DETERMINANTS OF CHILD MALNUTRITION AMONG URBAN POOR OF INDIA

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entitled

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ABSTRACT

Rivaling drought-hit Ethiopia in its proportion of stunting, India holds 48% of children under five as victims of persistent malnutrition. In spite of national aid programs the situation barely improved over two decades and even worsened among the poorest. The ever growing mass of urban poor eventually reached the same rate of child malnutrition as rural poor. This study aimed at unveiling the relative contribution of determinants such as mother nutritional status, child diet, water and sanitation, and other household characteristics. By focusing on age below 3 years, when effects of malnutrition are still reversible, a sample of 691 children was drawn from the latest Family Health Survey of India (NFHS-3, 2005-2006). Generalized Ordered Logistic Regression was run first to test association of individual, maternal, and household factors with wasting (short-term malnutrition), secondly to test association with stunting (long-term malnutrition). 89% children among urban poor were stunted or wasted.

Findings revealed that as child age advanced risk of stunting increased (12-23 months: OR=7.2, 95% CI=3.4-15.2; 24-35 months: OR=10.0, 95% CI=4.5-22.0), as well as risk of wasting (12-23 months: OR=5.2, 95% CI=2.4-11.3; 24-35 months: OR=8.1, 95% CI=3.5-18.5), jumping between 6 and 18 months. Four other factors were unveiled as determinants of both stunting and wasting. Breastfeeding less than 12 months entailed an increased risk of stunting (OR=1.9, 95% CI=1.0-3.6) and wasting (OR=2.9, 95% CI= 1.5-5.7). If the mother was underweight, the child was more likely to be stunted (OR=1.5, 95% CI=1.1-2.0) and wasted (OR=1.7, 95% CI=1.2-2.3). Being low-birth-weight came out as contributing to both stunting and wasting (OR=1.7, 95% CI=1.2-2.5). Compared to children consuming at least two important food groups, those not consuming any were almost two times more likely to be stunted or wasted (OR=1.7, 95% CI=1.1-2.6). Additional risk factors specific to wasting were: missing vitamin A supplementation (OR=3.0, 95% CI=1.3-7.4), mother primary education instead of secondary (OR=1.7, 95% CI=1.0-2.8), and more than six household members (OR=1.5, 95% CI=1.0-2.1). Additional risk factors specific to stunting were: not receiving food assistance (OR=2.0, 95% CI=1.2-3.4), three or more children under five living in same household (OR=1.6, 95% CI=1.0-2.6), and toilet facilities shared with other households (OR=1.8, 95% CI=1.1-3.0).

Existing aid programs must reach out to urban poor, focusing both on mother and child nutrition, delivering food and supplementation assistance, as well as training mothers on child appropriate feeding and health care.

KEY WORDS: URBAN POOR / CHILD MALNUTRITION / STUNTING / WASTING / LOW-BIRTH-WEIGHT / MOTHER NUTRITIONAL STATUS / DIET DIVERSITY

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ha : height-for-age, also known as stunting level

wa : weight-for-age, also known as wasting level

SD : standard deviations (relatively to a mean value)

BMI : Body Mass Index

ORS : Oral Rehydration Salt, also called Oral Rehydration Solution

NFHS : National Family Health Survey (national household survey)

DHS : Demographic and Health Surveys central repository

CI : Confidence Interval

p : significance level (probability to occur in the confidence interval)

ICDS : Integrated Child Development Scheme

MDG : Millennium Development Goal

CHAPTER I
INTRODUCTION

1.1 Background

Malnutrition is the condition that develops when the body does not get the right amount of the vitamins, minerals, and nutrients it needs to maintain healthy tissues, organ function, and ensure growth (in case of children). Child malnutrition leads to poor cognitive, intellectual and physical development, and stunted growth.

Malnutrition is usually associated in the common understanding with rural areas where crops harvests are sometimes insufficient. This image is mainly conveyed by the recurrent draught in sub-Saharan Africa leading to peaks of famine and malnutrition. Hence Africa has long been considered as the main continent impacted by hunger and malnutrition. However both these preconceived ideas about rural areas and Africa are to be challenged by the situation of malnutrition in Asia, especially in India..Young children in India suffer from some of the highest levels of stunting, underweight, and wasting observed in any country in the world, and 7 out of every 10 young children are anemic. The percentage of children under five who are underweight is almost 20 times as high in India as would be expected in a healthy, well-nourished population and is almost twice as high as the average percentage of underweight children in sub-Saharan African countries (Kothari and Abderrahim 2010). Stunting level is an indicator of long term malnutrition whereas wasting level is an indicator of recent malnutrition. Underweight is a combination of both. A child can be both stunted and wasted, if he has been suffering from persistent malnutrition and still is.

In spite of several large scale programs from the government of India, such as the Integrated Child Development Scheme (ICDS), the situation hardly improved between the latest two national health surveys, NFHS-2 (1998-1999) and NFHS-3 (2005-2006): prevalence of child underweight went from 43% to 40%.

Among women, the problem of malnutrition is also widespread. Thirty-six percent of women in the whole India are undernourished, with a BMI less than 18.5, indicating a high prevalence of nutritional deficiency. The progress has also been insignificant for women between the two latest national health surveys.

Child malnutrition is the underlying cause of death of 2.2 million children worldwide and of 21% of disability-adjusted-life-years (DALYs) among children under 5 (Black, Allen et al. 2008). Consequently, child malnutrition is a pivot point of the Millennium Development Goals: it is at the center of Millennium Development Goal 1 ("Eradicate Poverty and Hunger"); it is directly linked Millennium Development Goal 4 ("Reduce Child Mortality"), and indirectly linked to other important MDGs (1A, 2A, 3A, 7C and 7D).

Table 1-1 Direct link between child malnutrition and MDGs 1 and 4

MDG 1	***Eradicate Extreme Poverty and Hunger***
MDG1.C.	Halve, between 1990 and 2015, the proportion of people who suffer from hunger
	Measurements: - Prevalence of underweight children under-five years of age - Proportion of population below minimum level of dietary energy consumption
MDG 4	***Reduce Child Mortality***
MDG4.A.	Reduce by two-thirds, between 1990 and 2015, the under-five mortality rate
	Measurements: - Under five mortality rate - Infant mortality rate

As outlined in Chapter II, poverty (targeted through MDG 1A), mother's low education (targeted through MDG 2A and 3A), and poor water and sanitation (targeted through MDG 7C and 7D) were found in many studies to be important determinants of child malnutrition.Table 1-2 Links between child malnutrition and other MDGs.

Table 1-2 Links between child malnutrition and other MDGs

MDG 1 Eradicate Extreme Poverty and Hunger
MDG 1.A. Halve, between 1990 and 2015, the proportion of people whose income is less than one dollar a day
MDG 2 Achieve Universal Primary Education
MDG 2.A. Ensure that, by 2015, children everywhere, boys and girls alike, will be able to complete a full course of primary schooling
MDG 3 Promote Gender Equality and Empower Women
MDG 3.A. Eliminate gender disparity in primary and secondary education, preferably by 2005, and in all levels of education no later than 2015
MDG 7 Ensure Environment Sustainability
MDG 7.C. Halve, by 2015, the proportion of people without sustainable access to safe drinking water and basic sanitation
MDG 7.D. By 2020, to have achieved a significant improvement in the lives of at least 100 million slum dwellers.

A recent survey highlights how disproportionate the concentration of malnutrition is among the poor of India (lowest wealth quintile) as opposed to non-poor (Pathak and Singh 2011). Besides the differential in malnutrition between poor and non-poor has widely increased between 1992 and 2006 (Pathak and Singh 2011). Hence urban poor are more likely to be underweight than urban non-poor (UNICEF 2012). The vulnerability of urban poor is often underestimated, because hidden from surveys, whenever data is not disaggregated according to urban/rural and wealth categories (Agarwal 2011). Average health indicators among urban population show better results than average health indicators among rural population.

However disaggregating data according to household wealth can unveil a huge disparity between urban poor and urban non-poor, with sometimes even more vulnerability among urban poor than among rural (UNESCAP 2007). According to

NFHS-3, child malnutrition among urban poor is 47.1 percent, hence slightly worse than child malnutrition among rural, which is 45.6 percent ((IIPS) and International. 2007).

The cause of urban poor is crucial in the 21st century. Indeed the World population grew almost three-fold between 1950 (2.5 Billion) and 2011 (7 Billion), from which the proportion living in urban areas increased at an even higher allure, from 29% of the overall population in 1950 to 50% in 2011. Hence the absolute number of people living in urban areas changed scale over the last sixty years, rising up from 750 Million in 1950 to more than 3.5 Billion in 2011. Furthermore, according to recent projections, the current urbanization trend should bring the World urban population to the impressive count of 5 Billion by 2030. Among this ever-growing urban population, the ones living in slums will be inflating the most and at an unprecedented rate, literally doubling size between today and 2030, reaching the impressive count of 2 billion people. Urban areas growing at a fast pace, like today in India, usually reveal an important wave of migration from rural to urban, families and individuals being pushed away from rural areas because of famine or extreme poverty, and coming into cities, full of hope, but with low resources, hence swelling the proportion of urban population at risk of food insecurity and malnutrition.

Poverty is usually estimated by calculating the number of people living with less than 1.25$ per day. By looking at the extended threshold of 2$ per day, 75.6% of India population could be considered as poor. Among the poor population, an important proportion of urban poor live in slum settlements, where hygiene and sanitation are lacking, and where conditions of living are particularly harsh. An estimated 95 million of urban dwellers in the whole India are considered as urban poor, as per 2011-census. Besides, an estimated total of 93 million urban dwellers live in slums.

Started by the Government of India in 1975, the Integrated Child Development Scheme (ICDS) has been working on improving the health of mothers and children under 6 by providing health and nutrition education, health services, supplementary food, and pre-school education, through one million village-level *Anganwadi Centres* staffed by *Anganwadi workers.* The ICDS national development program is one of the largest in the world. It reaches more than 34 million children

aged 0-6 years and 7 million pregnant and lactating mothers. The government of India also put in place a Public Distribution System (PDS) of essential food through the usage of food ration cards in 500,000 Food Distribution Shops (FDS), providing households which are below the poverty line with portions of wheat, rice, and sugar, in exchange of a low price. Why, in spite of these two large-scale and long term programs, malnutrition is so omnipresent and persistent among children of India?

Actually, when PDS food is accessible, it still consists of the trio wheat-rice-sugar, which cannot be considered as a combination promoting good and diversified nutrition; these tree essential supplies are only the base to fight hunger and starvation, they do not bring all nutrients essential to the child development. Besides, in 2005, the World Bank conducted a review of ICDS program (Gragnolati, Shekar et al. 2005), explaining that ICDS mainly reached children from 3 to 6 years old when malnutrition has already set in, and mainly focused on nutrients supplementation. The report from the World Bank recommends that the program be reoriented towards younger children (below 3-years old) and cover the following domains:

- Improving maternal nutrition during pregnancy and lactation
- Improving feeding practices for young children (0-3 years)
- Improving household water and sanitation
- Strengthening prevention and treatment of common child diseases

Being in line with World Bank's recommendations, the present study will focus on the link between malnutrition and feeding practices, while also considering the potential impact of breastfeeding practices, water and sanitation, and diarrhea, for children below 3 years of age.

1.2 Problem Statement

Traditionally associated to rural population, malnutrition is now widespread among urban settings, especially among the poorest families. The resources in urban and rural settings are not the same: urban inhabitants do not farm their products, have rarely the possibility to raise chickens, and need to buy fresh food at the urban price, while rural inhabitants often rely on their own food production. Urban poor often live in congested areas, where facilities, including toilets and water

source, may be shared between many people, leading to increased risks for health. Women in urban poor settings may have to work away from home to cope with the high cost of living, leaving young children alone or under older siblings' supervision. All these urban specificities may have an impact on the patterns and causes of malnutrition among young children. At the same time, unlike rural families, urban poor usually live close to food shops, or to centers where food assistance can be received. They do not depend on crop production as much as rural dwellers do. Urban poor can take public transportation and potentially access support systems, health centers and assistance services. Hence it is necessary to understand what prevents urban poor children from having a good nutritional status.

The problem consists in examining why urban poor children are malnourished, how widespread the problem is, and what the underlying causes are.

1.3 Research Question

Among urban poor of India, what are the determinants of malnutrition (stunting, wasting) for children aged 6 to 35 months old, and what are their respective contribution to malnutrition?

CHAPTER II
LITERATURE REVIEW

Malnutrition is caused by a combination of many factors including household food insecurity, poor care of women and children and lack of proper access to health and sanitation facilities (Black, Allen et al. (2008)). The latest version of a generic conceptual framework on child's and mother's malnutrition was published in 2008 by Robert E. Black in *The Lancet* ((Black, Allen et al. 2008)), showing the following information:

- Two immediate causes: inadequate dietary intake and burden of diseases. Inadequate dietary intake is determined by household food insecurity and inadequate care of women and children; disease is determined by unhealthy household environment, lack of health services, and inadequate care.
- Income poverty as underlying cause
- Social, economic and political contexts as basic root causes

We will focus in the present study on the immediate and underlying causes of child malnutrition.

Among urban poor, child dietary intake was found to be the lowest of the whole India, and child malnutrition to be caused by the following main characteristics (Ghosh and Shah 2004):

- Poor maternal nutritional status, leading to low-birth-weight newborns
- Inadequate breastfeeding practices (delayed and non-exclusive breastfeeding)
- Delayed and insufficient complementary feeding (supposed to start at 6 months of age, and no later than 8-9 months)
- Lack of knowledge and awareness of caregivers on infant nutrition
- Absence from home of a responsible adult caregiver
- Faulty intrafamilial distribution of food (impacting mostly women, and sometimes children)

2.1 Low Birth Weight, Mother Educational Status

In a recent study realized across three Indian states representing three different stages of development, it was shown that mother education was the main determinant of child malnutrition, followed by low-birth-weight and household wealth index(Som, Pal et al. 2007). Low-birth-weight is itself strongly determined by mother nutritional status (BMI) (Ahmed, Mahfuz et al. 2012).

Entitled “Hunger and Malnutrition”, or in short “HUNGaMA”, the latest large-scale survey on malnutrition among young children of India was realized in 2011(HUNGaMA 2011), including 109,093 children under 5, 74,020 mothers, spread across 9 Indian states. The former survey done in India at district level was the District Level Health Survey (DLHS) in 2004. By comparing both surveys it was revealed a reduction in child malnutrition of 20.3% in 7 years (underweight prevalence: 53% (DLHS, 2004), 42% (HUNGaMA, 2011)). The HUNGaMA survey highlighted several determinants of malnutrition: low birth weight was demonstrated as being a risk factor, mother education level was shown as positively linked to the good child nutritional, lack of hygiene and insufficient breastfeeding were presented as favoring malnutrition. It was also interesting to note that among children below 36 months of age, girls were not more malnourished than boys; they actually had a slightly better nutritional status.

2.2 Food Affordability

A household is considered as food insecure when, it faces problems such as limited or uncertain availability of nutritionally adequate and safe food. Several studies have found food insecurity to be strongly associated with low income, unemployment of father and overcrowding. A study(Agarwal, Sethi et al. (2009)) was done in an underserved urban slum of North Delhi to find levels and determinants of household food insecurity. Out of 410 respondents, illiteracy rates were high (64.9%), average family size was six, and in most households (58.8%) there was only one currently employed family member (e.g. rickshaw pulling, daily labour, domestic servant) 51% of urban slum inhabitants were found being food insecure, factors predicting food insecurity within a household were directly or indirectly related to low

income. Employment related food insecurity among urban poor appeared to be linked to irregular forms of employment, daily labour and low wages (Agarwal, Sethi et al. 2009).Besides, for urban poor, relative prices of commodities are higher, levels of wages are lower, and because of expenses such as rent or school, the amount of money available to spend on food is reduced(Agarwal, Sethi et al. 2009).

A Bangladeshi study also showed that household wealth was strongly associated to child stunted growth (Hong, Banta et al. 2006).

2.3 Access to Food Assistance

Less than one-third (29%) of urban poor have Below Poverty Line (BPL) cards, which is a mandatory item to get food from PDS (Press Information Bureau, Government of India 2007). Besides, only 53.3% of urban poor children under 6 live in areas covered by an Anganwadi center (Urban Health Resource Center 2008). Indeed many urban poor live in unauthorized slums and are de facto excluded from any government support program (Agarwal and Taneja 2005). Even for those living close to an Anganwadi center, access to assistance food is not always available. In HUNGaMA survey (2011), it was estimated that only 61% of Anganwadi centers had dry food available on the day of the survey, and only 50% were able to provide assistance food to families on that day.

2.4 Water and Sanitation, Diarrhea

Most urban poor live in overcrowded spaces with poor hygiene and sanitation favoring the development of infectious diseases, including the most common one, diarrhea. Lack of hygiene practices within families with young children certainly accentuates the risk of diarrhea: in HUNGaMA survey (2011), it was found that hand-washing with soap was practiced by only 19% of households before meal, and by only 11% of households after going to the toilet. Infectious diseases are important determinants of stunting (Black et al. 2008). Although there can be contributions to growth faltering from respiratory illnesses or malaria, the role of diarrhea seems to be particularly important, perhaps because of its association with

malabsorption of nutrients (Black et al. 2008). Appropriate treatment of diarrhea is crucial to limit its extent and consequences on child health. However knowledge on the need to use ORS (Oral Rehydration Salt) is often low among urban poor settings.

2.5 Breastfeeding

Even if breastfeeding is almost generalized in India, breastfeeding is most often not initiated soon enough after birth, preventing the newborn from the benefits of nutritious colostrum, and exclusive breastfeeding usually becomes fairly quickly non-exclusive breastfeeding, the newborn being fed water and traditional food preparations. In a study among urban slums of Indore(Agarwal, Srivastava et al. 2007), 58.3% mothers mentioned that they exclusively breastfed their infants only until 2 months of age, instead of 6 months as recommended by WHO. Besides, 37.2% predominantly breastfeed (fed non nutritional supplements such as water and *'ghutti')* and 4.5% of them partially breastfed (fed animal milk) up to 2 months of age. In a study on infants (6 to 12 months) among urban slums of Peshawar, Pakistan (Khawar, Raza Kazmi et al. 2002), colostrum was not given by 44% of the mothers indicating the continuation of traditional practices, the usage and dilution of top milk was also practiced by 86% of the mothers.

In infants aged 6–23 months there is a statistically raised risk of not breastfeeding for all-cause mortality and diarrhea incidence (Black, Allen et al. 2008). Breastfeeding less than 12 months was shown as associated to high prevalence of stunting in a Chinese study ((Zhou, Wang et al. 2012)). Besides, the concentration of some micronutrients (e.g. vitamin A, iodine) in breast milk is dependent on maternal status and intake, so the risk of infant depletion is increased by maternal deficiency. This factor is most evident in the case of vitamin A, where the content in breast milk is the main determinant of infant status because stores are low at birth (Black, Allen et al. 2008).

2.6 Food Intake

Insufficient food intake generally consists of low quantity of food, inappropriate frequency of meals per day and low diet diversity. This applies to both women and young children, but women are generally more impacted, sacrificing first their own food intake in case of household food insecurity (Agarwal, Sethi et al. 2009).In the study mentioned earlier in the North Delhi urban slum, two-thirds (65.8%) of households reported that they sometimes or often could not afford to eat balanced meals in the 12 months preceding the survey. Similarly, 51.7% households sometimes or often faced the problem of 'food not lasting for the purchased period and having no money left to buy more food'.

Introduction of non-breast milk food into infant's diet either comes too early, before 6 months of age, causing repetitive diarrhea episodes, or too late, after 9 months of age, and in insufficient quantity (Ghosh and Shah 2004). Non breast milk food is often referred to as complementary food, and the process by which the child starts consuming complementary food and regularly being given new types of aliments in increased quantities, is called diet diversification. In the Pakistani mentioned before, only 47% of mothers initiated giving semi-solids and 55% of the mothers were giving solids by the age of six months, delaying the diet diversification of the child, and leading to an inadequate intake of nutrients. Moreover, it was found that 67% of the mothers fed their children three or less than three times a day, which was less than the recommended frequency of five times a day. Nearly 37% of the children were being given commercially available weaning foods instead of homemade preparations.

Food intake of poor children often consists of a single type of cereal, with insignificant quantities of fat and animal protein. Besides consumption of vitamin A-fruits and vegetables are low, especially in summer and rainy season times, when retailing prices are higher (Ghosh and Shah 2004). The proportion of ready-to-use food, often inexpensive but low in nutrients, is increasing among the urban poor, this new practice being favored by the fact that both mother and father may work long hours away from home (Ghosh and Shah 2004). The mother being absent from home, working in a factory, as daily laborer, or as domestic servant, is also an important factor of weakened breastfeeding practices and nutrition patterns; the child being left

alone at home or under the supervision of older siblings, and getting wrong or irregular food intake (Ghosh and Shah 2004).

2.7 Need for Supplementation

In India major nutrients deficiencies consist of: protein energy malnutrition (PEM), vitamin A-deficiency (VAD), iron deficiency anemia (IDA) and iodine deficiency disorder (IDD) (Ghosh and Shah 2004).

- Iodine Deficiency

Iodine deficiency has consequences on child development. Presence of iodine in breast milk is very low in some areas, considerably aggravating impaired child development; a study also showed that populations with chronic iodine deficiency have a 13·5 point reduction in IQ (Black, Allen et al. 2008).

In a cross-sectional study done in a slum of North-East Delhi (Agarwal, Sethi et al. 2009), it was found that only 75% households were consuming iodized salt; besides, the level of awareness on the benefits of iodized salt was very low.

- Iron Deficiency Anemia

The major cause of iron deficiency anemia is low consumption of meat, fish, or poultry, especially among poor people. In young children the peak prevalence of iron deficiency anemia occurs around 18 months of age and then falls as iron requirements decline and iron intake is increased through complementary food (Black, Allen et al. 2008).

- Zinc Deficiency

Zinc is mainly present in meat, fish, shellfish and legumes. Zinc deficiency in children results in increased risk of diarrhea, pneumonia, and malaria, as proven by many studies done in various populations in all regions of the world (Black, Allen et al. 2008). Zinc deficiency contributes to important morbidity and mortality especially from diarrhea. Zinc supplementation as additional treatment and prevention for diarrhea is highly recommended (Fischer Walker, Ezzati et al. 2009).

- Vitamin A Deficiency

Among deficiencies of vitamins and minerals examined by Robert Black, the largest disease burdens were attributed to vitamin A and zinc (Black, Allen et al. 2008).

Vitamin A was shown to be a determinant of malnutrition among children aged 12 to 35 months (Semba, de Pee et al. 2010).

- Other Micronutrient Deficiencies

Other micronutrient deficiencies include calcium, iodine, B vitamins (especially folic acid and vitamin B12), and vitamin D. Calcium deficiency is the main cause of rickets in Africa and some parts of Asia, and increasingly in other parts of the world. Vitamin D deficiency in-utero can cause poor fetal growth and skeletal mineralization and is followed by lower concentrations of the vitamin in breast milk. In women with deficiency content of B12 in breast milk can be so low that symptoms of deficiency appear in their breastfed infants, including stunting, poor neurocognitive function, and global developmental delays, all of which can be irreversible (Black, Allen et al. 2008).

2.8 Conceptual Framework

As just explained child malnutrition appears to be a consequence of determinants at mother level (mother nutritional status, mother supervision), individual level (child's dietary intake, supplementation, child's digestive health, low-birth-weight, child age), and household level (food affordability, household size, water and sanitation).

Demographic characteristics of the mothers, all belonging to urban poor households, are quite homogenous. Besides, demographic characteristics of the mothers (e.g. mother's age, age at first child) were not unveiled as determinants of child's malnutrition in any article of the literature review. As a consequence, they were not included in the conceptual framework.

First a synthetic conceptual framework, highlighting the main examined areas is presented, then a detailed conceptual framework is exposed.

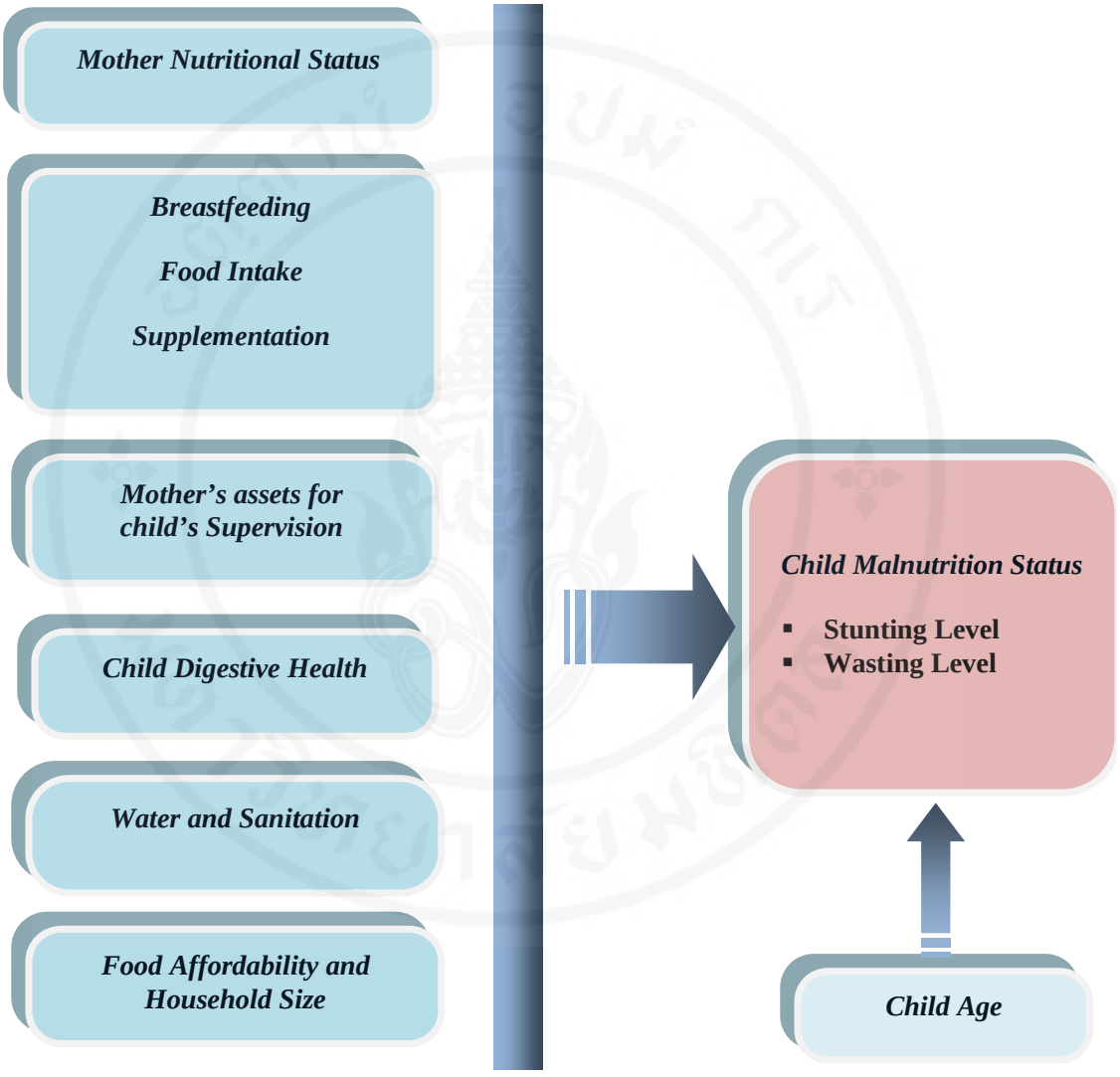

Figure 2-1 Determinants of malnutrition - High level Conceptual Framework

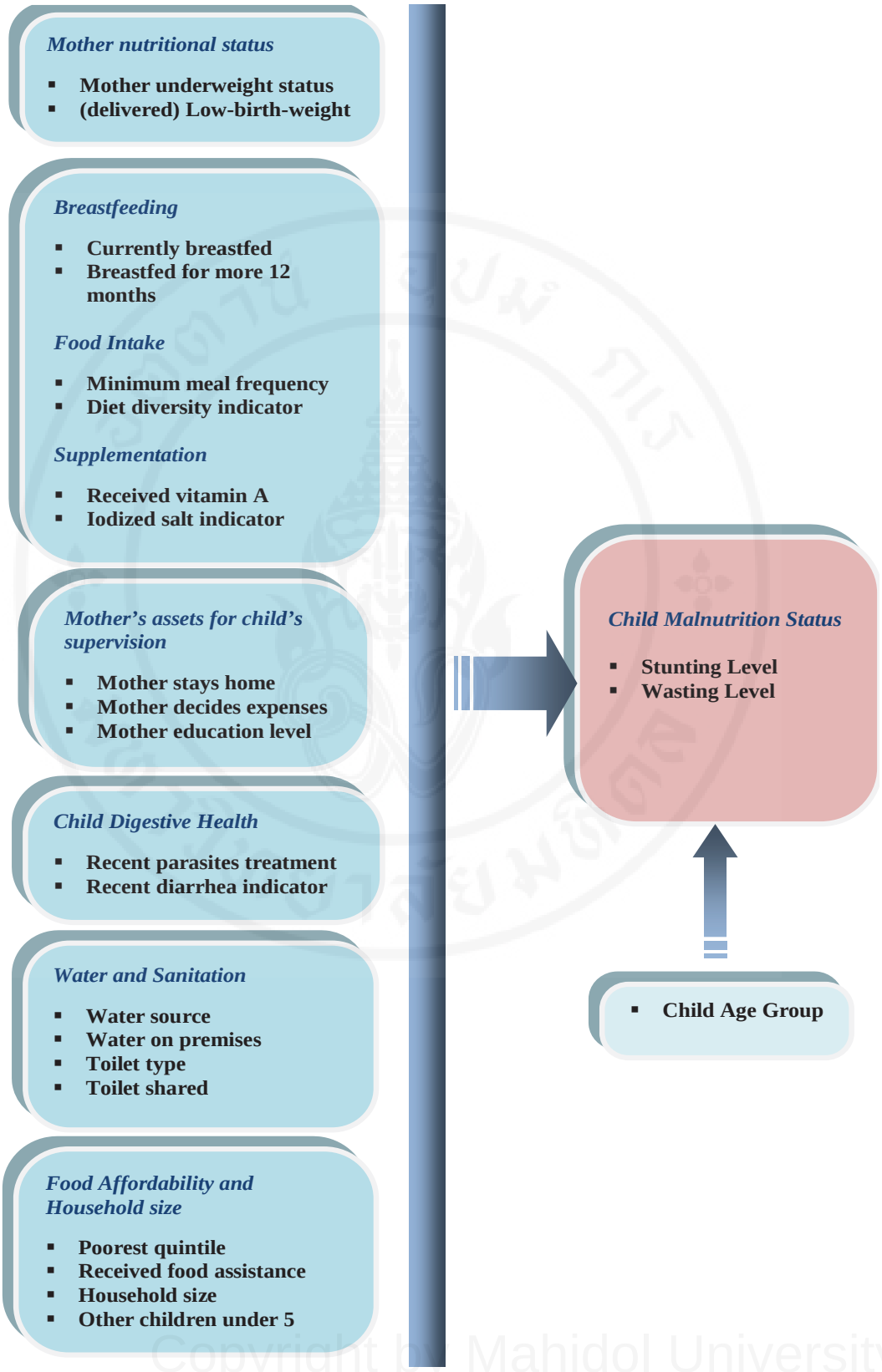

Figure 2-2 Determinants of malnutrition - Detailed Conceptual Framework

2.9 Research Objectives

1) For each malnutrition type (wasting, stunting), identify if there is a causal relationship with breastfeeding patterns, food intake, diarrhea, food affordability, household size, mother supervision, mother nutritional status, and conditions of living (water and sanitation).

2) For each malnutrition type (wasting, stunting), determine the relative contribution of each significant factor to child malnutrition status.

2.10 Research Hypothesis

1) Patterns of feeding (breastfeeding, food intake) are the first determinants of child malnutrition (both for stunting and wasting).

2) Poor water and sanitation are the second determinants of child malnutrition (both for stunting and wasting).

3) Among feeding patterns, diet diversity is the main contributor to stunting. The more diverse the diet is, the less stunted the child is.

4) There is a negative association between presence of mother at home and child malnutrition: a child whose mother is daily present at home is less likely to be malnourished than a child whose mother is absent.

5) There is a positive association between mother's malnutrition status (mother underweight, mother delivered low-birth-weight) and child's malnutrition status (both for stunting and wasting).

CHAPTER III
DATA AND METHODS

3.1 Data collection/survey

The quantitative data was taken from the latest family health survey available for India, the National Family Health Survey-3 (NFHS-3) conducted in 2005-2006, and provided by DHS. Accordingly with the previous health surveys (NFHS-1, 1992-93; NFHS-2, 1998-99), NFHS-3 gathered data on fertility, mortality, family planning, HIV-related knowledge, and important characteristics of mother and child nutrition, health status, and health care. NFHS-3 sample covered 99 percent of India's population living in all 29 states and was designed through a multi-stage stratified sampling method. It collected information from a nationally representative sample of 109,041 households, including 124,385 women age 15-49, 74,369 men age 15-54, and 51,555 children age 0-5. At the same time as the survey, in every sampled household, health workers took blood sample from women aged 15-49 and from children aged 6-59 months so as to assess levels of hemoglobin and prevalence of anemia; portable instruments allowed to get the test resulst in less than 1 minute ((IIPS) and International. 2007).

3.2 Sample

The sample of the present study was built to focus on children, among urban poor, aged from 6 to 35 months. Malnutrition generally onsets for young children around 18-24 months of age (Som, Pal et al. 2007), and is particularly difficult to reverse after 36 months of age, it is relevant to identify causes of malnutrition among children under 3, and even more to focus on those under 2 (Bhutta, Ahmed et al. 2008). The first 1,000 days (from conception to 2 years-old) are particularly crucial in the life of the child for his physical and cognitive development (SaveTheChildren 2012). It was also decided to exclude from this study newborns and

infants below 6 months of age, since they constitute a very specific group, whose weight and height depend predominantly from their weight and height at birth, and are expected to have fairly different feeding patterns than child aged 6 months and older.

The initial NFHS-3 children data file, made of 51,555 children between 0 and 59 months (5 years old) was first filtered according the area of residence, which is urban, as opposed to rural. The data set then contained 19,483 children aged 0 to 5 living in urban areas. Then, the children data file was filtered according to households' wealth quintile. Poverty is defined in the present study as corresponding to the two lowest wealth quintiles of India. Before filtering, there was the following repartition of urban children over the respective five wealth quintiles.

Table 3-1 Number of children per wealth quintile

Wealth Quintile	Frequency	Percent	Cumulative Percent
Poorest	651	3.3	3.3
Poorer	1,400	7.2	10.5
Middle	3,158	16.2	26.7
Richer	6,004	30.8	57.5
Richest	8,270	42.5	100.0
total	19,483	100.0	100.0

Non-poor quintiles seem to be over-represented among children sampled from urban areas, probably because urban areas are on average richer than rural areas, and the health survey may have not fully covered the poorest urban dwellers. Looking at the table here above, by keeping the two lowest quintiles, the filtered data file gave the following decomposition:

651 (Poorest quintile) + 1,400 (Poorer Quintile) = 2,051 children.

It corresponds to a little bit more than 10% of the children present in the initial NFHS 3 sample and living in urban areas. Then, from this file, which contained

children aged 0 to 5 of poor urban areas, were extracted only the children age 6-35 months.

The data file hence filtered gathered 950 children age 6-35 months, living in poor urban settings. Then, it was necessary to check if the anthropometric measures (height-for-age, weight-for-age) were available for each one of these children, and remove from the data file all those who did not have any associated anthropometric measures. In that way 783 children were selected. They all had anthropometric measures, however there was no additional selection done on the basis of these measures: were included in the sample all children, whatever they were stunted or not stunted, wasted or not wasted. From these 783 children, it was noticeable, based on the household id, that some of them belonged to the same household and may have been siblings. Siblings share the same mother as well as the same household, which are both important units of observations in this study, hence only one of the siblings was kept, and the other one(s) was discarded. Since most of the data collected referred to the recent situation of the household, it was more reasonable to keep the younger sibling and to discard the older one(s). It is interesting to note that some children shared the same household but did not have the same mother. In these specific cases, where the mother was not the same, both children were included in the sample, no one was discarded.

Finally, when looking for outliers via SPSS, by examining histograms and scatter plots, the outliers removed were all verifying the following conditions:

- Weight-for-age > 2.0 SD, or
- Height-for-age > 3.0 SD

Eventually, the final sample was made of 691 children aged 6-35 months, living in urban areas, among the two poorest quintiles of India.

3.3 DHS Data File

Most variables presented here after are variables created for the purpose of this study, and were not present in the initial DHS file. They were re-coded and/or computed from the initial variables present in the DHS file.

Some variables of interest are not included in the present study because they have too many missing values. For instance, the variable providing information on whether the household is located in a slum or not, was too scarcely collected and could not be integrated here.

3.4 Operational Definitions of Variables

3.4.1 Dependent Variables Definition

Malnutrition status of the child (dependent variable) will be measured through two different variables, which respectively derive from two types of anthropometric measures:

- height/length-for-age
- weight-for-age

Please note that weight-for-height (commonly referred to as underweight level) will not be considered as third dependent variable, since weight-for-age is actually the combination result of height-for-age and weight-for-age. Both dependent variables need to be defined by recoding the original variables present in DHS file, in terms of standard deviations relatively to the mean, mean values being defined for each age by World Health Organization (WHO 2006). Only with the quantity of standard deviations can the child malnutrition status be easily evaluated. Low height-for-age (<-1 SD) is an indicator of long term malnutrition whereas low weight-for-age (<-1 SD) is an indicator of recent malnutrition. Then, the interval-scale variables height-for-age (-deviations) and weight-for-age (-deviations) are recoded into categorical, ordinal, variables as described here below. They are also renamed with a concern of both simplification and readability:

- stunting level for height-for-age-deviations
- wasting level for weight-for-age-deviations

Both stunting level and wasting level are defined through 3-levels ordinal variables.

Table 3-2 Stunting levels definition

Height-for-age / Stunting (Standard Deviations)			
	stunting level name	stunting 3-levels	coded value
ha<-4	acutely stunted	severely/acutely stunted	3
-4<ha<-3	severely stunted		
-3<ha<-2	moderately stunted	mildly/moderately stunted	2
-2<ha<-1	mildly stunted		
ha>-1	not stunted	not stunted	1

Table 3-3 Wasting levels definition

Weight-for-age / Wasting (Standard Deviations)			
	wasting level name	wasting 3-levels	coded value
wa<-4	acutely wasted	severely/acutely wasted	3
-4<wa<-3	severely wasted		
-3<wa<-2	moderately wasted	mildly/moderately wasted	2
-2<wa<-1	mildly wasted		
wa>-1	not wasted	not wasted	1

3.4.2 Independent Variables – Definition

The details of all variables are summarized in Appendix

- Mother underweight status. Body Mass Index (BMI) of the mother is a simple index of weight-for-height that is commonly used to classify underweight, overweight and obesity in adults. It is defined as the weight in kilograms divided by the square of the height in meters (kg/m2). A woman will be considered as underweight, and mother underweight status will be set to 1 (”Yes”) if her BMI is below 18.5. Otherwise it will be set to 0 (“No”).

- **Low birth weight indicator** takes the value 1 (“Yes”) if the mother replied in the survey interview that she considered her child at birth being “small” or “very small”. It is based on the appreciation and recall of the mother and not on any anthropometric measures. If the child was only “average” or “above average”, the low birth weight indicator takes the value 0 (“No). Since most low-birth-weights newborns are delivered from stunted or underweight mothers, this variable is used in the present study as a proxy of the nutritional status of the mother at the time of the child’s birth.

- **Currently breastfed** is a binary indicator which says whether the child is currently breastfed by the mother or not.

- **Breastfed more than 12 months** indicates if the child has been breastfed for 12 months or more. It does not give any other information on the nature of the breastfeeding (e.g. exclusive vs. partial breastfeeding).

- **Minimum meal frequency indicator** is set to 1 (“Yes”) if the child had meals during the 24 hours preceding the survey interview a number of times equal or superior to the minimum value recommended by WHO. Minimum daily meal frequency as defined by WHO is the following:

  - At least 2 times for breastfed infants aged 6-8 months

- At least 3 times for breastfed infants aged 9-23 months
- At least 4 times for non-breastfed infants aged 6-23 months; this can be extended to age group 23-35 months.

- **Diet diversity indicator:** In order to evaluate the diet diversity of the child, the focus is made on four specific food groups, especially rich in vitamins and essential for child growth. In NFHS-3, the respondent was expected to reply "Yes" regarding the consumption by the child of a food type, only if it was consumed during the 24 hours preceding the interview; besides there was no information recorded about the quantity eaten. The four food groups are defined as follows:
  - animal protein [meat, fish, eggs]
  - legumes [beans, peas, lentils, nuts]
  - dairy products [cheese, yogurt, milk]
  - vitamin A-rich vegetables/fruits

For each of these food groups, one variable is created to identify the child intake (Yes/No) within the last 24 hours. In the evaluation of the diet diversity other food groups such as grain/rice/cereals are ignored, since they do not bring significant level of information regarding the diet of the child.

First group (animal protein intake) is an important source of Zinc and Iron, with fish products providing also Iodine. Legumes are rich in Iron, Zinc, Vitamin B, magnesium. Dairy products contain vitamin A, vitamin B, vitamin D, vitamin K and are an important source of Calcium, essential for the growth of the child. The group of vitamin A- rich vegetables/fruits corresponds to the following types of aliments, as defined per DHS - they are also rich in vitamin C:

- pumpkin, carrots, squash (yellow or orange inside)
- dark green leafy vegetables
- mangoes, papayas, other vitamin A fruits

The diet diversity of the child is evaluated through the number of these food groups the child consumed in the last 24 hours: "no important food group

consumed", "1 important food group consumed", and "at least 2 important food groups consumed". There were too few children who were recorded as consuming 3 or 4 four food groups in the studied sample, hence these cases were gathered within the category "at least 2 important food groups consumed".

- **Received vitamin A** indicates if the child received at least one dose of Vitamin A within 6 months before the day of the survey.

- **Iodized Salt indicator.** If there is no salt in the household on the day of the survey, the indicator is set to No. If there is salt in the household, its concentration in iodine is tested. Only if its concentration in iodine is equal or superior to 15 ppm, which is the recommended value, the indicator is set to 1 ("Yes"). In case the concentration is between 0 and 15, the iodine content is insufficient and the indicator is set to 0 ("No").

- **Mother stays home** indicates whether the mother usually stays at home during the day, whatever it is because she is housewife or because she works from home. It is set to 1 ("Yes") if the mother is a stay-at-home mother; it is set to 0 ("No") otherwise.

- **Mother decides expenses** is set to 1 ("Yes") if during the survey interview it was reported that the mother was free to decide on daily expenses, either by herself, or together with her husband, or together with someone else. It is set to 0 ("No") if it was reported that the husband only or the mother-in-law only could decide on daily expenses but the right was denied to the mother.

- **Mother education** indicates the highest level of education the mother attended. It can correspond to "no education" (1), "primary education" (2), or "secondary or higher" (3).

- **Recent parasites treatment** indicates if the child received parasites treatment within the 6 months preceding the day of the survey.

- **Recent diarrhea indicator** This indicator provides information whether the child had recent diarrhea or not (diarrhea occurrence), and in case he had recent diarrhea, it also provides information on whether the child received appropriate treatment (diarrhea treatment). Diarrhea treatment is considered as appropriate, if the respondent answers that the child was provided with appropriate drinking ("same" or "more" compared to before diarrhea), with appropriate eating ("somewhat less" or "same" compared to before diarrhea), and was given ORS (Oral Rehydration Solution). The Recent Diarrhea indicator is categorical and takes the following values:

  - Recent Diarrhea = 1 if the child did not have recent diarrhea (last 2 weeks)
  - Recent Diarrhea = 2 if the child had recent diarrhea and received appropriate diarrhea treatment (appropriate drinking, appropriate eating, and ORS)
  - Recent Diarrhea = 3 if the child had recent diarrhea and received only one of the following: (Appropriate drinking, and appropriate eating) or (ORS).
  - Recent Diarrhea = 4, if the child had recent diarrhea and received neither (appropriate drinking & appropriate eating) nor (ORS)

- **Toilet type**: indicates the type of toilet facilities used by the household members, it does not say where the toilets are located, neither if they are shared with other households. Categories present in NFHS-3 were gathered into 3 broader categories, representative of the main levels of sanitation: flushed toilet, pit or dry toilet, and open field (no facility).

- **Toilet shared** indicator says whether the toilets are shared with other households.

- **Water source** indicates the type of water source in use by the household members. Categories present in NFHS-3 were gathered into 3 broader

categories representative of the main types of water source: piped water, protected well, and unprotected well.

- **Water on premises** indicates if there is a water source within the household or within immediate reach of the household (less than 5 minutes away).

- **Received food assistance** indicates if the household was able to get food assistance from an Anganwadi center in the past 6 months.

- **Poorest quintile** takes the value 1 (“Yes”) if the household wealth index belongs to the (fifth/) lowest wealth quintile of India. It takes the value 0 (No”) otherwise, meaning that the household wealth index belongs to the fourth wealth quintile of India, qualified as “poorer” quintile as opposed to “poorest” quintile.

- **Household size** indicates whether the number of household members is 5 or below, or 6 or more.

- **Other children** indicate the number of children below 5 years of age present in the household beside the child being part of the sample.

- **Child age group** allows to classify children into 3 main age groups: children aged 6-11 months (less than 1 year-old), children aged 12-23 months (between 1 and 2-years-old), and children aged 24-35 months (between 2 and 3-years-old).

3.5 Statistical Method

To identify the magnitude and relative impact of the different components presented in the conceptual framework on child malnutrition, the initially chosen method was Ordered Logistic Regression. The dependent variables being measured in ordinal scale, with 3 possible values; the method of Ordered Logistic Regression is naturally preferred to any other method. However, this method is valid if and only if

the so called “assumption of the parallel lines” is verified. After running the calculation, it appeared that some variables in the model could fully verify this assumption. Hence a similar method, which allowed loosening the constraint from some variables whenever needed, was finally chosen; it is the Generalized Ordered Logistic Regression (gologit2 in STATA, Williams (2006)). Two distinctive runs of the method need to be performed: one for the dependent variable called stunting level and one for the dependent variable called wasting level.

CHAPTER IV
RESEARCH FINDINGS

This chapter aims at presenting the results of univariate, bivariate and multivariate analysis, both for stunting level and wasting level. The interpretation is done jointly on both parameters, since they illustrate two complementary aspects of the same problem, child malnutrition. As a reminder here, wasting reflects recent malnutrition whereas stunting is the long-lasting effect of past malnutrition. First, the characteristics of the sample will be described. Then, the variables impacting malnutrition will be outlined (bivariate analysis), followed by the interpretation of odds ratios (multivariate analysis) so as to examine the relative contribution of each variable to child malnutrition. Finally will be shown predicted probabilities.

4.1 Urban Poor Children – description of the sample

The sample is made of 691 children, aged between 6 months and 35 months (up to 35 months and 29 days), living in urban areas, within a household belonging to one of the two lowest wealth quintiles of India.

Urban poor represent 9.4% of the overall population of India (NFHS-3, 2005-2006). However the sample design of NFHS-3 results in having only 4% of the sampled children under 5 being part of urban poor, which leads to an under-representation of urban poor children in NFHS-3 sample. Hence, the following analysis has been done thanks to the available sample of 691 children under 3 years old, whereas it would have been done with approximately 1,600 children if NFHS-3 sample had taken into account the right proportion of urban poor children among the overall population.

4.1.1 Nutritional Status

Looking at Height-for-Age, only 1 child out of 5 was not stunted at all, whereas 1 child out of 2 was mildly or moderately stunted and 1 child out of 3 was severely or acutely stunted.

Table 4-1 Proportion of children per stunting level

Height for Age /Stunting Level	Freq	Percent
Not Stunted (>-1SD)	140	20.3
Mildly Stunted (<-1SD)	159	23.0
Moderately Stunted (<-2SD)	170	24.6
Severely Stunted (<-3SD)	128	18.5
Acutely Stunted (<-4SD)	94	13.6
total	691	100.0

There were as many children who were mildly stunted as children who were moderately stunted, and fewer children who were acutely stunted than children who were severely stunted.

Table 4-2 Proportion of children per wasting level

Weight for Age / Wasting Level	Freq	Percent
Not Wasted (>-1SD)	127	18.4
Mildly Wasted (<-1SD)	203	29.4
Moderately Wasted (<-2SD)	218	31.6
Severely Wasted (<-3SD)	102	14.8
Acutely Wasted (<-4SD)	41	5.9
total	691	100.0

There were as many children who were mildly stunted as children who were moderately stunted, and much fewer children who were acutely wasted than children who were severely wasted.

After looking separately at the levels of stunting and wasting, it is interesting to go one step further and identify how many children were both stunted and wasted, how many were only wasted, or how many were only stunted. Indeed, combining analysis of both variables can tell us not only about the current malnutrition status of the child but as well about its evolution. For instance, children who were stunted but not wasted could be going through a period of recuperation, as indicated by the fact that they were not wasted. Inversely, children who were wasted but not stunted could have suffered from recent malnutrition, and were at risk of becoming stunted if the problem persisted over time. After analysis it appears that only 11% of children were neither stunted nor wasted, meaning that among urban poor only one out of ten children under 3 years old managed to slip through the trap of malnutrition.

By decomposing more finely according to the different levels of malnutrition, the following results were obtained.

Few children were severely or acutely wasted but not stunted (0.4%) as well as few children were severely or acutely stunted but not wasted (1.4%). Besides, 7.6 % of children seemed to be in recuperation phase regarding their stunting level, and 10.5% seemed to be in an aggravating phase. Most of children suffering from one type of malnutrition also suffered from the other type, hence a total of 72% of children suffered at the same time of a state of stunting and a state of wasting.

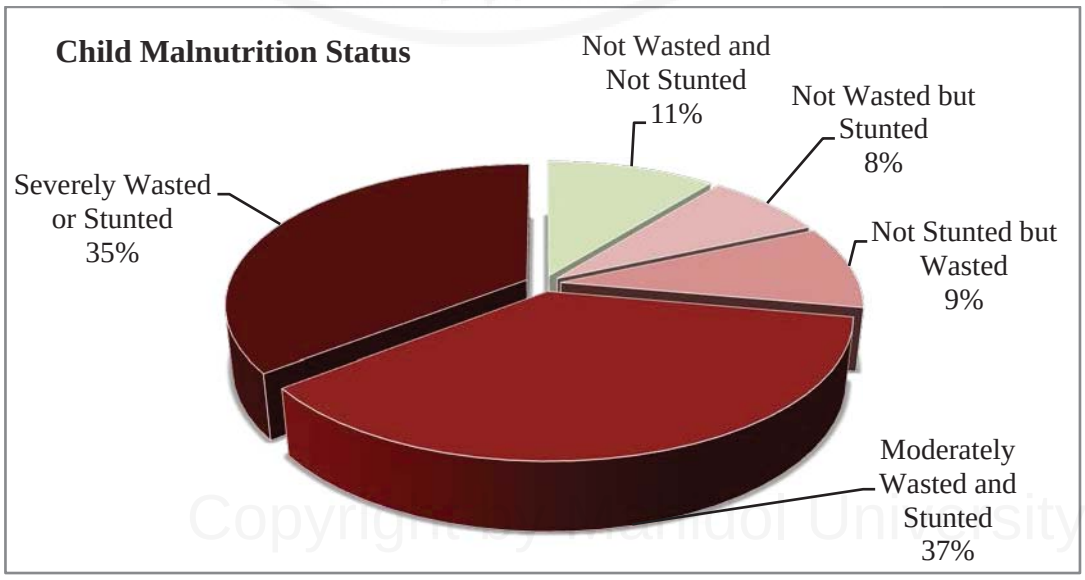

Figure 4-1 Prevalence of combined stunting and wasting levels

Among them, half of children suffered from at least one severe or acute malnutrition type, and half of children suffered from the consistent double malnutrition status of “mildly/moderately stunted” and “mildly/moderately wasted”.

4.1.2 Households characteristics

Two-thirds of households belong to the second lowest wealth quintile, so called “poorer quintile” (68%), while only one-third belongs to the lowest quintile, so called “poorest quintile”. Hence among the poor, urban poorest were under-represented within the present sample.

Regarding household facilities, level of sanitation was very low: as much as 65% have no toilet and go to an open field, and access to water was rather limited: less than one third of households have direct access to water within their household (30.2%). There was almost the same proportion of small families (5 household members or less) as of large families (6 household members or more). More than eighty percents of households did not have more than 2 children under 5, and around 40 percents had only one child under 5.

Table 4-3 Number of children by Household Characteristics

Food Affordability and Household Size		
Household Wealth Index	Freq	Percent
Poorer Quintile	468	67.7
Poorest Quintile	223	32.3
total	691	100.0
Number of household members		
5 or less	356	51.5
6 or more	335	48.5
total	691	100.0
Number of children under 5		
(1)	270	39.1
(2)	305	44.1
(3+)	116	16.8
total	691	100.0
Water and Sanitation		
Toilet Facilities	Freq	Percent
Yes, toilet	244	35.3
No, open field	447	64.7
total	691	100.0
Water on premises		
Yes	209	30.2
No	482	69.8
total	691	100.0

4.1.3 Mothers characteristics

Mothers were mainly non-educated (63.4%), however among those educated, a bit less than half (47%) went up to primary school, and a little bit more half went to secondary school (53%). Mothers were young, with only 9% of them being aged more than 35 years old, and a mean age of 26 years old. It may be explained by the fact that urban poor are often migrants coming from rural areas at the beginning of their adulthood. Moreover, a tremendous proportion of mothers were not working (71.6%).

Table 4-4 Number of children by Mother Characteristics

Mother characteristics		
Mother Education level	Freq	Percent
no education	438	63.4
primary	119	17.2
secondary	134	19.4
total	691	100.0
Mother Age		
15-24	328	47.5
25-34	300	43.4
35-49	63	9.1
total	691	100.0
Mother Occupation	Freq	Percent
not working	495	71.6
working	196	28.4
total	691	100.0
Mother Nutritional Status		
BMI	Freq	Percent
underweight	293	42.4
not underweight	398	57.6
total	691	100.0
Mother's anemia		
no anemia	214	31.0
mild anemia	330	47.8
moderate anemia	127	18.4
severe anemia	20	2.9
total	691	100.0

Nutritional status of these mothers was low, since almost half of them were underweight (42.4%), and as many as two thirds of them were anemic (69%), including 21.3% who have moderate or severe anemia.

4.1.4 Children characteristics

The repartition of the children over the different age groups was quite uniform and proportional to the range of each age group. Age group 24-35 month was slightly smaller, probably because in case of siblings only the youngest was kept in the sample. It is also noticeable that there were more girls than boys (54% vs. 46%)

Table 4-5 Child Main Characteristics

Child Characteristics		
Age	Freq	Percent
6-11 months	135	19.5
12-23 months	300	43.4
24-35 months	256	37.0
total	691	100.0
Sex		
Female	373	54.0
Male	318	46.0
total	691	100.0
Size at Birth		
Average or more	515	74.5
Small or Very small	159	23.0
total	691	100.0
Child's anemia		
no anemia	124	17.9
mild anemia	172	24.9
moderate anemia	352	50.9
severe anemia	43	6.2
total	691	100.0

As for the nutritional status of these children, one out of 4 was low birth weight ("small" or "very small") as perceived by the mother (no actual measure). At the time of the survey, only 18% of children were not anemic and as many as 57.1% had moderate or severe anemia: these numbers illustrate the cruel lack of iron in the child's dietary intake.

4.1.5 Main characteristics of Dietary Intake

Nearly all children were breastfed during their first year, and then around 90% of them were breastfed during their second year. This is in line with WHO recommendations of continued breastfeeding during the first 2 years. It is interesting to note that as many as 65% of these children were breastfed during their third year of age - may be for economic reasons. Hence breastfeeding is well widespread among urban poor.

Meal frequency was not appropriate for half of the children, with a slight improvement through age (highly statistically significant). Meal diversity was very poor, especially at the time of food diversification (in age group 6-11 months) when 80% of children did not consume any important food group. In their second year of age, almost half children still did not get any important food group, and more than one third of them still did not get any important food group in their third year. As for the recommendation of consuming all 4 important food groups, the situation is far from being satisfying since by their third year, only 28% of children consumed 2 food groups or more.

Table 4-6 Child Diet Characteristics

Breastfeeding		
Children currently breastfed	Freq	Percent
6-11 months	132	97.8
12-23 months	263	87.7
24-35 months	167	65.2
all ages	562	81.3
Children not currently breastfed		
all ages	129	18.7
total	691	100.0
Diet characteristics		
Children receiving sufficient (minimum) meal frequency		
6-11 months	53	39.3
12-23 months	153	51.0
24-35 months	159	62.1
all ages	365	52.8
Children receiving insufficient meal frequency		
all ages	326	47.2
total	691	100.0

Table 4-6 Child Diet Characteristics (Continued)

Diet characteristics		
Children consuming 0 important food group		
	Freq	Percent
6-11 months	108	80.0
12-23 months	135	45.0
24-35 months	94	36.7
all ages	337	48.8
Children consuming 1 important food group		
all ages	205	29.6
Children consuming at least 2 important food groups		
6-11 months	7	5.2
12-23 months	69	23.0
24-35 months	73	28.5
all ages	149	21.6
total	691	100.0
Diet diversity in detail		
Children consuming animal protein (meat, fish, eggs)		
6-11 months	6	4.4
12-23 months	53	17.7
24-35 months	59	23.0
all ages	118	17.1
Children not consuming animal protein		
all ages	573	82.9
Children consuming legumes (beans, peas, lentils, nuts)		
6-11 months	8	5.9
12-23 months	43	14.3
24-35 months	56	21.9
all ages	107	15.5
Children not consuming legumes		
all ages	584	84.5
Children consuming dairy products (cheese, yogurt, milk)		
6-11 months	6	4.4
12-23 months	21	7.0
24-35 months	20	7.8
all ages	47	6.8
Children not consuming dairy products		
all ages	644	93.2
Children consuming fruits and vegetables rich in vitamin A		
6-11 months	16	11.9
12-23 months	138	46.0
24-35 months	120	46.9
all ages	274	39.7
Children not consuming fruits and vegetables		
all ages	417	60.3
total	691	100.0

When looking at the different food groups, dairy products were almost absent from the child diet (6.8%), mothers possibly relying essentially on breastfeeding for milk intake. Fruits and vegetables were the most consumed out of the four important food groups, but remain absent from the diet of more than half of the children. Fruits and vegetables intake was particularly low at the time of diversification, whereas they should actually be the one privileged food type for diversification. Legumes intake and animal protein intake were extremely low, around 15% each, and progressed very slowly with the age of the child. Lentils being very common in India, their low consumption among urban poor may appear as surprising but can be explained by their price - which is higher than potato or rice - and difficult affordability for very poor households.

There is a gap in diet diversity between children aged 6-11 months and children aged 12-17 months. However, children aged 6-11 months are expected to daily eat at least 3 of the 4 important food groups, and the only difference between the two age groups should be the quantity eaten and the food consistence (children aged 6-11 months rather eat mashed or semi-solid food, whereas children aged over 12 months usually eat every kind of solid food).

Regarding nutrients supplementation it is remarkable that only 2% of children got access to iron supplementation while more than 80% of them were anemic. Even vitamin A, which is the most common and routine supplementation for children under 5, was poorly received: only 10% of children among urban poor received it.

Table 4-7 Child Nutrients Intake

Nutrients supplementation		
Children with iron	Freq	Percent
6-11 months	2	1.5
12-23 months	9	3.0
24-35 months	5	2.0
all ages	16	2.3
Children with no iron		
all ages	675	97.7
Children with vitamin A		
6-11 months	7	5.2
12-23 months	46	15.3
24-35 months	20	7.8
all ages	73	10.6
Children with no vitamin A		
all ages	618	89.4

Table 4-7 Child Nutrients Intake (Continued)

Children with iodized salt in household	Freq	Percent
all ages	326	47.2
Children with no iodized		
all ages	365	52.8
total	691	100.0

The proportion of iodized salt available in the sampled households is similar to the national average, close to 50%, which is far from the wished value of 100%.

4.1.6 Digestive Health

The proportion of children aged 6-35 months having diarrhea in the last 2 weeks, 13.7%, is close to the national average of 12.5%. However diarrhea seems to be seen as a common state of the digestive status of the child and is poorly treated. Only 1 child out of 4 children with diarrhea got Oral Rehydration Salt (ORS) whereas it should be systematic given. Only 1 child out of 6 children got both ORS and appropriate feeding from the caretaker (more drinking, little less eating), revealing a lack of knowledge on diarrhea treatment. Besides, zinc supplementation which helps to cure diarrhea but also has a preventive effect on diarrhea occurrence, was only given to one child of the sample. Parasites treatment, which is crucial to the digestive health of the child, was only given to 8% of children.

Table 4-8 Recent diarrhea and digestive treatment

Diarrhea & Digestive Health			
Children with recent diarrhea		Freq	Percent
	all ages	95	13.7
Children with no recent diarrhea			
	all ages	596	86.3
	total	691	100.0
Among those with recent diarrhea			
Children who received appropriate treatment (including ORS)		14	14.7
Children who did not receive treatment		81	85.3
	total	95	100.0

Table 4-8 Recent diarrhea and digestive treatment (Continued)

Among those with recent diarrhea	Freq	Percent
Children who received zinc	1	1.1
Children who did not receive zinc	94	98.9
total	95	100.0
Children who received parasite treatment		
all ages	61	8.8
Children who did not receive parasite		
all ages	630	91.2
total	691	100.0

4.2 Determinants of Malnutrition - Bivariate Analysis

By using chi-square test 6 variables are found to be significantly linked to stunting and 9 variables are found to be significantly linked to wasting.

Table 4-9 Determinants of Stunting - Chi-square test

Factors	N	Height for Age / Stunting: not stunted	mild/ moderate	severe/ acute	Total
Overall	691	20.3	47.6	32.1	100.0
Mother underweight		(χ^2 = 6.273, df=2, p<.05)			
no	398	22.9	48.2	28.9	100.0
yes	293	16.7	46.8	36.5	100.0
Child low-birth-weight		(χ^2 = 10.964, df=2, p<.005)			
no	532	22.9	46.8	30.3	100.0
yes	159	11.3	50.3	38.4	100.0
Breastfeeding duration		(χ^2 = 9.033, df=2, p<.05)			
> 12 months	642	21.5	47.2	31.3	100.0
< 12 months	49	4.1	53.1	42.9	100.0
Water source		(χ^2 = 9.284, df=4, p<.05)			
piped water	269	18.6	49.1	32.3	100.0
protected well	328	18.3	48.2	33.5	100.0
unprotected well	95	31.9	41.5	26.6	100.0
Water on premises		(χ^2 = 9.545, df=2, p<.01)			
yes	213	24.4	38.8	36.8	100.0
no	482	18.5	51.5	30.1	100.0
Received food assistance		(χ^2 = 7.596, df=2, p<.05)			
yes	94	30.9	40.4	28.7	100.0
no	597	18.6	48.7	32.7	100.0
Child age		(χ^2 = 51.501, df=4, p<.001)			
6-11 months	135	40.7	43.7	15.6	100.0
12-23 months	300	16.3	50.0	33.7	100.0
24-35 months	256	14.1	46.9	39.1	100.0

Table 4-10 Determinants of Wasting - Chi-square test

Factors	N	Weight for Age / Wasting not wasted	mild/ moderate	severe/ acute	Total
Overall	691	18.4	60.9	20.7	100.0
Mother underweight		(χ^2 = 12.843, df=2, p<.005)			
no	398	21.1	62.6	16.3	100.0
yes	293	13.7	58.7	26.6	100.0
Child low-birth-weight		(χ^2 = 11.660, df=2, p<.005)			
no	532	21.1	59.6	19.4	100.0
yes	159	9.4	65.4	25.2	100.0
Breastfeeding duration		(χ^2 = 11.862, df=2, p<.005)			
> 12 months	642	19.2	61.5	19.3	100.0
< 12 months	49	8.2	53.1	38.8	100.0
Diet diversity		(χ^2 = 11.465, df=4, p<.05)			
>2 food groups	149	20.8	67.8	11.4	100.0
1 food group	205	20.0	56.1	23.9	100.0
0 food group	337	16.3	60.8	22.9	100.0
Vitamin A		(χ^2 = 7.771 df=2, p<.05)			
yes	73	20.6	71.2	8.2	100.0
no	618	18.1	59.7	22.2	100.0
Mother education		(χ^2 = 8.649, df=4, p<.01)			
no education	438	16.9	61.9	21.2	100.0
primary	119	14.3	63.0	22.7	100.0
secondary	134	26.9	56.0	17.2	100.0
Child diarrhea and treatment		(χ^2 = 13.900, df=6, p<.05)			
no recent diarrhea	596	18.8	60.6	20.6	100.0
recent diarrhea and …treatment+	14	0.0	50.0	50.0	100.0
...treatment-	44	15.9	75.0	9.1	100.0
...no treatment	37	21.6	54.1	24.3	100.0
Household Size		(χ^2 = 12.176 df=2, p<.01)			
2 to 5	356	23.0	59.3	17.7	100.0
> 6	335	13.4	62.7	23.9	100.0
Household Wealth		(χ^2 = 6.022 df=2, p<.05)			
poorer	468	20.3	61.1	18.6	100.0
poorest	223	14.4	60.5	25.1	100.0
Child age		(χ^2 = 10.422, df=4, p<.05)			
6-11 months	135	24.4	61.5	14.1	100.0
12-23 months	300	17.7	63.0	19.3	100.0
24-35 months	256	16.0	58.2	25.8	100.0

Note: "treatment+" refers to ORS and (appropriate drinking and eating), "treatment-" refers to ORS or (appropriate drinking and eating).

Hence, 12 out of 22 independent variables appear not to be significantly associated with either both of malnutrition types (stunting, wasting). Ten other variables are significantly associated with at least one malnutrition type and allow an interpretation of the results as well as a generalization from the sample to the population. The hereafter description follows the exact same structure as the conceptual framework presented in chapter II.

4.2.1 Mother nutritional Status

The mother's nutritional status is an important determinant of the child's nutritional status, in accordance with the findings of many other studies ((Mostafa 2011),(Ghosh and Shah 2004)). A higher proportion of children are stunted or wasted among underweight mothers than among non-underweight mothers (stunted: 83% vs. 77%, wasted: 86% vs.79%). The proportion of children severely wasted or severely stunted is significantly higher among underweight mothers (severely stunted: 36% vs. 29%, severely wasted: 27% vs. 16%).

Besides, the nutritional status of the child is significantly linked to the fact that he/she was low-birth-weight or not. Hence there are more stunted or wasted children among those who were low-birth-weight than among those who had average weight or more (stunted: 89% vs. 77%, wasted: 91% vs. 79%). Besides, the proportion of children with severe malnutrition status is more important among those who were low-birth-weight than among those who were not (severely stunted: 38% vs. 30%; severely wasted: 25% vs. 19%).

In a study done in urban slums of Kenya (Abuya, Ciera et al. 2012), low-birth-weight was similarly found to be a strong predictor of stunting.

4.2.2 Breastfeeding, Food Intake, and Supplementation

Breastfeeding for 12 months and more appears to be significantly favorable to the nutritional status of the child. There is a much higher proportion of children who are not stunted or wasted among those who were breastfed for more than 12 months than among those who were breastfed for less than 12 months (not stunted: 21% vs. 4%, not wasted: 19%

vs. 8%). Besides, for each severity level of stunting, the proportion of malnourished children is also lower among those who were breastfed during more than 12 months (moderately stunted: 47% vs.53%, severely stunted: 31% vs. 43%). As for wasting, the difference is noticeable regarding the severely wasted category: only 19% of children who were breastfed for more than 12 months are severely wasted, compared to 38% among children who were breastfed for less than 12 months.

Diet diversity is not significantly associated to stunting, however it is associated to wasting, with a confidence interval as high as 98%. Among the two groups of children having consumed none or one important food group within the 24 hours preceding the survey interview, the levels of wasting are similar, although children who consumed one food group are slightly less wasted than the ones who consumed no important food group at all (80% vs. 84%). Among the children who consumed at least two important food groups, the level of non wasted-children is similar to the other cases. However the severity of malnutrition is significantly different: there is a higher proportion of children severely wasted among those who consumed only one important food group as opposed to those who consumed two important food groups or more (severely wasted: 24% vs. 11%). Hence diet diversity seems to have a protective effect against severe wasting. Low diet diversity was often shown as a determinant of stunting. For instance, a study on Chinese toddlers (Taren and Chen 1993) found that children above 12 months whose complementary diet was made of 3 or more food groups had better height for age.

Regarding vitamin A, there is a higher number of children severely wasted among those who did not receive any in the last 6 months than among those who received at least one dose (severely wasted: 22% vs. 8%).

As mentioned in Chapter II, vitamin A was also found to be an important determinant of malnutrition (stunting, underweight) in a preceding Indian survey focused on vitamin A intake among 12-35 months old children ((Semba, de Pee et al. 2010)).

4.2.3 Mother Supervision

There is no significant relationship between the presence of the mother at home, or her decision power regarding daily expenses, and the nutritional status of the child. However there is a possible association (confidence level of 93%) between mother education and wasting level of the child. Children from mothers who did not get any education and

children from mothers who went to primary school present the same proportions of wasting. Yet, there is a noticeable demarcation regarding the children whose mothers attended secondary education: only 73% among those are wasted (vs. primary education: 86% and vs. no education: 83%), with only 56% who are mildly or moderately wasted (vs. 63% and 62%), and 17% who are severely or acutely wasted (vs. 23% and 21%).

The association between mother education and malnutrition is usually found stronger than in the present study (e.g. (Som, Pal et al. 2007)).

4.2.4 Child Diarrhea

There is a significant relationship between occurrence of child diarrhea in the last two weeks and wasting level. However the number of children in each category related to diarrhea is too low for generalizing the results presented here below

4.2.5 Water and Sanitation

Children whose household uses piped water or a protected well have similar nutritional status: around 18% are not stunted, 49% are moderately stunted, and 33% are severely stunted. Surprisingly though, children whose household uses an unprotected well as source of water have better nutritional status: 32% of them are not stunted, 41% are moderately stunted (vs. 49%) and 26% are severely stunted (vs. 33%). This result is unexplained.

When a source of water is available within the immediate proximity of the household, the proportion of stunted children (76%) is lower than when the source of water is further away (82%). However, when a source of water is available, the proportion of severely stunted children is higher (37% vs.30%). This last part remains unexplained.

4.2.6 Food Affordability and Household Size

The proportion of wasted children is higher among households which hold 6 members or more than among households which hold only 5 members or less. It is true for moderate wasting (63% vs. 59%) as well as for severe wasting (24% vs. 18%).

The proportion of wasted children is also higher among households which are the poorest (fifth wealth quintile) as compared to the households which are the poorer (fourth

wealth quintile). Among the poorest quintile, only 14% of children are not wasted (vs. 20% among the poorer), and 25% are severely wasted (among 18% among the poorer).

Households which received food assistance have much lower proportion of stunted children (69% vs. 81%). Both numbers of moderately stunted children and severely stunted children are lower in case of food assistance recently received (moderately stunted: 40% vs. 48%, severely stunted: 28% vs. 32%).

4.2.7 Child Age Group

The proportion of children who are wasted is the lowest within age group 6-11 months (76%), and takes similar values among age group 12-23 months (82%), and age group 24-35 months (84%). Whereas the proportion of moderately wasted children is quite similar across the three age groups, running around 60%, the proportion of severely wasted children increases significantly with age: 14% for 6-11 months, 19% for 12-23 months, and a maximum of 26% for 24-35 months.

As for stunting level, there is a sharp difference between age group 6-11 months and age-group 12-23 months. The proportion of non stunted children plunges from 41% to 16%, with a proportion of moderately stunted children going from 44% to up 50% and a proportion of severely stunted going from 15% up to 33%. The transition of age between age group 6-11 months and 12-23 months seems to be a turning point in the nutritional status of many children, who in mass become stunted. The nutritional status also tends to worsen between age group 12-23 months and 24-35 months, but to a lesser extent than before: the proportion of severely stunted children goes from 33% up to 39%.These observations can be generalized to the whole population with a level of certitude superior to 99.9% (p=0.000).

Then, it is interesting to look at the curves of mean stunting level and mean wasting level depending on the child age in months.

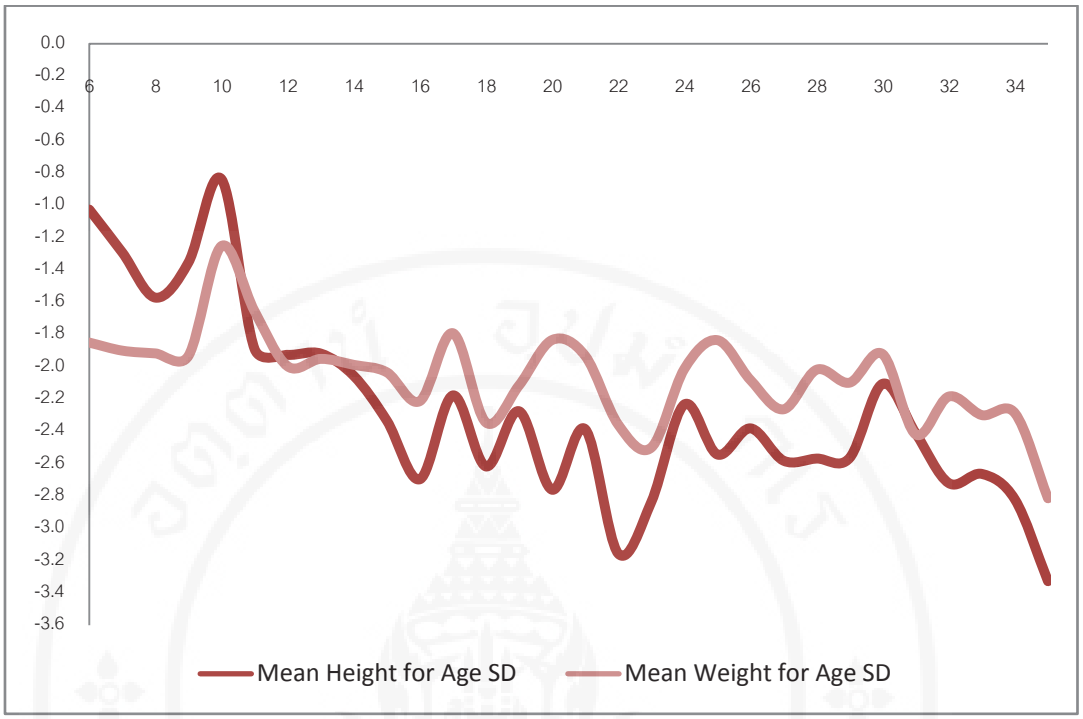

Figure 4-2 Evolution of stunting and wasting according to child age (months)

Five phases appear on the graph:

- **6-8 months**: stunting level worsens, suggesting the impact of a potential delay in diet diversification.

- **9-10 months:** appears as a phase of recuperation and corresponds to the period when mothers introduce more solid and semi-solid food into their child's diet.

- **11-16 months:** height-for-age and weight-for-age sharply plunge, suggesting that following the introduction of solid food into the child's diet, some feeding practices went fundamentally wrong, most probably in insufficient quantities, lacking diet diversity, or insufficient meal frequency. There may have been also more episodes of diarrhea, following poor hygiene practices and inadequate feeding.

- **17-33 months:** height-for-age and weight-for-age oscillate but respectively remain around the same values through the whole age range. Profiles of the curves are very similar, since a stunted child presents a lack of growth, he is also more likely to have a low value of weight-for-age (wasting). However stunting level is

worse than wasting level and presents more variations through age, with more amplitude in the direction of a worse nutritional status. It may be more sensitive than wasting to episodes of child diseases.

- **34-35 months:** there is an aggravation of both stunting and wasting levels around the third birthday of the child; it may be due to an increased nutritional need from the child and nutrition practices which do not respond appropriately.

4.3 Determinants of Malnutrition – Multivariate Analysis

In the chosen method of Ordered Logistic Regression, it is easier to interpret results if the independent variables take the value 0 as referring to good practices, and the value 1 as referring to detrimental practices. Hence some of the variables presented in chapter III keep the same functional definition but need to be re-coded in terms of numeric values. For instance “Received vitamin A” (0=”No, did not receive vitamin A”, 1=”Yes, received vitamin A”) needs to be recoded into “Did not receive vitamin A” (1=”Yes, did not receive vitamin A, 0=”No, the child did actually receive vitamin A”).

By running the Generalized Ordered Logistic Regression step-by-step, both for stunting level and for wasting level, some variables were dropped from the final run of the regressions, because they were at the same time not significantly linked to the dependent variable and not bringing any explanatory value to the models. For stunting level, the dropped variables were *meal frequency, vitamin A, iodized salt, presence of mother at home, recent parasites treatment, and wealth quintile*. For wasting level, the dropped variables were *iodized salt, recent parasites treatment, and toilet shared*.

Regarding the regression on stunting level, only one variable was violating the parallel lines assumption and the constraint was automatically removed from the variable at execution time: *water on premises*. The same was true for the regression on wasting level, only one variable was violating the parallel lines assumption and the constraint was automatically removed from the variable at execution time: *vitamin A*.

Odds ratios are presented in Table IV-11 next page.

Table 4-11 Odds ratios to worsen Height-for-Age / Stunting

	Height for Age / Stunting	
Factors	Odd Ratio (OR)	[95% CI]
Mother nutritional status		
mother underweight status (ref: not underweight)		
yes, underweight	1.5 *	[1.1-2.0]
delivered low-birth-weight (ref: no)		
yes, low-birth-weight	1.7 **	[1.2-2.5]
Breastfeeding and food intake		
breastfeeding duration (ref: > 12 months)		
breastfed less than 12 months	1.9 *	[1.0-3.6]
diet diversity (ref: at least 2 important food groups)		
1 food group	1.1	[0.8-1.5]
0 food group	1.7 *	[1.1-2.6]
Water and sanitation		
toilet type (ref: flushed toilet)		
pit or dry toilet	0.6	[0.4-1.1]
no toilet (open field)	1.0	[0.6-1.8]
toilet shared (ref: no, private toilet)		
yes, toilet shared	1.8 *	[1.1-3.0]
water on premises (ref: yes, water on premises)		
no water on premises (i)	1.5 *	[1.0-2.3]
	0.7	[0.5-1.0]
Food affordability and household size		
household size (ref: 2 to 5 members)		
6 or more members	1.1	[0.8-1.6]
number of other children under 5 (ref: none)		
1 other child under 5	1.1	[0.8-1.5]
> 2 other children under 5	1.6 *	[1.0-2.6]
received food assistance (ref: yes)		
no, did not receive food assistance	2.0 **	[1.2-3.4]
Child Age		
child age group (ref: 6-11 months)		
child aged 12-23 months	7.2 ***	[3.4-15.2]
child aged 24-35 months	10.0 ***	[4.5-22.0]

p<.05; **p<.01; *<.001; CI: Confidence Interval*
(i) when "no water on premises", first line of odd ratio relates to the transition from "not stunted to "mildly/moderately stunted", second line relates to the transition from "mildly/moderately stunted" to "severely/acutely stunted

Table 4-12 Odds ratios to worsen Weight-for-Age / Wasting

	Weight for Age / Wasting	
Factors	**Odd Ratio (OR)**	**[95% CI]**
Mother nutritional status		
mother underweight status (ref: not underweight)		
yes, underweight	1.7 **	[1.2-2.3]
delivered low-birth-weight (ref: no)		
yes, low-birth-weight	1.7 **	[1.2-2.5]
Breastfeeding and food intake		
breastfeeding status (ref: currently breastfed)		
currently not breastfed	0.5 **	[0.3-0.8]
breastfeeding duration (ref: > 12 months)		
breastfed less than 12 months	2.9 **	[1.5-5.7]
meal frequency (ref: sufficient meal frequency)		
insufficient meal frequency	1.3	[1.0-1.9]
diet diversity (ref: at least 2 important food groups)		
1 food group	1.6 *	[1.0-2.4]
0 food group	1.7 *	[1.1-2.6]
vitamin A (ref: received vitamin A)		
did not receive vitamin A (i)	1.1	[0.6-2.0]
	3.0 *	[1.3-7.4]
Mother education		
mother education level (ref: secondary)		
primary	1.7 *	[1.0-2.8]
no education	1.5	[1.0-2.2]
Food affordability and household Size		
household size (ref: 2 to 5 members)		
6 or more members	1.5 *	[1.0-2.1]
Child age		
child age group (ref: 6-11 months)		
child aged 12-23 months	5.2 ***	[2.4-11.3]
child aged 24-35 months	8.1 ***	[3.5-18.5]

p<.05; **p<.01; *<.001; CI: Confidence Interval*
(i) when the child "did not receive vitamin A", first line of odd ratio relates to the transition from "not wasted to "mildly/moderately wasted", second line relates to the transition from "mildly/moderately wasted" to "severely/acutely wasted"

- Mother Nutritional Status

A child whose mother is underweight is around 1.5 times more likely to go from one nutritional status to the next worse one than a child whose mother is not underweight (1.5 times for stunting level, 1.7 times for wasting level). In a study from Bangladesh (Mostafa 2011) it was found that odds for the child to be severely stunted increased when mother weight decreased. Having an underweight mother can lead to multiple consequences for the child. For instance, an underweight mother may be undernourished or sick, both conditions potentially entailing a poor capacity of breastfeeding, if not in quantity, at least in quality of nutrients content. An underweight mother may also be more likely to give birth to a low-birth-weight newborn, which is another risk factor for malnutrition. Besides, an underweight mother may also lack energy to ensure a good care of her child.

A child who was low-birth-weight is around 1.7 times more likely to go from one nutritional status to the next worse one than a child who was not low-birth-weight. Similarly, in a study among urban slums of Kenya, low-birth-weight was found to be a strong predictor of stunting (Abuya, Ciera et al. 2012).

- Breastfeeding

A child who is not currently breastfed is 50% less likely to go from one wasting level status to the next worse one than a child who is currently breastfed. This reverse relationship between breastfeeding status and child malnutrition was previously examined in several studies (Mostafa 2011), and further investigated in a longitudinal study of Peruvian toddlers living in a urban poor area (Marquis, Habicht et al. 1997), showing that child stunting as well as child low-birth-weight were two factors leading to increased duration of breastfeeding, and not the opposite. Hence a mother tends to breastfeed her child longer as long as she perceives her child as weak. As reported in a Thai study (Panpanich, Vitsupakorn et al. 2003), continued breastfeeding does not lead in itself to poor nutritional status, yet wrong weaning and feeding practices do. Continued breastfeeding may also play an indirect role in disfavoring appropriate diet diversification. Indeed, in the present study, breastfeeding status is strongly associated with poor diet diversity (p=0.000). Among children not currently breastfed, the proportion of those who consume at least one important food group is significantly higher than among children being currently breastfed (67% vs. 47%).

Table 4-13 Association between breastfeeding status and diet diversity

		Number of important food groups consumed			
Factors	N	0	1	2	
Overall	691				100.0
breastfeeding status		(χ^2 = 16.885, df=2, p<.001)			
currently breastfed	562	52.5	27.2	20.3	100.0
currently not breastfed	129	32.6	40.3	27.1	100.0

As for impact of breastfeeding duration, a child who is breastfed less than 12 months is almost 2 times more likely to go from one stunting level to the next worse one, and almost 3 times more likely to go from one wasting level to the next worse one, compared to a child who is breastfed for at least 12 months. Seemingly in a Chinese study ((Taren and Chen 1993)), toddlers not being breastfed anymore by age 12 months had significantly higher levels of stunting than toddlers still being breastfed. The impact of this determinant is however limited by the fact that only 8.3% of children among urban poor are breastfed less than 12 months (p=0.05).

- Food Intake

Regarding meal frequency, an insufficient number of daily feeds can slightly increase the odds of getting to a worse wasting level (+33%).

Regarding diet diversity, low consumption of important food groups increases the odds of both being wasted or stunted: compared to a child who consumed at least 2 important food groups during the 24 hours preceding the survey, a child who consumed 0 or 1 important food group is around 1.5 times more likely to go from one nutritional status to the next worse one. A cross-sectional study on Kenyan children aged 1-3 years already revealed in 1998 that diet diversity is strongly associated to child nutritional status (Onyango, Koski et al. 1998). It also found that after 1 year of age, fully weaned or partially weaned children had similar nutritional status, suggesting that the impact of breastfeeding after 12 months on child nutritional status is secondary compared to the impact of appropriate diet diversity.

Grain foods such as rice or cereal are generally much more affordable than non-grain foods such as meat, fish, legumes or even vegetables. Several studies looked at diet diversity through household expenditure on different food groups - making household food

affordability appear as a potential underlying cause of low diet diversity - and showed that prevalence of child stunting is lower among households which spend greater proportion of expenditure on non-grain food ((Sari, de Pee et al. 2010),(Murphy and Allen 2003)); this association is even stronger with animal source food, particularly rich in essential nutrients.

- Supplementation

A child who did not receive vitamin A in the last 6 months is 3 times more likely to go from "mildly/moderately wasted" to "severely/acutely wasted" than a child who received a dose of vitamin A. The importance of vitamin A intake was previously highlighted in a Sudanese study as a strong determinant of stunting but also as a determinant of actual recovery from stunting, particularly among toddlers aged 1 to 2 years old (Sedgh, Herrera et al. 2000).

- Mother supervision

A child whose mother got only primary education is around 1.5 times more likely to go from one wasting level to the next worse one than a child whose mother got secondary education. The proportion is almost the same between a child whose mother got no education (1.7 times) and a child whose mother got primary education (1.5 times), but the significance level in that case is low (p=0.083). Similar association between nutritional status and secondary education of mother was presented in the Kenyan study mentioned before (Abuya, Ciera et al. 2012). There is no difference however between mothers having no education and mothers having primary education, suggesting that preventing malnutrition may imply from the mother the capacity of thorough thinking and decision making.

- Water and Sanitation

A child whose household shares toilet facilities with other households is almost 2 times more likely to go from one stunting level to the next worse one, compared to a child whose household avails from private toilet facilities. There may be a worse level of hygiene in shared toilet facilities than in private toilets, adding to the lack of hand-washing practices, inducing easier spread of bacteria and increased incidence of diarrhea or other infectious diseases. Association between stunting and improved toilet facility (flush toilet vs. pit toilet) was found in other studies ((Mostafa 2011),(Hong and Mishra 2006)), but no association was

previously examined between stunting and toilet characteristic of being shared vs. non shared.

Even if no significant relationship could be found in the present study between diarrhea occurrence and malnutrition – probably due to the scarcity of data and sample size – diarrhea was shown to be a strong predictor or stunting in many studies. A multi-country analysis (9 studies, 5 countries, over 20 years,(Checkley, Buckley et al. 2008)) on children below 24 months of age found odds of stunting increasing with each episode of diarrhea and with each day of diarrhea (p=0.001).

A child whose household does not have water available on premises is 1.5 times more likely to go from "not wasted" to "mildly/moderately wasted", but 30% less likely to go from "mildly/moderately wasted" to "severely/acutely wasted". A previous water and sanitation study (Esrey, Potash et al. 1991) concluded that proximity and quantity of water available were more important than improved quality of water to reduce prevalence of diarrhea and hookworm infections. Proximity of water promotes hand-washing and hygiene practices, which explains the odds of 1.5 to become more wasted when water is far away. However no consistent explanation has been found regarding the other result (30% less likely).

- Food Affordability and Household Size

A child whose household counts 6 or more members is 1.5 times more likely to go from one wasting level to the next worse one, compared to a child belonging to a household with 5 or less members. Household capacity of expenditure on food is not infinite, and as family grows each individual meal quantity or quality may become more and more reduced. Besides a household having 6 or more members may be overcrowded, favoring the spread of germs among adults and children.

When there are at least 2 other children under 5 within the same household, a child is around 1.5 times more likely to go from one stunting level to the next worse one, compared to a child whose household fosters no other child under 5. Similarly a longitudinal study of children living in an Indian slum revealed an odd ratio equal to 2 for a child to be stunted when having another sibling (Rehman, Gladstone et al. 2009). This suggests a potential link to household capacity of expenditure on food, with quantity or diet diversity being reduced as new siblings add up to the family.

When the household did not recently receive any food assistance from Anganwadi center, a child is 2 times more likely to go from one stunting level to the next worse one, compared to a child living in a household which received food assistance. Hence food assistance may truly help families to have better nutrition. It may also mean that households receiving food assistance are not excluded from existing support systems and are more likely to rely on them in case of difficulty. In other words households which rely on external help may be less likely to have malnourished children.

- Child Age Group

A child aged 12-23 months is 7 times more likely to get a worse stunting level and 5 times more likely to get a worse wasting level than a child aged 6-11 months.

A child aged 23-35 months is 10 times more likely to get a worse stunting level and 8 times more likely to get a worse wasting level than a child aged 6-11 months.

This implies that malnourished status of a child goes generally unnoticed or untreated as the child grows older.

A high-level view on odds ratios is presented in the table hereafter.

Table 4-14 Synthetic view of odds to worsen nutritional status

Summary of odds to worsen stunting level		Summary of odds to worsen wasting level	
7 to 10 times		5 to 8 times	
	- age group		- age group
2 times		3 times	
	- breastfed less than 12 months		- breastfed less than 12 months
	- did not receive food assistance		- did not receive vitamin A
1.7 times		1.7 times	
	- low-birth-weight		- low-birth-weight
	- low diet diversity		- low diet diversity
	- 2+ other children under 5		- mother underweight
	- toilet shared		- mother education
1.5 times		1.5 times	
	- mother underweight		- number of household members

4.4 Predicted Probabilities

After odds ratios were found, predicted probabilities were simulated for each independent variable which was statiscally significantly associated to the dependent variable. Then, the various predicted probabilities were compared to the predicted probabilities obtained when taking the mean value of each variable, and only the ones which neatly differed were subsequently examined in details.

When taking mean values, a child has a probability equal to 17.5% to be "not stunted", 53% to be "mildly or moderately stunted", and 29.5% to be "severely or acutely stunted". As for wasting, a child has a probability equal to 16.1% to be "not wasted", equal to 66.1% to be "mildly or moderately wasted", and 17.8% to be "severely or acutely wasted". In other words, the probability of being not wasted is similar to the probability of being not stunted; however the probability of getting a severe status of stunting is much higher than the probability of getting a severe status of wasting (29.5% vs. 17.8%).

Then, when looking at predicted probabilities obtained for fixed values of variables, the internal parameter Delta was used to identify those predicted probabilities which differed the most from the mean values.

$$\text{Delta} = \sqrt{((P1(i) - m1)^2 + (P2(i) - m2)^2 + (P3(i) - m3)^2)}$$

$P1(i)$: $probability\ to\ be\ not\ stunted\ for\ simulation\ (i)$

$P2(i)$: $probability\ to\ be\ moderately\ stunted\ for\ simulation\ (i)$

$P3(i)$: $probability\ to\ be\ severely\ stunted\ for\ simulation\ (i)$

$m1$: $probability\ to\ be\ not\ stunted\ for\ means\ values\ of\ all\ variables$

$m2$: $probability\ to\ be\ mildly\ or\ moderately\ stunted\ for\ means\ values\ of\ all\ variables$

$m3$: $probability\ to\ be\ severely\ or\ acutely\ stunted\ for\ means\ values\ of\ all\ variables$

By looking at the values taken by Delta, a minimum threshold of 10 seemt a reasonable choice to select the most meaningful simulations of the height-for-age/stunting model and a minimum threshold of 8 seemt appropriate for the weight-for-age/wasting model.

Table 4-15 Predicted Probabilities for Stunting

	Probabilities to be…				
	Not stunted (%)	Mildly/ Moderately stunted (%)	Severely/ Acutely stunted (%)	Total	Delta
Mean values	17.5	53.0	29.5	100.0	0
Mother underweight status					
not underweight	20.0	53.8	26.2	100.0	4.2
underweight	14.5	51.2	34.3	100.0	5.9
Child birth weight					
child was not low birth weight	19.3	53.6	27.1	100.0	3.1
child was low birth weight	**12.5**	**49.2**	**38.3**	100.0	10.8
Breastfeeding duration					
> 12 months	18.2	53.2	28.6	100.0	1.2
< 12 months	**10.5**	**46.3**	**43.2**	100.0	16.8
Diet diversity					
2 important food groups	**24.2**	**54.0**	**21.8**	100.0	10.3
0 or 1 important food group	15.9	52.1	32.0	100.0	3.1
Other children under 5					
no other child und 5	19.5	53.7	26.8	100.0	3.4
only 1 other child und 5	17.8	53.1	29.1	100.0	0.5
2 or more other children und 5	**12.9**	**49.5**	**37.6**	100.0	10.0
Toilet shared					
toilet not shared	19.8	53.8	26.4	100.0	3.9
toilet shared	**12.2**	**48.8**	**39.0**	100.0	11.7
Water on premises					
no water on premises	15.8	57.2	27.0	100.0	5.2
water on premises	**21.8**	**42.6**	**35.6**	100.0	12.8
Food assistance					
yes, received food assistance	**28.1**	**43.5**	**28.4**	100.0	14.3
no, did not receive food assistance	16.1	54.3	29.6	100.0	1.9
Child age					
child aged 6-11 months	**41.7**	**47.2**	**11.1**	100.0	30.9
child aged 12-23 months	15.5	51.9	32.6	100.0	3.8
child aged 24-35 months	**11.7**	**48.1**	**40.2**	100.0	13.1

in bold if Delta equal or above 10

Table 4-16 Predicted Probabilities for Wasting

	Probabilities to be…				
	Not wasted (%)	Mildly/ Moderately wasted (%)	Severely/ Acutely wasted (%)	Total	Delta
Mean values	16.1	66.1	17.8	100.0	0
Mother underweight status					
not underweight	19.2	66.0	14.8	100.0	4.3
underweight	12.6	65.0	22.4	100.0	5.9
Child birth weight					
child was not low birth weight	17.9	66.1	16.0	100.0	2.5
child was low birth weight	**11.3**	**64.1**	**24.6**	100.0	8.6
Breastfeeding status					
currently breastfed	14.2	65.8	20.0	100.0	2.9
currently not breastfed	**26.4**	**63.2**	**10.4**	100.0	13.0
Breastfeeding duration					
> 12 months	17.3	66.1	16.6	100.0	1.7
<12 months	**6.0**	**54.7**	**39.3**	100.0	26.3
Minimum meal frequency					
sufficient meal frequency	18.0	66.1	15.9	100.0	2.7
insufficient meal frequency	14.1	65.8	20.1	100.0	3.1
Diet diversity					
2 important food groups	**15.4**	**66.1**	**18.5**	100.0	7.8
0 or 1 important food group	14.3	65.8	19.9	100.0	2.8
Vitamin A					
received vitamin A	**17.0**	**75.6**	**7.4**	100.0	14.1
did not receive vitamin A	16.0	64.5	19.5	100.0	2.3
Mother education					
secondary	21.0	65.5	13.5	100.0	6.5
primary	13.5	65.5	21.0	100.0	4.2
no education	15.5	66.1	18.4	100.0	0.8
Household size					
5 or less household members	18.9	66.0	15.1	100.0	3.9
6 or more household members	13.5	65.5	21.0	100.0	4.2
Child age					
child aged 6-11 months	**27.0**	**63.0**	**10.0**	100.0	13.8
child aged 12-23 months	16.8	66.2	17.0	83.0	1.1
child aged 24-35 months	**11.3**	**64.2**	**24.5**	100.0	8.5

in bold if Delta equal or above 8 (7.8)

The results which stand out from the two tables are the following. As for stunting level, the probability to be severely stunted is considerably heightened when the child is breastfed for less than 12 months (43.2% vs. 29.5%). When the household uses shared toilet facility the child is also at greater risk of being severely stunted (39.0%), and similarly if the child was low-birth-weight (38.3%), or if there are at least 2 other children under 5 years old within the same household (37.6%). To a lesser extent, when water is directly available on premises, the child is also more likely to be severely stunted (35.6% vs. 29.5%).

On the opposite, receiving food assistance is the one factor which increases the most the chances of the child to be "not stunted" (28.1% vs. 17.5%). Getting a diversified diet (eating at least 2 important food groups) comes in second position to insure a higher probability for the child to be "not stunted" (24.2%). In third position comes the fact that water is available on premises (21.8%).

As for age groups, children aged 6-11 months are the most protected against the possibility of stunting, but the situation deteriorates when age advances through higher age groups (probability of being not stunted goes from 41.7% through 15.5% to 11.7%).

For wasting, by far the fact that the child was breastfed for less than 12 months is the most aggravating factor in terms of probability to be severely wasted (39.3% vs. 17.8%). Then, to a much lesser extent though, a child who was low-birth weight is more likely to be severely wasted (24.6% vs. 17.8%).

On the other side, among the positive factors which seem to protect the child from probability of being wasted, first comes the fact that he/she is not breastfed anymore (26.4% vs. 16.1%). Like for stunting, comes in second position the fact that the child gets a diversified diet (eating at least 2 important food groups, 22.0% vs.16.1%), which is fairly dependent on household food expenditure (Thorne-Lyman, Valpiani et al. 2010). Then, receiving vitamin A does not increase much the chances of being not wasted but considerably decreases the risk to be severely wasted (7.4% vs. 17.8%).

Table 4-17 Factors protecting against the probability to be stunted/wasted

Summary - factors increasing the probability to be **not stunted**		Summary - factors increasing the probability to be **not wasted**	
1.	Receive food assistance	1.	Currently not breastfed
2.	Get a diversified diet	2.	Get a diversified diet
3.	Have water on premises	3.	Receive vitamin A

CHAPTER V
CONCLUSION AND RECOMMENDATIONS

5.1 Discussion

The first determinant of child malnutrition appears to be child age, defining a pattern of persistency rather than an actual causal relationship. The fact that stunting and wasting keep worsening with age means that caretakers either do not recognize the problematic status of their child or do not find the means to alleviate it. From articles posted on UNICEF website, it appears that within populations facing widespread child malnutrition, almost all toddlers are short or thin. Because of this comparison bias, mothers do not fully realize the malnutrition status of their child, and only seek help when an acute disease occurs (e.g. dehydration following persistent diarrhea, infectious disease) or when the general health status of their child critically deteriorates. Even when the mother acknowledges the weak status of her child, she may not bring the appropriate response to it. She may be more inclined to pursue breastfeeding, due to traditional beliefs or health workers recommendations (breastfeeding should be pursued until 2 years of age), but neglect diet diversification. However, after 12 months of age, breastfeeding cannot solely prevent or reverse malnutrition unless the complementary diet of the child is truly diversified, providing all nutrients required for health and growth.

The second most important determinant is the mother's nutritional status, including her latest weight status as well as the child's weight at birth. An underweight mother may encounter difficulties in providing breastfeeding with appropriate quantity and nutritive quality. Besides her tiredness may constitute a barrier to seek healthy food for her child and for herself, as well as a barrier to seek help or health care. An underweight mother may have a low-birth-weight newborn, and perceiving her child as weak, she may try to continue breastfeeding for as long as possible, privileging breast milk over food intake, even though breast milk may be empty of nutrients because of her own malnutrition status. Facing a lack of breast milk production she

may as well decide to stop breastfeeding, exposing her child to an increased risk of diarrhea incidence. Hence it seems that mother and child are trapped in an intergenerational legacy of malnutrition, with mother malnutrition entailing child malnutrition.

In third place comes the necessity for the child to be breastfed for at least 12 months. Indeed relying on infant formula before 12 months, among unhygienic settings, can only increase diarrhea incidence - which is generally high at that age (Gladstone, Das et al. 2010).

In fourth place of importance come both access to food assistance and access to vitamin A supplementation. This result may imply the possible failure of ICDS program in reaching urban poor, since only 10% of children got vitamin A and only 14% of households received food assistance.

Then the following determinants have similar levels of importance: low diet diversity, shared toilet, water not available on premises, other children under 5, number of household members. Diet diversity is all the more important that urban poor children seem to be deprived from easy access to nutrients supplementation. Usage of shared toilet and absence of water on premises illustrate the cruel lack of basic water and sanitation among urban poor, increasing the risk of malnutrition, especially if the household is overcrowded.

Going back to the research hypothesis stated at the beginning of this study, it was not demonstrated here that presence of mother at home was an important predictor of the nutritional status of the child. However regression revealed a strong association between mother's malnutrition and child's malnutrition. Moreover, feeding practices (breastfeeding, food intake) as well as water and sanitation were demonstrated as important determinants of malnutrition. Among feeding practices, diet diversity was third in importance after breastfed more than 12 months and vitamin A supplementation.

Predicted probabilities brought an insight on malnutrition prevention, confirming the key role of good hygiene (having water available on premises), the essential part played by vitamin A supplementation, the relief coming from food assistance, and the regrettable neglect of diet diversity.

5.2 Conclusion

Children among urban poor appear to be heavily stricken by malnutrition. As high as 89% of children are either wasted or stunted, and 72% of children are both wasted and stunted. They seem to be dragged into a vicious circle of malnutrition along with their mothers (42% of mothers are underweight). Even when excluding cases of mild stunting and mild wasting, cumulative values of stunting and wasting remain high: 52.8% of urban poor children are moderately to acutely stunted, and 48.5% of urban poor children are moderately to acutely wasted. Comparatively, national values respectively reach 42.0% of stunting and 34.5% of wasting, whereas rural poor values go as high as 53.9% stunting and 48.9% wasting. Hence stunting and wasting prevalence are similar among urban and rural poor children.

The population of children among urban poor is quite homogeneous in its main characteristics. Evidently, by definition, they all belong to poor households of urban areas. It is reflected in data by the low level of water and sanitation. As many as 65% of households do not have any access to toilet facilities, and as many as 70% have no water available on premises. Most children benefit from the regular supervision of their own mother: 71.6% of mothers are not working and 7.4% of mothers are working from home, adding up to a total of 79.0% of mothers who can daily be present at home. Mothers are mostly not educated (almost 2 out of 3, 63.4%) and young aged (91% below 35 years old). Although breastfeeding is generalized - with close to 100% children breastfed below 1 year, 90% children breastfed between 1 and 2 years, and 65% between 2 and 3 years - wrong feeding practices are widely spread.

First, introduction of soft or semi-solid food into the child's diet comes too late along with insufficient diversity. Whereas diversification of infant's diet is expected to take place between 6 and 8 months of age, 4 children out of 5, between 6 and 12 months, do not consume any important food group: no vitamin A-rich fruits and vegetables, no animal protein (meat, fish, eggs), no legumes, and no additional dairy products (yogurt, cheese). Secondly, insufficient meal frequency concerns more than half of the total of children (52.8%) and lack of diet diversity is generalized: only one out of 5 children under 3 consumes a minimum of 2 important food groups, and by the time the child's diet is expected to be fully diversified (between 1 and 2 years

old), almost 1 child out of 2 (45%) consumes no important food group at all. Daily intake of animal source food is dramatically low: as little as 15% children consume animal food via meat, fish, or eggs, as little as 7% consume animal food via dairy products, and a total of 79% children do not consume either animal food or dairy products. Legumes consumption averages 15%. Since children do not eat enough animal source food and legumes, which constitute an essential source of nutrients such as iron and zinc, 82.1% children are anaemic. This seems to be a trans-generational problem, 69% of mothers being also anaemic.Thirdly, children among urban poor areas seem to be largely deprived of supplementation and basic medical care opportunities: only 2% of children got iron supplementation whereas more than 80% needed it, and as low as 10% of children got vitamin A in the last 6 months when it consists of the most basic routine intervention for children under five. It is also noticeable that only one child out of 691 got zinc supplementation, which is yet essential to prevent child mortality and morbidity, and is highly recommended to prevent (and treat) diarrhoea. Diarrhoea is also insufficiently treated: only 1 child out of 4 children with diarrhoea got ORS, and only 1 child out of 6 benefited from both ORS and appropriate feeding practices at home. While parasites are known as being widespread in India (Bansal, Sehgal et al. 2004), only 8% of children got recent deworming treatment.

Overall it seems that urban poor live in the worst possible conditions, and whereas they would be the ones most in need of food assistance, supplementation, and other support interventions, they seem to be the ones getting the least. It is true that urban poor dwellings are often hidden from sight, urban slums being physically spread out in hazardous locations, partially or totally unseen such as isolated construction areas, dumping grounds, and even sometimes cemeteries. When slums are visible, authorities often wish they were hidden, regarding them as a threat to security or a downgrade to the image of the city, and command their demolition, forcing urban poor to relocate into more remote and more hazardous locations. Hence the temporary aspect of urban poor inhabitation may hinder authorities in their potential willingness to develop permanent health care or Anganwadi centers nearby.

However the proportion of urban poor keeps growing, consequently tackling poverty and malnutrition across India necessarily means for authorities to implement sustainable solutions in response to the suffering of urban poor.

5.3 Recommendations

Since mother and child nutritional status are deeply interlaced, any program should simultaneously address child's and mother's malnutrition. Mothers should be given nutrients supplementation (at least iron and vitamin A) and given training on their own nutritive needs during pregnancy and lactation. They should also be given information on breastfeeding and appropriate infant feeding practices. Programming a nutrition intervention solely on children will not solve the problem of widespread malnutrition, as it comes substantively from mother malnutrition status. This approach is already part of the ICDS program; unfortunately, it seems to be mainly out of reach of urban poor.

According to our findings, supplementation, child care and assistance programs seem to be inaccessible from most urban poor. New structures may need to be deployed by government and other stakeholders near slums and urban poor areas. New mobile units providing nutrition and health counseling may need to be created with the aim of parking close to informal settlements wherever and whenever they appear, even in the most hazardous urban settings.

Growth of children aged 6-35 months must be closely and regularly monitored, so as to detect early cases of malnutrition. An even stronger focus should be made onto children aged 6-18 months, since nutritional status usually deteriorates around that age. To tackle the problem of malnutrition appearing between 6 and 18 months, training and information given to mothers and social/health workers should develop and reinforce the part related to diet diversification and weaning practices, insisting on the pivot role of diet diversity and richness of animal source food. As reported in a previous study (Bhutta, Ahmed et al. 2008), strategies promoting breastfeeding have a large effect on child survival but a reduced effect on child malnutrition. Hence, for children above 6 months, more emphasis should be brought on diet diversification and food intake.

Messages regarding nutrition education should be simple and clear, best illustrated through info graphics, posters or paintings, on school walls and other public places, informing on the food groups needed by the child on a daily basis. By looking at the pictures, mothers should be able to instantly know how to create appropriate meals for their young child. This information campaign must be complemented by the availability and accessibility of assistance food for the young children. The assistance food must be diversified, contain animal protein and legumes as a priority, beside fruits, vegetables and dairy products.

All children below 3 must receive regular supplementation in vitamin A, iron and zinc. ORS must also be widely distributed along with simple info graphics explaining home treatment of diarrhea.

Finally, since improving the conditions of living of urban poor require large-scale interventions directed by political will, most urban poor may have to cope with many more years of unhygienic surroundings. Hence, as a first hand remedy to the problem of insalubrities, campaigns promoting hygiene and hand-washing practices must be efficiently carried out throughout the country.

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APPENDIX

Table Appendix - 1 Variables Summary

Category	Variable name	Variable Definition	Scale	Value
Child Malnutrition Status	stunting level	indicates whether the child is - "not stunted" (Height for Age SD>-1) - "mildly or moderately stunted" (-3<SD<-1) - "severely or acutely stunted" (SD<-3)	ordinal	1..3
Child Malnutrition Status	wasting level	indicates whether the child is - "not wasted" (Weight for Age SD>-1) - "mildly or moderately wasted" (-3<SD<-1) - "severely or acutely wasted" (SD<-3)	ordinal	1..3
Mother Nutritional Status	mother underweight status	indicates if the mother Body Mass Index (BMI) is: - higher than 18.5 (not underweight) or, - lower than 18.5 (underweight)	nominal	Yes, No
Mother Nutritional Status	low birth weight	indicates if the mother recalls that her child at birth was "small or "very small"	nominal	Yes, No
Breastfeeding	currently breastfed	indicates if the child is currently breastfed	nominal	Yes, No
Breastfeeding	breastfed more than 12 months	indicates whether the child has been breastfed for a total duration more than 12 months	nominal	Yes, No
Food Intake and Breastfeeding	minimum meal frequency	indicates if number of times the child ate food in the last 24 hours was at least equal to the minimum number of meals as defined by WHO according to the child's age	nominal	Yes, No
Food Intake and Breastfeeding	diet diversity indicator	indicates if the child consumed in the last 24 hours, 0 important food group, or 1 important food group, or at least 2 important food groups among the following food groups: animal protein, legumes, dairy products, and vitamin A-rich fruits and vegetables	ordinal	0,1,2

Table Appendix - 1 Variables Summary (Continued)

Category	Variable name	Variable Definition	Scale	Value
Supplementation	received vitamin A	indicates if the child received a dose of vitamin A within the last 6 months	nominal	Yes, No
Supplementation	iodized salt indicator	indicates if the household salt is iodized and concentration is equal or above 15 ppm	nominal	Yes, No
Food Affordability and Household Size	other children	indicates whether there is 0, 1, or 2 (or more) other children under 5 living in the same household	ordinal	0,1,2
Mother Supervision	mother stays home	indicates whether the mother stays at home (either working at home or housewife)	nominal	Yes, No
Mother Supervision	mother decides expenses	indicates whether the mother can decide on daily expenses	nominal	Yes, No
Mother Supervision	mother education	gives mother educational level (no education, primary, secondary or higher)	categorical	0,1,2
Child Digestive Health	recent parasites treatment	indicates if the child received drugs for parasite treatment within the last 6 months	nominal	Yes, No
Child Digestive Health	recent diarrhea indicator	indicates if the child had recent diarrhea and the level of home treatment he received	categorical	1..4
Water and Sanitation	toilet type	indicates the type of toilet accessed by the household (flushed toilet, pit or dry toilet, open field)	categorical	0,1,2
Water and Sanitation	toilet shared	indicates if the toilet facility is shared with other households or not (not applicable to "open field")	nominal	Yes, No
Water and Sanitation	water source	type of water source (piped water, protected well, unprotected well, tanker truck)	categorical	0,1,2
Water and Sanitation	water on premises	indicates whether the household members can access a source of water directly on premises	nominal	Yes, No

Table Appendix -1 Variables Summary (Continued)

Category	Variable name	Variable Definition	Scale	Value
Food Affordability and Household Size	household size	indicates whether the number of household members is 5 or below	nominal	Yes, No
Food Affordability and Household Size	poorest quintile	indicates if the household wealth index belongs to the lowest/poorest quintile	nominal	Yes, No
Food Affordability and Household Size	received assistance food	indicates if the household received recent food assistance from Anganwadi centre	nominal	Yes, No
Child Age	child age group	classifies children within 3 age groups: 6-11 months,12-23 months, 24-35 months	categorical	1,2,3

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