin p-val | 0.332 | | 0.117 | | 0.0137 | |

49

Notes: The dependet variables are measures of psychosocial skills and the explanatory variables follow same setup as

Table 21: Drought and the agricultural sector

| Variables | Crop Revenue | Rice production |
|---|---|---|
| | (1) | (2) |
| Drought subjective | -0.185 | -0.0317 |
| | (0.182) | (0.0296) |
| Household head education | 0.0512*** | -0.00943*** |
| | (0.0183) | (0.00242) |
| Age of household head | 0.00928 | -0.000566 |
| | (0.0105) | (0.00139) |
| Constant | 8.295*** | 0.294*** |
| | (0.482) | (0.0621) |
| Observations | 316 | 939 |
| R-squared | 0.029 | 0.014 |

Notes: OLS regressions. Dependent variable in natural logarithm. Robust standard errors in parentheses. *** $p<0.01$, ** $p<0.05$, * $p<0.1$. Source: Author's calculations based on the YL dataset - Wave II.

Table 22: Formal and informal coping mechanisms

| Variables | Asset | Social network |
|---|---|---|
| | (1) | (2) |
| Drought subjective | -3.747*** | 0.0254 |
| | (0.776) | (0.0199) |
| Constant | 9.297*** | 0.898*** |
| | (0.511) | (0.0117) |
| Observations | 642 | 943 |
| R-squared | 0.031 | 0.002 |

Notes: OLS regressions. Robust standard errors in parentheses. *** $p<0.01$, ** $p<0.05$, * $p<0.1$. Source: Author's calculations based on the YL dataset - Wave II.

# Appendix B

## B.1 Construction of Wealth Index

The wealth index is intended to be the primary instrument to measure socioeconomic status of the households. It draws on work undertaken by the World Bank and Macro International that developed a wealth index cited in the UNICEF Multiple Indicator Cluster Surveys. The YL's wealth index is the simple average of the three indices: Housing Quality Index (HQ), Consumer Durables Index (CD) and Services Index (SI). Each of the indices are just a simple means of variables that are in a 0-1 range. Hence, the wealth index can take a value between 0 and 1, whereby a higher wealth index indicates a higher socioeconomic status.

### Housing Quality Index

- HQ1 - Rooms per person. Number of rooms divided by the number of household members. The HQ1 variable is set to take a maximum value of unity. Ratios higher than i are recoded accordingly.

- HQ2 - Floor quality. The variable has the value 1 if the floor is made of a finished material (cement, tile or laminated material); 0 otherwise.

- HQ3 - Roof Quality. The variable has the value of 1 if the roof is made of iron, concrete tiles or slates; 0 otherwise.

### Consumer Durables Index

- Constructed from simple means of the following variables; ownership of (i) radio, (ii) bicycle, (iii) motorbike or scooter, (v) motorised vehicle or truck, (vi) landline telephone, and (vii) a modern bed or a table.

### Services Index

- S1 - Electricity, takes the value of 1 if the household has access to electricity; 0 otherwise

- S2 - Water, takes the value of 1 if the household's source of drinking water is piped into dwelling or yard; 0 otherwise.

- S3 - Toilet, takes the value of 1 if the household has access to its own pit latrine or flush toilet; 0 otherwise

- S4 - Cooking fuel, takes the value of 1 if the household uses electricity, gas or kerosene as cooking fuel; 0 otherwise.

## B.2 Construction of Psychosocial competencies

The psychosocial competencies are created accordingly educational psychology , intended to capture childrens dimensions of what she or he believe is possible to achieve in life. The YL implemented and worked closely with other disciplines to understand the complexity of these dimensions. Hence, before implementing the survey on psychosocial, the YL team went through several piloting sessions before the final survey. In my work, as previously mentioned, I follow similar to Dercona and Sanchez (2013) and Dercona and Krishnan (2009) to create the psychosocial competencies. The way the authors shape the measurement is among the commonly used procedure to extract emotional and happiness instruments in psychology. In the YL survey, the psychosocial trait questions are based on how much the child or the caregiver agrees or disagrees with a number of statements. The degree of agreement or disagreement is a measurement on a 4-point Likert scale that ranges from strongly agree, agree, disagree to strongly disagree. The answers to the statements were used to construct the individual average scores on aspiration, self-efficacy and self-esteem. Here below, I have stated all the items which are included in each of the three psychosocial trait dimensions.

To make the questions more comprehensible to understand, I have used of three explorative analysis that I apply to extract maximum information from the items on YLs' childrens' psychosocial competencies before constructing the three dimensions; aspiration, self-esteem and self-efficacy. For aspiration, there is no need to apply any of these methods because there is only one item to capture this dimension. Further, the aspiration gives the average educational achievement the YL child would like to see her or himself pursuit. However, the other two psychosocial traits have 5 and 9 items respectively. For an overview of the psychosocial traits, I have chosen to apply principal component analysis (PCA), factor analysis and Cronbach's alpha analysis before constructing a valid indices from each psychosocial dimensions. Briefly, the PCA considers the total variance in the data and transforms the original variables into a smaller set of linear combination of the variables. The total variance is explained by each factor is the eigenvalue.

While the factor analysis is very similar to PCA, yet it provides me with elements not analysed in PCA which is valuable to validate the measurement before building the psychosocial indices. The factor analysis groups similar variables into several dimensions. In order to achieve with grouping, the information in the data is reduced by reducing the number of dimensions of the observations. This process makes the data more comprehensible to read because the analysis is intent to discover the latent variables through the observed variables.

Lastly, Cronbach's alpha is a tool used for dichotomous and continuously scored variables which estimate the reliability i.e. the internal consistency reliability (Cortina, 1993). It is not a statistical test, rather a coefficient of reliability. The reliability assumption of this tool relies upon the assumption which is worth to mention; the unidimensionality, that all items measure on a single dimension. However, a high degree of alpha does not necessarily indicate a high degree of internal consistency nor that the measure is unidimensional. In fact, it can be due to several reasons such as xxxxx. There are several formula for Cronbach's alpha, nevertheless, I am applying of the most insight full and most accessible. Formula 4, is standardized on correlation.

$$\alpha = \frac{k\bar{r}}{1 + (k-1)\bar{r}} \tag{4}$$

where $k$ is the number of indicator, or items (ex. in self-esteem the YL survey have 5 items on a 4-point Likert scale while self-efficacy have 9 items.) $\bar{r}$ is the mean inter-indicator correlation (the average correlation between the items)

### Educational aspiration - (1 item)

1. Imagine you had no constraints and could stay at school as long as you liked, what level of formal education would you like to complete?

### Self-esteem - (includes 9 items)

1. I feel proud to show my friends or other visitors where I live.
2. I am ashamed of my clothes.
3. I feel proud of the job done by the head of household.
4. I am often embarrassed because I do not have the right books, pencils or other equipment for school.
5. I am proud of my achievements at school.
6. I am embarrassed by/ashamed of the work I have to do.
7. I am ashamed of my shoes.
8. I am worried that I don't have the correct uniform.
9. The job I do makes me feel proud.

### Self-efficacy - ( includes 5 items )

1. It I try hard I can improve my situation in life.
2. Other people in my family make all the decisions about how I spend my time.
3. I like to make plans for my future studies and work.
4. If I study hard at school I will be rewarded by a better job in future.
5. I have no choice about the work I do " I must work.