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Full Length Research Paper

Economic growth and increasing trends of child malnutrition in Mumbai City

Sanjay Rode

Somaiya College, Mumbai University, Mumbai, India. E-mail: sanjayjrode@gmail.com.

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Malnutrition among children reduces the physical growth, school achievements and future employment opportunities. Present study finds that the incidence of malnutrition among below five age group children in Kutcha slums of Mumbai city is increasing. The incidence of stunting is rising faster whereas the incidence of underweight remains stagnant. The incidence of severe malnutrition is also increasing among children in slums. The deaths related to severe malnutrition are also rising in city. The logit model shows that the incidence of child malnutrition is negatively correlated with per capita income, breastfeeding among children and health care facilities. The policies of recruiting more nurses and doctors in health care facilities, supplementary food coverage by anganwadi workers will work to improve child health. Government must invest more in terms of water supply, sanitation and housing for slum dwellers. Women must be given educational and technical training for self employment.

Key words: Economic growth, self employment, child malnutrition.

INTRODUCTION

Mumbai is a financial and cultural capital of India. Most of the head quarters of financial institutions and multi-national companies are located in city. The growth of services sector such as finance, IT, telecom, tourism, entertainment, advertising, communication is higher. Therefore most of the skilled and unskilled work force attract city from all over India. The educated skilled migrants do not find any problem in city as far as housing and employment is concerned. But the unskilled and less educated people do the menial and minor jobs which are bottom line of economic pyramid of city. Over the period of planning, there is continuous growth of population in city. The per capita income and contribution of tax to central government has increased. It was expected that the municipal corporation will invest more resources in civic physical infrastructure. But rising population and lower investment in physical infrastructure has affected on the housing, health care, transport, sanitation, etc. Due to unaffordable housing fifty percent of the population stay in slums.

The poor people of the slums have greater reliance on wage labor for their livelihood and daily purchase of food and non food items. Due to uncertain and fluctuating income, women are also supplementing income through involving various activities. Pregnancy is not unusual and they do not have time to register in health care facilities and receive antenatal care. Informal sector do not allow women to visit health care facilities or recuperate after delivery. Most of the women return immediately to work without providing proper breastfeeding to their children. Children are left to supervise, care and feed on older sibling, relatives, and neighbors. Infections are rampant in slums and lack of access to breastfeeding, water supply, health care, hygiene and sanitation affects on children's health.

Public health care facilities are in great demand in city. The utilization cost of health services includes high direct and indirect cost. The mother's opportunity cost of time play more of a role than user fees although both waiting and travel time are less elastic. Urban slum dwellers do not have access to safe regular and convenient supply of good quality of drinking water at an affordable cost. People of kutcha slums wait in a long queue to get few liters of water which is necessary for a day. If the distance increases then women and children have to carry drinking water. The opportunity cost of carrying drinking water is much higher for women and children. Most of the time, drinking water is purchased at

substantial cost. The water use is depending on the cost of water, total family members, distance, storage facility, etc. The inadequate quality and quantity of water leads to water washed and water borne diseases. Most of the kutcha slums do not have the facility of sanitation. The public latrines are over used, poor serviced and rarely maintained. The coverage of anganwadi services is lower in slums. The single overburdened anganwadi worker cannot provide supplementary feeding to under five age group children, pregnant and lactating women. Due to high density of population and time constraint, slums are remaining without supplementary feeding. In order to make Mumbai as world class city that is Shanghai, the slums are demolished. The poor people of kutcha slums are neglected in terms of basic facilities such as water, electricity, health care, sanitation, etc.

DATA AND METHODOLOGY

Data for this study is collected in to two parts. Firstly, data of 1007 households is collected from kutcha slums. Total ten settlements were selected in city in which five were from the eastern and five were from western suburbs. For comparison of child malnutrition, again in 2011, we collected 1050 household data. Such data is collected from the eastern and western suburbs of 15 slum settlements. We administered same questionnaire for first and second sample.

Measurement of child malnutrition

Given a child's weight, height, sex and age, its nutritional status conventionally has been expressed in three ways.

(1) Gender specific height for age;
(2) Gender specific weight for height;
(3) Gender specific weight for age;

Each of these indicators evaluates a different aspect of the child's nutritional status. Height for age reflects a child's past or chronic nutritional status. Children who are too short for their age are called "stunted". Slow growth in height over longer period of time causes children to fall further and further behind the height of the reference population. Thus ""stunting"" is a cumulative indicator of slow physical growth.

Weight for height reflects more a child's current nutritional status, because weight can fluctuate because of acute disease whereas height cannot. Children whose weight is too low, relative to their heights are called "wasted". This is an indicator of acute malnutrition and thus, may be a sensitive indicator of short-term response to changing conditions.

While stunting is usually not reversed, children who become stunted typically remain so throughout their lives and thus never "catch up". The weight loss associated with ""wasting"" can be restored quickly under favorable conditions. ""wasting"" represents depletion of body tissue whereas "stunting," indicates a slower rate of new tissue deposition (Osmani, 1989).

The third indicator, weight for age, combines information of "stunting", "wasting" or both. In short, weight is influenced by thinness and by height. Children whose weight is too low for their age are called "underweight".

The Z score

All three measures are commonly expressed in the form of Z score (Harold, 2000; Kostermans, 1994; Galloway, 1991; Giliespie and Lawrence, 2003), which compares a child's weight and height with the weight and height of a similar age, sex, child from a reference healthy population. More precisely weight and height of children of a certain age group follow more or less the normal distribution. The stunting Z score of a child i^{th} is the difference between the height of that child Hi and the median height of a group of healthy children of the same age and sex from the reference population Hr divided by the standard deviation of the height of those same group of children (same age and sex) from the reference population SDr. The value of the Z score can be conceived as the number of standard deviations that the child is away from the median of the concerned indicator of the children of that age/sex group from the standard population.

Mathematically,

$$\text{Z score} = \frac{\text{Child's anthropometric value} - \text{median of reference population}}{\text{Standard deviation of reference population}}$$

The basic idea is to assume that the given child comes from a healthy population. Under this null hypothesis, the Z score should follow the standard normal distribution. If the value of the Z score is sufficiently low that it has a very small probability of occurring, we reject the null hypothesis and classify the child as malnourished. Relatively short children have negative height for age, Z score and thus moderately stunted children are classified as those that have Z score –2 and severely stunted children are classified as those that have Z score –3.

The Z score for low weight for age ("underweight") is calculated in the same way using the weight of the child (instead of height) and the median weight (and standard deviation) of the children of the same age and sex from a healthy reference population. Finally Z score for "wasting" (low weight for height) is obtained by comparing the weight of the child with the median weight (and standard deviation) of children from the reference population who

have the same height as this child. The international reference population advocated by the US, Centers for Disease Control (CDC) is based on data from the National Center for Health Statistics (NCHS). The two preferred anthropometric indices for the measurement of nutritional status of children are stunted and wasted, since they distinguish within long run and short run of physiological processes. The "wasting" (low weight for height) index has the advantage that it can be calculated without knowing the child's age. It is particularly useful in describing the current health status, of a population and in evaluating the benefits of intervention programs, since it responds more quickly to changes in nutritional status than does stunting. "Stunting" measures in the long run reflects social condition, because it is reflecting past nutritional status. Thus the WHO recommends it as a reliable measure of overall social deprivation (Glewwe et al., 2002) and it is proxy for multifaceted deprivation. By consequences, being wasted is a better indicator for the determination of short-term survival, whereas sensitivity and specificity of survival in a one or two year period is highest for weight for age (Kostermans, 1994). The weight for age indicator is intended to capture both long term (stunting) and short term (wasting) under nutrition. It has been the indicator used most frequently by World Health Organization (WHO), United Nations International Children's Emergency Fund (UNICEF) and other international organizations concerned with the health status of children.

Econometric model

The study used a logit model to estimate the causes of the child malnutrition both survey in urban slum. The initial OLS regressions that we tried did not give satisfactory results. The nutritional status of a child is not a continuous variable, children are either malnourished or are not malnourished. The categories are discrete; consequently we decided to use a logit model. Also, because we were testing only for the categories mal-nourished versus not malnourished, we decided to use a binomial instead of a multinomial logit model. The logit model is given as follows (Greene, 2003).

$$\text{Prob (a given child is malnourished)} = \frac{\exp(b'x)}{(1+\exp(b'x))}$$

where, X is the vector of explanatory variables; b is the vector of associated coefficients. The dependent variable is codes as 1 if the child suffers from malnutrition and as 0 if the child does not suffer from malnutrition depending upon the criterion used.

The study classified a child as malnourished if it falls below 2 standard deviation of reference population in terms of weight for age, height for age and weight for height for specific age and sex. Such classification is made up of urban slums in both surveys.

Definition of malnutrition

Malnutrition means "an inadequacy or deficiency in the quality of several essential nutrients which if made good enables a person to live a healthy active life" (Sukhatme, 1965).

Malnutrition refers to "impaired capacities of human body because of nutrient and health related inputs. The essential nutrients required by the human body from food are: carbohydrates, proteins, fat, vitamins and minerals. The last two are classified as minor nutrients and are required in small quantities. The main concern all along has been with protein – calorie malnutrition" (Mehta, 1982).

A person's nutritional status does not depend upon food availability and composition alone. The body uses up nutrition in order to fight infections. Hence the frequency and intensity of infections also play an important role in determining an individual's nutritional status.

Consequently, "malnutrition is the combined result of inadequate dietary intake and disease. It may also result from a combination of causes, such as the lack or low utilization of health services and professionals who are poorly trained and motivated, inadequate water supplies and sanitary facilities, poor food hygiene and inadequate child care (Rokx et al., 2002).

Stunting among children in urban slum - below five years

The Z score estimates the incidence of "stunting", wasting and underweight; child who lay below two standard deviation below the reference population by the Z score were classified as stunted, wasted and underweight.

Table 1 shows the incidence of "stunting" in urban slum among 0 to 5 age group children. Such incidence is shown according to the sex of the child and the slums of the suburbs in Mumbai city. It is an incidence of 2003 sample.

Table 1 shows that the incidence of "stunting" in urban slums is cluster specific. The overall incidence of "stunting" is higher in the suburbs of Mahim. The incidence of "stunting" is lower in Matunga (East). The figures in Dadar, Matunga and Bandra are comparable to the incidence in the 2011 sample. This is shown in Table 2.

The incidence of stunting among girls in Mumbai city is62.94% among boys, the incidence of stunting is 60.22%. In Lower Parel and Borivali all girls of kutcha slums are stunted. The stunting incidence is not observed in Mazgaon and Govandi. The incidence of stunting

Table 1. Incidence of "stunting" and "wasting" among children (percent) (2003).

Suburbs	Incidence of "stunting"		Incidence of "wasting"	
	Boys	Girls	Boys	Girls
Matunga(West)	13.3	0.0	6.6	0.0
Dadar	8.1	6.3	5.1	4.7
Matunga (East)	0.0	0.0	0.0	0.0
Mahim	22.5	8.6	4.76	2.1
Bandra	14.8	3.0	4.0	0.0
Mankhurd	13.6	0.0	0.0	4.5
Kurla	25.0	0.0	0.0	0.0
Vikroli (East)	9.0	0.0	0.0	2.9
Vikroli (West)	0.0	0.0	0.0	5.88
Ghatkopar	2.1	0.0	0.0	0.0

Table 2. Incidence of stunting among children (percent) (2011).

Suburbs	Incidence of "stunting"	
	Girls	Boys
Jogeshwari	60.00	62.50
Malad	80.00	50.00
Chembur	77.78	80.00
Mankhurd	63.64	54.55
Kurla	62.50	69.23
lower parel	100.00	14.29
Dadar	89.47	87.50
Matunga	80.00	87.50
Bandra	60.00	69.23
Goregaon	66.67	84.62
Mazgaon	0.00	7.69
Govndi	0.00	21.05
Dahisar	56.25	44.44
Kandivali	72.22	85.00
Borivali	100.00	20.00

among boys is observed as 87.50% each in Dadar and Matunga. The lowest incidence of stunting among boys is observed as 7.69% in Mazgaon. The highest incidence of stunting among boys and girls is observed as 88.57% in Dadar and 85.71% in Matunga.

*"*Stunting*"* refers to low height for age reflecting a relatively long-term malnutrition status. It reflects the cumulative effects of the numerous insults experienced by children during their intrauterine and preschool years. In other word, it is slowing of skeletal growth and stature resulting from extended periods of inadequate food intake and bouts of childhood infections. *"*stunting*"* occurs at immediate level because of poor maternal nutritional status at conception and in utero under nutrition, inadequate breastfeeding, delaying complementary feeding for infants and or inadequate quality or quantity of complementary feeding, impaired absorption of nutrients due to intestinal infections or parasites or usually a combination of these problems. Underpinning these factors are various inadequacies with respect of household and community level access to food, health, environmental and caring resources. In the urban slum area, incidence of *"*stunting*"* among boys is greater than in girls. In the 2003 sample, except Vikroli and Ghatkopar, the incidence is much higher among boys in the under five-age group. This difference is difficult to account for. Most studies have shown that there is usually no significant difference between boys and girls as far as the incidence of *"stunting"* is concerned (Aoyama, 1999).

Taking the two samples as a whole, we found that 62.94% boys in present sample and 17.58% boys in last sample of urban slums is classified as stunted. For girls the two percentages are 60.22 and 5.99%, respectively.

"Wasting" is defined as low weight for height; *"*stunting*"* is an indicator of chronic malnutrition, whereas "wasting" is an indicator of acute malnutrition. "Wasting" represents a deficit in tissue and fat mass compared with the amount expected in a child of a given height, whereas *"*stunting*"* indicates a slower rate of new tissue deposition.

In 2003 urban slum sample, the overall incidence of "wasting" among boys was 5.03% and among girls, it was 4.11%. In 2011 sample, we have not observed incidence of wasting among boys and girls.

Incidence of underweight among children- below five years

We gave the estimated values of the percentage of children who are underweight in the two samples. Weight for age is measure of *"*stunting*"* as well as "wasting". Individuals with a Z score less than 2 standard deviation for weight for age called underweight. Because of the difficulties in measuring height, several studies report

Table 3. Incidence of weight for age among urban slum children (percent) (2003).

Suburbs	Incidence of underweight	
	Boys	Girls
Matunga (West)	26.6	8.33
Dadar	35.8	30.9
Matunga (East)	46.1	18.1
Mahim	30.9	39.1
Bandra	25.9	12.1
Mankhurd	27.2	23.8
Kurla	56.2	42.8
Vikhroli (East)	31.8	20.5
Vikhroli (West)	4.1	23.5
Ghatkopar	14.8	26.9

Table 4. Incidence of underweight among children (0 to 5 years) (2011) (percent).

Area	Girls	Boys
Jogeshwari	20.00	50.00
Malad	20.00	0.00
Chembur	33.33	26.67
Mankhurd	27.27	27.27
Kurla	25.00	23.08
lower parel	0.00	0.00
Dadar	42.11	43.75
Matunga	40.00	43.75
Bandra	60.00	61.54
Goregaon	66.67	23.08
Mazgaon	8.33	0.00
Govandi	0.00	0.00
Dahisar	18.75	0.00
Kandivali	44.44	55.00
Borivali	50.00	0.00

estimates based on weight for age ratio. In very small children, weight is as good a measure of nutritional status as height. In older children, low weight for age largely reflects *"*stunting*"* because the weight for height is usually normal. We have given figures on weight for age as that is the most commonly used indicator in international as well as national studies. The integrated child development services (ICDS), one of the world's largest and unique program, WHO, UNICEF and Maharashtra human development report have used the weight for age indicator to classify the nutritional status of children. We present the estimates of underweight children in Mumbai Slums in 2003 and 2011 sample. The following table presents estimates of the percentage of underweight children in Mumbai slums (Table 3).

We see that the incidence of undernourishment when measured as weight for age is much higher than the incidence of *"*stunting*"*. Individual who are below 2 standard deviation below the reference population is classified as "underweight"

The worst incidence is in Kurla followed by Matunga and Dadar. Overall the incidence was 28.70% for the whole sample for boys and 30.27% of the whole sample for girls. The incidence of underweight in second sample of urban slums is shown in Table 4.

Table 4 shows that 35.66% of girls and 26.88% of boys are underweight in Mumbai slums. Incidence of underweight among the girls is 66.67 percent in Goregaon. In Lower Parel and Govandi, incidence of underweight among the girls is not found. Among boys the underweight incidence in Bandra is 61.54%. The underweight incidence among boys in Mazgaon, Govandi, Dahisar Borivali, Lower parel and Malad is not found.

In the second sample, 35.66% of boys and 28.88% of the girls are underweight in urban slums in Mumbai city.

Incidence of severe malnutrition

Incidence of severe malnourishment is classified as the child falls below three standard deviation in terms of weight for age, height for age and weight for height. The classified children are further arranged in terms of gender. It is presented in the Table 5.

The incidence of severe malnourishment is classified as the child falls below three standard deviation of reference population. The overall urban incidence of severe *"*stunting*"* is 3.96% whereas the overall incidence of severe *"*stunting*"* in second sample is 28.71%. First sample of urban area has severe under-weight incidence. This incidence is 0.94%. In 2011sample, underweight incidence is 8.57%. Consequently, the total incidence of severe malnourishment in 2003 sample of urban area works out to be 3.96 + 0.94%, which is equal to 4.9%. Where as for the second sample, it can be works out to be 28.71 + 8.57%. It is 37.28% among children in urban slum.

Estimates of likely deaths from under-nutrition-below five years

Given that the 4.9% of urban slum children are severally undernourished in 2003 and 37.28% in 2011, we need to find out what the total numbers involved are. For that, we will need to know (a) a percentage of urban population that lives in katcha urban slums; (b) The age distribution of that population. Table 6 gives the age distribution of urban population calculated from our sample.

In 2003, we saw that 17.14% of the total urban kutcha slums population falls in the 0 to 5 age group. In 2011 sample, it is 8.48%. We do not know the percentage of

Table 5. Comparison of urban percentage of severally malnourished children (below five years) (percent).

Indicator	Percentage of severally malnourished children			
	2003		2011	
	Boys	Girls	Boys	Girls
Underweight	1.13	0.75	8.11	9.03
Stunted	5.68	2.63	27.57	29.86
Wasted	0.0	0.0	0.0	0.0

Table 6. Age classifications of urban slum children (number).

Age group in years	2003		2011	
	Total number	Percent	Total number	Percent
0 to 2	189	6.18	115	2.91
2 to 5	343	11.21	220	5.57
5 to 15	1053	34.43	857	21.73

Mumbai population that lives in katcha slums. However, we can build different sets of estimates of the population living in kutcha slums on the basis of different assumptions about the fraction of the urban population living in katcha slums. The next problem is to estimate the number of severally malnourished children who have died because of nutrient related reasons. We cannot estimate the exact number because we have no information on the survival chances of severally malnourished child. This number is bound to be highly context specific. But we can build lower bound on this number with a reasonable degree of accuracy. Let E(D/M) is the expected number of deaths per year among children who are classified as severally malnourished. Then

E(D/M) = P(DM/M)* NM

P(DM/M) = conditional probability that a severally malnourished child under age five dies within a given year ;NM = number of severally malnourished children in that year.

P(DM/M)=P(DMN/M)+P(DMNM/M)

where, P(DMN/N) = conditional probability that a severely malnourished child that has died due to reasons unrelated to malnourishment. Our objective is to build a lower bound on the number of malnourishment related deaths. We are interested in the lower bound on P(DMN/M)*NM. Hence we can substitute the general death rate (GDR) among the 0 to 5 population age group for P (DM/M), which is likely to be lower than P (DM/M), and can at most be equal to it. Further we can assume that P (DMN/M) = P (DMNM/M) (the death of severally malnourished child is likely to occur through non-nutritional related reasons). In that case we can substitute ½ (GDR) for P (DMN/M). Similarly, malnutrition is directly or indirectly responsible for more than half of the deaths of children under five years of age worldwide (Measham and Chatterjee, 1999). Therefore it will be lowest bound on the number of likely deaths among malnourished children due to nutritionally related reasons.

Thus as the percentage of slum population goes up by 5% the, number of deaths in this age group, assuming a mortality rate of 20 per thousand, increases by 100, we are not counting deaths among the five to fifteen age group; where the incidence of severe malnourishment is about 3%. We can do a similar exercise for the assumed death rate. Assuming that 50% of the urban population lives in katcha slums, we can work out the implications of alternatives assumptions regarding death rate (Table 7).

Thus, there is a wide range of deaths in both surveys. In 2003, the smallest is 750 deaths per year, while the highest is 2500 deaths per year. In the current sample, the smallest death could be 980 deaths and the highest could be 5231 deaths per year. These are deaths in the below five age group alone. We have not counted deaths in the 5 to 15 age groups. The smallest number of 750 in 2003 to 980 deaths in 2011, which can be interpreted as a floor, estimate should itself be sufficiently alarming. The higher estimated number of 4000 deaths in 2003 and 5231 deaths in 2011 per annum is not necessarily a ceiling estimates. One study showed that death rates among 0 to 5 age group in Maharashtra is likely to be as high as 82.9 per thousand (Bang et al., 2002). In that case the number of deaths could exceed beyond 4000 per year for both samples. The percentage of slum population is also likely to be above 50% and it is rising

Table 7. Severally malnourished children and likely deaths due to nutrition related reasons in Mumbai.

Assumed percentage of urban population living in kutcha slums	Number of children severally malnourished		Likely number of deaths among malnourished children (assumed death rate = 40/1000)	
	2003	2011	2003	2011
40	39884	52316	800	2092
45	44982	58855	900	2354
50	49980	65395	1000	2615
55	54978	71934	1011	2877
60	54976	78474	1200	3138

Table 8. Alternative death rate and number of deaths (assuming 50% of urban population lives in slums).

Assumed death rate per thousand	Estimated deaths among severally malnourished children	
	2003	2011
15	750	980
25	1250	1634
30	1500	1961
40	2000	2092
80	4000	5231

fast in city. For both sample, under the assumption of 80 deaths per thousand and 60% of the population living in slums, annual deaths in the 0 to 5 age group from nutrition related causes alone exceeds 5300. We have measured only severe malnutrition related deaths but mild and moderate malnutrition is also responsible for deaths, which we have not studied. We should add to this the deaths occurring among pucca slums, which we have not studied. Additionally there would be deaths among the 5-15 age groups. Where, the incidence of severe malnourishment is non-negligible in city (Table 8).

Logit model of stunting: (2003 data) (0 to 5 age group children)

A separate model is estimated for stunting and underweight for all under-five age group children in the urban area. From the policy point of view, this model will help us to get an overall picture of underweight among children under five years of age. We have not estimated a model for wasting. The cases of wasting in urban areas were too few to run a logit model.

The logit model for stunting:

$$\text{Prob (A given child is stunted =1)} = \frac{\exp(b'x)}{1+\exp(b'x)}$$

b'x =1.4155-0.00098*pci-0.949258*girls-0.79665*fampop-0.67491*momilk; Likelihood ratio = 24.3697 with 4 degrees of freedom (significant at 1%).

All variables were also individually significant at five percent.

Where:

Girls: A dummy variable, which is equal to 1 if the child is a girl, or zero otherwise.
Mother's milk: A dummy variable, which is zero if, the child was being breastfeed 1 if not.
Pci: Per capita income of household measured in terms of actual rupees.
Fampop: A dummy variable, which is, equal to 1 if the mother /father have had a family planning operation otherwise 0. It is critical here to emphasize that family planning operation is used as a proxy for general access to health care and in particular to pre and post natal care by the household.

This model indicates that the probability of stunting is negatively associated with higher per capita income, breastfeeding, exposure of the household to family planning operation and the child being a girl. Higher per capita income clearly allows the household to purchase better nutrition as well as to ward off infections. The higher income is also associated with higher probability of child being immunized, sleeping under a bed net, treatment being given of oral re-hydration therapy (ORT) when sick with diarrhea and being taken to a formal provider when it has fever. It also has an effect on pregnant women receiving antenatal care and skilled care during delivery. The negative association with breast feeding is too well known to deserve a comment here. The negative association with the female sex does not

mean that there is no gender discrimination. Since most of the cases of stunting are less than one year of age, the negative sign for a girl probably just reflects the higher inherent survival chances of the girl child.

Logit model for stunting (0 to 5 age group): (2011 data)

In order to understand the change in the nutritional status of children in urban slums, we have again used the logit for 0 to 5 age group children. The results are presented as follows:

Logit model for stunting among children (0 to 5 age group children)

$$\text{Prob (A given child is stunted =1)} = \frac{\exp (b'x)}{1+ \exp (b'x)}$$

b'x = 1.46 - 0.00 pci + 0.00 pciclexp + 0.02 pciwatex - 0.01pcifue - 1.09landl + 1.44ufath + 2.10 umoth - 0.06 tcdw - 0.65 tbg - 4.47spbir + 1.44 preg

Likelihood ratio=123.77 with 4 degrees of freedom (significant at 1%)
Pseudo R^2 = 0.29 log likelihood =-149.84
All variables are significant at 5%.

Where:

pciclexp: Per capita expenditure on cloth, it is measured in rupees
pciwatex: Per capita expenditure on drinking water, it is measured in rupees
pcifue: Per capita expenditure on fuel, it is measured in rupees
landli: Landline with household, if household owns landline then 1 is used
ufath: undernourished father, it is coded as 1 otherwise 0
umoth: Undernourished mother, it is coded as 1 otherwise 0
tcdw: Time to carry drinking water, it is measured in minutes
tbg: Total birth given by the women in lifetime
Spbir: Spontaneous birth in past, it is measured in actual number
Preg: Women is pregnant, if a women is pregnant then 1 is used other wise 0

The per capita income is negatively co-related with stunting. The lower per capita income does not help households to purchase essential food, health care etc. The lower quality and quantity of food intake reduces the households do not have money to spend for the health care. The repeated incidence of illness affect on the weight and height of children. The lower growth of height height of children affects in the long run and they remain stunted. Per capita expenditure on cloth is higher of the slum households. This is mainly because such households do not have the more worm cloths and they regularly purchase the lower quality cloths. But it is difficult to observe the quality of cloths during survey. Per capita expenditure on drinking water supply is positively co-related with stunting among children. The households spend more on drinking water supply. They have to pay a higher price to get the minimum drinking water which is required everyday for the family. Per capita fuel expenditure is negatively co-related with the stunting among children. The households do not have money to spend on cooking gas or kerosene. They usually prepare food on wood outside their house. Therefore the expenditure is negatively co-related and statistically significant. The landline phone is negatively co-related to the slum households. For landline permanent structure, ownership of house is required. Nowadays, most of the people prefer cell phone rather than landline. Therefore the landline phone is negatively co-related with the stunting among children. Undernourished father has positive co-relation with stunting among children. Undernourished father cannot work more for family and bring income which is necessary for the health and food. Therefore it is a positive corelation with stunting among children. The undernourished mother is positively co-related with stunting among children. The undernourished mothers cannot take care of children and provide good food. It is her illness which prohibits from providing the care to children. Therefore it reflects in the stunting among children. Time taken for water is negatively co-related with stunting among children. Most of the piped water connections are available in the slums. Therefore the time spend to carry water is negatively co-related to stunting among children. Total births given by the women are negatively co-related to the stunting among children. The women with more children will have more stunting but fewer children will have the less possibility of stunting. Family spends more if they have fewer children. Spontaneous abortions are negatively co-related to stun-ting among children. Current pregnancy is positively co-related to the stunting among children. Current preg-nancy is a burden on women health and women cannot breastfeed for children. If mothers do not take care and provide good health care then children may become stunted.

The logit model for underweight-2003 data

In order to find the co-relation of child malnutrition with other socio-economic and demographic variables, we have used the logit model for 2011 data. The results are presented as follows:

The logit model for underweight (0 to 5 age group children)

The 0 to 5 age group children are most vulnerable to mal-

nutrition. The environment in the slums is not healthy for the growth of the small children.

$$\text{Prob (child is underweight =1)} = \frac{\exp(b'x)}{1+\exp(b'x)}$$

b'x = -0.60319-0.0010017*pci – 0.51938*fampo - 0.61830 momilk.
Likelihood ratio: 24.4372 with 3 degrees of freedom, which are significant at 1%.
All the variables were individually significant at 5%.
where

Fampo: family planning operation, if the women had family planning operation then 1 is used otherwise 0
Momilk: mother's milk, if mother breastfeed child then 1 is marked other 0 used

Underweight among the 0 to 5 age group children is negatively co-related to the per capita income, family planning operation and mother's milk. Lower per capita income is itself a determinant of the underweight among children because at lower income families do not afford to purchase the necessary health inputs required for child health. Most of the women have not done their family planning operation. The possible reason would be that the children would be small and health care facilities are overcrowded. Mother's milk is negatively co-related to the child malnutrition. This is mainly because mothers do not have sufficient milk to breastfeed their children. Sometime supplementary food is also given to children.

Logit model for Underweight (0 to 5 age group children): (2011 data)

$$\text{Prob (child is underweight =1)} = \frac{\exp(b'x)}{1+\exp(b'x)}$$

b'x =1.53 + 0.83 hhsize - 0.00 pci – 0.01 pcimex + 0.02 pcifex - 0.00 pcieexp - 0.08 ttw - 0.25aam - 1.31 tbg - 1.40 sbir + 2.17 preg + 2.77 pob - 1.38 ebr

Likelihood ratio: 114.79 with 3 degrees of freedom, which are significant at 1 %.
Pseudo R^2 = 0.28 Log likelihood = -145.12
All the variables were individually significant at 5 %.
where

Hhsize: Household size, it is measured as total persons stay in house since past one month;
Pcimex: Per capita expenditure on milk, it is measured in rupees;
Pcifex: Per capita expenditure on fruits, it is measured in rupees;
Ttw: Time taken to carry water, it is measured in minutes
Pcieexp: Per capita expenditure on eggs, it is measured in rupees
Aam: Age at marriage, it is measured in actual years
Tbg: Total birth given, it is measured in actual number
Sbir: Still births, it is measured in number and if they are no still birth then it is marked as 0
Preg: if the woman is pregnant then 1 is marked otherwise 0
Pob: Place of birth, it measured as public, private and home deliveries. The codes are given as 2, 1 and 0 for different options.
Ebre: If a woman provides exclusive breastfeeding then 1 is marked otherwise 0

Underweight among the children is positively co-related to the household size. If the household size is large then it is difficult to provide the health care to all. Per capita income is negatively co-related to the underweight among children. The slum households have lower incomes. The children are underweight; therefore the per capita milk expenditure is higher. It is positively co-related to the per capita expenditure on milk but at the same time exclusive breastfeeding for underweight children is not there. It is negatively co-related. The per capita expenditure on eggs is negatively co-related to the underweight children. Family cannot spend much income on purchase of eggs. This is mainly because of lower per capita income. Time taken to carry water is negatively co-related to underweight children. It is because in kutch slums, water taps are provided at different locations. The age at first marriage is negatively co-related to under nutrition among children. It means most of the women have less age when they got married. Total births given are negatively co-related to the total births given by women. There is no positive co-relation of still births and underweight among children. Therefore it is negatively co-related. The women, those are pregnant at the time of survey are underweight. It is an extra burden on women's health. Therefore the co-relation is positive and statistically significant. Most of the women have delivered the baby in the public health care facility. The hospitals are admitting women for delivery. It is a short term phenomena therefore these women easily deliver the baby in the hospital. Therefore the relation is positive and statistically significant.

The variables that then come out to be important from the general policy point of view are:

(A) Income of the household
(B) Duration of breastfeeding
(C) Exposure to public health facilities like pre-and postnatal care.

The other variables like the distance from water, availability of toilet, means that education level of the household, specially the mother's education, these variables did not come out to be significant in the 0 to 5 age

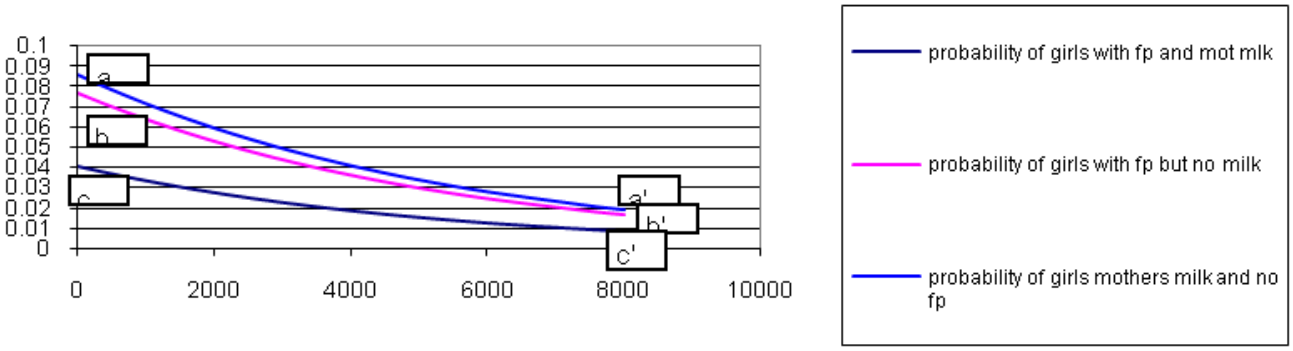

Figure 1. Probability of stunting as a function of income.

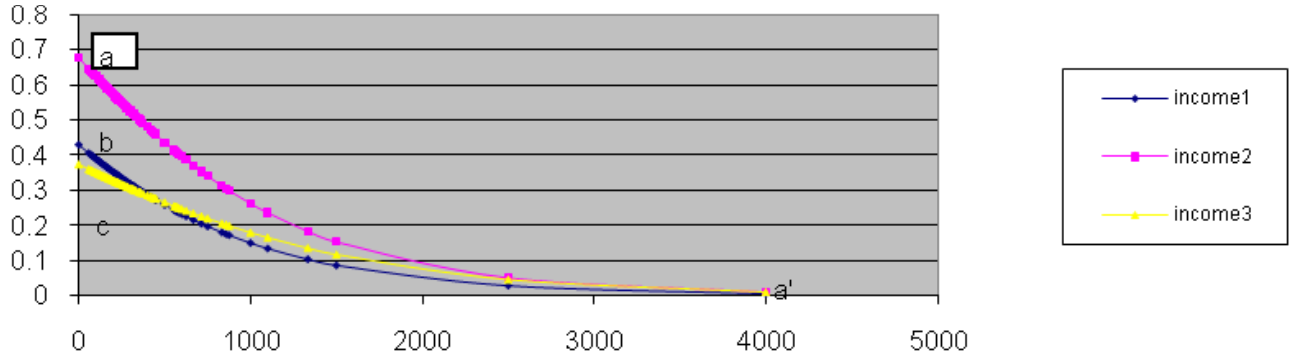

Figure 2. Probability of underweight for girl child.

age group. That does not mean that they do not matter. It is possible that there were measurement errors in these variables, leading to estimated coefficients being biased downwards. In fact, the aforementioned results have led us to believe that these infrastructural variables, especially access to toilets and latrines, are important. The fact that they do not show up in our results most likely is a result of measurement biases those are there in these variables. The alternative interpretation is that access to toilets and mother's education are particularly important in the 0 to 2 age groups (where they come out to be significant), but for the entire 0 to 5 group, they are not so. These variables could be mattering much more in the first years of life, rather than later. It could also be that the most malnourished children are concentrated in the 0 to 1 age group. As the age group expands, there are more and more households coming into the picture, but fewer and fewer malnourished children. Consequently, the marginal probabilities associated with these variables tend to fall as the age group expands.

In Figures 1 and 2, we have tried to show the different levels of probabilities in relation to household income for the female child. Such probabilities are shown in three alternatives, firstly the girls are being breastfeed by mother but parents do not have family planning operation Secondly the parents have had family planning operation but girls are not being breastfeed. Thirdly, the parents have had family planning operation and girls are being breastfeed by mother. Figure1 and Figure 2 indicate how the probability of stunting and underweight changes with various combinations of these factors.

Figure 1 shows the probability of stunting for girls as a function of household income. The top most line aa' in the figure shows the probabilities of stunting as a function of income for households with no family planning but where girls are being breastfed. Similarly, line bb' is the probability of stunting for girls as a function of income for household where parents have undergone a family planning operation and girls are not being breastfed.

The Lowest line cc' indicates probability of stunting for girls as a function of household income where parents have had a family planning operation and the girl child is being breastfed. In all the three figures, family planning operation could be standing as a proxy for general levels of parental awareness as well as access to healthcare.

Figure 1 indicates a three prolonged strategy: An improvement in health care coverage will lead to a large drop in the probability of stunting especially at the lowest level of income. A smaller drop will be achieved by a stepped up campaign for breastfeeding. This is because

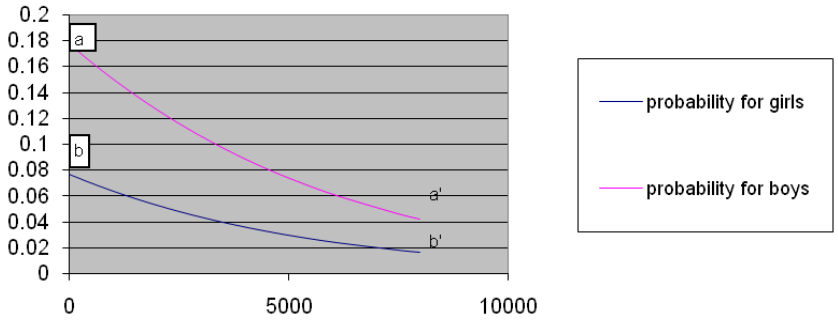

Figure 3. Probability of stunting as a function of income.

the mothers are involved in income generating activities and do not get time to breastfeed their children. Such mother's can neither afford to take time off nor do they have the facility to breastfed their children at their work place.

The largest gain will come from a policy that combines health with incomes. Thus mere growth will not be the most effective strategy to reduce malnutrition. In the ideal situation, moving a household from zero income and a no health access scenario to a middle income household with health access would reduce the probability of stunting from 8.5 to 1% which is the largest gain. Without income intervention, the same gain would be from 8.5 and to 4%. Thus a policy combining income and public health inputs, such as family planning, pre-and post natal care, communicable disease control is more likely to yield much better results, in comparison to just health. In fact an income improvement policy in isolation would be preferable to health intervention in isolation as far as its effects in reducing the probability of stunting is concerned. The actual choice should be guided by this factor, in combination with the costs of these policies. The figure for the probability of stunting for boys shows the same results and hence is not produced in this chapter.

Figure 2 shows the probability that a given girl child is underweight. The figure shows three possibilities as it is mentioned in the earlier figure. The line aa' gives the probability of being underweight as a function of household income for households without family planning but the girl child is being breastfeed.

The second line ba' shows that the same probability for households that have been exposed to family planning as well as breastfeeding girl child. The line ca' gives the probability of being underweight as a function of household income for households with no mother's milk but with exposure to family planning.

Therefore, Figure 2 shows that, probability of underweight among girls can be driven to practically zero by improving access to public health care (access to immunization, pre-post natal care, family planning operation and communicable diseases) as well as an increase in income and ability to breastfeeding. At a very low level of income, it is breastfeeding that helps the most because it reduces significant underweight among children. Therefore at a whole range, it is a combination of three policies that is, income, health care, and breastfeeding which will work the best.

Figure 3 shows the probability of stunting for boys and girls as a function of household income. At a lower level of income boys are much more likely to be stunted than girls. It is seen reflects that girls have a biological advantage and they are genetically more robust than boys. At the pre-natal and infant stages males are at a disadvantage and more vulnerable relative to female. In the first place, they are vulnerable to congenital disorders associated with their x-linked recessive gene. The different studies also shows that if no difference is made in the treatment between girls and boys, a girl is more likely to survive than a boy during the first month of her life. Therefore the girl at lower level of income will not die or be malnourished. However as household income increases, the probability of stunting for boys drops much faster than that for girls. It is a connection of sex-biased health and nutrition related behavior favoring male children. Son preference in parental care, intra family food distribution, feeding practices and utilization of health services are some of the behavioral mechanisms by which sex-based attitudes may lead to such effect. Therefore this effect can be explained in two ways. First, the girls may not be properly breastfeed, given less supplementary feeding or are neglected by mothers. Secondly the mother may not be providing health care to the girl child at the time of diarrhea or other illness.

At a lower level of income, even though the girl child has an advantage in terms of less stunting the mother's time is an important aspect. It has a high trade off between the income generating activities, maternal and child health. The mothers may provide less supplementary feeding or less breastfeeding to the girl child than to the boy. Dasgupta (1987) explains that it may be difficult to quantify neglect factors among boys and girls. Children aged 0-1 years ate partly at home and partly outside, there was little difference in male/female

consumption of cereals and sugars at home but girls were given much less milk at home than boys and very little fat. It seems that efforts are made to ensure that boys get their usual amounts of milk and fats within the house even if they are away for some of the days, while girls are allowed to go without. Once again, this could have some nutritional effect on girls, but in any case suggests that girls aged 0 to 1 years receive less care than boys. A similar study by the World Bank (2004) has observed that parents tend to selectively bring their boys, but not their girls for supplementary feeding to the ICDS center. Therefore even though boys are disadvantaged as an initial stage more breastfeeding and supplementary feeding positively affects their health.

Secondly, the boys are given more treatment from health facility during their illness. The girls are comparatively offered less treatment than boys. In the urban area, mother's opportunity cost of time in terms of providing medical care has high direct and indirect cost. Mothers cannot remain absent because of informal sector job market, household income and food security. Mothers may take boys to the public health facility but not girls. Similarly the infant male may be more likely to be treated professionally than infant females (Masako Ii, 1996). The recent study conducted in the Nasik district of Maharashtra shows a significant gender difference in the treatment of illness, the percentage of untreated illness are 17.7 for males and 20.3 (without probing) and 45.3 (with probing) for the females. Women have reported higher morbidity for young boys below five years than for girls of the same age. This finding is explained by the fact that more attention is paid to boys in their childhood. Surprisingly this gender difference is not found in the older age group (Madhiwala et al., 2000). The study of Chen et al. (1981) has explained that despite free transport and services, male children were brought to the treatment facility more frequently than female children by their guardians.

Therefore the Figure 3 shows the steady declining in the stunting of boys rather than girls. But at monthly household incomes of around Rs. 8000, an average middle class household, the probability for boys is only higher by 2%. This indicates that at lower level of income, the difference of stunting among sexes is more apparent but at higher level of income such difference is very less.

Comparison of surveys: Urban incidence of child malnutrition

Here, we test our central hypothesis that the incidence of malnutrition among urban children in the 0 to 5 age category in urban areas is not significantly lower than that in the second sample. As indicated, we will test this by pooling our first sample of 2003 and second sample of 2011 from urban slums. The dependent variable will be a binary variable =1 if the child is classified as malnourished in any of the three categories, 0 otherwise. The independent variables are now augmented by a variable that is a dummy for second sample of 2011. This variable = 1 if the household is in second sample and will equal zero otherwise. We will reject the null hypothesis (that the second survey of incidence is no higher than the first survey) if the sign of the dummy is positive and significant. If not, we cannot reject the null hypothesis.

Logit model for comparative study

A Logit model is used for all below five age group children for both surveys of slum. The model for malnutrition among the pre-school children as a function of similar socio-economic variables in both urban surveys was used. In which, we used dummy variable for comparison that is urban survey one and two. The model is given as follows. The reasons why we expect the null to be rejected are already explained in the introduction. To recapitulate, a priori we expect the following three reasons to lead to rising incidence of child malnutrition compared to our first sample:

(1) For reasons relating to the structure of informal labor markets in urban areas, urban mothers are constrained from providing adequate amount of child care. Also, the opportunity cost of time is high for mothers; consequently, better childcare can be not provided.
(2) Urban health facilities are relatively more overcrowded. This interacts with the higher opportunity cost of time for women and leads to a lower amount of health care, when adjustments are made for income.
(3) The nutritious food in urban slum is not available as a free natural resource. In Mumbai city, everything has to be routed through the market. Therefore diets are less likely to be nutritious.

The Logit model for malnourishment

$$\text{Prob (a given child is malnourished =1)} = \frac{\exp (b'x)}{1+\exp (b'x)}$$

b'x = 1.16-1.035 age - 0.518 elect - 0.524 breas + 1.16 dumvar
Likelihood ratio = -393.75 with 4 degrees of freedom (significant at 1%)
Pseudo R^2 = 0.329, P-value: 0.0000
All variables are individually significant at 5%.
Where:

Age: Age of the child is measured in actual months/ years;
Ele: Access to electricity to household;
Breas: breastfeeding by mother, it is used as 1 otherwise 0 for no breastfeeding.

Dumvari: A dummy variable is used as 1 for second urban survey and 0 for first survey.

Child malnutrition in both surveys is negatively co-related to the age of child, electricity connection and breast feeding. The coefficient on the comparative dummy is statistically significant and positive. This implies that holding all other variables constant, second survey implies a greater probability of being malnourishment of children. This finding runs counter to the common place understanding of malnutrition and economic growth and development in financial capital of India. Government and Brihanmumbai Municipal Corporation are not investing adequately in civic infrastructure facilities in city.

POLICY IMPLICATION

We found that the incidence of child malnutrition is no lower than the first survey of 2003. In fact, because of the sheer numbers involved, the absolute number of children affected as well as the number of deaths could be alarmingly high in urban areas like Mumbai. They are rising fast because population density and incidence is increasing. So far, malnutrition has been considered to be tribal-rural phenomena in Maharashtra. However, the focus needs to be directed towards urban areas too. Currently, the integrated child development service (ICDS) is slowly making itself felt in Mumbai. The ICDS staff payments are not found remunerative for women in Mumbai and hence ICDS has difficulty recruiting its staff. Also, there is the problem of space. Most Anganwadis operate from small homes and cannot accommodate many children. Often, it is difficult to cook mid-day meals because of the paucity of space. Alternative space will have to be provided where the centers can run and cooking is possible. Often, Anganwadis in Mumbai are not even equipped with basic weighing devices because of the lack of space. As we have shown, at least 800 to 1200 in 2003 sample and 2092 to 3138 in 2011 children die every year from malnutrition related illnesses in Mumbai city alone. The numbers of death are rising every year. Those who survive bear the scars for life.

We also found that though, health facilities are available in Mumbai, the imperatives of the urban infor-mal market prevent people from accessing these. It would be possible to bring medical facilities to the door steps of the poor at a time of their convenience through a medical van equipped with basic facilities. This will play an important role in improving access to medical care. Other ways of improving access must be though of. A good way to maximize the effectiveness of these facilities is to build the communities capacity to utilize them effect-tively. An educated girl from the locality can be put in charge of basic health care of children and can be entrusted with monitoring illnesses, and growth of children. She will be an interface between the anganwadi worker and the community. Currently, the anganwadi workers are too busy with their responsibilities of cooking and weighing children. They do not have time for commu-nity capacity building program.

Access to water and toilets also needs to be improved. Currently, there are legal problems because the areas that the slums in the sample occupy are notified for some other purposes. Consequently, latrines cannot be constructed on those areas. Also, there is the problem of maintenance even for areas where latrines can be built. At least in the areas worst hit, mobile latrines on a payment basis can be introduced. Government and Municipal Corporation should take initiatives for mobile latrines in kutcha slums in Mumbai.

We have also found that inability to breast feed for the required duration is one of the important antecedents of urban malnutrition. Legislation should be passed of making it mandatory for informal sector employers to provide crèches where mothers can carry young children who need breastfeeding to work. A mechanism will have to be put in place to ensure compliance. This can be best ensured with the help of the local community workers and NGO's.

Conclusion

Mother's health is so critical to the nutritional outcome of the children; serious steps will have to be taken to improve the health of adult women. A good solution will supplement special efforts like the ICDS with a significant improvement in the overall health and infrastructure facilities. Finally, we have found that incomes are a critical variable. The existence of a good system of primary and secondary schooling is a must; this is what will enable people to translate latent abilities into incomes. A policy needs to be adapted to providing housing for the urban poor. Currently, demolitions are one of the largest threats to the stability of incomes of the poor. Insecurity of housing leads to poor educational, health and financial outcomes. Demolitions should be resorted to as the last resort; the state seriously needs to be thinking in terms of providing affordable housing to the poor. One of the major hurdles in this is the failure of the financial markets; the poor cannot access housing credit because of pervasive problems of information and uncertainty. Some viable solution needs to be worked out if we have to take long term steps towards eradicating malnutrition.

All this is possible only if the administration and activists seriously take account of the existence of a high incidence of malnutrition among urban children. As of now, the focus is entirely on rural areas. Policies that will prove most efficient at combating malnutrition will have to be context specific. Policy interventions designed to work in rural areas might not work in urban areas. Hence, policies will have to be redesigned from the roots up, with the help of community organizations, existing ICDS expe-

rience as well as bureaucracy in order to make them more suitable in urban environment. Also, these policies will require inter-departmental coordination on several fronts. Health, education, shelter and other policies cannot be operated in isolation. There is need of more investment in water supply and sanitation. The economic growth should get equal distribution of resources otherwise many more children will continously die in city due to malnutrition. A financial capital of country should not report deaths due to malnutrition.

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