The Great Escape From India's Malnutrition Enigma Among High Risk Tribal of Melghat (India)

KEYWORDS

Balu Mote	Geeta Deshmukh	Ashish Satav
(MPH-SE) Tata Institute of Social Sciences (TISS) Mumbai	(MPH-SE) Tata Institute of Social Sciences (TISS) Mumbai & Operational Research (GVKEMRI)	Director (Mahan Trust)

ABSTRACT *Objective of study: To identify the predictors of maternal, child and household sanitation – environmental for status of well-nourished child among tribal of Melghat (India)*

Design: Quantitative cross sectional study using questionnaire of maternal, child and household sanitation-environmental practices.

Setting: Ten villages from the Dharani block of Melghat (India).

Subject: Fifty one mother of malnourished and fifty one mother of well-nourished child

Result: Among maternal factors availability of social support in pregnancy (p<0.05), ANC visit more than two (p<0.05) and education received during pregnancy (p<0.05) associated with well-nourished child. Among child related predictors, Birth weight (p<0.005), active feeding to child (p<0.005), psychosocial care (p<0.05) and interaction between family members and child (p<0.05) found related to well-nourished status of child. Among household sanitation-environmental factors, presence of Hygienic practices (p<0.001), animal entry in house (p<0.05), protected source of water (p<0.05) and location of kitchen (p<0.05) found associated with health status of child. After incorporating all these significant factors in a logit model then, One maternal factor; ANC visit with (p<0.05), two from child related predictors birth weight with (p<0.005) and active feeding with (p<0.05) and one from household sanitation –environmental factors - protected source of water with (p<0.05) found significant predictors for well-nourished health status of child.

Conclusion: Eventually it is active feeding to child, birth weight (more than 2500Kg), at least two ANC visit in pregnancy, education received in pregnancy (alert mother) and availability of protected source of water found lend a hand for making escape of child from high risk malnourished environment of tribal part of Melghat (India).

Introduction:

'Malnutrition enigma' in South Asian countries is refers to high rates of undernutrition (low weight for Age) among children below the age of five as compared to underdeveloped Sub-Saharan African countries.[1] Phenomenon of enigma is ascribed to 'low status of women' in these countries. Low status of women leads to female infanticide, ignorance to care of adolescent girl, low female literacy, early marriages, early pregnancy, and giving birth to low birth weight child (LBW) forming linkages to complicated causal cycle of malnutrition. [2] India today is facing challenges of double burden of diseases; on one hand India is facing burden of morbidity and mortality of maternal child diseases and communicable diseases sometimes termed as 'Diseases of poverty' and on other hand non-communicable diseases like diabetes, hypertension, heart diseases and mental health diseases sometimes termed as 'Diseases of changed Life style' is indicating unequal distribution of health and wealth in the country. [3]

Proportion of malnutrition in India and Bangladesh are higher than poorest countries of sub-Saharan Africa. [1] Even within India, according to economic survey of India year 2011 – 12, status of child varies from high IMR (infant mortality rate-death of child below the age of one year per thousand live births) states like Uttar Pradesh (61), Madhya Pradesh (62), and Bihar (61); to medium IMR states like Gujarat (44), Himachal Pradesh (40); and low IMR states like Kerala (13), Tamil Nadu (24), Goa (10) and Maharashtra (28). Despite low IMR of 28 in Maharashtra, prevalence of malnutrition (weight for age) is 46.3 percentage with cases of Severe Acute Malnutrition (SAM) (19.1%) is unacceptable in Maharashtra.[4, 5 – 6] Five tribal districts

out of 35 such as Amravati, Gadchiroli, Nandurbar, Nasik and Thane accounts for one third of severely acute malnourished children (SAM) in the state. Here hilly tribal area like Gadchiroli, Melghat and Nandurbar adds more burden of undernutrition in Maharashtra. In this area, low-status of women is leading to early marriages (mean age of marriage in this region below 21 years), Ante Natal Care (ANC) visit (full ANC care less than 38%), institutional deliveries (less than 65%), and home delivery (more than 36%) which lead to high rates of malnutrition. [4 - 6]

Melghat is situated in the heart of India and is tribal part of Amravati district comprises Dharani and Chikhaldara. With tiger reserve forest centre Melghat is also home for malnutrition in the Maharashtra state. Recent study published by MAHAN trust (Dharani) showed surprising high prevalence of severely or moderately undernourished children of 76.59%, indicating failure of state government policies for the maternal and child health of tribal people.[25] According to NRHM PIP report 2012, in Dharani, number of children in Severe Acute Malnutrition (SAM) and Moderately Acute Malnutrition (MAM) were 1154 and 2228 respectively. Despite living in the same environment, where most of children are affecting to various diseases, more than 70 % of children below the age of five are malnourished and most of children are dying to interaction of malnutrition with pneumonia and diarrhoea, how very few of children are not affected by morbidity and mortality indeed staying healthy and well-nourished. Question arises in mind, how remaining 30 % of children remains healthy and well-nourished despite leaving in same environment? What is modifier of their health status in area of Melghat?

Aim of study:

Aim of study is to understand how very few (remaining 30%) of those children are able to maintain their good health status and survive or escaped from high risk of susceptible environment of morbidity and mortality. Focus of study is to identify those positive determinants of mother and child related variables which helped well-nourished child to make escape from susceptible environment of malnutrition. Number of factors determining health of child divided into three main categories viz. Proximate (immediate), intermediate (underlying) and ultimate (socio-cultural) factors. These factors further classified as 'maternal factors (12 studied)', 'child factors (12 studied) and 'household environmental and sanitation factors' (4 studied)'.

Method:

Cross-sectional quantitative study using structured questionnaire were used. 51 mother of malnourished (SAM and MAM) child and 51 mothers of well-nourished child were selected from 10 villages of Dharani randomly. Within villages systematic random sampling done with the help of list provided by Anganwadi workers, total of 102 interviews in ten villages were conducted. In one village 12 (instead of 10) interviews conducted for additional or adjusting withdrawal of study. Mother of Malnourished child selected from the same village from where the mother of well-nourished child selected to minimise the effect of confounding.

Operational definition:

Mothers – Refers to Women having Mal-nourished and Well-nourished child. Consent of mother taken before starting the interview.

Criteria for identifying well-nourished child
Exclusion criteria:

1. Big baby losing weight now
2. Child of scavenging background
3. Child first born or receiving special care
4. Having malnourished sibling
5. Low birth weight enrolled in supplementary feeding

Criteria of selection malnourished child:

Underweight was defined as weight for age using WHO standardized Z scores criteria. Underweight consist of three category; Mild (<1SD to >2SD), Moderate (<2SD to >3SD) and Severe (≥ 3SD) using ICDS card [34] for identifying the malnutrition grade in children.

Statistical Analysis:

Analysis of the effects of demographic and socioeconomic variables on the status of child malnutrition is multivariate and employs multiple logistic regression models. The response (or dependent) variable in each model is a dummy (two-category) variable that simply indicates whether a child is malnourished or well-nourished. Twenty eight predictor variables are used in the analysis. All predictor variables are categorical. These twenty eight predictor variables are further grouped into three category; twelve maternal factors, twelve child care and feeding related practices and four environmental hygiene related practices. All these predictor variables are categorical. [7]

Maternal predictor variables are Educational status of mother (Less than primary education, Above primary education); Change in diet during pregnancy (Added some kind of supplementary diet (Yes, No); ANC visit (Less than two ANC visit, More than two visit); Education status of mother during the period of pregnancy (Received education from health workers, Not received education from health workers); Social support to mother (Received support from ANM, Arogyadoot, Angawadi workers, and ASHA workers during the period of pregnancy, Not received any support from these health workers); Age at first pregnancy (Less than 18, Above 18); Age at marriage (Less than 18, Above 18); Parity history of mother (Less than three, More than three); Gravida history of mother (Less than two, More than two); Mother's knowledge of family planning (Present, Absent); Husbands education (Literate, Illiterate); Mothers substance abuse practices such as use of tobacco, alcohol or charcoal present (Present, Absent); [7]

Child care related predictors are Status of immunization (Given, Not given); Hygienic behaviour like nail cutting practices etc. (Present, Absent); Weight of child at birth (Less than 2500gm, More than 2500gm); Morbidity of child in prior to three months of interview e.g. illness fever, diarrheal, cough, cold etc. (Present, Absent); Treatment seeking behaviour (Institutional treatment, Other than institutional); Complementary feeding practices (Started before nine months, After nine months); Frequency of milk feeding practices (Less than four times a day, More than 4 times a day); Feeding practices (Active feeding, Passive feeding); Psychosocial care given by mother or family member at the time of feeding (Yes, No); Availability of anganwadi diet (Yes, No); Weaning practices (In 6 to 10 months, above 10 to 12 months); There is always interaction between child and family members (Yes, No). [7] Environmental or sanitation related factors are Location of kitchen or Chula (Within the house, Separate room for Chula or Kitchen); Do animal come inside the house frequently (Yes, No); Source of drinking water (Protected, Unprotected); Personal hygienic practices like regular hair cutting, bathing etc (Present, Absent). Apart from this perceived susceptibility of mother regarding various diseases, family eating practices, place of delivery and blade used for cord cutting were there. Analysis of these factors excluded as response were not given or not known for these variables. Neither these factors were found significant in binary analysis so excluded in multiple logistic regression. [7 & 28]

All these factors; twelve maternal, twelve child health related and four environmental related factors were analysed in three levels. Three groups individually analysed first for chi-square (bivariate) followed by logit regression (multivariate). Significant factors from each group again put together for final logit model for discarding effect of confounding.

Results:
Maternal factors affecting health status of child:
Bivariate analysis of maternal factors (Chi-square test and phi-test) (see table no.1)

All the selected predictor variables except (age at marriage and initiation of breast feeding) were found to be significantly associated with status of child health. (Table No.1 – Chi-square test), Phi-test also applied to know the strength and direction of association. Among these factors, availability of social support from various health workers, ANC visit of mother, changed diet (added some kind of extra food) and education received in pregnancy found to highly significant (P-value <0.001) to health status of child. These factors are negatively associated with the malnourished status of child indicating inverse relationship between attributes. Education of father, education of mother are moderately associated (p-value <0.05 and phi-test 0.302 and 0.277) and inversely related. Age of mother (<18 years), Gravid and parity history of mother (less than 2 and 3times

respectively) are moderately associated (P-value <0.05) and showed inverse association between the attributes indicating as number of birth to mother decreases, chances of child being well-nourish increases and vice versa. Age at first pregnancy less than 18 years is significantly associated (P-value <0.05) and showed positive moderate relationship (phi-test 0.287) indicating as age at first pregnancy decreases (less than 18 years) then chances of child being malnourished increases and vice-versa. Melghat is tribal (comprising Goud, Korku and Bhilala tribes) area and marriages at early age is common cultural practices giving high rates of fertility and subsequently burden of high malnutrition. [8 – 10]

Multiple logistic analysis of maternal factors (see table no.2)
To minimise the effects of confounding among maternal factors, Model of multiple logistic regression created by incorporating ten significant factors (from table no.1) to know the ultimate factors affecting health status of child. Table no.2 showed that after incorporating all significant factors into the model, only three among ten found to be significantly associated with child health status. Availability of social support, ANC visit (more than 2 visit) and education received in pregnancy found significantly associated (P-value <0.05) to health status of child. [19, 22, 25] Odds of availability of social support is 8.649 (with C.I. 1.80 – 40.22) indicating positive association between well-nourished child and social support. If social support to mother increases by one unit then child status being well-nourish increases by eight times. Odd of ANC (less than 2 visits to well-nourished child) is 0.144 and showed inversely associated. (i.e. 1- 0.144 = 0.856) means, less number of ANC visit increases the chances of child being malnourished. [11] Education of mother (literate mother) found to be insignificant, Indeed education received in pregnancy significantly associated (P-value <0.05) with health status of child and odds of significance is 5.88 (with C.I. 1.44 – 24.03) indicating increase in education in pregnancy by one unit child being well-nourishe increases by 5.88 nearly by six times. Table no. 1 Bivariate analysis showed it is educated mother who is associated with positive health status of child. [12] Indeed multivariate analysis showed that it not only the education but education received in pregnancy is positively associated with well-nourished child. Here it is also proven that those non-educated mother lost the chance of being 'educated mother' but win the race of being 'Alert mother' during the pregnancy.

Child related determinants of health: (See table no.3)
Bivariate analysis of Child related factors (Chi-square test and phi-test) (see table no.3)
Total of twelve factors related to actual feeding, care and treatment seeking behaviour of child were analysed. Birth weight as a principle factor also analysed with health status of child. General care (psychosocial care, interaction of family member with child), feeding related factors such as initiation of breast feed, frequency of milk feeding, weaning practices, food practices of child (complementary food and food above twelve month) and overall active or passive feeding were analysed. Availability of Anganwadi diet (Government big food policy of child) is also analysed. Of these twelve factors, total of eight factors were significantly associated with health status of child. Table No. 3 shows, of these eight factors, four factors viz. weight of child, starting period of complementary food, active feeding, psychosocial care by mother or family member and interaction of family member to child found strongly (P<0.001) associated with health status of child. [23] Weight of birth

(<2500) found positively associated (Phi-test +ve sign) with malnourished child and all other factors such as active feeding, interaction of family member with child, starting period of complementary food, psychosocial care were showing inverse relation between the dependent and independent variables. Morbidity was also showing strong association but frequency in one of the cell is four so could not be considered as a valid. Other three factors viz. Types of food practices above twelve month, frequency of milk feeding to child, and treatment seeking behaviour of child were found moderately associated (chi-test p-value <0.05) with child health status. Weaning period immediate/after 2 or more days and availability of Angawadi diet were found insignificant. [13& 32]

Multiple logistic analysis of Child related factors (see table no.4)
To check sustainability in significance all above factors incorporated into multiple logistic regression. Among those, Table no.4 shows, birth weight of child, Active feeding, psychosocial care and interaction between of family member with child found significant to health status of child. Birth weight and active feeding found strongly associated (p-value = 0.001) with health status of child whereas psychosocial care, interaction of family member were moderately associated (p-value<0.05) health status of child. An odd of birth weight was 0.020 (with C.I. 0.002 – 0.189) and showing inverse relation with well-nourished child i.e. (1-0.020 = 0.98) means as birth weight of child fall below 2500 gm then chances of status of child being well-nourished decreases by 0.98 times. In other words, birth weight >2500gm positively associated with well-nourished child. Odds of active feeding, psychosocial care and interaction family member with child were 23.98 (with C.I. 3.44 – 167.19), 8.29 (With C.I. 1.38 – 49.56) and 18.28 (2.07 – 161.40) respectively and positively associated with dependent variable. [14 - 15] Means active feeding, psychosocial care and interaction with child increased by one unit then chances of child being well-nourished increases by 24 times, eight times and 18 times respectively. [16] Here, other factors viz. Availability of Anganwadi diet were not found significant with well-nourished status of child indicating failure of maternal and child health policies for tribal area. Those policies are failing to resolve the high rates of undernutrition.

Bivariate & Multiple logistic regression analysis of Household environment and sanitation factors affecting health status of child (see table no.5 & 6)
All four factors of household environment viz. Location of kitchen or Chula (made from soil for cooking purpose mostly used in rural and tribal area), source of water, and hygienic practices of child such hand washing, nail cutting, hair cutting etc. found significantly associated with health status of child. (See table no.5). Among these, location of kitchen (Chula) and hygienic practices were strongly (p-value≤0.001) associated with health status of child. After incorporating in Model of multiple logistic all factors remain significant (See table no.6). Hygienic practices were found strongly (p-value <0.0001) associated with well-nourished child. Odds of hygienic practices is 9.67 indicating unit change in hygienic practices will increases the chances of child being well nourished by 9.7 times nearly 10 times. [30] Odds of animals comes inside the house (YES), location of kitchen (within house) and source of water (protected) were 0.171, 3.87 and 0.20, and coefficient for animal come inside house (YES) and location of Chula (within) showed inverse relation while protected source of water showed positive relationship with malnourished as a status of

child. Odds of protected source of water to well-nourished child is 3.8 (with C.I. 1.3 - 11.29) indicating unit change protected water as a source, chances of child being well nourished increases by 3.9 times (nearly 4 times). Hygienic practices and clean water positively associated with nutritional status of child. [17]

Overall significance: Logit model of all significant factors (see table no.7)
Further minimising the effects of confounding, all significant factors were incorporated in model of logistic regression to see the ultimate impacting factors associated with nutritional status of child. Three maternal factors viz. Availability of social support, ANC visit, and education received in pregnancy. Child related significant factors such as Birth weight, feeding (active/passive), psychosocial care and interaction between family members. All four environmental factors were put in model for ultimate association of significance.

Table no. 7 showed, among eleven significant factors, only four factors remained as a significant; one from maternal related factor i.e. ANC visit, two from child related factors i.e. Birth weight and active feeding and one from household environment factors such as protected source of water. Among maternal factors, ANC visit had shown significant (P-value – 0.021) and showed inverse relationship with the well-nourished health status of child. Means if ANC visit of mother increases by more than two, chances of child being well-nourish increases by 16 times [19, 22, and 27]. Strong positive relationship between active feeding and well nourish as a status of child (P-value – 0.006) was seen, odds of active feeding is 23.97 (with C.I. 2.48 – 231.49) indicating chances of baby being well-nourish increases by 23.97 (nearly 24) times if baby is provided active feeding.[23] Birth weight is also found (p-value 0.002) significant. Odds of birth weight is 0.020 and showed inverse relationship with well nourish status of child.Among household sanitation and environmental factors, protected source of water found to be significantly (P-value – 0.018) impacting health status of child. odds of source of water to well-nourish as a status of child is 21.22 indicating as people start drinking water from protected source, then their child being well-nourish increases by 21.22 times. i.e. unit increasing in clean/pure source of water (protected water source), will changes the status of child being well nourish by 21 times. [18 - 19] Ultimately there is need of integrated approach for the care of child. Birth weight as a universal factors remain significant in Melghat region too. Active feeding is new factor discovered for the tribal people which helping child being well-nourished. ANC visit is only maternal factor found remain significant indicating relation between maternal care and status of child. Source of water as per literature review across the world found significant in Melghat region too, indicating importance and relation between source of water and health status of child.

Discussion:
Melghat, is a tribal, hilly and densely forest corner in the north-eastern fringes of India's richest state-Maharashtra, is an example of almost everything that has gone wrong in India's response to malnutrition and child deaths of tribal population. Almost three children out of four facing problem of undernutrition. Focus of our study is on those families having well-nourished children. Finding those maternal, child and environmental predictors which facilitate very few children to make escape from very highly graveyard type and susceptible environment of child undernutrition, morbidity and mortality. [25]

One of the universal factors, education was found significantly associated with the health status of mother and child. In this study among maternal predictors, it is not the academic education rather it is education received during pregnancy, was found significantly associated with well-nourish as a status if child (see table no.2). It proves that it is not the 'educated mother' instead it is the 'alert mother' having positive impact on health status of child. It also highlights the importance of 'capacity building' work done by community health workers. When significant maternal factors (from table 2) incorporated with other significant factors of child (from table 4) and environmental factors (from table 6) then eventually it is the ANC visit found significantly affecting the health status of child (see in table no.7). ANC visit emerged as a significant factor impacting health status of child indicating need of intervention in ante-natal care of mother. Most of the Indian women are anaemic and ignorant about their health (received full ANC coverage 18.8%) [20 - 21] indicating poor ANC compliance in Indian women. As ANC visit increases, chances of mother being underweight decreases which enhances the chances of child being well-nourish (Osmani & Sen 2003; Lancet series). Multiple micronutrients to mother during the period of pregnancy will help to reduce the maternal anaemia helping for the child being born with normal weight. [33]

Low birth weight (LBW) among children associated with underweight in pregnant women imposing question of nutritional status of women. [22] LBW mainly reflects intrauterine growth retardation (IUGR) condition of child. IUGR of child in pregnancy is outcome of short maternal stature, low pre-pregnancy body mass index and low gestational weight gain indicating overall picture of low status of women in India.Low social status of women coupled with low health is major factor contributing poor health status of child compared to children of other countries. [1,31] Study done by IIPS argued that measurement criteria of WHO – UNICEF may not be fit for Indian children as Indian children are genetically shorter than the children of other countries and malnutrition in Indian children is myth. But research done for standardization of weight and height were shown that there is no such finding indicating malnutrition in children is a myth, indeed it is reality. It is the poor social status of Indian women contributing poor health status of children. [28] Finding of Melghat research also indicates poor health status of women coupled with rigid cultural practices of tribal people eventually impacting the health status of child. Rigid cultural practices such as low literacy of women, early marriages coupled with behavioural factors such as not initiation of early breast, liquor practices, not attending ANC and PNC visit leads to poor health status of children in tribal of Melghat.

Of child related twelve factors only four factors found significant in logistic regression (see table no.4). When child related significant factors (from table no.4) incorporated into the logit model with other maternal (from table 2) and environmental factors (from table 6), then ultimately it is the 'birth weight' and 'type of feeding' were found to be significant (see in table no.7).Birth weight more than 2500 gm and active feeding were found significant. Strong strength of association of birth weight and active feeding with the well-nourish as a status of child (p-value 0.002 and p-value 0.006 respectively) suggesting importance of birth weight and active feeding. Birth weight < 2.5 Kg (LBW) emerged as significant predictor of Malnutrition in Melghat. (See table no.7) LBW can be used proxy indica-

tors for the low health status of women as said earlier and also for the health status of child. LBW is key indicator for explaining the vicious cycle of malnutrition and infectious diseases. LBW in child increases child's susceptibility for respiratory and diarrheal infection which eventually ends in child malnutrition. Other child related factors - active feeding consisting caring attitude of mother such as talking to the child, playing with child etc. stimulates the appetite of child. Giving separate plate for one to two years of child and motivating them for self-eating increases the appetite of child. Mother of healthy child (alert mother) found successfully implementing above all strategies on her child and encourage them for the eating food on time. So, active feeding and involvement of mother in the process emerged as a new significant factor in high risk Melghat region, which lend a hand for making escape from malnutrition.

In present study four household sanitation factors were studied and all of this found significant in bivariate and multivariate analysis (see table no.5 and 6). After incorporating all these with significant factors of maternal (from table no.2) and child (from table no.4) then only protected source of water found significantly associated with health status of child (see table no.7). Being tribal region mostly people drink water from river, small dams and unprotected well increasing susceptibility for the diarrhoeal diseases. Mostly children from Melghat were found susceptible for pneumonia, fever and diarrheal diseases. These triad of diseases forms the complicated cycle of malnutrition. Country like India where fifty percentages of population involve in open defecation practices, the question of water sanitation and clean environment unanswered, which eventually end with adding burden of communicable diseases. Government program 2014, 'Swatch Bharat Abhiyan' (making India clean by 2019 on the 150 anniversary of Mahatma Gandhi to fulfil the Gandhi's Vision for clean India) will help to decrease morbidity and mortality induced by communicable disease. Perhaps, study conducted in the state of Orissa by Lancet and supported by Bill and Melinda gates Foundation showed that there is no relation between number latrines and decreased incidence of diarrheal diseases. [30] Author could not explain the reason behind the outcome but at the end they showed that it is the awareness regarding various behavioural factors such as 'compliance of toilet practices', 'hand washing' and 'using of water' impacting the outcome of healthy environment. In this study, 'Hand washing' were found strongly associated with the healthy and well-nourished child (see table no.5 & 6) in bivariate and multivariate analysis as well. When compared with other factors such as child and maternal factors, it is only the protected source of water found significantly associated with the health status of child. (See table no.7) Though, study identifies maternal, child and environmental positive predictor of nutritional status, low sample size is one of the drawbacks of our study. Further study of same factors with large sample size is essential for identification of significant factors for effective intervention.

Table No. 1 Maternal Determinants of child health status (Bivariate analysis)

Name of variable		Dependent variable (Child status) (column percentage)		Chi-square test & Association	Phi-test & Association	Risk ratio
Independent	Attribute	Malnourished	Well-Nourished			
Social support of health workers	Available	20 (39.2%)	43 (84.3%)	21.96 P-value < 0.001	-0.464 P-value < 0.001	0.120
	Not available	31(60.8%)	08 (15.7%)			
Father education	Educated	31 (60.8%)	36 (87.8%)	8.38 P-value<0.05	-0.302 P-value<0.05	0.215
	Illiterate	20 (39.2%)	05 (12.2%)			
Mothers education	Less than primary	06 (11.8%)	18 (35.3%)	7.84 P-value<0.05	-0.277 P-value<0.05	0.244
	Higher than primary	45 (88.2%)	33 (64.7%)			
Age at marriage of mother	Less than 18	39 (76.5%)	31 (60.8%)	2.91 P – 0.88 Non-significant	0.169 P – 0.88 Non-significant	2.097
	Above 18	12 (23.5%)	20 (39.2%)			
Age at first pregnancy	Less than 18	25 (49.0%)	11 (21.6%)	8.41 P-value <0.05	0.287 P-value <0.05	3.49
	Above 18	26 (51.0%)	40 (78.4%)			
Gravida history of mother	Less than 2 times	21 (41.2%)	33 (64.7%)	5.66 P-value <0.05	-0.236 P-value <0.05	0.382
	More than 2 times	30 (58.8%)	18 (35.3)			
Knowledge of family planning	Yes	39 (76.5%)	28 (54.9%)	5.26 P-value<0.05	0.227 P-value<0.05	2.67
	No	12 (23.5%)	23 (45.1%)			
Parity history of mother	Less than 3	34 (66.7%)	45 (88.2%)	6.79 P-value<0.05	-0.258 P-value<0.05	0.267
	More than 3	17 (33.3%)	06 (11.8%)			
ANC visit	Less than 2 visit	32 (62.7%)	14 (27.5%)	12.82 P-value<0.001	0.355 P-value<0.001	4.45
	More than 2 visit	19 (37.3%)	37 (72.5%)			

Change in diet of mother in pregnancy	Yes	15 (29.4%)	34 (66.7%)	14.17 P-value<0.001	-0.373 P-value<0.001	0.208
	No	36 (70.6%)	17 (33.3%)			
Education received in pregnancy	Yes	17 (33.3%)	38 (74.5%)	17.40 P-value<0.001	-0.413 P-value<0.001	0.171
	No	34 (66.7%)	13 (25.5%)			
Substance abuse practices	Yes	42 (55.3%)	34 (44.7%)	3.3 P > 0.05 Non-significant	0.180 P > 0.05 Non-significant	2.333
	No	09 (34.6%)	43 (65.4%)			

Note: ** Indicates significant level at P value < 0.05 *** indicates significance at P< 0.005 & **** indicates significance at P< 0.001

Table No. 2. Maternal Determinants of Well-nourished Child in Melghat region shown by Multiple logistic regression(Malnourished used as reference category)

Co-variable	B	Std. Error	P-value	Exp(B) with 95 % C.I.
Coefficient	-1.441	1.445	0.319	
Social support in pregnancy(Not-available as a reference)				
Available	2.157	0.784	.006**	8.649 (1.860 – 40.227)
Education of father (Illiterate as a reference category)				
Educated	0.388	0.868	.655	1.474 (0.269 – 8.082)
Education of Mother (Higher than primary used as a reference category)				
Completed at least primary level	1.048	0.856	0.221	2.853 (0.533 – 15. 269)
Ageat marriage of mother (above 18 as a reference category)				
Less than 18 years	.631	0.746	0.397	1.880 (0.436 – 8.110)
Age at first pregnancy of mother (above 18 as reference category)				
Less than 18 years	-1.287	0.780	0.099	0.276 (0.060 – 1.273)
Gravid history of mother (more than 2 times as a reference category)				
Less than 2 times	0.520	0.795	0.513	1.683(0.354 – 7.998)
Parity history of mother (more than 3 times as a reference category)				
Less than 3 times	0.592	1.082	0.584	1.808 (0.217 – 15.073)
Knowledge of family planning (NO as a reference category)				
Yes	-1.389	0.732	0.058	0.249 (0.059 – 1.048)
ANC visit (more than 2 visit as reference category)				
Less than 2 visit	-1.935	0.722	0.007**	.144 (0.035 – 0.594)
Change in diet during pregnancy (No as reference category)				
Yes	.314	0.648	0.628	1.369 (0.384 – 4.875)
Education received during the pregnancy (No as reference category)				
Yes	1.773	0.718	0.014**	5.886 (1.442 – 24.034)
Substance abuse practices of mother (No as reference category)				
Yes	-1.199	0.791	0.130	0.302 (0.64 – 1.421)

Note: ** Indicates significant level at P value < 0.05 *** indicates significance at P< 0.005 & **** indicates significance at P< 0.001

Table No. 3 – Child-related determinants of child health status (Bivariate analysis)

Name of variable		Dependent variable(Child status) (Column percentage)		Chi-square test & Association	Phi-test & Association	Risk ratio
Independent	Attribute	Malnourished	Well-Nourished			
Types of food practices after 12 months	All types	11 (21.6%)	23 (45.1%)	6.35 P-value < 0.05	-0.250 P-value < 0.05	0.335
	Selected	40 (78.4%)	28 (54.9%)			
Weight at Birth (gm)	Below 2500	41 (80.4%)	13 (25.5%)	30.852 P-value < 0.001	0.550 P-value < 0.001	11.98
	Above 2500	10 (19.6%)	38 (74.5%)			

Name of variable		Dependent variable(Child status) (Column percentage)		Chi-square test & Association	Phi-test & Association	Risk ratio
Independent	Attribute	Malnourished	Well-Nourished			
(Morbidity) Diseases in last three month prior to interview	Yes	47 (92.2%)	33 (64.7%)	11.35 P-value = 0.001	0.334 P-value = 0.001	6.40
	No	04 (7.8%)	18 (35.3%)			
Complementary feeding started	Before 9 months	31 (60.8%)	45 (88.2%)	10.11 P-value = 0.001	-0.315 P-value = 0.001	0.207
	After 9 months	20 (39.2%)	06 (11.8%)			
Feeding	Active	16 (31.4%)	41 (80.4%)	24.85 P-value < 0.001	-0.494 P-value < 0.001	0.111
	Passive	35 (68.6%)	10 (19.6%)			
Psychosocial care by mother/family while feeding	Yes	17 (33.3%)	39 (76.5%)	19.16 P-value < 0.001	-0.433 P-value < 0.001	0.154
	No	34 (66.7%)	12 (23.5%)			
Availability of Anganwadi diet	Yes	38 (74.5%)	32 (62.7%)	1.63 P-value > 0.05 Non-significant	0.127 P-value > 0.05 Non-significant	1.7
	No	13 (25.5)	19 (37.3%)			
Always interaction between child and family member	Yes	19 (37.3%)	38 (74.5%)	14.35 P-value < 0.001	-0.375 P-value < 0.001	0.203
	No	32 (62.7%)	13 (25.5%)			
Initiation of breast feeding	Immediate	42 (82.4%)	43 (84.3%)	0.071 P-value > 0.05 Non-significant	-0.026 P-value > 0.05 Non-significant	0.868
	After 2 or more days	09 (17.6%)	08 (15.7%)			
Milk feeding practices per day	5 times a day or less	14 (27.5%)	5 (9.8%)	5.23 P-value<0.05	0.227 P-value<0.05	3.48
	More than 5 times	37 (72.5%)	46 (90.2%)			
Treatment seeking behaviour	Non-Institutional	11 (21.6%)	04 (7.8 %)	3.83 P-value = 0.05	0.194 P-value = 0.05	3.23
	Institutional	40 (78.4%)	47 (92.2%)			
Weaning period	6-10 months	27 (52.9%)	25 (49.0)	0.157 P-value > 0.05 Non-significant	0.039 P-value > 0.05 Non-significant	1.17
	Above 10 months	24 (47.1%)	26 (51.0%)			

Table no.4 - Child related determinants of Well-nourished Child in Melghat region shown by Multiple logistic regression (Malnourished used as reference category)

Co-variable	B	Std. Error	P-value	Exp(B) with 95% C.I.
interception	-1.1859	1.421		
Birth weight (gm) (>2500 as a reference category)				
< 2500	-3.892	1.134	0.001***	0.020 (0.002 – 0.189)
Anganwadi diet (No as a reference category)				
Yes	-0.482	0.895	0.098	0.227 (0.039 – 1.313)
Type of food practices above 12 years (Selected food as a reference category)				
All types	-2.499	1.279	0.051	0.82 (0.007 – 1.007)
Morbidity to child (no as a reference category)				
Yes	1.798	0.954	0.059	6.039 (0.931 – 39.184)
Initiation of breast feed (after 2 or more days as a reference category)				
Immediate	-0.334	1.145	0.771	0.716 (0.76 – 6.76)
Complementary feeding (after 9 months as a reference category)				
Before 9 months	1.943	1.326	0.143	6.98 (0.519 – 93.83)
Milk feeding > 5 times a day as a reference category				
< 5 times a day	-2.954	1.331	0.27	0.052 (0.004 – 0.709)
Feeding (passive as areference category)				
Active	3.177	0.991	0.001***	23.985 (3.44 – 167.19)
Psychosocial care (No as a reference category)				
Yes	2.116	0.912	0.020**	8.299 (1.38 – 49.56)
Interaction between family members and a child (No as a reference category)				
Yes	2.906	1.111	0.009**	18.28 (2.07 – 161.40)
Treatment seeking (Institutional as a reference category)				
Non-institutional	-0.948	1.064	0.373	0.387 (0.048 – 3.118)
Weaning practices (above 10 months as a reference category)				
6-10 months	-0.159	1.158	0.891	0.853 (0.088 – 8.264)

Table no. 5 Bivariate analysis of household and sanitation factors

Name of variable		Dependent variable(Child status) (Row percentage)		Chi-square test & Association	Phi-test & Association	Risk ratio
Independent	Attribute	Malnourished	Well-Nourished			
Location of kitchen or Chulha	Within the house	46 (90.2%)	31 (60.8%)	11.92 P-value = 0.001	0.342 P-value = 0.001	5.93
	Separate room	5 (9.8%)	20 (39.2%)			
Do animal come inside house	Yes	15 (29.4%)	6 (11.8%)	4.85 P-value <0.05	0.218 P-value = 0.001	3.12
	No	36 (70.6%)	45 (88.2%)			
Source of water for household	Protected	23 (45.1%)	33 (64.7%)	3.96 P-value <0.05	-0.197 P-value <0.05	0.448
	Unprotected	28 (54.9%)	18 (35.3%)			
Hygienic practices e.g. hair cutting, hand washing etc.	Yes	10 (19.65)	36 (70.6%)	26.76 P-value < 0.001	-0.512 P-value < 0.001	0.102
	No	41 (80.4%)	15 (29.4%)			

Table no. 6 – household environment and water sanitation related determinants of Well-nourished Child in Melghat region shown by Multiple logistic regression (Malnourished - as reference category)

Co-variable	B	Std. Error	P-value	Exp(B) with 95 % C.I.
Hygienic practices e.g. hair cutting, hand washing etc. (No as a reference category)				
Yes	2.269	.540	.000****	9.671 (3.359 – 27.847)
Do animal come inside house (No as a reference category)				
Yes	-1.765	.758	.020**	.171 (0.039 – 0.757)
Source of water for household (unprotected as reference category)				
Protected	1.354	.546	.013**	3.873 (1.328 – 11.298)
Location of kitchen or Chulha (separate kitchen as a reference category)				
Within the house	-1.586	.662	.017**	.205 (0.056 – 0.749)

*Note: ** Indicates significant level at P value < 0.05 *** indicates significance at P< 0.005 & **** indicates significance at P< 0.001*

Table No.7 Well-nourished Child in Melghat region shown by Multiple logistic regression (Malnourished used as reference category)

Co-variable	B	Std. Error	P-value	Exp(B) with 95 % C.I.
Intercept	-3.181	1.968	0.106	
Social support in pregnancy (Not-available as a reference)				
Available	1.837	1.344	0.172	6.277 (0.450 – 87.47)
Feeding (passive as a reference category)				
Active	3.177	1.157	**0.006****	23.976 (2.483 – 231.49)
Psychosocial care (No as a reference category)				
Yes	1.295	1.136	0.254	3.652 (0.394 – 33.84)
Interaction between family members and a child (No as a reference category)				
Yes	2.041	1.296	0.115	7.699 (0.607 – 97.65)
Hygienic practices e.g. hair cutting, hand washing etc. (No as a reference category)				
Yes	1.708	1.210	0.158	5.516 (0.515 – 59.04)
Do animal come inside house (No as a reference category)				
Yes	-2.377	1.445	0.100	.093 (0.005 – 1.577)
Location of kitchen or Chulha (separate kitchen as a reference category)				
Within the house	-1.168	1.135	0.303	.311 (0.034 – 2.87)
Source of water for household (unprotected as reference category)				

Co-variable	B	Std. Error	P-value	Exp(B) with 95 % C.I.
Protected	3.055	1.293	.018**	21.223(1.68 – 2.67)
ANC visit (more than 2 visit as reference category)				
Less than 2 visit	-2.800	1.213	0.021**	.061(0.006 – 0.65)
Birth weight (gm) (>2500 as a reference category)				
<2500	-3.912	1.245	0.002***	.020 (0.002 – 0.230)
Education received during the pregnancy (No as reference category)				
Yes	0.306	1.051	0.771	1.358 (0.173 – 10.66)

Note: ** Indicates significant level at P value < 0.05 *** indicates significance at P< 0.005 & **** indicates significance at P< 0.001

Figure 1 – Conceptual framework adapted from UNICEF 2013; WORLD BANK 2013 and theory of W.H.Mosley and L.C.Chan 1984
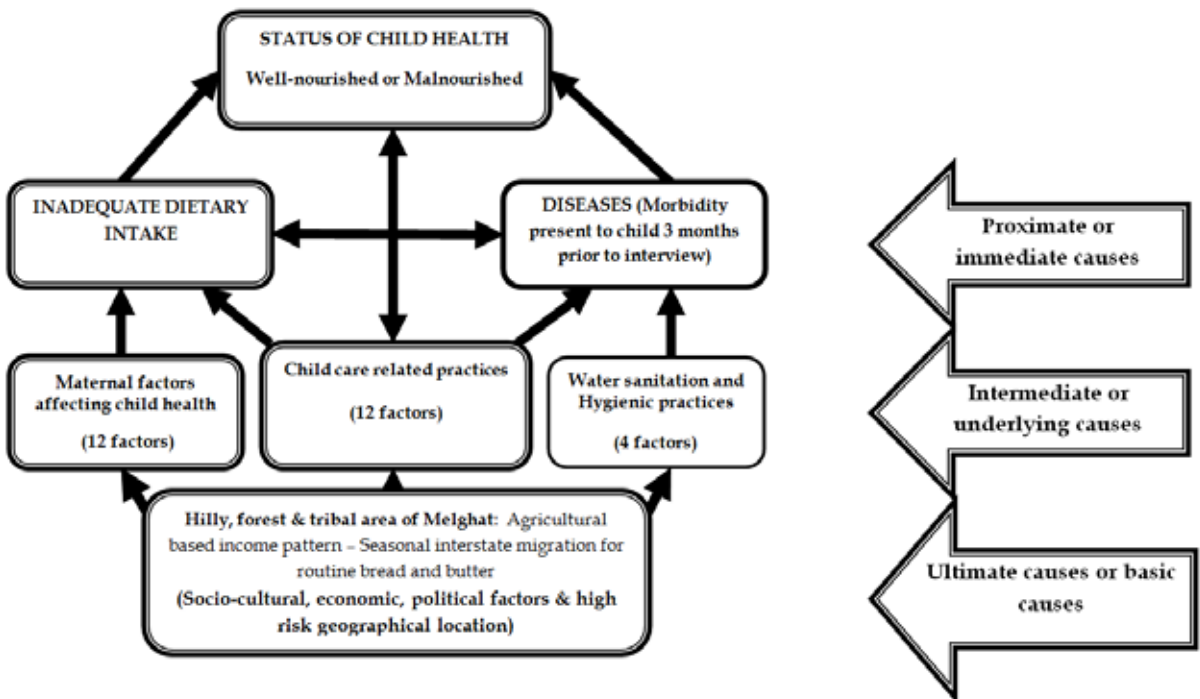
REFERENCE
1. Ramlingaswami V. Urban J. & Jon R. et al (1996) The Asian enigma (South Asian enigma) Indian Institute of Medical sciences | 2. Dreze J. & Sen A. (2014) An uncertain glory: India and its contradictionsPenguin book | 3. Deaton A. (2013) The great escape health, wealth and origins of inequalityPrinceton University Press Princeton and oxford | 4. National Nutritional Monitoring Bureau report (2012) | 5. Amravati Final report (2012) | 6. National Family Health Survey (NFHS-3), 2005–06: India: Volume I. Mumbai: IIPS. | 7. Mosely H & Chen L (1984) An Analytical Framework for the study of child survival in developing countries. Population and development review (10) 25 – 45 | 8. Godelieve M (2001) The determinants of infant mortality; how far are conceptual framework really modelled. Institute of demography UCL | 9. Nguyen T, Eriksson B & Petzoid M, et al.(2013) Factors affecting with physical growth of children during the first two years of life in rural area of Vietnam 13; 149. | 10. Fernandez I, Himes J & Onis M. et al.(2002) Prevalence of nutrition wasting in population; building explanatory models using secondary data. Bulletin of world health organization 80 (4) | 11. Rahman L, Miah Z & Biswas H, et al. (2013) Maternal Factors Causing Under-Nutrition among the under-Five Slum Children in Dhaka City. Dinajpur Med Col J Vol. 6 (1) pp 92-96. | 12. Islam M, Rahman M & Mahalanabis et al. (1994) Maternal and socioeconomic factors and the risk of severe malnutrition in a child: a case-control study 48 (6) pp 416 – 424. | 13. Mittal A, Singh J & Ahluwalia S K.et al. (2014) Effect of maternal factors on nutritional status of 1-5-year-old children in urban slum population. Indian J Community Med [serial online] 2007 [cited 2014 Oct 8]; 32:264-267. | 14. Salah E, Mahgoub M & Theodore B et al. (2006) Factors affecting prevalence of malnutrition among children under three years of age in Botswana.African Journal of Food Agriculture Nutrition and Development Vol 6, No. 1 | 15. Kebede M, Kassahun A and Bikes D et al. (2013) Prevalence of Malnutrition and Associated Factors Among Children Aged 6-59 Months at Hidabu Abote District, North Shewa, Oromia Regional State. Nutrtional Disorders & therapy Journal T1. | 16. Connor F, Tania S & Tahmeed A et al (2014) Factors Associated with Acute Malnutrition among Children Admitted to a Diarrhoea Treatment Facility in Bangladesh. International journal of Paediatrics. Hindawi Publishing Corporation Article ID 267806 pp 5. | 17. Kate S, Zeba M, & Azim A et al. (2008) The social and environmental factors underlying maternal Malnutrition in rural Bangladesh: Implication for reproductive health and Nutrition programs. Health care for women international Vol. 29 pp 826-840. | 18. Victor A (2009) A quantitative Analysis of determinants of child and maternal malnutrition in Nigeria. NSSP Background paper 10. | 19. Zulfiqar A Tahmeed A. &Robert E et al What works? Interventions for maternal and child undernutrition and survival (2012) Lancent journal of Maternal and child Nutrition study group. | 20. Svedberg P (2008) Why Malnutrition in shining India persists. NFHS 1/2/3. (11) 25. | 21. National Guidelines for Infants and young child feeding. (2004) Ministry of human resource development department of women and child development | 22. http://www.drishtant.com/stories-of-social-work-and-csr-in-india/entry/melghat-malnutrition-statistics | 23. Humgama report (2008) | 24. Unicef framework determinants of child health (1998) | 25. Dani V, Satav A & Pendarkar J. et al. (2014) Prevalence of under nutrition in under five tribal children of melghat; community based cross sectional study in central India. Clinical epidemiology and global health I – 8. | 26. Das S & Rahman R. (2011) Application of ordinal logistic regression analysis in determining risk factors of child malnutrition in Bangladesh. Nutritional Journal 10: 124. | 27. Desmissie S & Worku A (2013) Magnitude and factors associated with Malnutrition in children 6-59 months of age in pastoral community of Dollo Ado district, Somali region, Ethopia. Science journal of public health 1(4) 175-183. | 28. Mostafa K (2011) Sociao-economic determinants of severe and moderate stunting among under-five children of rural Bangladesh. Journal of nutrition 17 (1) 105-118. | 29. Bhavsar S, Hemant M & Kulkarni R et al. (2012) Maternal and environmental factors affecting the nutritional status of children in Mumbai urban slum. International journal of scientific and research publications (2) 2250-3153. | 30. Ahmed M. Billoo & Murtaza G et al. (2002) Risk factors of persistent diarrhoea in children below five years of age. Department of Paediatrics medicine, dow medical college and civil Hospital Karachi. 290-292. | 31. Haddad L. (2013), India's Malnutrition Enigma; why they must not be a distraction from action. Institute of development studies Sussex. | 32. Joshi H, Gupta R, & Joshi M et al. (2011) Determinants of nutritional status of school children: A cross sectional study in western region of Nepal. NJIRM Vol.2 (1). | 33. Abubakar A, Holding P & Mwangome1 M et al. (2011) Maternal perceptions of factors contributing to severe under-nutrition among children in a rural African setting. Rural and remote health Vol. 11: 1423. | 34. http://www.who.int/childgrowth/standards/en | 35. Economic survey of India statistical appendix (2011-2012) |