YOUNG LIVES STUDENT PAPER

The Effect of Maternal Education and Maternal Mental Health on Child's Growth

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Paper submitted in part fulfilment of the requirements for the degree of MSc in Global Health Science, Department of Public Health and Primary Health Care, University of Oxford.

The data used in this paper comes from Young Lives, a longitudinal study investigating the changing nature of childhood poverty in Ethiopia, India (Andhra Pradesh), Peru and Vietnam over 15 years. For further details, visit: www.younglives.org.uk.

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Young Lives
An International Study of Childhood Poverty

THE EFFECT OF MATERNAL EDUCATION AND MATERNAL MENTAL HEALTH ON CHILD'S GROWTH

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MSc IN GLOBAL HEALTH SCIENCE

Department of Public Health and Primary Health Care

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"Asato ma sad gamaya
Tamaso ma jyotir gamaya
Mrityor ma amritam gamaya"

Lead me from untruth to truth;
Lead me from darkness to the light;
Lead me from mortality to immortality

- An Ancient Sanskrit Verse

Being a part of the Department of Public Health, University of Oxford has been an incredible experience. It was surreal to have met and be mentored by such brilliant minds.

At the very outset, I owe my deepest gratitude to Dr Lucy Carpenter, my placement supervisor, who gently guided me in each step of this research, responded to my infinite queries, and resolved my problems. I admire her patience and fortitude in guiding me during the entire process of developing, structuring and writing this dissertation.

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ABSTRACT

Background: child growth is recognised internationally as the best global indicator of physical well-being in children. This study identifies the main factors associated with trajectory of child's growth among poor children in the state of Andhra Pradesh, India, with specific focus on the effects of maternal education and maternal mental health.

Materials and method: data from two consecutive rounds of the Young Lives cohort study were individually linked to obtain continuous measures of child growth between the ages of 1 and 5: a) increase in child's height (in centimetres) and b) increase in child's weight (in kilograms). Each measure was analysed using linear regression to estimate the effects of maternal education, maternal mental health and other factors on child's growth.

Results: simple regression found increases in height and weight to be positively associated with maternal education and maternal mental health. Associations were also observed with child's gender, maternal height, weight and caste, paternal education, household wealth index and debt, type of setting (urban versus rural) and region (agro-climatic). Multiple regressions revealed increases in child's height and weight to be independently associated with child's gender, maternal height and weight, household wealth index and region but not with maternal education and maternal mental health.

Conclusion: this study illustrates the pivotal role of a prospective design in identifying key factors affecting increases in child's height and weight. Neither key factors of prior interest examined - maternal education or maternal mental health - was found to be associated with child growth independent of other factors identified.

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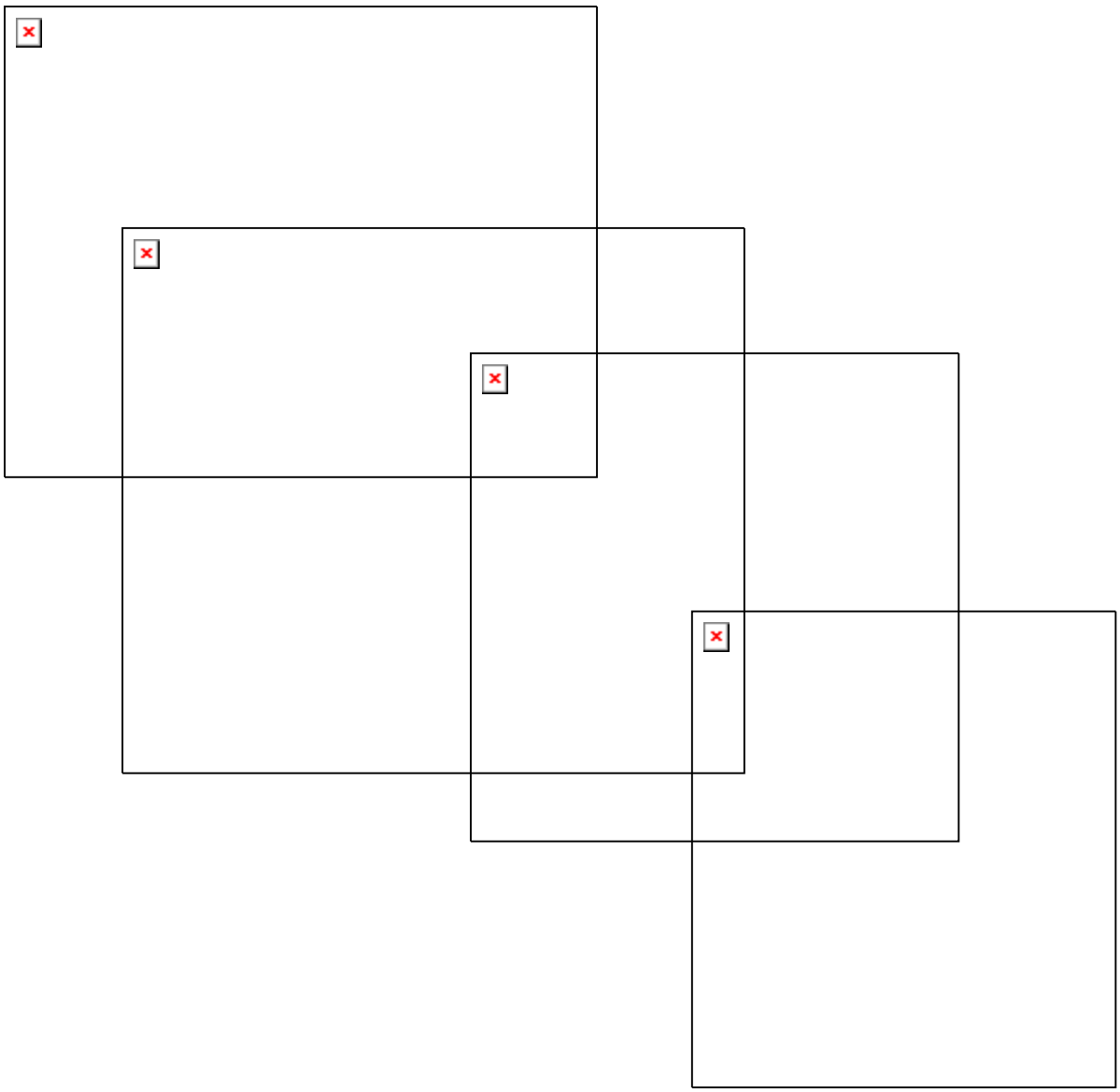
ABBREVIATIONS

Cm	centimetre
DALY	Disability Adjusted Life Year
Kg	kilogram
NFHS	National Family Health Survey
r	Correlation Coefficient
SD	Standard Deviation
UNICEF	United Nation's Children Emergency Fund
WHO	World Health Organisation
WHO MRGS	WHO Multicenter Reference Growth Study
YL	Young Lives



CHAPTER 1: LITERATURE REVIEW

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1.1 Introduction

Child growth has been internationally recognised as the best global indicator of physical well-being in children.[1,2] The WHO Multicenter Growth Reference Study (1997-2003) conducted in Brazil, Ghana, Norway, India, Oman and USA suggests that given the optimum start in life, children born anywhere in the world have the potential to develop to within the same range of height and weight. Estimates in the past suggested that height is to a large extent a result of the phenotypic variation in a given population and determined by genetic factors.[3] Notwithstanding individual differences, across large populations, regionally and globally, the WHO MGRS suggests that the average growth of the child should be remarkably similar when provided healthy growth conditions in early life.[4,5] While highest growth rates are attained during the human foetal period and early life, differences in children's growth to age five are more influenced by nutrition, feeding practices, environment, and healthcare than genetics or ethnicity.[4,6]

1.2 Perspectives of child growth

Child growth is a measure of a physiological process that depends on the child's nutrition both in utero and post-natally. This is modulated by many factors which include genetics, child illness, the care the child receives, maternal behaviour, and economic, health or emotional shocks suffered during pregnancy and during the lifetime of the child.[7] Development of physical capacity in the early years is the foundation of health, across the life course of an individual and is now recognized as a social determinant of health.[8,9] The human foetus initially differentiates and thereafter attains its highest growth rates during the early embryonic period. Growth slows during the late gestation period and continues to

slow in childhood. The supply of nutrients to the foetus has a major influence on growth and under-nutrition in early intra-uterine life and leads to permanent changes in body structure, physiology, and metabolism that are forerunner to diseases of the later life.[6]

Extensive work has been done linking childhood health to adult health using height and weight as proxy for early life health and nutrition. Height-for-age (stunting), weight-for-height (wasting) and weight-for-age (underweight) have been comprehensively used in anthropometry. The height-for-age is an indicator of linear growth retardation and cumulative growth deficits. It reflects long term failure to receive adequate nutrition and is also affected by recurrent and chronic illness. It does not vary according to the recent dietary intake. Weight-for-height is an indicator of current nutritional status of the child and represents failure to receive adequate nutrition or an episode of illness in the recent past. Weight-for-age is a composite index of height-for-age and weight-for-height. It takes into account both acute and chronic malnutrition.[5,10] In the assessment of growth, it is important to determine the overall trajectory of growth by observing whether the child is tracking along the growth curve or crossing over centiles towards a lower centile, and not merely a single measurement point.[11]

Poor child growth is of public health importance not only because it signifies infections, lack of adequate nutrition and poor psychological state of the mother or child, but can translate into infant and child death, developmental delays and diseases in adulthood.[12] Child growth is viewed with increased interest as the world grapples with child death due to malnutrition in the developing world and a growing burden of chronic disease of adulthood in the developed countries.

This chapter provides a review of the literatures on the factors that influence child growth in developing countries.

Anthropometric Measures

Height-for-age (stunting): The height-for-age is an indicator of linear growth retardation and cumulative growth deficits. The median height of the reference population is the point of reference. Children with height-for-age z score of minus two standard deviations from the median reference value are considered to be stunted while those which are minus three standard deviations away from the median reference value are severely stunted. Thus, stunting reflects long term failure to receive adequate nutrition and also affected by recurrent and chronic illness. It represents long term effects of malnutrition and does not vary according to the recent dietary intake.

Weight-for-height (wasting): weight-for-height is an indicator of current nutritional status of the child. Wasting represents failure to receive adequate nutrition or an episode of illness in the recent past. The median weight of the reference population is considered the point of reference. Children whose weight-for-height z scores are below two standard deviations of the median reference value of the reference population are considered thin or wasted and those whose weight are below three standard deviations from the median reference value are considered severely wasted.

Weight-for-age (under-nutrition): is a composite index of height-for-age and weight-for-height. It takes into account both acute and chronic malnutrition. Children whose weight-for-age is below minus two standard deviations from the median of the reference population are classified as underweight. Children whose weight-for-age is below minus three standard deviations (-3 SD) from the median of the reference population are considered to be severely underweight.

Source: 2,10

1.2.1 Historical Perspective

The long-term biological, psycho-social and behavioural processes in adult life that link adult life and disease processes can be attributed to physical and social exposures during gestation, childhood, adolescence and early adult life or across generations.[13]Initial research

done 1970s and 1980s especially in developed countries, revealed the importance of prenatal and infant exposures for adult chronic disease which were augmented by life factors such as poor growth, development and adverse environment during childhood.[6,13-15]

1.2.2 World Perspective

In 2005, child growth was studied in 139 countries and 388 national surveys produced estimates of prevalence of under-nutrition, wasting, and stunting.[16] These estimates revealed that 20% of children below 5 years in low-income and middle-income countries had under-nutrition. The highest rates of prevalence of under-nutrition were in South-Central Asia and Eastern Africa with 33% and 28% affected children, respectively.[16] Current WHO estimates indicate that approximately 16% of children from developing countries are severely malnourished.[17] With 2·2 million deaths and 21% of DALYs for children below 5 years,[16] the number of global deaths and disability-adjusted life-years (DALYs) attributed to stunting, severe wasting and under-nutrition, constitutes the largest percentage of risk factor in this age group.[16]

Country	Year of data collection	Sample size	Under-nutrition	Stunting	Wasting
Afghanistan	2004	946	32.9	59.3	8.6
Brazil	2007	4415	2.2	7.1	1.6
Ethiopia	2005	4968	34.6	50.7	12.3
India	2006	49233	43.5	47.9	20
Iraq	2006	16309	7.1	27.5	5.8
Kenya	2003	5536	16.5	35.8	5.8
Kuwait	2005	5601	2.7	4.5	7.5
Mexico	2006	7707	3.4	15.5	7.6
Peru	2005	1893	5.4	29.8	1.0
Vietnam	2000	3041	26.7	43.4	6.1
Zimbabwe	2006	5254	14	35.8	9.1
UK	1973	13380	1.0	2.4	2.1
Japan	1981	7308	0.8	5.6	3.7
Netherlands	1980	18930	1.6	1.8	2.3
USA	1999	3920	1.3	3.9	0.6

Table 1.1: Worldwide prevalence of Growth Measures in 0-5 year old children[18]

1.2.3 India

The National Family Health Survey (NFHS 3), India, in 2005, found 48% stunting and 43% underweight in children below 5 years of age. Among these children, 24% were severely stunted and 16% were severely undernourished. Wasting was present in almost 20% of children surveyed. Girls and boys were about equally undernourished. Under-nutrition was generally lower for first born child and consistently increased with increasing birth order and shorter birth intervals.[5,10] In urban areas of Andhra Pradesh, 33.2% children were stunted and 23.9% children were underweight. Corresponding figures were substantially higher in rural areas where 40% of children were stunted and 33% underweight.[10]

The NFHS 3 survey also revealed that Hindu and Muslim children were equally likely to be undernourished, but Christian, Sikh, and Jain children were considerably better nourished. It also evidenced that children belonging to Scheduled Castes (SC)[a], Scheduled Tribes (ST)[b], or other backward classes had relatively high levels of under-nutrition according to all three measures. Children from Scheduled Tribes (ST) had the poorest nutritional status on almost every measure with very high prevalence of wasting (28%).[10]

[a] Scheduled castes and Scheduled Tribes have been recognized in the Indian Constitution as the population groupings which were economically and socially depressed.

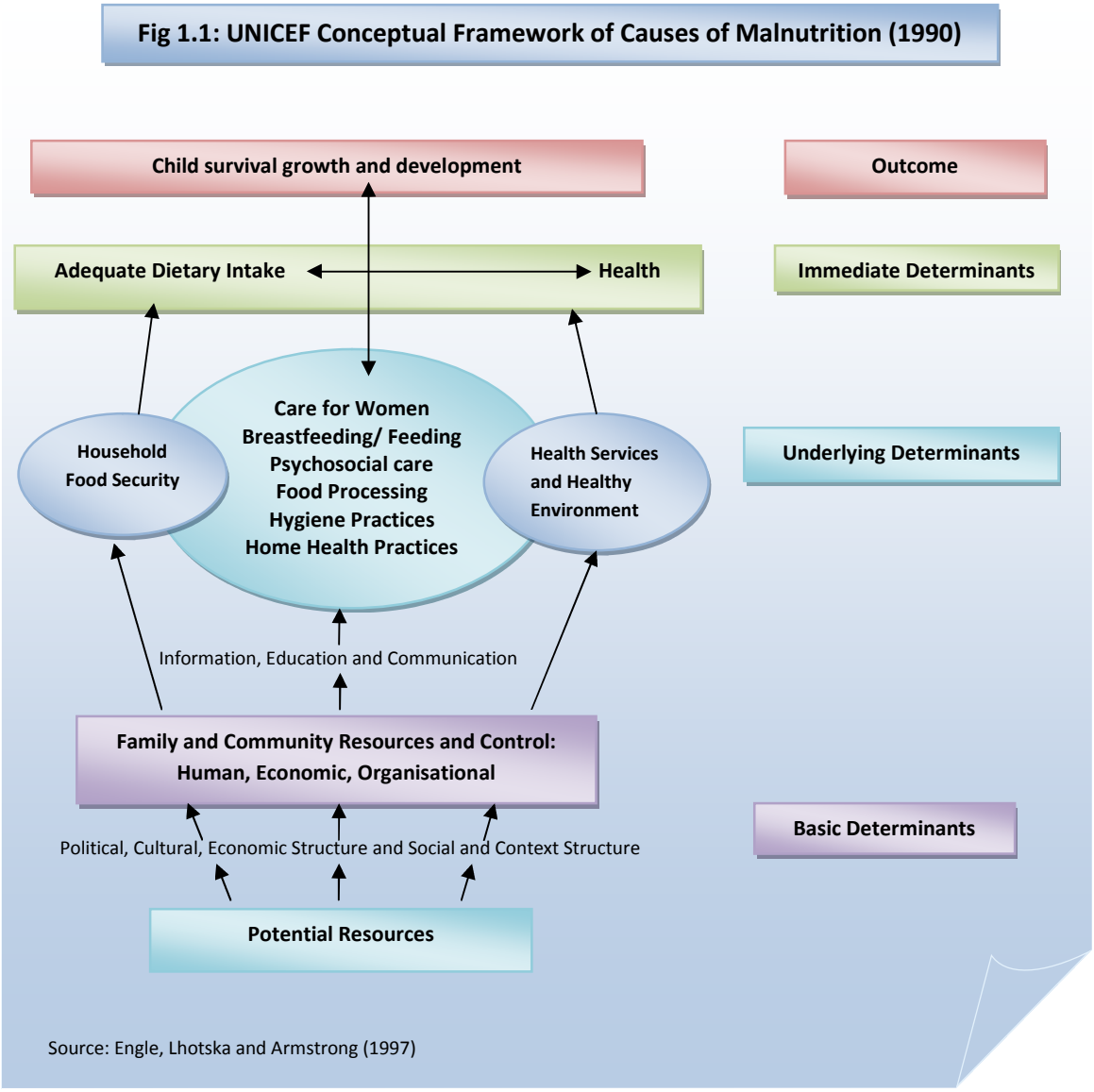
The "Scheduled Castes" is the legal and constitutional name collectively given to the groups which have traditionally occupied the lowest status in Indian society. It was Hindu religious and ideological basis for an "untouchable" group, which was outside the caste system and thus inferior to all other castes. [135]

[b] Indian Scheduled Tribes constitute a group of tribal communities that were given the name `Scheduled Tribes` during the post- Independence period, under the rule of Indian Constitution. The primary criteria adopted for delimiting Indian backward communities as "Scheduled Tribes" include, traditional occupation of a definitive geographical area, characteristic culture that includes a whole range of tribal modes of life, i.e., language, customs, traditions, religious beliefs, arts and crafts, etc., archaic traits portraying occupational pattern, economy, etc., and lack of educational and economic development. [136]

1.3 Conceptual Framework for Causes of Malnutrition

The UNICEF original conceptual framework for causes of malnutrition model (1990) suggests that child survival, growth and development were influenced by three underlying factors namely a) household food security, b) care for women and c) health services and healthy environment. Child survival, growth and development are effected by caregiver behaviours like feeding, hygiene, health practices, psychosocial stimulation and not food intake alone.[19,20] (refer Fig: 1.1)

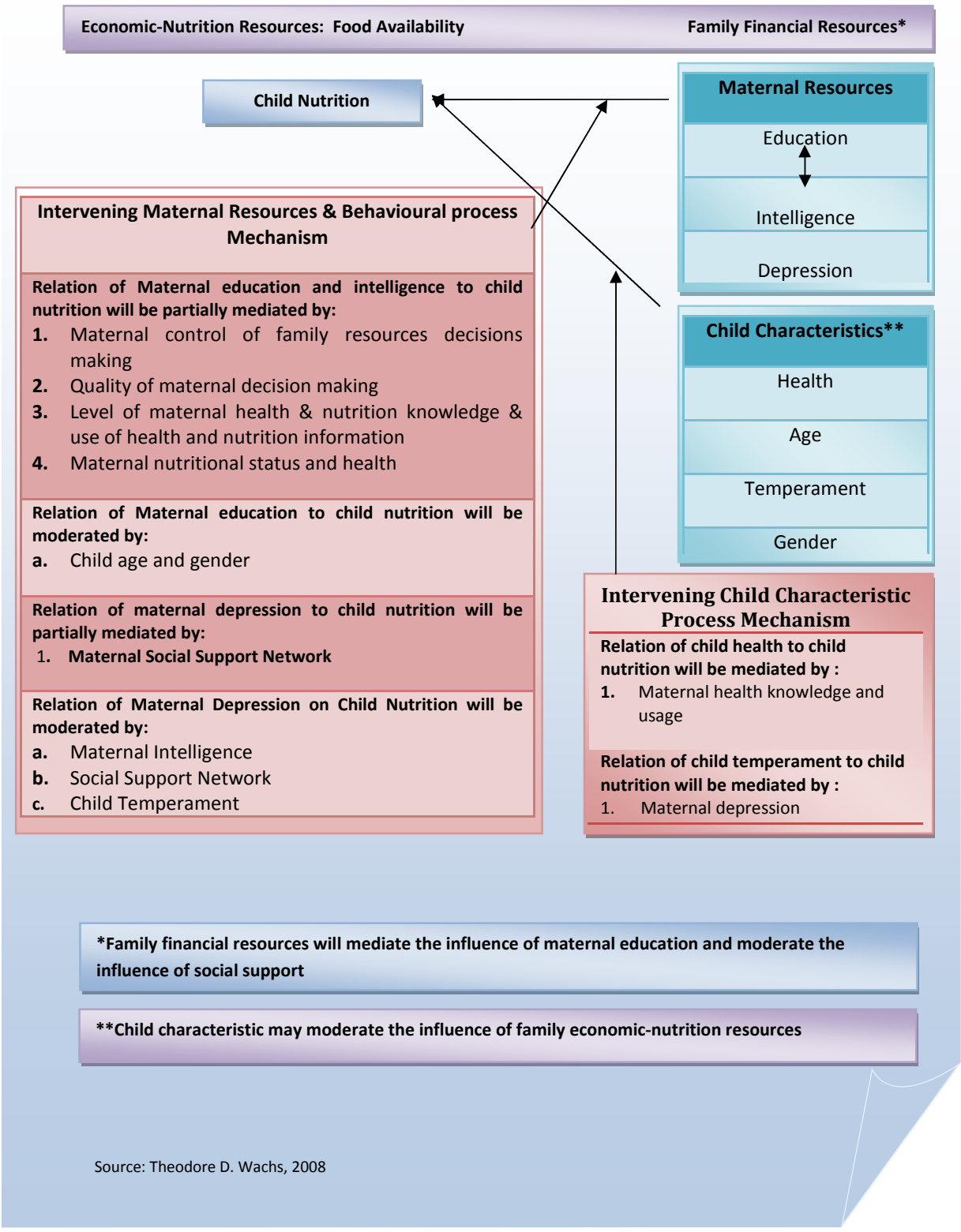
Fig 1.1: UNICEF Conceptual Framework of Causes of Malnutrition (1990)



Source: Engle, Lhotska and Armstrong (1997)

While this model has been highly useful in identifying the non economic influences of child malnutrition, it does not consider gender rate of physical growth or child temperament which also play a part in child growth.[20]One revision of UNICEF conceptual framework recently proposed includes maternal education, intelligence and depression as influencing the mother's care-giving behaviour and consequently child growth.[21] (Fig 1.2)

Fig 1.2: Proposed Revision of UNICEF Conceptual Framework of Causes of Malnutrition



Source: Theodore D. Wachs, 2008

1.4 Factors associated with child growth in developing countries

Plausible non-genetic determinants of height as noted in secular rises in childhood and adult stature across successive birth cohorts include socioeconomic status, nutrition, environmental factors, parental and caregiver factors, illness, injuries and psychosocial stress.[3,22] The reduction in child growth in any society can be thus viewed as an operation of social, economic, biological and environmental influence which operates through these determinants.[22]Young children in developing countries are exposed to multiple risks, including poverty, gender biases, incorrect feeding practices, infections, maternal care-giving behaviour, paternal education and urban and rural setting which detrimentally affect their physical, emotional and psycho-social development. Each of these factors has been considered below:

1.4.1 Poverty, household wealth and family income: family economic resources and food availability are important for reduction of malnutrition and improved child growth.[21] At the low end of the wealth spectrum, poverty is a key determinant of mortality and poor health in all countries.[23,24] Due to its numerous dimensions, it has a profound effect on child growth as it deprives children of the capabilities needed to survive, develop and thrive and also entrenches on social and economic aspects needed for child growth.[25] More than 200 million children under the age of 5 years fail to reach their growth and cognitive potential due to poverty, poor health, lack of adequate nutrition and deficient care.[26] A longitudinal study conducted in Uganda noted that the majority of the growth faltering occurred in the first 12 months of life.[27] Poverty leads to poor growth outcomes in children hence long term reduction in poverty is considered to be far more effective than short term management of issues.[28]

In contrast, household wealth offers leverage for improving child growth by providing an opportunity to improve material circumstances of the family to purchase goods and services that are health enhancing.[23,24]

Environmental factors such as overcrowding, unsafe water, lack of sanitation and sewerage and poor garbage disposal facilities have a deterministic role in child's growth.[3,7] Family income also allows the family to spend more on food, clean water, hygiene and sanitation, and preventive and curative health care.[29,30]

1.4.2 Gender: associations between nutritional status and thereby child growth with reference to the gender of a child are highly variable. Some studies reported no relation between gender of the child and the indices of nutritional status[10,31]while others found that the female child either received better nutrition or was nutritionally disadvantaged[27,32-34] Evidence from a study in Andhra Pradesh, India suggests that gender discrimination is notable among girl children.[35] Several studies in Rural Nepal[36], Peru[37], India[31,38]and Indonesia[39]have suggested that malnutrition can result from inequities in food distribution and preferential child care practices that favour certain age and sex groups within societies even when food supplies are sufficient.[37,40-42]The relationship between child gender and nutrition maybe moderated by a variety of factors including cultural values,[43,44] birth order or sex ratio of children in the family [38,45]and household decisions on allocation of supplementary food resources.[20,36,46-53]

1.4.3 Feeding Practices: longitudinal studies revealed that under-nutrition has a profound influence on the child's physical growth as well as their cognitive development.[16]

Poor feeding continues to affect a high proportion of children in developing countries. Improved breast feeding practices is estimated to save up to 1 million lives. Complementary feeding while breast feeding for up to two years or beyond could save up to half million lives by reducing the risk of infection leading to improved physical growth and motor development.[54,55] This is debatable in highly endemic HIV settings of resource poor developing countries, where an estimated 15% of children born to HIV-infected mothers are infected with HIV through breastfeeding. The longer a child is breastfed by an HIV-positive mother the higher the risk of HIV infection. The child's risk of acquiring HIV is reduced to one third when breastfed for 6 months as compared to breastfeeding for 2 years while exclusive breast feeding for shorter durations are protective.[56] On the other hand, early introduction of supplementary feeds is suggested to encourage excessive weight gain, increased risk of infections and allergies, and reduce the amount of breast milk ingested by the infant. In developing countries the protective effects of breastfeeding are compromised by malnutrition, poor environmental conditions, over-dilution of formula milk, and infectious diseases.[57]

1.4.4 Infections: there is considerable evidence mostly from resource poor countries that infections including diarrhoea, acute respiratory tract infection, and intestinal parasites such as hookworm, trichuris and ascaris each retard physical development.[3,35,58,59] A third of the world's children suffer from intestinal helminthiasis. Diarrhoea, dysentery, HIV/AIDS and malaria are some of the infections that compound the problem of malnutrition and thereby seriously hamper child growth.[25]

1.4.5 Maternal Factors

Since the early 1980's there has been a resurgence of interest in the role of the mother or caregiver on child's growth. Relevant maternal characteristics include her education, mental health and self confidence, intelligence, knowledge and beliefs, autonomy and control of resources, reasonable workload and availability of time, and family and community social support. Relying on the strong correlation between maternal education and child health, public policy discourse has increasingly assumed that investment in womens' education is important for lowering infant mortality and improving child growth.[3,16,24,41,51-53,60-94]

Maternal Education: it has often been argued that children of educated mothers experience lower co-morbidities such as gastro-intestinal disorders, inadequate nutritional status and lower mortality and achieve better health outcomes and higher growth than children of uneducated mothers.[21,72,95-101] While mother's education was found to have a positive effect on long-term nutritional status, as measured by stunting, evidence also suggests this is more important in the earlier years of child growth.[7]

Studies in developing countries indicate that higher levels of maternal education are related to increased knowledge and understanding of health information and use of health services.[19,24,27,79,102,103] Utilization of health-promoting activities such as vaccination and vitamin A supplementation of the off-spring, by educated mothers is one such mechanism through which maternal education influences their child's physical growth.[104]

A longitudinal study in Bangladesh suggests that there was improved feeding practices and cleanliness due to maternal education. Mothers were likely to feed the child more frequently, with fresh food and in cleaner, more protected environment.[105] Education may

also affect health through a reduction in the number of pregnancies and the number of children, which allows more resources to be devoted to the surviving children.[7,106]

Evidence suggests that associations between mothers' level of education and the physical growth of their children involves her greater participation in important family decisions, as mothers are more likely than fathers to allocate family resources in ways that promote their child's nutrition.[20,21,51,52,78,107,108] Increased levels of schooling are linked to higher levels of maternal intelligence.[74] A study shows that intelligent mothers make appropriate decisions on resource allocation when the family economic resources are limited leading to better physical growth of the child.[20,109] Knowledge and verbal skill enhance mothers' ability to be successful in decision making situations[110], and empower them through access to outside resources like job opportunities.[21]

Maternal education may thus transmit information about health and nutrition directly, by enabling mothers to acquire information, and exposing them to new environments thus making them receptive to modern medical treatments. It imparts self confidence which enhances the woman's role in intra-household decision making and interaction with health care professionals.[27,102,111]

Currently, Public Health Policies have been increasingly focused towards improving maternal education as an important discourse towards achieving lower infant and child mortality and improving child health. Education is linked to socioeconomic status of the family, which itself is one of the major determinants of child health.[60]

Maternal Mental Health: that poor mental health of mothers might adversely affect their child's health and development is evidenced by a study from South Asia which demonstrates

an association between postnatal maternal depression and impaired child growth.[112]Case-control and cohort studies in Pakistan and Tamil Nadu state of India revealed that, compared to controls, infants of depressed mothers were likely to be more than twice underweight at 6 months of age (30% versus 12%) and three times more likely to be stunted (25% versus 8%).[113,114] Studies in South Asia, indicated that the odds of a malnourished child having a depressed mother were 3.9 to 7.4 times higher.[94,112,114]

A study in Goa, India found that the more educated women are at lower risk for depression than are less educated women.[115] A cohort study in Rawalpindi, Pakistan noted that infants of mothers with depression are at greater risk of growth failure than are infants whose mothers are not depressed.[114] The mechanism through which depression in the mother influences the physical growth of their child probably entails reduced involvement in parental care by depressed women.[114,115]

1.4.5. Maternal Age and Height: there is a strong association between infant mortality, low birth weight and poor child growth in mothers younger than 20 years of age.[35,116-118]Studies have suggested that prominent risk factor for decreased childhood growth is maternal short stature.[3,7,119]

1.4.6 Paternal Education

In recent years researchers have begun to acknowledge the influence of fathers on the development of their young children.[120] Fathers assume multiple roles in families which influence children in numerous ways, directly and indirectly (via mothers).[120] The education of parents often is used as an indicator of the quality of time children spend with their parents.[121] It has been hypothesized that better educated parents are more concerned and

involved with their children's development as they are aware of children's developmental needs.[121-123] Paternal education along with maternal education is a strong predictor of child growth as evidenced by these studies.[104]

It is also hypothesised that more educated fathers usually earn more money and marry women of a comparable level of education.[104,124] A study in Bangladesh showed that lack of paternal education led to diminished child growth.[104]

1.4.7 Setting: Urban versus Rural

Evidence suggests that urban children generally have a better nutritional status than their rural counterparts.[125-128] This is of particular relevance for stunting and underweight.[128] Using data from FAO for 11 countries, most of which were from Africa, Stunting rates in urban areas were found to be 55–78% of those found in rural areas.[127] More recently UNICEF data from 33 countries in Africa, Asia, and the Americas showed that, on average, stunting was 1.6 times greater in rural compared to urban areas.[126]Demographic and Health Surveys from 28 countries have also documented consistently lower prevalence of stunting in urban areas, with wider urban/rural differences in Latin America compared to Africa and Asia.[125] Although typically prevalence of wasting is also higher in rural areas, most studies have found very small urban/rural differences and even slightly higher wasting in urban areas has been reported.[125-128]

1.5 Aims and Objectives

This study aims to identify main factors associated with the trajectory of child's growth among poor children in the state of Andhra Pradesh, India, with specific attention on the effects of maternal education and maternal mental health.

1.5.1 Research Question

To what extent does maternal education and maternal mental health influence early childhood growth in poor populations of Andhra Pradesh, India?

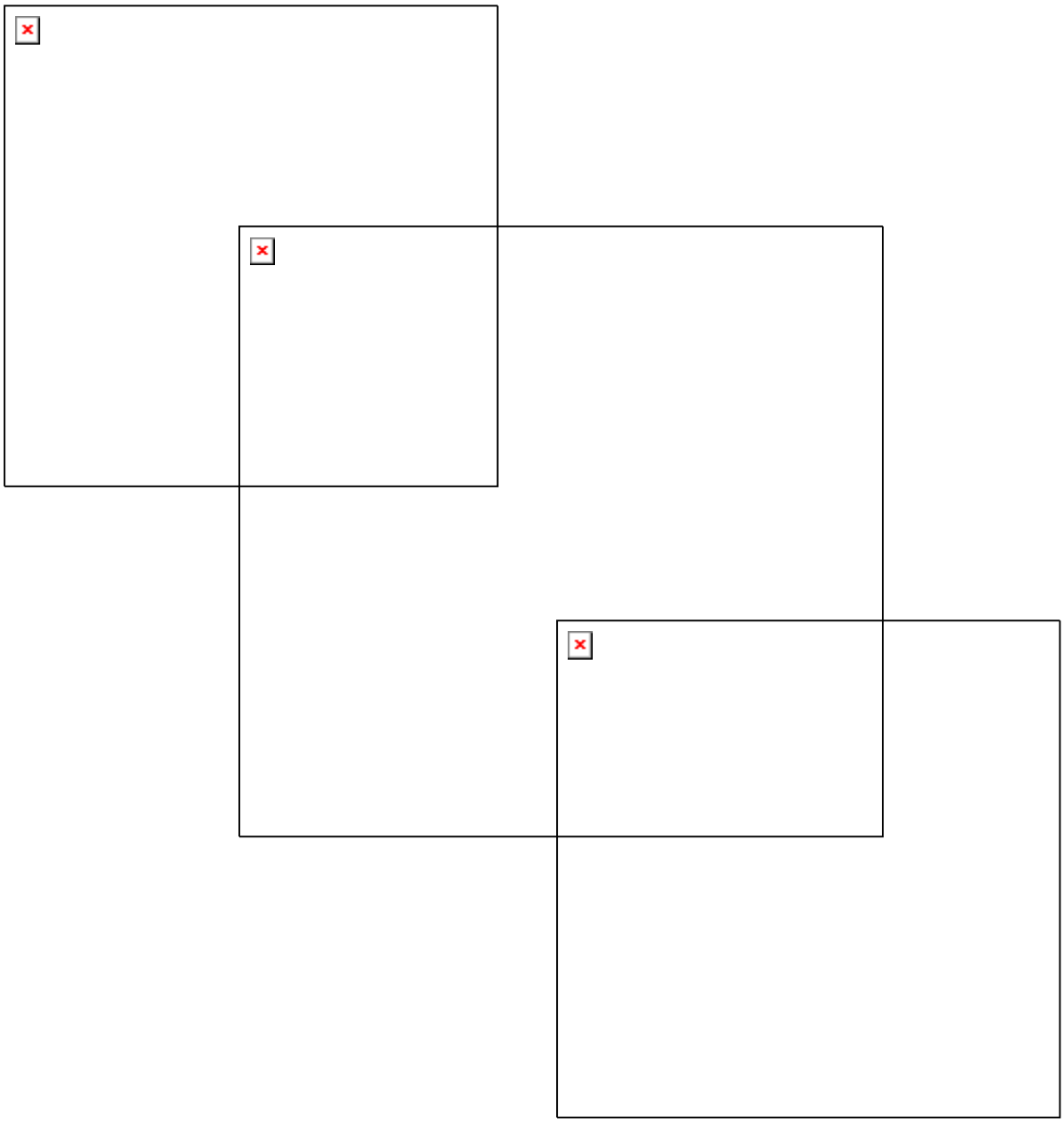
1.5.2 Objectives

Using data from two surveys of children conducted by the Young Lives project:

1. to individually link data to identify a cohort of children surveyed at ages 1 and 5 years;
2. to use increases in height and weight to describe their observed trajectories of child growth;
3. to examine associations between child growth and two key risk factors (maternal education and maternal mental health) and other potential risk factors at the child, maternal, paternal and community level;
4. to identify the independent effects on child's growth of each of risk factor considered.

1.6 Organisation of Dissertation

This introductory chapter has reviewed the literature regarding potential factors affecting the trajectories of child growth, particularly in developing countries. The next chapter describes the Young Lives data collected in Andhra Pradesh and explains the materials and methods used in the analyses. Chapter 3 describes the results of these analyses and Chapter 4 discuses these with reference to previous literature. Following consideration of strengths and limitations of this research, conclusions are drawn.



CHAPTER 2: MATERIALS AND METHODS

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2.1 Introduction

Young Lives is an international project investigating the changing nature of childhood poverty across four developing countries namely India, Peru, Vietnam and Ethiopia. It follows a total of 12,000 children of two birth cohorts, the first born in 1994-95 and the second in 2001-02.[129]There have been two survey rounds of data collection completed to date. The first was in the year 2002 and second in 2006-07. A third round is currently underway.

This chapter provides a background to Young Lives Project relevant to the current research. It uses quantitative data, for the second birth cohort of 2000 children born in 2001 – 02 in Andhra Pradesh, India collected at the first and second rounds. It describes the particular characteristics for which data were abstracted, the methods applied in the quantitative analysis of the trajectory of growth in this younger cohort of children followed to the age of five.

2.2 Background of the Young Lives Project

The state of Andhra Pradesh is divided into 23 districts spread over three distinct agro-climatic regions of Coastal Andhra Pradesh, Rayalseema and Telangana. For the first survey round in 2002, the Young Lives Project selected 2011 children born in the year 2001 - 02, from twenty sentinel sites, from 6 districts, 2 in each region. Together the districts selected comprise of 28% of the total population of Andhra Pradesh. (Fig 2.1)

They used a sampling methodology known as ***'sentinel site surveillance system'*** through a pro-poor approach, which consisted of a multi-stage semi-purposive method. 5 urban and 15 rural sites were selected in the districts of West Godavari, Srikakulam,

Anantapur, Cudapah, Mahbubnagar, Karimnagar and Hyderabad city, using a set of developmental criteria. Seven of these sites were located in coastal regions, 6 in Rayalaseema and 7 in Telangana. A hundred households in four villages were then randomly selected from each sentinel site using a list drawn from the 1991 census in such a way that they were uniformly spread. Three areas across Hyderabad city were also included in the survey to study the urban slum.[129]

2.3 Study Sample for the Present Research

The present study uses data obtained following individual linkage of the cohort of children surveyed at Round 1 to those surveyed subsequently in 2006-07 (from now on referred to as Round 2). Of the 2011 children initially surveyed in Round 1, 32 had died, 22 were lost to follow up and 7 refused to participate in Round 2, resulting in a total attrition of 61 children (3%). Thus, a total of 1950 children, whose data have been included in both rounds, will be the cohort for this analysis. The study uses these individually linked data to examine how factors measured in Round 1 influence the early period of a child's growth, specifically during the first five years of life. Special emphasis is given to the importance of maternal education and maternal mental health on early childhood growth.

Fig 2.1: Map of India and Andhra Pradesh[130]

2.4 Description of Variables

Two indices for child growth, ***'increase in child's height'*** and ***'increase in child's weight'*** between Round 1 and Round 2 were derived from the existing data on child's height and weight. The key explanatory variables chosen were maternal education and maternal mental health. There were fifteen other potential explanatory variables which were grouped under five categories: child factors, maternal factors, paternal factors, household factors and community factors. (refer Fig 2.11). These are described below:

2.4.1. Outcome Variables

Child Height: was measured at both rounds (1 and 2) in centimetres (cm) to the nearest agreed 0.1 cm. A length board was used to measure children below two years. Two persons measured the child; one held the child's head and the other measured the child. A height stick was used to measure the older children which was stabilised against a wall or a door. Two independent readings were taken before finalising the height. [131,132]

Out of 1950 observations, 0.87% (17) from the Round 1 and 0.35% (7) from Round 2 were missing. One observation was dropped from Round 2 because of suspected data entry error[c].The mean height at round 1 was 71.6 cm (SD 5.06) and at round 2 was 104.02 cm (SD 5.3). The mean height for girls and boys in Round 1 was 70.92 cm (SD 4.97) and 72.28 cm (SD: 5.05) respectively. The mean height for same cohort of girls and boys in Round 2 was 103.77 (SD: 5.30) cm and 104.23 cm (SD: 5.40). (Figs: 2.2, 2.3, 2.6)

[c] The child height was recorded as 173.5 cm

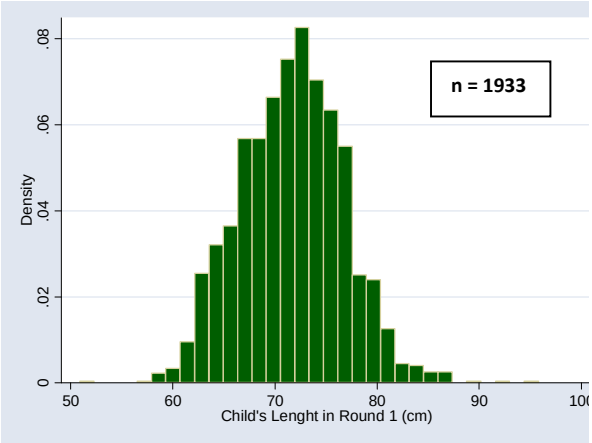


Fig 2.2: Distribution of Child Length in Round 1

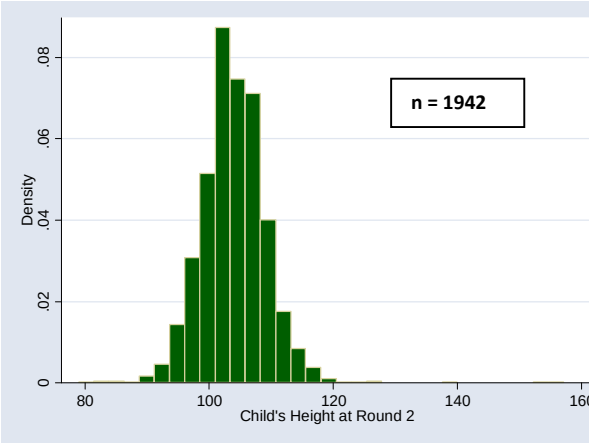


Fig 2.3: Distribution of Child Height in Round 2

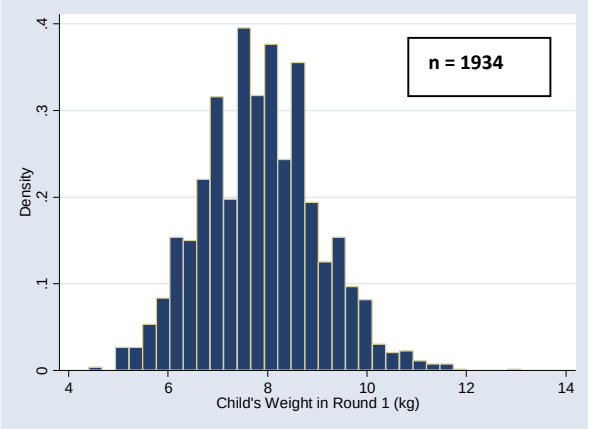


Fig.2.4: Distribution of Child Weight in Round 1

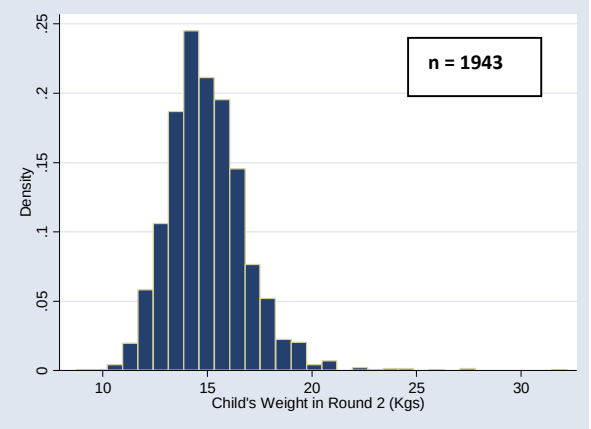


Fig 2.5: Distribution of Child Weight in Round 2

Child's Weight: was measured in both rounds to the nearest agreed 0.1 kg using a clock (spring) balance by two persons. Two readings were taken before finalising the measured weight. Out of 1950 observations, there were 0.82% (16) and 0.35% (7) missing observations, for Round 1 and Round 2 respectively. The mean weight of children was 7.84 kgs (SD 1.17) in Round 1 and 15.01 kgs in Round 2(SD 1.93).(Figs 2.4, 2.5). The mean weight of girls was 7.59 kgs (SD: 1.1) and 14.84 kgs (SD: 1.9) while the mean weight of boys, was 8.09 kgs (SD: 1.2) and 15.16 kgs (SD: 1.8), in Round 1 and 2 respectively.(Fig 2.7)

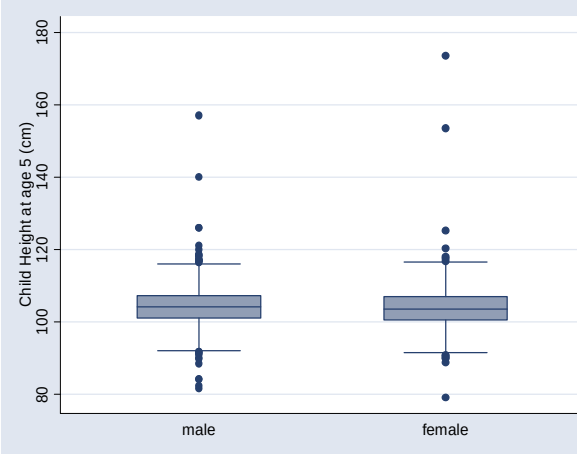


Fig 2.6: Distribution of Child's Height at age 5

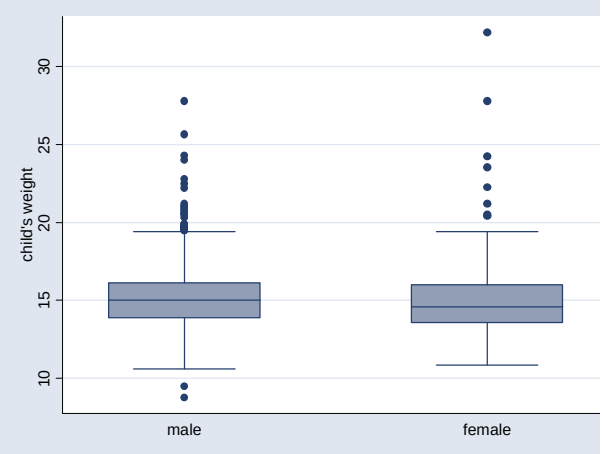


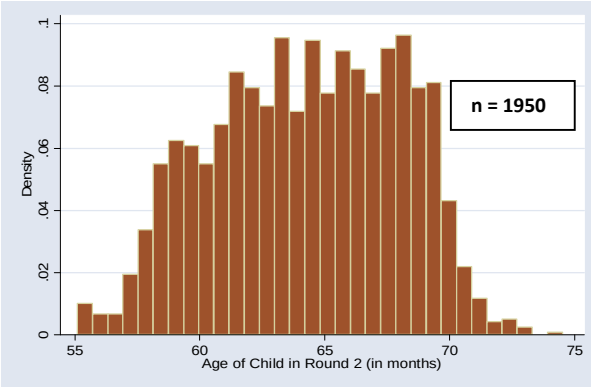
Fig 2.7: Distribution of Child's Weight at age 5

2.4.2. Calculation of Outcome Variables

Increase in Height of the Child: was calculated by subtracting child's height at Round 1 from child's height at Round 2. 1925 observations were generated. 44 observations were missing.

Increase in Weight of the Child: was calculated by subtracting Child's weight at Round 1 from Child's weight at Round 2. 1927 observations were generated and 42 observations were missing.

Time Interval of Growth: the time interval of growth between rounds was calculated by subtracting the date of interview in Round 1 from the date of Interview in Round 2. 1950 observations were generated. The minimum time interval for growth of the children between the two rounds was 49.22 months and the maximum was 57.78 months. The mean time interval between the 2 rounds was 52.48 (SD 1.19). (Fig: 2.9)



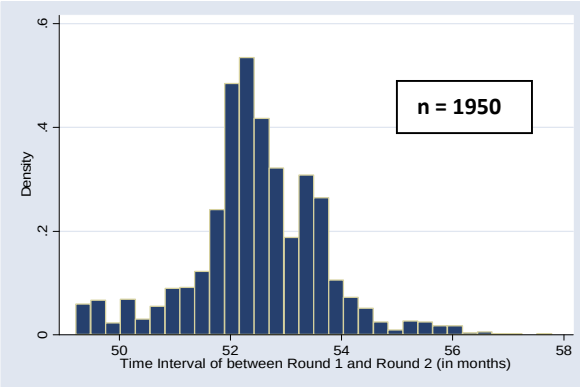


Fig 2.8: Estimated Age of Child in Round 2

Fig 2.9: Time Interval between two survey rounds

Age of Child: the age of the child in Round 1 was added to the derived time interval of growth to estimate the age at Round 2. The minimum age recorded in Round 1 was 5 months and maximum was 21 months. The mean age at Round 1 was 11.82 months (SD: 3.5). The minimum age recorded at Round 2 was 55.11 months and the maximum was 74.52 months. The mean age of the child at Round 2 was 64.30 months (SD: 3.72). (Fig: 2.8)

2.4.3. Key Variables

Maternal education: this variable was available only in Round 2 dataset of the Young Lives. The maternal education was coded as 'no education' 'primary', 'secondary' and 'tertiary'. Out of 1950 observations there was 4 missing observation. 51% of mothers received no education, 20% received primary education up to class 6, 25% received secondary education up to class 12 and 3% of mothers had higher education. It was used as a categorical variable in the study. (Table 2.1)

Level of Education	Category
Non educated	0
Primary Education:	1
Secondary education:	2
Higher education:	3

Table 2.1: Coding of Level of Maternal Education

Maternal mental health: this variable was available in Round 1 dataset only. Young Lives used WHO Self Reported Questionnaire 20 to assess the presence of maternal depression using 8 as cut-off to separate the probable case from non-case. Of the 1950 observations listed under caregiver depression, 93.4% (1827) was listed as mothers while 0.66% was listed as other relatives. 5.6% (110) observations were missing. 30.05 % (549) mothers were considered as a case of depression while 69.95% (1278) mothers were considered as non-case.

2.4.4. Other potential explanatory variables:

Child Factors: Measures from Round 1

Gender: gender was included in this research, coded as male and female, as gender disparities regarding food and resource allocation have been evidenced in previous studies. 53.36% children were males and 46.6% children were females in this study.

Siblings: studies have shown that allocation of food is reduced or biased with increase in the number of children in the household. Thus presence or absence of siblings was included.

Birth Order: Studies have also evidenced poorer growth associated with increasing birth order. Thus birth order was selected as a variable and children have been categorised according to the birth order as 'youngest child' and 'no siblings' and 'others'. (Table 2.2)

Birth Order Of YL Child	Frequency	Percentage	Cumulative Percentage
YL child is the youngest child	840	43.52	43.52
YL child has no siblings	1078	55.85	99.37
Others	12	0.62	100

Table 2.2: Birth order of the Young Lives Index Child

Breast feeding: as the length of breast feeding has an impact on the child's growth in the early period of life this variable was included from Round 1. It was coded as breast feeding 'up to 6 months' 'greater than 6 months' and 'still breast feeding'. There were 1874 observations. 5.23 % children have breast fed up to 6 months of age, 4.43% children have breast fed over 6 months and 90.34% children were still breast feeding.

Child Health: the variable labelled healthy was chosen to assess the perception of relative health of the child by the mother. The child has been categorised as 'same as the other children of his age', 'better than children of the same age' and 'worse than children of the same age'. There are 48.8% children who are considered same while 37.34% are considered better and 13.77% children considered worst than children of the same age.

Maternal Factors: Measures from Round 1

Maternal age: the age of the biological mother has been included and coded as 'below 19', '19 – 25' and '25 – 30' and 'above 30'. The median age of the mother is 23 years while the mean is 23.7 years (SD: 4.32 years). There are 11 missing variables in the dataset.

Caste of the mother: studies show that caste is an important factor in child's growth in India as children of higher castes fare better than those of scheduled castes. In this study 18.4% mothers belonged to scheduled castes, 14.57% mothers belonged to Scheduled Tribes, 46% mothers belonged to backward castes and 21.08% belonged to other castes.

Religion of the mother: previous studies revealed that Hindu and Muslim children have poor growth compared to Christian and Sikh children. In this dataset 3.93% mothers were Christians, 7.61% Muslims, 87.47% Hindus and 0.94% Buddhist.

Maternal Factors: Measures from Round 2

Maternal height: maternal height is an important genetic factor in the child's growth and hence included in the analysis. 1914 observations for maternal height were recorded in Round 2 and there were 36 missing observations. One observation was dropped[d]. The minimum height recorded was 104.1 cm and the maximum height was 175.5 cm. The mean height recorded was 151.48 cm (SD 6.08). (Fig: 2.10)

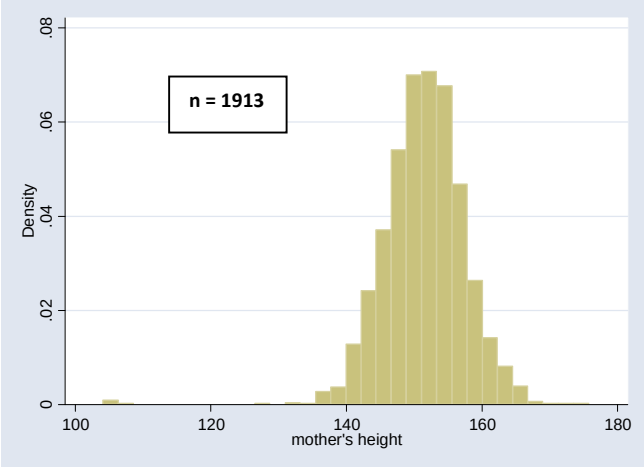


Fig 2.10: Distribution of Maternal Height

Paternal Education: paternal education has a role in deciding the resource allocation in the household which in turn affects child growth.[120] There are 1947 observations and 3 missing values. 33% fathers had no education, 21% had primary education, 33% secondary education and 9% higher education in the dataset of round 2 of the Young Lives. (Table 2.3)

[d] The minimum recorded value of 47.3 cm was dropped due to suspected entry error.

Fathers Education	Frequency	Percentage	Cumulative
None	645	33.13	33.1
Primary	471	24.19	57.32
Secondary	517	26.55	83.87
Higher Education	314	16.13	100
Total	1947	100	

Table 2.3: Paternal Education

Household Factors

Previous studies have revealed the importance of household size and household wealth in influencing a child's growth. Based on those findings the following variables were selected:

Household size: the household size was coded as 'less than 5 members' '5-7' members' and 'greater than 7 members'. The mean household size in the study population was 5.5 members (SD: 2.2 members).

Debt: 50.7% households are in debt while 49.4% households are not in debt.

Wealth Index: wealth index was a simple average of three components: housing quality, consumer durables and access to public services. Housing quality was a simple average of rooms per person and quality of floor, roof and wall. Consumer durables were proxied by the number of durables available in the household. Public services were a simple average of dummy variables reflecting access to drinking water, electricity, a toilet and fuel. This variable was available from the dataset.

Community Factors

Region: Young Lives Project sites are present in three agro-climatically distinct regions of Andhra Pradesh; Coastal Andhra Pradesh, Rayalseema and Telangana and these were coded as such for the purpose of this study.

Setting: five urban areas and 15 rural areas were included in the datasets and these were coded as Urban and Rural setting for the purpose of this study. (Table: 2.4)

Setting	Gender	Coastal	Rayalseema	Telangana	Not Known	Total	Percentage
Urban	Male	102	57	112	1	**272**	**14%**
	Female	91	51	85	1	**228**	**12%**
Rural	Male	252	242	273	0	**767**	**39%**
	Female	243	229	210	1	**683**	**35%**
Total		**688**	**579**	**680**	**3**	**1950**	
Percentage		**35.3%**	**29.7%**	**34.9%**	**0.2%**		**100%**

Table 2.4: Distribution of children in the regions and urban and rural setting

2.5 Analytical Methods

Data from both the rounds were merged and individually matched. 61 children with missing data were dropped from the analysis as was individual observations with suspected data entry error. The mean and standard deviation were calculated for continuous variables and frequency distribution for categorical variables. The two outcome measures were derived from existing data. These were 'increase in child's height' and 'increase in child's weight'.

STATA 11.0 was used for the analysis of this dissertation.

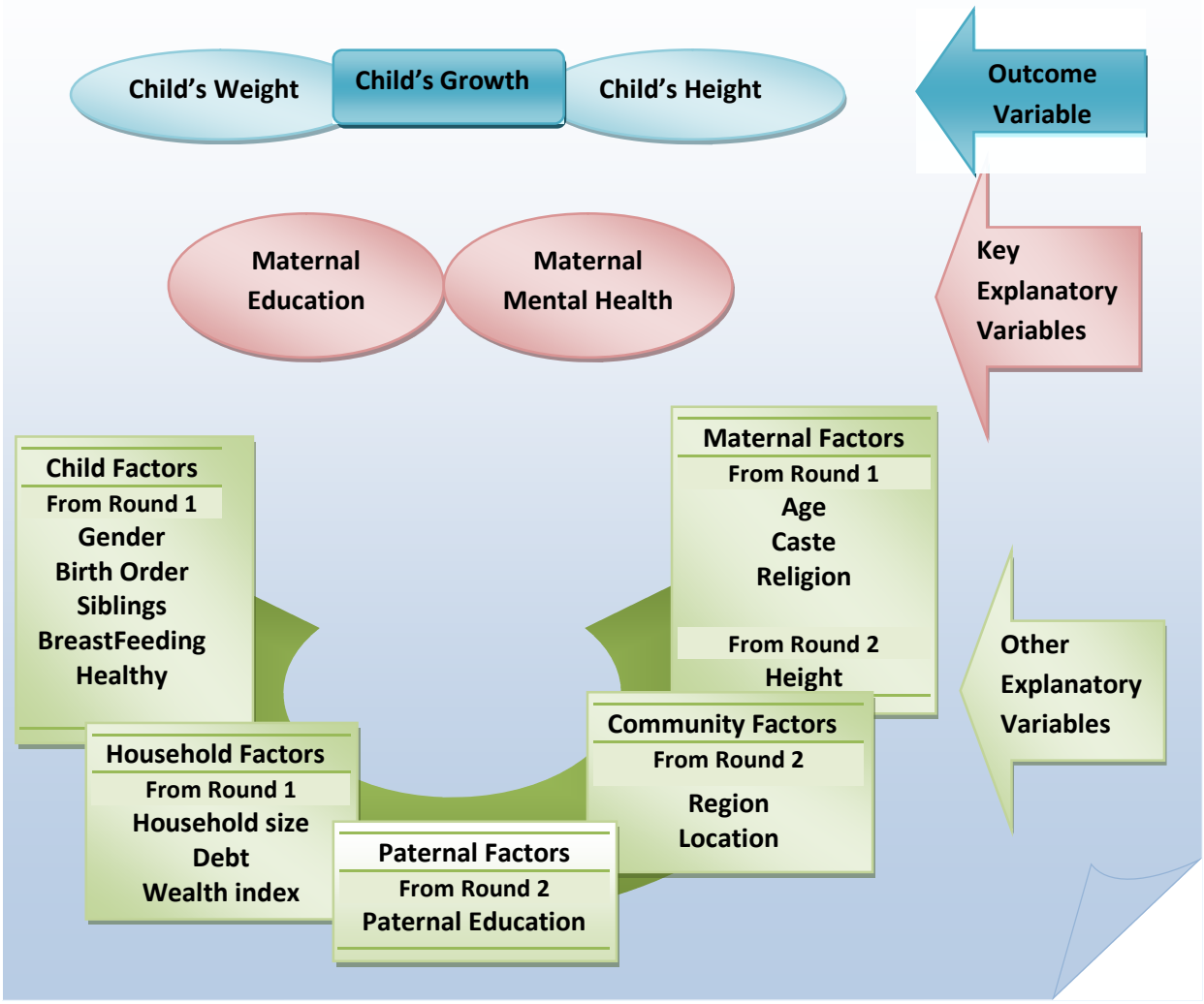
2.5.1. Correlations: the outcome variables were correlated with continuous explanatory factors variables and the correlation coefficient **"r"** was calculated.

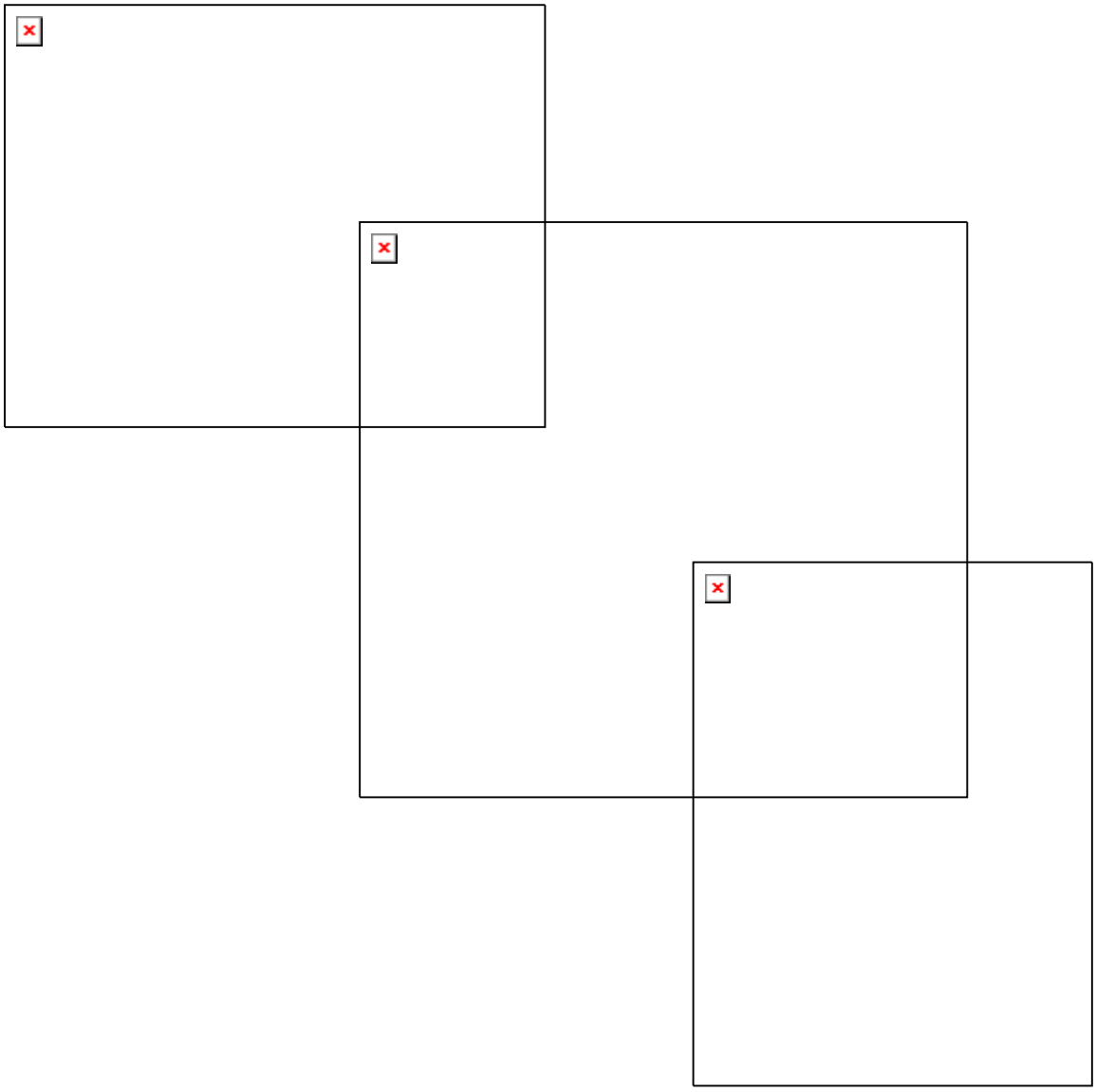
2.5.2. Descriptive Analysis: the mean and standard deviations was calculated for the outcome indices with regards to the explanatory variables.

2.5.3. Simple regression: the unadjusted association was calculated for the increases in child's height and child's weight according to the explanatory variables.

2.5.4. Multiple regressions: the adjusted association was calculated after controlling for confounding factors.

Fig 2.11: Description of Levels of Variables





CHAPTER 3: RESULTS

CHAPTER 3: RESULTS

3.1 Introduction

The previous chapter describes data collected by the Young Lives project from two survey rounds of children residing in Andhra Pradesh. In this chapter, data from these rounds is directly compared to obtain two indices of child growth between the age of 1 and 5 years: a) increase in height and b) increase in weight. Section 3.2 reports descriptive statistics obtained for each of these indices. In Section 3.3, increases in child growth are examined according to each of the two key factors of interest - maternal education and maternal mental health - and also other factors introduced in Chapter 2 (child, other maternal factors, paternal education, household, community). For each index of child growth, associations with each factor obtained using simple linear regression are reported in Section 3.4. Finally, independent associations between each index and each factor are assessed using multiple linear regression are reported in Section 3.5.

3.2 Descriptive Statistics

3.2.1 Outcome Variables

Increase in Height of the Child: the recorded minimum increase in height was 6.25 cm, maximum was 84.5cm and the calculated mean was 32.37 cm (SD: 4.75). The mean increase in boys height was 31.9 cm (SD: 4.7) and in girls was 32.8 cm (SD: 4.7). (Fig: 3.1)

Increase in Weight of the Child: the recorded minimum increase in weight recorded was 1.9 kgs, maximum was 23.5 kgs and calculated mean was 7.15 kgs (SD: 1.50). The mean increase in weight of the boys was 7.08 kgs (SD: 1.4) and in girls was 7.24 kgs (SD: 1.5). (Fig: 3.2)

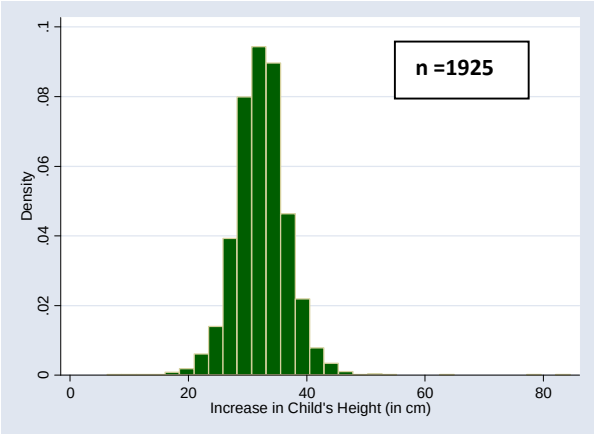


Fig 3.1: Distribution of Increase in Child's Height

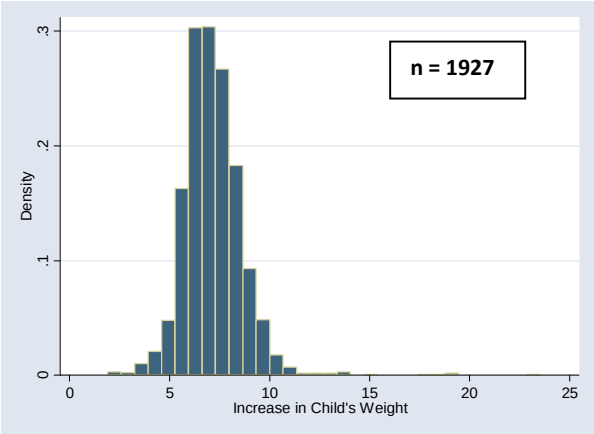


Fig 3.2: Distribution of Increase in Child's Weight

3.2.2. Distribution of the Outcome Variables according to the Explanatory Factors

The distribution of the two outcome indices according to the explanatory factors have been reported in tables 3.1 to 3.4.

Table 3.1 reports the increases in the child's height and weight according to two key explanatory variables; maternal education and maternal mental health. The mean increase in child's height was lowest in mothers who received primary education or had no education. The mean increase in weight was slightly higher in the children of mothers with primary education than in children of mothers with no education. Children of mothers who were not depressed on average had greater increases in height and weight.

The female children did marginally better in both indices compared to male children. Children with no siblings and those perceived to have worse health than their peers also had higher increases in mean height and weight than the rest of the children (Table 3.2).

Mean increase in height was the highest for children of younger mothers but mean increase in weight was the lowest in this group. Mothers belonging to Hindu religion and Scheduled Caste were associated with least increases in height and weight in children, while larger

increases in both indices were recorded with increase in levels of formal education received by the fathers. (Table 3.3)

The table 3.4 reports the household factors associated with increases in child's height and weight. The children living in Coastal Andhra Pradesh, urban areas, households having greater than 7 members and not in debt have been reported to have larger increases in both these indices.

	Increase in Child Height			Increase in Child's Weight		
Variables	**No of Observations**	**Mean**	**Standard Deviation**	**No of Observations**	**Mean**	**Standard Deviation**
Maternal Education						
None	980	32.12	4.88	983	7.02	1.34
Primary	394	32.12	4.65	393	7.10	1.38
Secondary	485	32.97	4.59	485	7.38	1.73
Higher	62	33.27	4.49	62	7.70	2.27
Maternal Depression						
Without Depression	1263	32.52	4.88	1265	7.24	1.53
With Depression	540	32.13	4.51	540	7.00	1.41

Table 3.1: Key Explanatory Variables

	Increase in Child's Height			Increase in Child's Weight		
Variable	**No of Observations**	**Mean**	**Standard Deviation**	**No of Observations**	**Mean**	**Standard Deviation**
Gender						
Male	1036	31.97	4.77	1036	7.08	1.45
Female	889	32.85	4.70	891	7.24	1.56
Siblings						
Yes	1196	32.24	4.61	1197	7.12	1.51
No	729	32.60	4.98	730	7.21	1.48
Health						
Same as others	948	32.29	5.01	948	7.14	1.54
Better than others	721	32.38	4.66	722	7.20	1.55
Worse than others	256	32.65	4.04	257	7.07	1.20

Table 3.2: Child Factors

	Increase in Child's Height			Increase in Child's Weight		
Variables	**No of Observations**	**Mean**	**Standard Deviation**	**No of Observations**	**Mean**	**Standard Deviation**
Age						
< 20 years	210	32.76	4.54	210	7.01	1.26
20 – 25 years	945	32.42	5.06	946	7.15	1.40
> 25 years	759	32.23	4.39	760	7.21	1.66
Caste						
Scheduled Caste	353	31.74	4.51	352	7.05	1.32
Scheduled Tribes	282	32.51	4.37	284	7.10	1.61
Backward Class	896	32.26	4.45	897	7.07	1.29
Other Caste	394	33.08	5.74	394	7.46	1.91
Religion						
Hindu	1696	32.33	4.78	1697	7.13	1.50
Muslim	139	32.78	4.54	139	7.32	1.51
Other	90	32.56	4.66	91	7.38	1.48
Paternal Education						
None	634	31.98	4.17	637	6.99	1.33
Primary	466	32.11	5.02	465	7.12	1.43
Secondary	512	32.66	4.59	512	7.20	1.45
Higher	310	33.08	5.59	310	7.46	1.92

Table 3.3: Other Maternal Factors and Paternal Education

	Increase in Child's Height			Increase in Child's Weight		
Variables	**No of Observations**	**Mean**	**Standard Deviation**	**No of observations**	**Mean**	**Standard Deviation**
Household size						
<5 members	815	32.35	4.95	817	7.16	1.44
5-7 members	802	32.38	4.77	802	7.14	1.61
> 7 members	308	32.40	4.21	308	7.18	1.35
Household Debt						
Yes	980	31.84	4.73	980	7.02	1.27
No	945	32.92	4.73	947	7.30	1.69
Region						
Coastal AP	672	33.34	4.73	674	7.35	1.68
Rayalseema	578	31.09	5.09	577	7.07	1.41
Telangana	675	32.51	4.23	676	7.03	1.36
Setting						
Urban	495	33.18	4.48	473	7.39	1.67
Rural	1430	32.09	4.82	1454	7.07	1.43

Table 3.4: Household Factors

3.3 Association with Continuous Explanatory Factors

Figure 3.3 reveals that increase in child's height and child's weight were positively correlated (r = 0.53). Increase in child's height strongly correlated with maternal height (r =

0.07), time interval of growth (r = 0.10) and wealth index (r = 0.15). Increase in child's weight was also found to strongly positively correlate with maternal weight (r = 0.15), time interval of growth (r = 0) and wealth index (r = 0.16). (Fig: 3.4 to 3.9)

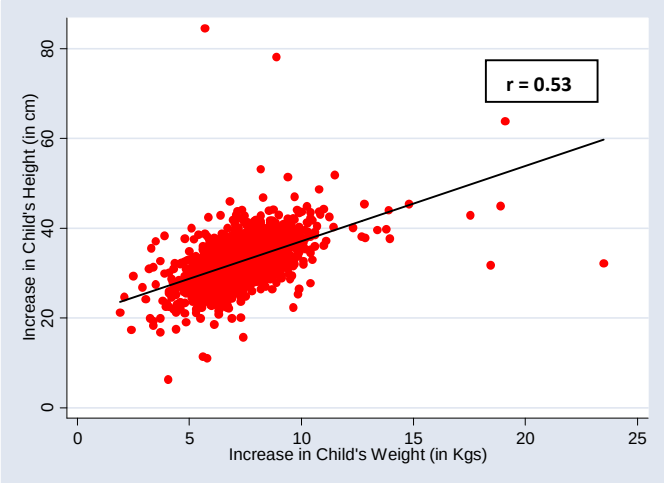


Fig 3.3: Scatter Plot: Increase in Child Height and Increase in Child Weight

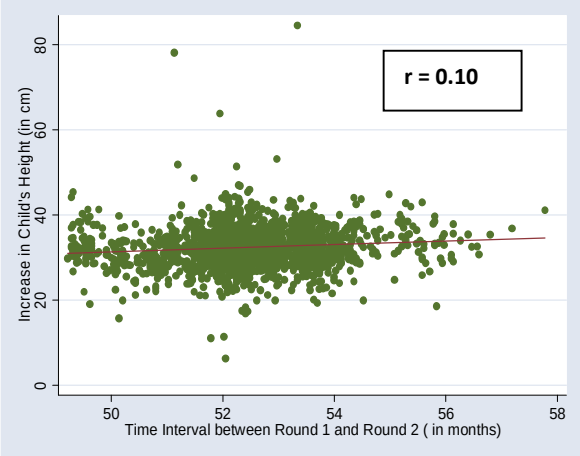


Fig 3.4: Scatter Plot: Increase in Child's Height and Time Interval between Rounds

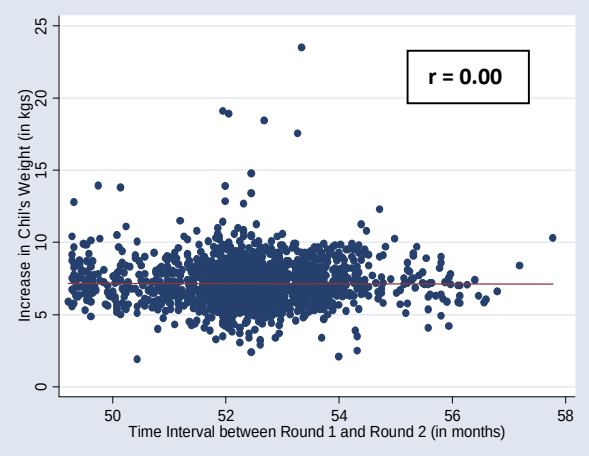


Fig 3.5: Scatter Plot: Increase in Child's Weight and Time Interval between Rounds

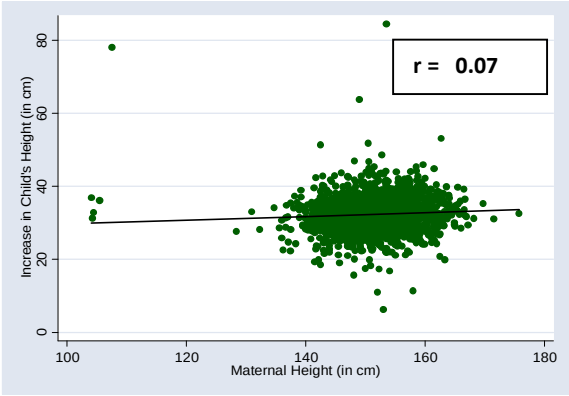


Fig 3.6: Scatter Plot: Increase in Child Height and Maternal Height

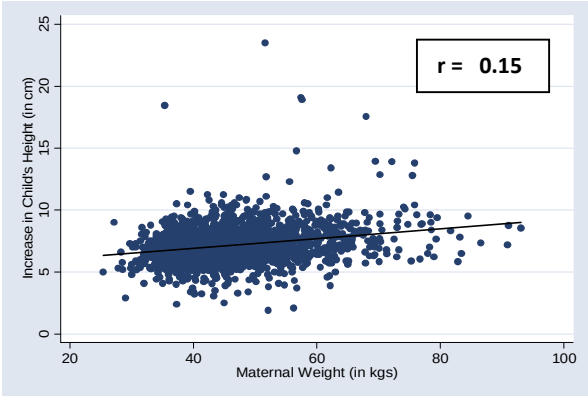


Fig 3.7: Scatter Plot: Increase in Child Weight and Maternal Weight

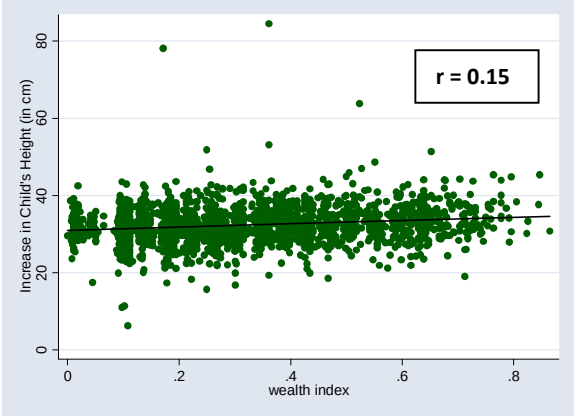


Fig 3.8: Scatter Plot: Increase in Child Height and Wealth Index

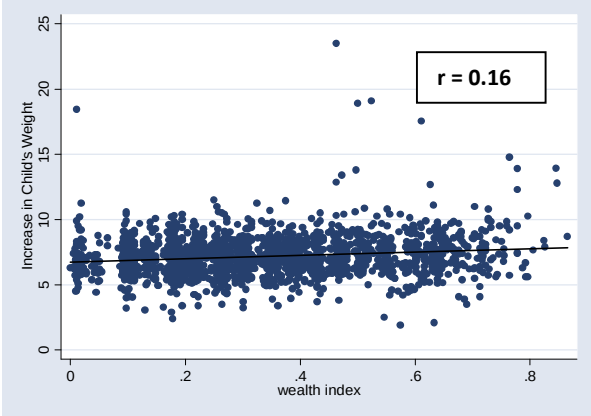


Fig 3.9: Scatter Plot: Increase in Child Weight and Wealth Index

3.4 Simple Regression

This section reports the association of increase between child's height and child's weight and the explanatory variables, by simple regression. Maternal education had an association with both indices, increases in child's height and weight while maternal mental health had an association only with child's weight. (Table 3.5)

The gender of the child, maternal height, mother's caste, father's education, household wealth and absence of debt, the region and setting had significant association with increases in child's height and weight. Interestingly, the outcome indices did not have any

associations with mother's religion, number of siblings, perceptions of the mother of healthy child and number of family members in the household. (Table: 3.6, 3.7 and 3.8).

	Increase in Child's Height			Increase in Child's Weight		
Variable	**Unadjusted Coefficient**	**Standard Error**	**Test for Linear Trend/ difference**	**Unadjusted Coefficient**	**Standard Error**	**Test for Linear Trend/difference**
Maternal Education						
None	Reference group		0.0033	Reference group		0.0000
Primary	0.00	0.28		0.08	0.09	
Secondary	0.84	0.26		0.36	0.08	
Higher	1.15	0.62		0.67	0.19	
Maternal Mental Health						
Non Case	Reference Group		0.11	Reference group		0.0022
Case	-0.39	0.25		-0.23	0.08	

Table 3.5: Simple regression: Maternal Education and Maternal Mental Health

	Increase in Child's Height			Increase in Child's Weight		
Variable	**Unadjusted Coefficient**	**Standard Error**	**Test for Linear Trend/difference**	**Unadjusted Coefficient**	**Standard Error**	**Test for Linear Trend/difference**
Gender						
male	Reference group		0.0000	Reference group		0.0182
female	0.88	0.22		0.16	0.07	
Siblings						
Yes	Reference group		0.1021			0.2084
No	0.37	0.22		0.08	0.07	
Health						
Same	Reference group		0.5529			0.4404
Better	0.09	0.24		0.07	0.07	
Worse	0.36	0.34		-0.06	0.11	

Table 3.6: Simple Regression: Child Factors

	Increase in Child's Height			Increase in Child's Weight		
Variable	**Unadjusted Coefficient**	**Standard Error**	**Test for Linear Trend/ difference**	**Unadjusted Coefficient**	**Standard Error**	**Test for Linear Trend/ difference**
Age						
< 20 years	Reference group			Reference group		
20 – 24 years	-0.34	0.36	0.3430	0.13	0.11	0.2366
> 24 years	-0.53	0.37		0.20	0.11	
Caste						
Scheduled Caste	Reference group			Reference group		
Scheduled Tribe	0.77	0.38	0.0013	0.05	0.12	0.0001
Backward class	0.52	0.30		0.02	0.09	
Other castes	1.34	0.35		0.41	0.11	
Religion						
Others	Reference group			Reference group		
Hindu	0.21	0.64	0.5172	-0.05	0.20	0.1318
Muslim	-0.23	0.51		-0.24	0.16	
Maternal Height or Weight	0.05	0.02	0.0042	0.01	0.001	0.0000
Paternal Education						
none	Reference group			Reference group		
Primary	0.13	0.29	0.0023	0.12	0.09	0.0001
Secondary	0.68	0.28		0.20	0.09	
Higher	1.10	0.32		0.46	0.10	

Table 3.7: Simple Regression: Other Maternal Factors and Paternal Education

	Increase in Child's Height			Increase in Child's Weight		
Variable	**Unadjusted Coefficient**	**Standard Error**	**Test for Linear Trend/difference**	**Unadjusted Coefficient**	**Standard Error**	**Test for Linear Trend/difference**
Household size						
< 5 members	Reference group		0.9836	Reference group		0.9159
5-7 members	0.03	0.24		-0.02	0.08	
>7 members	0.05	0.32		0.03	0.10	
Debt						
No debt	Reference group		0.0000	Reference group		0.0000
Has debt	1.08	0.22		0.28	0.07	
Wealth Index	3.42	0.51	0.000	1.13	0.16	0.000
Region						
Coastal AP	Reference group					
Rayalseema	-2.25	0.27	0.0000	-0.27	0.08	0.0002
Telangana	-0.824	0.25		-0.32	0.08	
Setting						
Urban	Reference Group					
Rural	-1.29	0.25	0.0000	-0.31	0.08	0.0001

Table 3.8: Simple Regression: House hold Factors

3.5 Multiple Regressions

This section reports the independent associations between each index of child growth and each explanatory factor assessed using multiple linear regressions.

The results indicated no association between the increases in child's height (P value = 0.40) and child's weight (P value = 0.74) and maternal education once adjusted for other explanatory variables (table 3.9), despite significant association between unadjusted maternal education and increase in child's height (P value = 0.00) and increase in child's weight (P value = 0.02) as reported in table 3.5.

The adjusted maternal mental health also indicated no association with the increase in child's height (p value = 0.80) and increase in child's weight (p value = 0.43). This is reported in table 3.10.

Similarly, there was no association between increase in child's height and the adjusted factors of maternal caste, paternal education, household debt or setting (table 3.9). But there was a significant association between increase in child's height and gender of the child, maternal height, the wealth index and the region to which the child belongs (table 3.9).

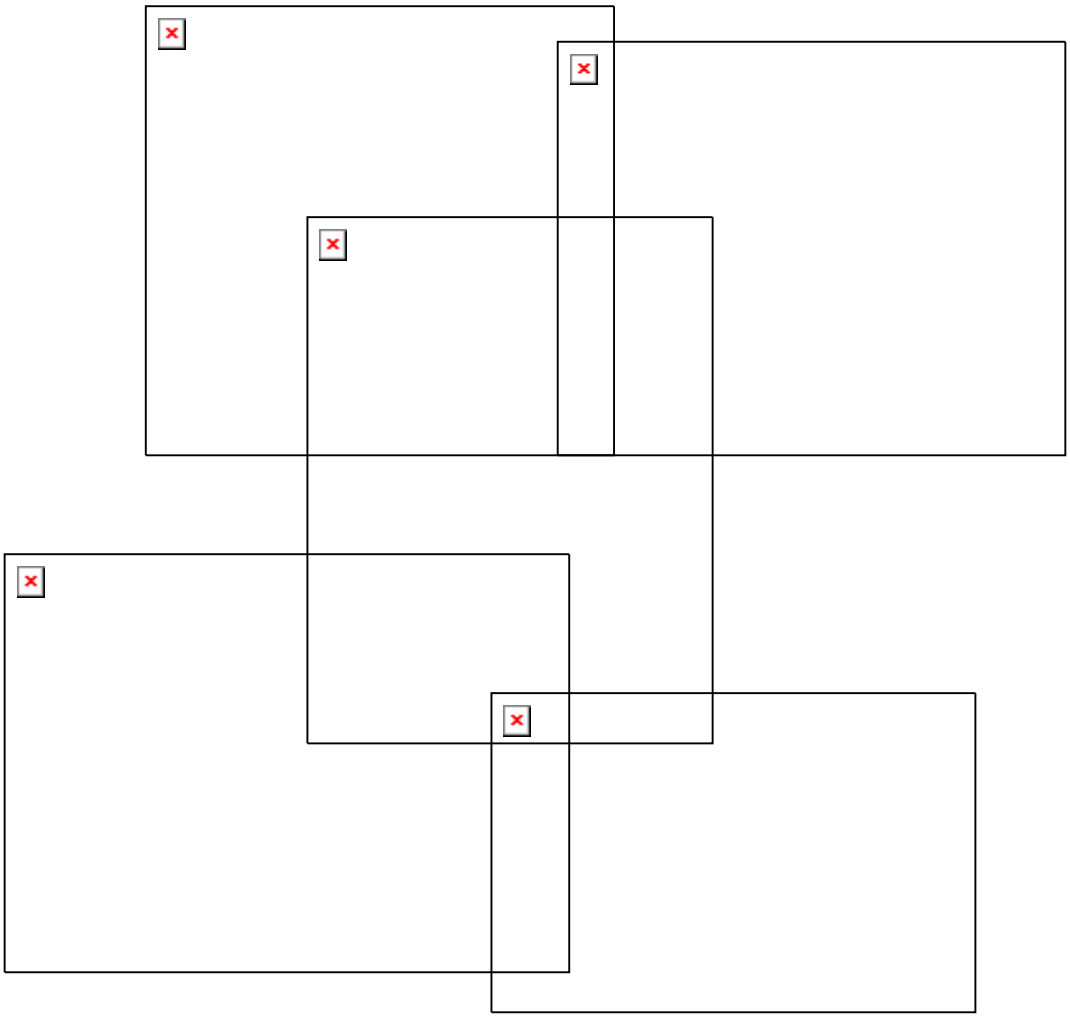
The increase in child's weight was significantly associated with the adjusted factors of gender of the child, maternal weight, maternal caste, wealth index and region while there was no association with paternal education, debt or setting (table 3.9).

	Increase in Child's Height			Increase in Child's Weight		
Variable	**Adjusted Coefficient**	**Standard Error**	**Test for Linear Trend / Difference**	**Adjusted Coefficient**	**Standard Error**	**Test for Linear Trend / Difference**
Maternal Education						
None	Reference group			Reference group		
Primary	-0.37	0.30	0.40	-0.08	0.94	0.74
Secondary	-0.39	0.33		0.01	0.10	
Higher	-0.97	0.71		0.12	0.22	
Gender						
Male	Reference group			Reference group		
Female	0.99	0.21	0.00	0.18	0.07	0.00
Maternal Caste						
Scheduled Caste	Reference group			Reference group		
Scheduled Tribes	0.22	0.40	0.14	0.22	0.13	0.08
Backward Class	-0.04	0.30		-0.08	0.09	
Other Castes	0.64	0.37		0.16	0.11	
Maternal Height or weight	0.05	0.02	0.01	0.01	0.00	0.00
Paternal Education						
None	Reference group			Reference group		
Primary	0.20	0.30	0.37	0.06	0.09	0.73
Secondary	0.44	0.31		0.00	0.09	
Higher	0.66	0.40		0.11	0.12	
Debt	0.19	0.25	0.45	0.12	0.08	0.12
Wealth Index	1.85	0.80	0.02	0.85	0.25	0.00
Region						
Coastal AP	Reference group			Reference group		
Rayalseema	-2.07	0.30	0.00	-0.15	0.10	0.09
Telangana	-0.58	0.27		-0.19	0.09	
Setting						
Urban	Reference group			Reference group		
Rural	-0.20	0.34	0.56	0.18	0.11	0.96

Table 3.9: Multiple Regressions: Maternal Education with Increases in Child's Height and Weight

	Increase in Child's Height			Increase in Child's Weight		
Variable	**Adjusted Coefficient**	**Standard Error**	**Test for Linear Trend / Difference**	**Adjusted Coefficient**	**Standard Error**	**Test for Linear Trend / Difference**
Maternal Mental Health						
Non Case	Reference group			Reference group		
Case	0.08	0.26	0.80	-0.64	0.08	0.43
Gender						
Male	Reference group			Reference group		
Female	0.90	0.22	0.00	0.15	0.07	0.03
Maternal Caste						
Scheduled Caste	Reference group			Reference group		
Scheduled Tribes	0.29	0.41	0.30	0.061	0.13	
Backward Class	0.06	0.32		-0.04	0.10	
Other Castes	0.60	0.38		0.16	0.12	0.19
Maternal Height or weight	0.04	0.02	0.02	0.01	0.00	0.00
Paternal Education						
None	Reference group			Reference group		
Primary	0.10	0.30	0.69	0.05	0.09	0.70
Secondary	0.22	0.31		-0.01	0.10	
Higher	0.45	0.38		0.11	0.11	
Debt	0.13	0.26	0.61	0.14	0.08	0.08
Wealth Index	1.82	0.82	0.03	0.85	0.26	0.00
Region						
Coastal AP	Reference group			Reference group		
Rayalseema	-2.09	0.31	0.00	-0.16	0.10	0.14
Telangana	-0.43	0.29		-0.17	0.09	
Setting						
Urban	Reference group			Reference group		
Rural	0.07	0.35	0.84	0.21	0.11	0.06

Table 3.10: Multiple Regressions: Maternal Mental Health with Increases in Child's Height and Weight



CHAPTER 4: DISCUSSION & CONCLUSIONS

CHAPTER 4: DISCUSSION AND CONCLUSIONS

4.1 Findings from the present research

This research reports trajectories of child growth for a cohort of children living in Andhra Pradesh using data from the Young Lives project. Children were followed up from an average age of 11.8 months to 5.5 years during which they grew, on average, 32.7 cm taller and 7.15 kgs heavier.

Increases in child height and weight both showed strong positive associations with maternal education in unadjusted analyses, these being least in children of mothers with either no formal education or only primary education. While increases in child's height and weight were both lower in mothers reporting mental health problems, this difference was only statistically significant for child's weight. Unadjusted analyses also revealed strong positive associations between increases in child's height and weight and eight other factors: gender of the child, caste of the mother, maternal height and weight, paternal education, wealth index, debt, the agro-climatic region and setting (urban versus rural). No associations were found, however, with presence of siblings, relative health of the child, age and religion of the mother. Associations between child growth and maternal education and maternal mental health did not persist after adjustment was made for the eight other factors. Increases in child's height and weight were, however, independently associated with gender of the child, maternal height and weight, wealth index and the agro-climatic region. Interestingly, associations with paternal education or household debt did not persist when adjusted for other factors.

4.2 Comparison of findings with previous research

Maternal Education: lack of independent associations between maternal education and the increases in child's height and weight contrast with previous studies which found mother's education to be a strong predictor of better physical growth of the child.[102,104,133] The findings of the current research were, however, similar to that of a prospective cohort study in Brazil.[71] There it was noted that, on controlling for other factors, the effect of maternal education on child's growth which was assessed by prevalence of stunting and under-nutrition was reduced by between 50 to 75%. It is noteworthy that several previous studies which found associations between child growth and maternal education had compared data from very different countries or regions. The Young Lives data used here, by contrast, were collected using a pro poor sampling method within one single state of India. The absence of an association persisting after adjustment for other factors may partly reflect smaller variation in population sampled in terms of level of maternal education, socioeconomic status or region in which these communities were located. In particular, the influence of household wealth appeared more important than maternal education. It is known from previous studies and reviews that better educated women contribute to household income.[71,104] The findings from the present study are similar to those of one which concluded that maternal education is a proxy for socioeconomic status and geographical area of residence and thus the effects of maternal education disappeared or greatly reduced once these factors were controlled.[61,134]

The lack of association found between maternal education and child's growth also raises questions regarding the quality of the primary educational system present in the community. This was also noted in previous literature which emphasised the need for

women's education beyond primary level and imparting better quality education to produce adequate health knowledge in mothers.[71,102]

Maternal Mental Health: a prospective cohort study in Pakistan documented maternal mental health as a strong predictor of child growth and viewed that prevalence of maternal depression could reduce the growth of the child by nearly 30 %.[114] Other case-control and cross sectional studies in India, Pakistan and other regions of world also indicated that depressed mothers demonstrated impaired child growth.[94,112,113] In contrast, the results of this study indicated no association between maternal mental health and decrease in child growth indices.

Paternal Education: while paternal education initially appeared to have an important role to play in child growth these influences disappeared once controlled for potential confounders. With a growing interest in paternal contribution to a child's growth studies the recent past have reported some associations with paternal education. [104,121-123]

Poverty and Household Wealth: the study found a strong positive independent association with wealth index but not household debt. Previous studies have documented that household wealth provides leverage for improving child growth by providing the opportunity to purchase goods and services which were health enhancing.[21,23,24,29,30]

Gender: unlike most previous studies, child growth was measured using two continuous measures: increase in height and increase in weight. While mean height of the boys and girls at age 5 years was similar, the increase in the female child's height and weight was slightly higher. This finding contrasts with previous studies which had not found any difference between the growth of male and female.[10,31]

Maternal Height and Weight: there was strong association between maternal height and weight and increases in child's height and weight. Previous studies have also documented similar findings.[3,7,119]

Setting and Region: evidence suggested that urban children generally have a better nutritional status than their rural counterparts.[125-128] Unadjusted analysis in this study revealed that urban children had greater increase in height but these differences ceased once adjusted for the other explanatory factors. Increases in height and weight were highest in children living in Coastal Andhra Pradesh and lowest among those living in Rayalseema. This is the first time such regional comparisons in child growth have been made within Andhra Pradesh.

4.3 Strengths of this research

This research observed increases in child's growth between the ages of 1 and 5 years, in resource poor settings of Andhra Pradesh using individually linked data. The Young Lives Project provided complete datasets for two consecutive survey rounds, with a follow-up of 97%.Two sensitive continuous measures of child's growth were used: a) increase in height in centimetres and b) increase in weight in kilograms. Most previous studies of child growth in developing countries have been predominantly case-control or cross sectional in their design and using prevalence stunting and wasting as their indices.

4.4 Limitations of this research

The Young Lives has used a pro poor sampling technique within a single state in India. The resultant smaller variation in maternal education may explain the lack of association with

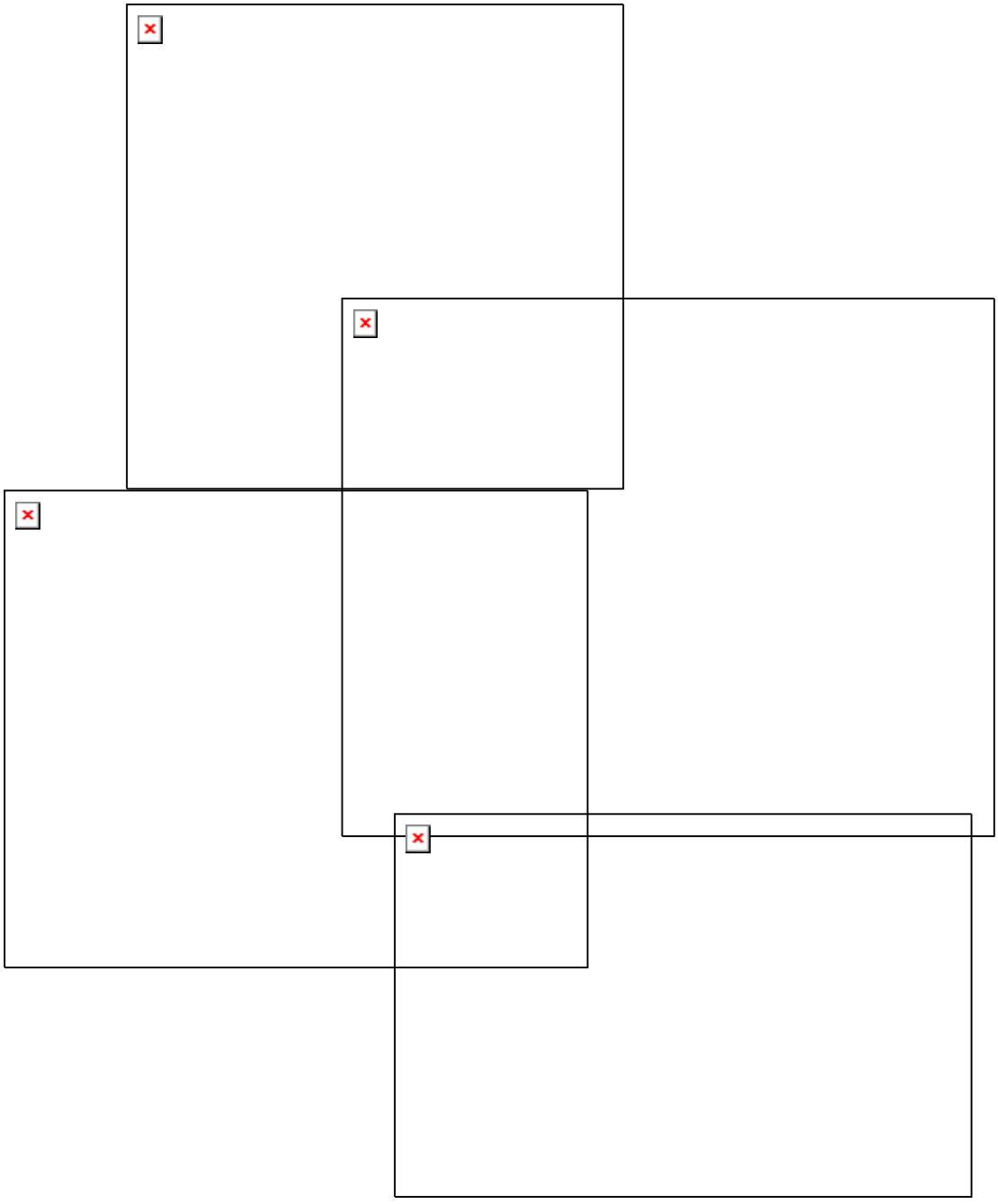
child growth after adjusting for the confounding effects of other important factors at the community level such as the wealth index.

The first survey took place when children were aged on average 11.8 months and second survey when aged 5.5 years. The time between the two survey rounds ranged from 49 to 58 months, which may have introduced variability into the period of child's growth. While data could have been restricted to a narrower age range, analyses would have lost precision.

Maternal depression was only recorded at Round 1 while maternal education was only recorded at Round 2. In addition the information on breastfeeding was incomplete. It would have been preferable to have had information regarding all these three variables at both survey rounds. Lack of information on the 32 children who died was not provided at Round 2.

4.5 Conclusions

This was the first study to assess child's growth using continuous measures derived from data from an international cohort study (Young Lives). It followed the children in their early period of their growth, from the ages of 1 to 5 years. Independent associations were found between child growth and child's gender, maternal height and weight, household wealth index and the agro-climatic region. While both key factors of prior interest, maternal education and maternal mental health, were initially associated with child growth, these did not persist after adjustment for other factors. Other factors, including paternal education were also not found to be associated. This study draws attention to the need for improved quality of the educational system in poorer areas of Andhra Pradesh. It also illustrates the pivotal role of the prospective study design in identifying key factors affecting child's growth.



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