UNDERNUTRITION IN INDIA
Dimensions and Correlates

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the award of the degree of Doctor of Philosophy in Economics
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I hereby affirm that this thesis titled UNDERNUTRITION IN INDIA: DIMENSIONS AND CORRELATES, being submitted as part of the requirements for award of the degree of Doctor of Philosophy in Economics of the Jawaharlal Nehru University, was carried out entirely by myself. I also affirm that it was not part of any other programme of study and has not been submitted to any other University for the award of any Degree.

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Thiruvananthapuram
December, 2008

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Certified that this study is the bona fide work of Rudra Narayan Mishra, carried out under our supervision at the Centre for Development Studies.

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To.....

The Undernourished in India

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UNDERNUTRITION IN INDIA: DIMENSIONS AND CORRELATES

ABSTRACT

Undernutrition continues to be grim in India. Several studies have focused on poverty as a correlate of education. Studies from clinical background focus on the role of specific ailments or on particular micronutrients on the outcome of different forms of undernutrition. The present study differs from the exiting studies by focusing on intervention worthy correlates of undernutrition at the individual and household level. It argues some of the established correlates of undernutrition like poverty, social status of the household, occupation, place of residence and religion of the households are either fixed or very difficult to change within a given period of time. Most of the policy intervention related to nutrition and health have definite time frame to achieve certain goals. Given the resource constraint in a country like India, one needs to priorities among the variables, which are intervention worthy. For the purpose food-health-care framework of UNICEF is used.

The study analyses the issue of undernutrition at individual as well as household level. Because of data constraints, analysis of undernutrition at individual level is restricted to pre-school children and women of reproductive age. But these two groups are most vulnerable to undernutrition. While undernutrition at individual level is measured in terms of anthropometric indicators, household undernutrition is measured in terms of calorie deficiency. The study uses data from 'National Family Health Survey-2' for analysing undernutrition at the individual level and 'National Sample Survey Organisation-55th round' for analysing undernutrition at the household level. The standard bi-variate exercise of identifying correlates of undernutrition is carried through cross tabulation and chi-square tests. Then selected variables are included in backward stepwise bi-noimal logit model to find their robustness on the outcome of undernutrition. A group differential measurement method is applied for certain selected direct proximates of undernutrition among children, which spells out the effect of the given direct proximate on the outcome of undernutrition. The significance of the group inequality measurement method adopted relates to it's pronouncing differentials in prevalence of undernutrition across two mutually exclusive groups at lower level of aggregate prevalence. The same method is also applied in determining the effect of household composition on household calorie adequacy. The given group inequality measurement adds value to the observed variation in outcome revealed by the simple bi-variate exercise.

The findings from child undernutrition suggest that among other correlates, direct proximate like childhood diseases have definite impact on both indicators of nutritional outcome of pre-school children, height-for-age and weight-for-age. While diarrhoea has strong impact on weight-for-age, fever has strong impact on height-for-age of the children. This is evident from both bivariate and multivariate exercises carried out for the purpose. Similarly, children who have taken all prescribed vaccinations in first one year of life have shown better nutritional outcome in stunting as well as underweight, visa-vie their counterparts who are not immunised at all or not completed all the prescribed vaccinations within one year of birth. However, the other direct proximate of child undernutrition measured in terms of mushy food diet supplementation for the children above age of six months and children with exclusive breastfeeding of age below six months, shows no definite pattern as far as the undernutrition is concerned. In fact it points out that the

children with supplementation have higher prevalence of stunting and underweight irrespective of the age category of below six months of age or above it.

Findings from maternal undernutrition shows that apart from household standard of living, ethnicity of the household, religion of the household, household place of residence, household size and occupation of the women, correlates like maternal autonomy measured in terms of decision making power in the household and intake of protein and vitamin rich food items also significantly associated with the nutritional status of women. The study argues in favour of the intervention potential of correlates like women autonomy and diet of women towards improving their nutritional status compared with other variables mentioned above.

Household calorie adequacy is found to be affected by not only the socio-economic status of the household but also the occupation of the household and household composition in terms of number of dependents for given adult male members. So any food security measure at household level must take into account the occupation of the household as well as household composition. The study found in rural areas, households irrespective of their caste, engaged in occupation like agricultural labour have higher prevalence of calorie inadequacy, where as in the urban area it is the casual labour category which has higher prevalence of the same irrespective of the caste of the households.

The contrasting pattern of undernutrition according to the two criteria, namely anthropometric and calorimetric assessment observed across the country places the northern region to be advantaged with regards to calorimetric assessment and the southern region is advantaged in anthropometric assessment with exception like Punjab. This contrast could be very well explained in terms of the regional divide in health care utilization and dietary intake pattern. Hence this differential pattern between two dimensions could be a topic for further investigation.

The study proposes that comparison of two situations on the basis of a dichotomous outcome could be misleading. Instead it suggests application of standard Foster, Greer and Thorbecke (FGT) criterion to measure undernutrition as well, which accommodates intensity and severity of the undernourished. This is demonstrated with both unit record data and grouped data. It also proposes to use a blended measure of 'Head-count-ratio' and 'aggregate headcount' instead of applying them separately, which interprets the same phenomenon differently. The study also demonstrates a method of assessing gender differential in dichotomous outcomes like undernutrition, which pronounces differential at better level of the outcome as against the worse level of the same.

In nutshell the thesis questions the established notion of understanding the phenomenon of undernutrition among vulnerable population of India, both at individual level and household level. It argues to focus on intervention worthy proximate of undernutrition, which could improve the situation in relative shorter period of time. It also proposes to measure undernutrition by taking other relevant aspects of the phenomenon like the intensity, severity, and gender differential. It also advocates the advantage of blending different measure of the undernutrition in a single index.

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CHAPTER 1

INTRODUCTION

1.1. The Problem

It is observed that undernourishment is starkly concentrated in certain geographical clusters. Particularly, the Latin American countries, countries of Sub-Saharan Africa and South Asia have the major concentration of this misfortune [Svedberg; 2004, ACC/SCN; 2000]. India being the largest country in South-Asia, both in terms of it's geography and population, shares the bulk of this misfortune where one in every two children suffer from some form of undernourishment [Svedberg; 2004]. It is also found that two thirds of its mothers are anaemic and half of them are suffering from anthropometric failure [IIPS; 2000]. Such alarming facts indisputably relegate India as one of the poor performers in the nutritional scenario across the region.

It is, both clinically and empirically, established that undernourishment at an early stage leads to poor skill development, motor development and development of cognitive skills among the children [Green et al; 1995, Glewwe et al; 1995, Alderman et al; 1996, 2001, 2004]. There is also a staggering relationship between educational achievement of the children and their corresponding nutritional status. The children who are undernourished are found to be starting their schooling at a later age [Alderman et al; 1996, 2004]. Undernourishment at adolescence and in subsequent prime age can affect the physical productivity as well [Victoria et al; 2008, World Bank; 2003, 2004]. It has been theoretically established that due to undernourishment the productive capacity of an individual will be low which will then affect his/her earning capacity [Deolalikar; 1988, Dasgupta and Ray; 1991]. Further, undernourishment during adolescence among girls leads to low birth weight for their babies in latter life [ACC/SCN; 2000]. From a human rights perspective it has been argued that denial of proper nourishment in a given society violates the right of its members to lead a life free of hunger and morbidity and pursue his/her own economic goal [Dreze and Sen; 1989, Sen; 1998]. Undernourishment restricts the 'human capability set' by increasing the risk of morbidity and lessening opportunity.

Clinical literature suggests that morbidity risk is significantly higher for undernourished persons [Hoyle et al; 1980, Brown et al; 1989, 1990, WHO; 2000]. For instance, low birth weight babies lack adequate biological defence against frequent diseases and therefore it is difficult for them to maintain proper physical growth.

Frequent episodes of ailments like diarrhoea, fever, coughing, typhoid and jaundice further weaken the child. So the child becomes less and less immune against future episodes of illness. Frequently ill children experience low level of absorption capacity from the available intake, which further aggravates the problem and leads to higher child mortality among the undernourished children [Brown et al; 1989, 1990, WHO; 2000].

It has been observed that a person born undernourished is also more likely to face undernourishment in subsequent years [ACC/SCN; 2004]. This impact could also get transmitted to the next generation and such a problem is referred to as the 'life cycle hypotheses' [ibid]. According to this hypothesis, undernutrition starts at foetal level and hence results in low birth-weight for babies and in the absence of favourable factors this nutritional disadvantage continues and gets cumulated in latter years. It leads to a cycle where underweight babies become underweight mothers and again give birth to underweight babies [Barker; 1998, Ashworth; 1998, Martorell et al; 1998, World Health Report; 2005, WHO/BASIC; 1999]. So it is argued that interventions are required while the mother is pregnant by giving her food supplements and proper pre and post partum care to break this vicious cycle [ACC/SCN; 2000, World Health Report; 2005a]. It is theoretically possible to extend this hypothesis to both the sexes for explaining undernourishment among them; but it is often used in studying undernourishment among female sex.' One of the possible reasons could be that the reproductive compulsions for women provide them insufficient time to recover from the undernourishment at an early stage compared to their male counter parts [ACC/SCN; 2000]. In a nutshell, undernutrition reflects the underdevelopment of a society in terms of both economic as well as human development and is one of the major policy concerns [Dreze and Sen; 1989, ACC/SCN; 2000].

It is well recognised in the economic literature that there exists a broad nexus between undernourishment and poverty and many of the correlates are same for both forms of deprivation[1] [Osmani; 1992, Haddad and Smith; 2000, Svedberg; 2002a, 2002b]. Specific factors like hunger, lack of productive assets, social backwardness, lack of capabilities in terms of low education, poor health care and lack of basic needs in the household are found to be influencing both the outcomes of deprivation [World Health Report; 2005, Ramalingaswami et al; 1997]. But measures to eradicate poverty may not automatically reduce the prevalence of undernourishment among the given population. The reason

[1] However, the issue of simultaneity (causality i.e. which of them is the cause and which is the effect) has been categorically overruled. It is found that while poverty may cause under nourishment, the reverse is not necessarily true.

for such a limitation arises from the fact that whereas the poverty is the outcome of mainly socio-economic deprivation, undernutrition is an outcome of socio-economic deprivation as well as poor health status given the genetic endowments of the individual (factors, which may have always not the *quid pro quo* relation with socio-economic indicators). The increase in per capita income may help to reduce the poverty but not necessarily improve the nutrition status. It is found that in many low-income countries, the prevalence of undernourishment is lower than that of countries like India, which has a relatively higher per capita income [Dreze and Sen; 1989, ACC/SCN; 2004, Human Development Report; 2007, Svedberg; 2004].

Economic growth facilitates nutritional outcome in two ways: one, it increases the availability of resources at household/individual level for consumption of essential items like food and second it generates resources with the government to spend more on social sectors like education and health which would ultimately contribute to achieve better nutritional outcomes [Smith and Haddad; 2002, Haddad et al; 2003, Hoddinot and Immanuel; 2004]. But it is now universally accepted that increase in per-capita income does not necessarily bring improvements in nutritional outcome, especially for children, unless it is supported by other non-economic factors like maternal literacy, spread of immunisation and increase in availability of safe drinking water and sanitation etc. The study by Peter Svedberg for 37 developing countries points to this fact [Svedberg; 2004]. Thus, it could be argued that though poverty and undernutrition share some commonalities (in terms of correlates) these are two different phenomena or at best two different but related dimensions of human deprivation.

Undernourishment is one of the burning issues in the developing countries. India is one of the countries that have the largest share of the undernourished in the world, which has changed little in recent years. The phenomenon of undernourishment is widespread across various age and sex groups in India [see IIPS; 2000]. While studies on the subject abound, most of them argue that the correlates of poverty are responsible for widespread undernourishment. While some researchers have related the issue of undernourishment with the problem of food security [see, among others Swaminathan; 2003, FAO; 2002, Radhakrishnan; 2002 and Svedberg; 2004], others have addressed the issue purely from a medical perspective [see various issues of Indian Council of Medical Research (ICMR)].

This study attempts at examining correlates of undernourishment on the ground of immediacy as well as operational process of these correlates. It argues that though there are many correlates identified in literature to be determining undernourishment, none

of them is either specific to undernourishment or any different from the correlates of deprivation of other kind. From a policy and programme intervention perspective, it is important to identify those correlates that are of immediate proximity to the phenomenon called undernourishment. It will help us to formulate intervention measures, which will be truly consequential in the short run. As it is known that some of the correlates which are associated with household characteristics, social norms, economic status of the household as well as the society and technology (these are more structural in nature), takes a long time to respond (and also huge resources) to any intervention for reducing any kind of deprivation. Nutritional deprivation is not an exception. But any society, which aims to improve the nutritional status of it's population in a given time period not only needs to identify the vulnerable features but also the intervention that will yield prompt results. The vulnerable features may be the guiding means to focus intervention but not sufficient to design intervention that may be effective. In this regard, this study designates possible intervention parameters and reflects on their relative priority in accordance with the prevailing level of this deprivation. It considers the two vulnerable groups namely children and women of reproductive ages. It is widely agreed that the health status of women and children in the total population reflects the health condition in general in any given society. Generally the health status of children and women is understood in terms of biological norms of growth potential and growth succession in children and reproductive energy utilization in women [editorial; 2004]. In addition it examines undernutrition at household level. Apart from providing a fresh understanding on the correlates of undernourishment, this study woks on the limitation of dichotomous measurement of undernourishment (both calorimetric as well as anthropometric) as regards its comparison and evaluation.

1.2. Points of Departure of the Study

The widely used framework for study of undernourishment, especially maternal nutrition is the one based on the so called 'life cycle hypothesis', wherein undernourishment is seen to start from the womb in terms of 'intrauterine growth retardation or IUGR' [ACC/SCN; 2000]. If the fetus is a female one, then the cycle expands to the next generation where the fetus becomes mother of an undernourished child, this perpetuating the vicious cycle of undernourishment. The limitation of the 'life cycle approach' is that it does not cover the correlates associated with the outcome, which are not in immediate proximity. This makes interventions difficult, as one has to find out the stage of life cycle at which intervention will be more successful and on

which correlate. Nonetheless this approach is useful for studying undernourishment at the individual level.

The food-health-care framework, or the UNCIEF framework, approaches the issue by identifying the major correlates of undernourishment at three broad levels, namely immediate, intermediate and basic. This categorisation is based on the proximity of the correlates to the outcome of undernourishment. This framework treats inadequate dietary intake and disease as the immediate factors and most intervention-worthy[2] as they have a direct bearing on nutritional outcome. Whereas correlates like insufficient access to food, inadequate maternal and child caring practices, poor water/sanitation and inadequate health services are clubbed as underlying causes at household level, better known as intermediate factors. The set of intermediate correlates followed from the basic correlates, which is determined by the society, like political, cultural, religious, economic and social systems including status of women and other power relations. These societal correlates govern the quantity and quality of available human, economic and organizational resources to the household to which most of the intermediate correlates are attached. Unlike the 'life cycle approach' this framework can be used to study undernourishment at different levels like individual, household and society.

This study departs on the account that it tries to identify the prime correlates of child undernutrition, specifically the diet of children and their risk to childhood ailments. Since, these are direct proxies to children's nutritional outcome; interventions on these correlates would provide us with the desired results in a short time span. Also, the results from intervention in intermediate and basic correlates are time consuming and costly. For example the household's economic status cannot be improved overnight or its social marginalisation cannot be terminated immediately. Because these structural variables - due to their dependence on many other factors from both present and past - change at a very slow pace even if the socio-political condition favours such a change. Though earlier studies focus on theses immediate correlates (food and disease), these are basically micro-studies carried out mainly by clinical researchers, whose interest is more medical than social, to find out medical solutions in terms of better disease surveillance and preventive measures (Studies published in 'ICMR journal' and 'Nutrition and Dietrics' are best sources for these studies). On the other hand, given the resource constraints it is difficult to make improvement in structural variables in short period of time to reduce the burden of undernourishment for different population groups in India. Therefore the present study tries to argue that focusing on immediate

[2] Intervention-worthy refers to modifiability of the target variable. In other words how fast the targeted variable brings intended change in the outcome.

correlates will be effective to reduce the nutritional deprivation of Indian children in short time.

As the present study is based upon nationally representative survey data, the pattern for some of the bigger states can be studied independently as the cause of undernutrition may vary from state to state. In recent findings it is observed that increasing rate of economic growth and high per-capita income may not transform to better nutritional status for children of those states [Planning Commission; 2001]. While some of the high-income states like Maharashtra, Punjab, and Gujarat, report high child underweight and stunting, middle-income states like Andhra Pradesh and Kerala have better nutritional outcomes for children. It indicates that reduction in economic poverty does not necessarily improve nutritional status of Indian children [ibid].

1.3. Research Questions and Objectives

Keeping all these issues in mind this study enquires into the following specific research questions. First of these questions relate to identifying the immediate factors that are responsible for undernourishment among Indian children at pre-school age. Second, whether the autonomy among women has any positive impact on their nutritional outcome? Third, does composition and size of the household influence the calorie poverty of the household? Last but not the least, does the present approach of defining undernourishment based on a dichotomous criterion limits itself in terms of robust comparison (both temporal and cross-sectional).

Based on the above research questions, the objectives of the study are stated as follows

i) To understand the group identities of population vulnerable to undernutrition
ii) To identify key factors relevant from policy perspective for enhancing effectiveness in implementation of intervention programmes
iii) To understand the role of characteristics and composition of households in nutritional make up of the households
iv) To undertake suitable revisions or adjustment to obtain enhanced comparability of the existing aggregate measures of undernutrition

1.4. Data and Methodology

The study uses data from National Family Health Survey-2 (1998-99) and National Sample Survey Organisation's consumption expenditure survey for 55th round (1999-2000). NFHS-2 facilitates individual level analysis of young children (0-35 months) and reproductive age women (15-49 years), the two most vulnerable groups for undernourishment. NSSO 55th round facilitates household level analysis. In NFHS-2, information on anthropometric dimension of undernourishment is available where as in NSSO 55th round calorie consumption of households are reported. So the two data set complement each other. The two surveys are carried out almost around the same time. They both cover all the states and union territories of India and represent around 90 percent of population and 80 percent of geographical area. The sample sizes are also adequate for all India, 90303 women and 33, 000 children from NFHS-2 and 1,20,000 households from NSSO 55th round. Both facilitate only cross section analysis. Since the focus of the study is to find out correlates of undernourishment in different dimensions at individual and household level, the stated source of data seem quite appropriate for the study.

Considering the aspects of food security and nutrition security together, a new concept known as 'FNS' framework is developed [ACC/SCN; 2000]. Nutrition security at any given denominator like individual, household or at community level is inclusive of food security as well [ibid]. One of the basic requirements of household food security is 'availability' of food. Then arises the question of 'accessibility', which refers the households/individuals having resource to access the available food or in other words the necessary purchasing power to buy the available food. Next comes the 'utilisation' of food. The household has to distribute the available food according to the requirement of each of it's member. Then only household level food security will be transformed into individual food security. The use of the available food by individual body is known as 'absorption', which depends upon health status of the given individual. These four properties i.e. availability, accessibility, utilisation and absorption are to be sustainable in the long run to ensure better nutritional outcome for the individual. In case of no member within a given household found undernourished makes a household free from undernourishment, by the same logic the community or a given country will be judged free from bane of undernourishment. Thus the properties of food security along with the factors that determine the health status are responsible for nutritional outcome of a given individual.

The food-health-care framework proposed by WHO/UNDP to analyse the factors affecting nutritional outcome of the population is nothing but manifestation of 'FNS' [ACC/SCN; 2000]. Here the correlates that affect the nutritional outcome are divided in to three broad categories; called immediate, intermediate and basic correlates. Immediate correlates consist of those, which have a direct bearing on nutritional make-up like diet or health care with the former being an input indicator and the later ensuring better absorption as well as reduced vulnerability to undernourishment. The intermediate correlates are those, which create enabling conditions for positive immediate correlates in the household food security, health care accessibility among women and children as well as across rich and poor households. The basic correlates comprise of those attributes that systematically define the intermediate correlates like poverty, poor economic and social status of household, poor governance and repressive social and political structure in the country. Hence food security might be a necessary pre-condition for nutrition security but not a sufficient one given the role of access to health care in sustaining nutritional make-up of an individual [ibid].

Prior to identifying the correlates one needs to recognise that undernutrition could be measured at individual, household as well as community level. In the literature there are several correlates identified which causes undernourishment [ACC/SCN; 2000, Weingärtner; 2004]. Hence, the correlates of undernutrition could vary in keeping with the unit/level of measurement. At the individual level, all the three sets of factors that are individual factors, factors related to households and community related factors are of significance in determining the nutritional outcome. Studies at individual level have indicated that age, sex, educational achievement, food intake and poor health are important correlates of the nutritional outcome. On the other hand, at the household level correlates like income, occupation, consumption pattern, affordability of food, overall hygiene, rural-urban divide and composition of the household becomes more crucial. Similarly, at the community level (or at national level) total availability of food, price of the food items, economic performance, availability of infrastructures like road and communication, transport, and nature of the regime become more crucial [ACC/SCN; 2000, Weingärtner; 2004].

So the correlates of under nourishment are specific to the population in focus whether it is children, women, young adults as well as the elderly. This is due to the varied requirement of food intake and health related vulnerability during the life course. If the focus of the study is pre school children then children will be the unit of analysis and correlates, that affect their nutritional outcome, has to be identified (like for example diet, poor health, ailments are considered to be important for child's nutritional

outcome). If the focus is adolescent children then diet become crucial factor with other relevant correlates at individual and household level [ACC/SCN; 2000]. If the focus of the study is reproductive age women then correlates like age at marriage, age at first birth, pre and post-partum care, number of children, space between pair of children along with the diet is crucial for the nutritional outcome [UNICEF/UNU/WHO; 1999]. Similarly among the elderly, diet and ailments are relevant for the outcome [Manandhar; 1995]. Components of food and ailment sets might be widely variant between children and the elderly; although household and community level correlates remain same for both (old and children). Further, the morbidity risk is higher among the children and elderly; the nature and degree of severity may vary with respect to other age groups [ACC/SCN; 2000].

In a nutshell, it can be identified that all the correlates considered for an individual level analysis, can be broadly divided into three major sets as Immediate, Intermediate and Basic. Immediate sets of correlates include diet/intake related correlates on the one hand and ailments/morbidity related ones on the other. While household factors are mainly intermediate correlates, community level correlates are basic correlates for any nutritional outcome at the individual level. If the focus of the study is to examine undernourishment at household level then only those correlates, which affect the household food intake, will be considered (mainly intermediate and basic correlates). This is the theme behind food-health-care-frame work, which will be adopted in this thesis [UNICEF; 1998].

Given the framework above, the study seeks to establish the one-way association between the selected correlates and outcome of undernutrition. The statistical significance of the association is tested based on chi-square test of significance. Then in case of child undernutrition analysis, a method called 'group-inequality measurement method' is used. This particular method is useful to reassess the one-way association between immediate proximate of child undernutrition and the nutritional outcome of children (when the outcome as well as the controlling correlate is dichotomous and mutually exclusive) based on cross tabulation. This helps us to compare the risk of undernutrition for children with a given correlate across varying levels of undernourishment. This particular method is also used for assessing the relationship between calorie deprivation at household level and household composition (in terms of households, either with more number of girl children than male children or having more number of dependents in the household visa-vie the adult male members). Though at household level nothing can be termed as immediate proximate like that for individual level (as in case of children) the 'group inequality measurement method',

mentioned above is applied to reconfirm the association between the focused correlate (household composition) and nutritional outcome at household level (a dichotomous and mutual exclusive one). However, this methodology is not found suitable for analysis of maternal undernutrition, where the focused correlates are having more than two mutually exclusive groups. In Chapter 4, Chapter 5 and Chapter 6 which deals with undernutrition among pre-school children, undernutrition among reproductive age women and calorie deprivation at household level respectively, the findings from one-way association is confirmed in a multivariate binomial logit exercise. The backward stepwise method is used in the binomial logit model to figure out the best model, which fits the data. The study also uses different contrasts available in the SPSS package for the binomial model. It not only helps to compare the effect of each category of a given predictor with the pre-determined reference category for that predictor but also facilitate intra-category comparison as well as comparing the effect of the predictor as a whole on the outcome of undernutrition. Thus one of the highlights of the present study as regard its methodology relates to assessing a bivariate response of immediate proximate (or modifiable proximate) to nutritional outcome that is level responsive. In addition, the recognition of the limitations relating to the dichotomous measurement of undernourishment and forwarding suggestive refinements in the same is another highlight of this work. These refinements though not entirely innovative in itself, can no doubt be considered as innovative adoption of methods in poverty literature into measuring undernourishment.

1.5. Chapter Scheme

The present study is divided into eight chapters including the present introductory chapter. The following chapter (Chapter 2) provides a comprehensive review of literature on issues of undernutrition in India and compares it with some of the studies available from other countries. For ease of exposition, this chapter is divided into four broad sections; the first three sections review the literature on pertinent aspects of undernutrition among children, women (particularly mothers) and households respectively whereas, the fourth and final section discusses the nature of indicators and methods employed in contemporary literature to obtain an account of undernutrition in a given population. Furthermore, Chapter 3 provides a detailed exposition on the available information relating to nutrition from various sources along with their potential for use and limitations. A brief description of the methodology too is elaborated in this chapter.

The analysis and results of the study for child, maternal and household nutritional problems are presented in chapters four, five and six respectively. In the case of children (Chapter 4), the immediate factors identified are diet and disease. Using *group inequality* measures, we found the incidence of diarrhoea and fever has a role to play in outcome of stunting and underweight. Binomial Logit Model is used to confirm these associations between diseases and undernutrition outcomes by controlling for other child specific and socio-economic correlates. A similar exercise is repeated towards verifying the relationship between diet of the children and the nutritional outcome for them. The 'diet' of children comprised breastfeeding by the mother and supplementation of mushy foods. Here we try to challenge the established notion that exclusive breastfeeding for first six months is good for the children, because it is safe and sufficient. Children who are older than six months and already have mushy food supplementation have better height-for-age but not the weight-for-age due to the fact that children with mushy food supplementation are frequently taken ill and loose weight. This observation leads to an apprehension regarding hygienic safety associated with supplementation in particular given the adaptation of infants to diet other than mother's milk. The issue is relevant while making recommendation for early supplementation for the children below six months because at that time their vulnerability to disease is even higher. Overall the discussion on child nutrition tells us that diseases and child feeding are two crucial indicators, which can be directly intervened to reduce the risk of ailments for the children in India and would lead to better nutritional outcomes.

In Chapter 5, the issue of maternal undernutrition is addressed in a slightly different manner than the issue of child undernutrition. For this purpose information from NFHS 2 for reproductive age women (15-49 years age group) has been used. The selected correlates are divided into four sets - individual characteristics, socio-economic or household characteristics, dietary aspects and issues related to women's autonomy. The motivation stems from the fact that the first two sets of characteristics are widely addressed in the literature, but the third (mainly discussed in medical literature) and fourth sets have received attention and demands rigorous scrutiny for economic comprehension. In the present study the diet and autonomy are captured in terms of indices. It uses the qualitative information on diet and women's autonomy from the data sources and tries to construct indices to see whether a particular score in index value is associated with the outcome of nutrition measured in terms of Body Mass Index or BMI. The finding does show that women with better score in diet and status index perform better in terms of nutritional outcome measured in terms of BMI. So the argument here is that when many of the correlates of undernutrition among women at

the individual and household level are non-modifiable in nature or may need sufficient time and resources to realise a desired change, intervention in terms of improving women's status in the household could bring about the change earlier.

The issue of household calorie deprivation has been addressed in Chapter 6. The approach here is different as regard its focus being not only on household characteristics, but also the composition of the household as well, to identify the household vulnerable to calorie deficiency. The rationale behind such an approach is to overcome the incompleteness in our focus to the poorest ones, because several households may not be poor but are undernourished owing to their composition. If the household has higher number of children, women, widows and old age or sick person, who can be grouped into dependent population, then it is more likely that they will be neglected while the intra-household allocation of available food is based on the hierarchy of the household members. The results reveal that the agricultural labour households in rural India and casual labour households in urban India are most vulnerable to calorie deprivation in general. Interestingly, irrespective of social identity, the analysis indicates that if the household's are engaged in these two occupations, they are at greater risk of calorie deprivation. Results also point out that households having higher number of female children and old age persons (or widows or sick persons) have higher prevalence of calorie deprivation.

In Chapter 7 the study focuses on the measurement issues concerning the dichotomous nature of assessing undernutrition. The dichotomous nature of undernourishment is symmetric with the measurement of income poverty. There are two simple yet universally accepted measures, which are used to identify the phenomenon of poverty. One is the number of poor and other their share in total population (Head-count-ratio). No doubt that these have identical purpose of comprehending the magnitude of undernourishment in a population. Both in case of poverty as well as undernourishment, the total number of deprived and percentage of deprived inform the same based on the principle of agency and principle of likelihood. Given this comprehension on varied principles, one cannot be considered a complement of the other rather than both together representing the phenomenon. So a composite index of 'Head-count-ratio' and 'aggregate Head-count' is adopted towards making a better sense of comparison. Subramanian (2005), explores this possibility in case of poverty, which is adopted here to illustrate the case of undernourishment across states of India.

The dichotomous nature of defining undernourishment being similar to that of poverty suggests refinement in the measure of undernourishment as regard its severity and

inequality. This concern in case of income poverty is resolved by the application of 'FGT' approach [Foster et al; 1984]. A similar adaptation in measuring undernourishment is illustrated on account of the prevalence of stunting and underweight among preschool children as well as calorie deficiency at aggregate level for the selected states of India. The dichotomous nature of measuring undernourishment also gives rise group differential measurement that is insensitive to the prevailing level of the phenomenon. Female children are negatively favoured for food and care, which is then reflected in higher prevalence of undernourishment among female children, despite the fact that median anthropometric indicators for height and weight is less than that of male children. By considering the issue of gender inequality in measuring prevalence of undernourished children in India, shows there are states where the aggregate prevalence is low for a given indicator, but female children have higher prevalence than male children.

1.6. Limitations of the Study

The major limitations of the present study are the following. Firstly, the issue of undernourishment among other vulnerable groups, such as adolescents and elderly could not be attended because of insufficient information. Due to similar problems the issue of intra-household allocation is also not addressed. Also, the issue of seasonal fluctuation in the calorie intake at the household level demands apt scrutiny but data paucities led to confining the analysis to an aggregate level. Since, we do not have any single indicator to apply for all the units of analysis in the study, *calorie intake* is used to assess nutrition at household level and different anthropometric indicators are used for children and women. As the present study is essentially a cross-sectional study, we could not capture the dynamic aspects of the underlying time dependent correlates. Our focus is to identify the 'intervention worthy' factors, which helps to overcome this problem and suggest correlates, which change in shorter time span. The data corresponds to the late 1990s and therefore may be considered dated but this database is preferred fort the two databases NFHS-2 and NSSO 55th round is representing compatibility in time. Such comparable datasets are not available for a more recent period.

CHAPTER 2
REVIEW OF LITERATURE

2.1. Introduction

Among all forms of deprivation, nutritional deprivation is supposed to give rise to other forms of deprivation across age and stage of human life. This has been examined from varied perspectives across disciplines, which could be broadly divided in two groups clinical and non-clinical. The yardstick of undernourishment too differs in terms of either being input based or outcome based. The input based yardstick relates to consumption (like calorie, nutrient intake and its balance) where as the outcome based one is in terms of physical attributes (like height, weight, arms circumference as wells as waist -hip ratio etc). This often leads to conflicting assessment of the magnitude of undernourishment as well as its correlates. On this count the present chapter reviews the selected literature on different aspects of nutritional deprivation, relating to pre-school children, reproductive age women and household nutrition security. The discussion begins with a focus on outcome indicators used to measure undernutrition. Issues related to child undernutrition will be discussed in section 2.3 and 2.4 will focus on undernutrition among reproductive age women. Discussion on specific correlates, indicators used and intervention strategies followed in India to improve children and women nutritional status will be discussed in respective subsections under 2.3 and 2.4. The same structure of discussion will be followed in case of household calorie deprivation in section 2.5. Section 2.6 focuses on the existing approaches to measure nutritional deprivation at an aggregate level.

2.2. Measurement of Undernutrition: Conflicting Indicators

The available indicators to measure nutritional outcome can be categorised as calorimetric/intake measures, anthropometric measure and clinical indicators. In the first set of measures, calorie intake is quantified by collecting the information on the actual food intake by the person. The calorie intake of an individual is compared with a defined calorie norm in order to appraise the individual's nutritional status. While deciding the calorie norm for various population groups, age and sex of an individual are also considered for along with the nature of economic activity performed. The household calorie requirement could be obtained as the aggregate of calorie requirements of all the members of the household [NSSO; 2000, Svedberg; 2004]. However, the critics of calorimetric approach argue that it does not account for the nutritional absorption capacity of an individual, therefore, the nutrient value of the food

may not be fully realised. In this regard a related hypothesis of *adaptability* argues that even with low calorie intake body can maintain its activity level because it has already been adapted to low calorie intake [Svedberg; 2004, Sukhatme; 1983]. The concept of absorption itself may not be as simple as it is thought, but it may be determined by other factors like genetic potential, history of ailment episodes, availability of care and proper hygiene etc [Osmani; 1992].

In order to overcome some of the shortcomings of calorimetric approach, the anthropometric measures are used. Anthropometric outcomes are considered to be more reliable because these can be directly observed and measured in a scale (for example, measuring height-for-age or weight-for-age). Measures like stunting - low height-for-age - shows cumulating impact of poor health for a longer period of time. Underweight - low weight-for-age - on the other hand can be used to capture prevalence of undernourishment in immediate as well as distance past [Cole; 2000]. Wasting - low weight-for-height - is time independent which measures the overall stature irrespective of the age. All three measures are considered to be ideal for measuring undernutrition among children [Osmani; 1992, Smith and Haddad; 2002]. In addition, Body Mass Index helps us to measure the nutritional status of the adults, especially women [IIPS; Macro; 2000, Shetty et al; 1996], whereas, arm-circumference is found to be ideal for the old aged persons because it measures functional ability of the old, and is more crucial than mere height or weight for that category [Manandhar; 1995]. These anthropometric measures compare the deviation of height or weight (from the median of the reference population for the specific age and sex combination) for a given observation. The deviation from the median determines the degree of severity of undernourishment.

Clinical indicators are often used to know specific deficiency of different micronutrients. For example, prevalence of anaemia, goitre (due to iodine deficiency), vitamin-A deficiency, Zinc deficiency etc. refers to deficiency of respective micronutrients. Most of the micronutrient deficiencies are measured in terms of their shortfall from the prescribed level in per milligram of blood. These micronutrients are crucial to maintain the hormonal balance and other vital functions of the body. Lack of these micronutrients can lead to anaemia, blindness, thyroid, beriberi, scurvy etc. and also cause damage to child's immune capacity. Nutritional interventions to tackle these ailments are mainly consists of supplying required micronutrients separately for each ailment or in combinations. A large body of epidemiological and clinical studies have also established that inadequate diet is significantly associated with child undernutrition. Particularly, inadequate intake of nutrients like protein, vitamin and minerals push the children towards mental and physical retardation. However, in socio-economic studies, mainly

calorimetric or anthropometric indicators are used, because these are simple to use by non-clinical persons. Between the two preferred measurement approaches discussed above undernutrition only the first one (calorie intake) can be used to study undernourishment at both individual and household level [Svedberg; 2004, Osmani; 1992]. Nevertheless, in the literature it is observed that the anthropometric measures are preferred to study nutritional health because of its advantage in terms of capturing past growth (cumulative effect of bad health in past) as well [Osmani; 1992] and therefore it is of some relevance to elaborate upon this aspect of measurement.

In most of the nutritional assessment reports it is common to observe anthropometric indicators such as *stunting, wasting* and *underweight.* In brief, *stunting* reflects chronic undernutrition which may be the result of prolonged food deprivation and (or) ailments; *wasting* measures acute undernutrition and reflects food deprivation or illness in recent past; while *underweight* is used as a composite indicator to reflect both acute and chronic undernutrition, although it cannot distinguish between them [WHO; 1995a, 1995b]. These indices developed for a population are compared against an international reference population developed from anthropometric data collected in the United States by the National Centre for Health Statistics [Hamill et al; 1979]. Children whose height (weight) is twice below (-2 standard deviation) the median height (weight) score of the reference population of a given age (z-scores) are considered moderately undernourished. Those children who have their height (weight) thrice below the median score of the reference population (-3 standard deviation) of given age are considered as severely undernourished. These indices reflect distinct biological processes, and their use is necessary for determining appropriate interventions. Nonetheless, because they overlap, none is able to provide a comprehensive estimate of the number of undernourished children in a population. Some children who are underweight will also have wasting and (or) stunting; and some children who have wasting will also be stunted and (or) underweight [Nandy et al; 2005]. Given the merits and demerits of the three approaches discussed above, it could be concluded that the choice of a particular indicator to study the prevalence of undernutrition is primarily dependent upon the focus and objective of the study as there is no sufficient evidence to order one indicator above the other as they serve different purposes.

2.3. Child Undernutrition: Facts and Factors

Social planners in underdeveloped countries are grappling with the problems of nutritional deficiencies and poor health outcomes. This untoward combination of malnutrition and infectious diseases cause most of the preventable deaths in developing

countries, certainly among young children[1]. A report of World Health Organisation establishes a linear relationship between being underweight and under-five mortality [WHO; 1995]. According to this report, out of 11.6 million deaths among children under age five in the developing countries, 6.3 million (54 per cent) were associated with low weight-for-age (underweight). Undeniably, the first two years[2] of human life warrants high energy levels to overpower morbidity risks and nutritional traps[3] [Alderman et al; 2003, Beherman et al; 2004, ACC/SCN; 2000]. Malnourished and underweight children in early stages of life are susceptible to severe illness, including diarrhoea, pneumonia, jaundice, various physical disabilities blindness and memory loss [ACC/SCN; 1993, 2000, Haddad and Smith; 2000, Ashworth; 1998].

Undernutrition is considered as one of the deprivations, which has serious implications for the all round development of a society. It is widely acknowledged that the impact of this abysmal problem is largely observed in terms of poor functional outcomes, poor productivity and work efficiency in adulthood, which manifests into poverty [Wagstaff and Watanabe; 1999, Barker; 1998, WHO; 1995a, 1995b, Ashworth; 1998, Alderman et al; 1996, Martorell et al; 1995, 1996, 1998, Behrman et al; 2004]. It implies that there is a possibility of two-way relationship between poverty and undernutrition since both forms of deprivation are primarily identified with similar correlates[4].

2.3.1. Correlates of Undernutrition among Pre-School Children

It is a matter of contention among researchers that whether undernutrition is a cause or an effect of poverty. On one hand, a plethora of literature identifies economic poverty as an elemental correlate of child undernourishment in developing countries, including

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[1] The malnutrition-infection complex has been well documented in the clinical literature, for instance see [Tomkins and Watson; 1989, Piwoz et al; 1994], for a comprehensive review of the interaction between nutrition and infection, with major emphasis on developing countries.

[2] It is clinically established that most growth faltering, resulting in stunting, underweight or waisting take place within first two years of life [WHO; 1995a, 1995b, ACC/SCN; 2000, Osmani; 1992, Osmani and Sen; 2003].

[3] The epidemiological literature evidences on the bearing of foetal undernutrition (i.e. Intra Urine Growth Retardation or IUGR) with the increased risk of various chronic diseases. A child born with low birth weight has greater risk of undernourishment through out his/her life cycle [Ashworth et al; 1998, Osmani and Sen; 2003]. The situation further worsens during infancy and early childhood, if the child is exposed to frequent and prolonged infectious diseases. This increases the risk of child mortality for low birth weight babies [Martorell et al; 1980, Campos et al; 1987, Sommer et al; 1987, Brown et al; 1990, Ashworth; 1998, Stephensen; 1999].

[4] There are studies arguing out the ambiguities in bi-directionality and propose that poverty may cause undernourishment but the reverse may not be necessarily true [Osmani; 1992].

India [Dreze and Sen; 1989, Osmani; 1992, Svedberg; 2002a, 2002b]. Even it is contended that, poverty and undernutrition is identified with several common correlates, it is plausible to measure poverty by the extent of population's failure to achieve desirable nutritional status [Osmani; 1992]. In this regard, the role of economic growth in enhancing the nutritional status for children is highlighted in several cross-country studies. It is well established that growth in terms of GDP per capita is associated with the decline in prevalence of stunting and underweight [Haddad et al; 2003, Smith and Haddad; 2002, Svedberg; 2000]. The mechanism between increase in GDP per capita and improved nutritional outcomes is attributed to two things; first in terms of increased income of households to obtain nutritionally rich food and essential health care. Second, higher economic growth generates enough resources for government agencies to invest on health and nutritional interventions. This growth-nutrition hypothesis is further confirmed in a study based on an analysis of 128 countries [Svedberg; 2004]. After controlling for other relevant variables, the study reveals that though the effect of per capita income on both stunting and underweight has weakened from 1980's to 1990's; still it remains a significant one. The downward shift in effect of per-capita income on nutritional outcome of children is attributed to shifts in focus for interventions on non-income dimensions such as child immunisation, food supplementation, disease control and female literacy.

On the other hand, it could be argued that poverty may be one of the correlates of undernourishment but necessarily not the only one. To elaborate, it is observed that in India almost one third of the children belonging to the richest quintile (of consumption expenditure) are underweight. Such instances provoke many to ascertain the role of non-economic factors in determining nutritional outcomes [Deolalikar; 2005]. In other words, it advances a message that poverty should not be viewed as the sole determinant of undernutrition among children, rather as a part of a set of correlates, both economic and non-economic. In this regard, mother's education is identified to be a prominent determinant of the child's nutritional outcome. For instance, the case studies from Nepal and Mozambique respectively noticed that improvement in maternal education had helped rural women to gain healthier child care practices, which in turn got reflected in the form of improved anthropometric indicators for their wards [Joshi et al; 1994 and Garret et al; 1999]. Father's education was also found to be crucial for the outcome of height-for-age among children of Brazil. Perhaps, it may be due to the fact that father's education could be related with the economic status of the household and thereby has its bearing on child's health status [Kassouf and Senauer; 1996, Haughton and Haughton; 1997].

Apart from education, maternal correlates such as her health status is considered to be significant because breast-feeding is a major determinant of child health and hence is promoted both by government and non-governmental organisation as a way to boost child health, especially during first six months [PHRN/BPNI/IBFAN; 2008]. But if the mother herself is undernourished, then exclusive breastfeeding may not result in the desired growth potential of children and under such circumstances one would provide early supplementation to children to have better nutritional outcome [Anandaiah and Choe; 2000]. Supplementation is a significant means of child health intervention and this proposition gathers strength especially in countries like India where around 35 percent of Indian mothers are of low Body-Mass-Index and 75 percent are anaemic. However, judicious mix of breast-feeding and supplementation in case of nutritionally compromised mothers remains an alternative towards ensuring better nutritional make-up among children. While one cannot substitute the other a complementary approach may be a desirable one.

Several studies have also highlighted the role of social factors such as caste and demographic factors like birth order, birth spacing and age at maternity in determining child's nutritional profile [Rajaram et al; 2003, Som et al; 2006, Maitra and Pal; 2008]. Social disparities in Indian context are also highlighted as one of the important correlates of undernutrition among children. The burden of undernutrition among children is disproportionately higher for marginalised communities like Scheduled Caste and Scheduled Tribe [Thorat; 2007, Rao et al; 2005]. Moreover, the issue of gender discrimination against female children is a major concern in India [Narayana; 2008]. The girl children are discriminated in food, health care and educational opportunities compared to their male siblings [Deolalikar; 2005, Barooha; 2004]. Particularly, in rural India, female children are provided with less nutritious food against there male siblings and this problem typically aggravates for the marginalised communities (such as scheduled caste) in lean agricultural seasons [Beherman; 1988, Barooha; 2004].

Utilisation of maternal and child health care services have positive impact on nutritional outcome of children. Despite limited economic development, the provision of better health care facilities for mother and children and its subsequent utilisation can improve the nutritional status of children. Ensuring better care practices in economically poor households can improve the nutritional health of the pre-school children. The experience from rural Nepal and urban Ghana, both poor countries confirms this proposition [Joshi; 1994, Hotchkiss et al; 2002, Ruel; 1999b]. However, apart from physical healthcare, the psychological state of the mothers also affects the care of children and is primarily governed by the status of women in the household and

therefore efforts should be made to improve the status of women [Engel et al; 1999]. In addition, it is equally important to meet the household demand in terms of basic amenities like safe drinking water and sanitation, as well as educate them regarding safe hygienic usage behaviour[5]. All these can reduce the risks of several communicable water and vector borne diseases (such as diarrhoea) for young children and have a positive impact on nutritional status of the children [Sahn and Alderman; 1997, Caulfield et al; 2004].

While the literature on child Undernutrition expose its associative attributes, it doe not emphasise in particular upon the modifiable ones that can have immediate effect. In fact, a whole range of attributes involving maternal, household as well as relating to the child itself may not offer a systematic mechanism of intervention that can be adopted. Such a systematic mechanism requires creation of a hierarchy of these attributes in terms of its proximity to the event. On this count, this work offers immediate attributes for intervention with regard to child undernourishment.

2.3.2. Undernutrition among Pre-School Children: Available Course of Intervention

In India, the Integrated Child Development Scheme (ICDS), launched in 1974, continues to be the major intervention programme to enhance child health and welfare. The ICDS provides eight types of services to its beneficiaries - children and mothers. These are supplementary feeding, immunisation, health checkups, referral, nutritional and health education for mothers, micronutrient supplementation, and introduction to formal education to child aged between three to six years. However, recent government policies and judicial verdict by the Honourable Supreme court of India makes it mandatory for ICDS to universalise it for all the children in the country[6]. But as regards its impact on the nutritional health of children, recent studies conclude that ICDS is half-heartedly implemented in different parts of the country (barring the states of Tamil Nadu, Kerala and Andhra Pradesh) and therefore its impact potential is not realised. For instance, though ICDS intends to have 300 days of feeding for the children of age 0-6 years, actually on an average it is only 64 days. Moreover, lack of proper 'Aanganwadi centres', insufficient volunteers and workers, poor finance and infrastructure (like

[5] For instance, the importance of providing basic amenities is apparent from the observation that provision of pipe safe drinking water reduces the risk of diarrhoea by 40 percent among Indian children as it is relatively free from pathogens [Ravallion and Jalan; 2003].

[6] As on 30th June 2007, there are 7,36,80,593 number of beneficiaries under ICDS out of which 3,07,55,232 are children of age 6-36 months, 2,98,94,421 are children of age 3-6 years and 1,30,46,087 pregnant and lactating mothers in 8, 73,467 'Aanganwadi centres' across the country through 8,14,717 'Aanganwadi workers or AWW' [Ministry of Women and Child Development; 2008].

water, sanitation, electricity and storage for food articles and vaccines) makes the ICDS inefficient. In some states it is also noticed that the respective state governments are not releasing timely resources, which are aggravating the financial difficulties of *Anganwadis* to purchase food from Food Corporation of India (FCI). Irrespective of these loopholes in implementation, National Institute of Public Cooperation and Child Development (NIPCCD) observed that the ICDS villages have better nutritional status for their children in contrast to non-ICDS ones. These findings of NIPCCD are also supported from nationwide surveys such as NFHS-1 [IIPS, Macro; 1993]. In fact some studies have observed that ICDS has become more synonymous with food supplementing and disease control programme whereas other cost effective measures like educating mothers about their own health and child's health are receiving inadequate attention, despite being a part of the basic objectives of ICDS. This tendency has reduced the impact of ICDS [Gragnoalti et al; 2006, Dreze; 2006].

In addition to ICDS, some states have devised their own strategy to deal with the issue of child health and welfare. For instance, in contrast to ICDS, Tamil Nadu Integrated Nutrition Project (TNIP) initiated in 1980, focused upon the children below two years of age[7]. If children were found to be underweight for ninety consecutive days they were directly provided with food supplementation. TNIP also provides health care to children in terms of treatment of diarrhoea, deworming, immunisation as well as regular check-ups for child and mother. The mothers are also provided counselling to monitor the health of their child and hygienic practices. The services of health care are extended to pregnant and lactating women as well. It takes help of women's self-help groups to identify the needy mothers and children. Over the years the severe undernutrition has come down significantly in Tamil Nadu, though the moderate undernutrition persists. In a nutshell; TNIP could be regarded as a short-term intervention programme which bridges the crucial gap in ICDS and needs of the very young and is treated as one of the most successful nutritional intervention programme [Berg; 1987]. Cost-wise also TNIP is economical compared to that of ICDS because the recurrent cost for same children is very low, because it is easy to rescue children from undernutrition trap when they are very young [Measham and Chatterjee; 1999]. The success story of ICDS and TNIP in Tamil Nadu is also attributed to political and public sensitivity over the issue of child undernutrition in that state [Rajivan; 2006].

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[7] TNIP started in 1980s is now known as TNIP-1. It is succeeded by TNIP-2, which covers non ICDS areas in of Tamil Nadu during 90's. From 1998 onwards it is known as WB-ICDS-III, as the name suggest, the programme is funded by World Bank and it is merged with national programme of ICDS with the added features of TNIP schemes.

In recent times, there have been a few attempts to decentralise and integrate various intervention schemes for women of reproductive age and children in to 'Reproductive child health' programme but it has failed to achieve the desired results [Srinivasan et al; 2007]. Similar conclusion also emerges from the comparison of findings from National Family Health Survey-I and II, where it is noted that improvement in several indicators of women's reproductive health and child health has been slowed down post RCH period, including underweight and stunting of children (RCH programmes started in 1998 to integrate various independent schemes for women and children). The underlying causes of failure is to do more with the incongruities in decision-making process under RCH scheme where decisions are taken at state level, while the implementation is at the district level 'Reproductive Health Societies'. These setbacks are also related with the fact that most of these district level agencies are often cash strapped bodies and have less than required human power for the purpose [ibid].

The observations from 2.3.1 and 2.3.2 suggest that the various child health programmes with maternal health component have not shown any substantial impact in child nutrition outcome (except in Tamil Nadu). It is rather disconcerting to note that the burden of undernourishment among children continues to be at a higher and improvements in the nutritional scenario across Indian states is marginal, a fact evident from the various reports of government as well as several international agencies [WHO; 1999, 2005a,]. The prevailing situation of child undernourishment warrants introspection of various policies and programmes in place towards addressing this persistent problem. There is reason to explore regarding the ineffectiveness of interventions, which depends on focus. Such focus to be effective requires immediacy to the phenomenon, which is validated by this empirical exercise.

This is primarily because the interventions seldom identifies and integrates the role of immediate determinants of child nutrition outcome, which are modifiable in shorter time period. In this regard, there is a dearth of studies that enquires into the role of immediate determinants and what could be its expected effectiveness if it gets converted into policy. So it is perhaps important to undertake a systematic analysis to comprehend the major immediate determinants and its performance across different population groups or geographical regions. This will help us to understand each correlates that affect the nutritional outcome of children at young age and choose the ones, which respond to the outcomes in shortest time period, predominantly from the perspective of policy interventions.

2.4. Maternal Undernutrition: Associations and Attributes

Physical and biological aspects make women more vulnerable to undernutrition than men. As a result, the risk of undernutrition is subjected to different age and sex groups within a given population. To be specific, the dependent (physical or economic) population is more prone to undernourishment than others for obvious reasons. Women need a lot of nutrients during their reproductive age. Biologists estimate women's calorie requirement in reproductive age is higher than the men of same age [Gopalan; 1978]. In India women face discrimination not only in socio-economic sphere but also discriminated in intra-household distribution of food. Predictably, it is observed that two-thirds of the Indian mothers are anaemic and half of them are suffering from anthropometric failure [IIPS; 2000]. Such disquieting facts irrefutably consign India as one of the poor performers in the nutritional scenario across the region.

Higgins and Alderman [1996], reveal the nutritional outcome of women could be influenced by their work status or the sector they work. The additional labour for the outside job and the traditional house keeping, unmet with adequate food can have negative impact on their health. Lack of social and economic autonomy in less developed countries might restrict women's access to health care, which has possible adverse effect on her health outcome [Furuta and Shara; 2006]. Early onset of reproductive life also contributes to deterioration of women's health status [Jejeebhoy; 1995]. In this regard it becomes a research priority to undertake an enquiry of the distinct components of women's characteristics as regard their bearing on undernutrition. These components include demography, dietary, socioeconomic as well as maternity related aspects [Chaurasia and Gulati; 2008].

The demographic component comprises of factors like age at marriage, age at first birth, total number of children and head of the household. It is found that women married at younger ages and having children early in life have higher prevalence of malnourishment [ACC/SCN; 1993, 2000]. Numbers of children also have a bearing on women's health outcome, measured in terms of body mass index [ibid]. Female-headed households also have higher prevalence level of undernutrition among women, because most of these households are likely to belong to poor section of the society or run by the women who are divorcee, widows or their husbands have migrated to other places leaving them in charge of the household [Buvinic and Gupta; 1997, Dreze and Srinivasan; 1995]. They have low income and low food intake compared to households headed by male [ibid]. NFHS-2 provides information on the marital status of women

and it is found that women who are divorcee and widows, reported higher prevalence level of undernourishment compared to their married counterparts [IIPS, Macro; 2000].

Similarly women with no education have higher prevalence of low BMI [IIPS, Macro; 2000]. Association between women's education and their nutritional outcome is well evidenced in literature [WHO; 2005, Black et al; 2008]. In Indian context Tribal women followed by the scheduled caste women are also more likely to be undernourished. Only exception is Assam and North-Eastern states where Tribal are different from other states in terms of the culture, education and social mobility [IIPS, Macro; 2000]. Household Poverty is one of the important correlate of undernutrition among any group including women [ACC/SCN; 2004, WHO; 2005b, Black et al; 2008]. India is no exception to that [IIPS, Macro; 2000]. There are even cultural underpinnings to some of this phenomenon of undernutrition among women, especially mothers. A study of three slums in Delhi, have shown that at least in 64 percent of the households women took food only at the end. In 25.6 percent cases husbands and in 50 percent cases male child were fed first. Only in a negligible proportion (0.61) of households daughters were receiving food without any orderings. Often in poor households, where food availability is inadequate, such cultural orderings allows little or negligible quantum of food share for the females who are entitled to eat only after the rest are through [Sudarshan and Bhattacharya; 2004].

Poor dietary energy and lack of antenatal care and postpartum care during and after the pregnancy are detrimental to women's health. Iron deficiency anaemia is found to be common among pregnant women in India, which is a result of poor dietary intake during pregnancy [IIPS, Macro; 2000]. Forty-seven percent of all maternal deaths in rural India is attributed to anaemia [WHO; 2006]. Maternal nutrition is also crucial to foetal outcome during pregnancy. Known as 'Intra-urine growth retardation', which starts in mother's womb is also starting point of poor nutritional status for the children. Needless to say 'IUGR' is the outcome of undernutrition among women. So the child and maternal undernutrition are complementary (interwoven) to each other rather than two separate incidents [Osmani and Sen; 2003, Black et al; 2008].

Poor access to nutritious food for women, are also crucial to the outcome of undernutrition among women [Bhutta et al; 2008]. The access to food again depends upon intra-household hierarchy, which is most unfavourable to women, especially in Indian context [Dreze and Sen; 1989, Barooah; 2004]. As discussed in earlier paragraphs, discrimination against women starts in their childhood [Barooah; 2004]. That discrimination extends to adulthood. The whole situation is described as 'poor

autonomy of women'. Majority of women are not allowed to decide about their reproductive health, especially about having number of children [WHO; 2005, Bhutta et al; 2008]. They are also deprived of access to the financial resources of the household and lack owning any assets [Agarwal; 1994]. Greater access to productive assets also positively affects the nutritional outcome of women [Chatterjee; 1990, Kurz and Johnson-welch; 2000]. In some societies the movement of women are restricted owing to cultural and social reasons and norms [Jeejebhoy[8] and Sattar; 2001, Jeejebhoy; 2000]. Lack of access to health care is also detrimental to nutritional and health outcome of women [WHO; 2005, Bhutta et al; 2008]. Lack of access to health care may happen due to absence of health care services, which, is failure on part of service provider (mostly public authorities) or due to lack of freedom to go and sought health care when it is available [WHO; 2005]. Domestic violence can affect not only women's health but child's nutritional outcome as well [Subramanian and Ackerson; 2007, Sethuraman; 2008]. It is also found that lack of autonomy even restricts positive impact of education on nutritional outcome of women [Saleem and Bobak; 2005]. Undeniably, all these disadvantages manifest in the poor nutritional outcome of Indian women (in anthropometrical as well as other clinical indicators) and transmitted to their children through 'IUGR'. [Osmani and Sen; 2003, Jeegebhoy; 1998].

The existing literature highlights the fact that intervention in immediate correlates (proximate) of maternal undernutrition like increasing dietary intake and reducing the burden of disease may not be fully materialised, if women's position in the household and society is not improved in terms of her mobility, access to financial resources, access to health care and role in decision making process in the household including matters related to her sexual and reproductive health. To quote, "*...Policymakers can help improve women and children's nutrition by addressing women's low status in society. Gender inequalities are often greatest among the poor, particularly in terms of household investments in health and education. Addressing gender inequalities can help ensure that women can get the nutrition they need, improving their own health and that of their families and, ultimately, contributing to their societies' development* [Ransom and Elder; 2003, WHO; 2005b]". From the foregoing discussion it emerges that the role of maternal autonomy is pivotal in determining the nutritional status of mother and the child therefore it deserves a great deal of attention, both analytical as well as socio-political. In this regard, the present study attempts to emphasise and quantify the role of maternal autonomy in improving

[8] The author in her 1995 work had identified five linkages through which literacy impacted on women's fertility. These are knowledge autonomy, decision-making autonomy, physical autonomy, emotional autonomy and economic and social autonomy [Jeejebhoy; 1995]. All these linkages are crucial to women's nutrition outcome, because women literacy is a crucial input to her nutritional outcome as well [Wagner; 2000, WHO; 2005, pp. 83-84].

nutritional outcome of Indian women given other well-known correlates of maternal undernutrition. From an analytical perspective, the anthropometric indicator in terms of Body-Mass-Index is used for measuring maternal nutritional outcome.

2.4.1. Maternal Undernutrition in India: Existing Interventions

Most of the maternal nutrition improvement programmes in India are also integrated with child nutritional programmes. All these programmes are supervised under Ministry of women, child and family welfare of Government of India. Both ICDS and 'Reproductive child health programmes' or RCH (started in year 1998) targets reproductive age women and pre-school children. The 'RCH' programme integrated the Maternal child Health programmes or MCH and Child Survival and Safe motherhood programmes or 'CSSM' along with programmes to control 'Sexually Transmitted Diseases or STDs' and 'Reproductive Tract Infection or RTI' programmes for better management of independent schemes of earlier years whose focus are primarily reproductive age women and young children. Along with ICDS and RCH programmes, 'National Population Policy or NPP' lunched in 2000, 'National health Policy or NHP' brought out in 2002 and 'National Rural Health Mission or NRHM' also have reproductive and child health components aiming to improve nutrition status of these two vulnerable groups. So there are considerable overlaps still dominating the maternal and child nutritional intervention programmes in India despite the focus on 'integration' of different programmes aiming to improve maternal and child health in India as advocated through 'RCH' in 1998 [Srinivasan et al; 2007]. The same Aanganwadi workers or 'AWW' are also entrusted with advising women on their maternal health issues. Recently lunched Janani Suraksha Yojna focus itself on the safe delivery and post-partum care for women. 'Accredited Social Health Activist' or ASHA workers are entrusted with door-to-door search of women in need of reproductive and nutritional counselling and ensure 100 percent institutional delivery in the area under their jurisdiction. They along with 'AWW' and 'Auxiliary Mid Wives or AMWs' forms the delivery agent of nutritional intervention schemes for women. They give counselling on nutritional requirement to women in their pregnancy, aware and educate women about 'Sexually Transmitted diseases', family planning and birth control especially about keeping gap between successive births, ensure that women deliver their babies in Primary Health Centres, encourage early breastfeeding and continuation of it, delivers supplementary feeding for women and children at designated centres (mostly at Anganwadis or at community centres), give iron tablet and folic acid to anaemic women and ensured new borne children are given proper immunisation against fatal infections and diseases and keep track of both mother and child's nutrition status. As mentioned

above only AMW are government employees and work at PHC where as AWW and ASHA workers are paid poor monthly honorarium. So there is lack of proper motivation for these workers to sincerely dedicate to the programme objectives as discussed earlier [ibid].

Apart from these national programmes, some states have their own variation, generally funded by international donors and executed through NGOs. The 'Tamilnadu Integrated Nutrition Project or TNIP' involves door-to-door counselling for pregnant mothers and iron supplementation. It becomes a model in itself for other states due to its coverage and positive benefits for both mothers and their children. However, broadly the intervention in maternal nutrition in India can be divided in to three aspects. First supplementary feeding for poor pregnant women and providing anaemic mothers with folic acid or iron tablet, giving them immunisation during pregnancy against ailments like tetanus and ensuring institutional delivery. But the issue of maternal undernutrition as discussed above is much more than just an issue of iron deficiency or lack of Antenatal care. It is also reflection poor status of women in Indian households as well, which compounds the problem further. All these mention intervention programmes do not focus on how to improve maternal autonomy for the women. Though there are some initiative in recent past to save women from domestic violence and ensure there access to financial assets through legal means, the concept of 'autonomy' has to be incorporated and emphasised in the nutritional intervention schemes as well.

From this brief review of intervention programmes in India it should be clear that their focus is primarily on either intermediary correlates or household correlates to improve the nutritional status of women. But the present study will highlight the role of 'autonomy of women' along with the known correlates of undernutrition among women. If the autonomy found to be of significantly affecting the outcome of undernutrition of women in presence of other correlates, then one can prioritise this variable for targeted group to improve its nutritional outcome.

2.5. Calorie Adequacy and Undernourishment: A Household Perspective

A household or a person is considered undernourished if they consume less than the prescribed level of calorie per day (in case of person the level is decided, according to his/her age, sex and occupation). Household calorie requirement implies the sum of individual calorie requirements of all the members of the household. However, the risk of undernutrition may vary for members of the household depending upon their age, sex and occupation [NSSO; 2000]. It is always possible that a household having calorie

security have calorie deficiency for it's certain members and similarly, a household with calorie deficiency may perhaps have enough calories for some its members. In both scenarios, the distribution of food among the members of the household is governed by relative positions of its members in intra-household hierarchy [Bouis and Haddad; 1992]. In India around 55.2 percent of the rural households suffer from calorie deprivation whereas for urban India the figure stands at a little higher than 57 percent [NSSO; 1999-2000]. One of the reasons behind low per capita calorie consumption in urban household is that, a considerable share of the urbanites actually leaves in slums with low income [MSSRF/WFP; 2004].

According to different sources, almost three quarters of the Indian population is believed undernourished in calorie dimension [FAO; 2002, Meenakshi et al; 2003]. The Scheduled Caste and Scheduled Tribe population in India have higher incidence of poverty compared tot their non-SC/ST counterparts in terms of poverty gap (20 percent for rural India and 15 percent for urban India) [Sundaram and Tendulkar; 2003]. So it must likely that Scheduled Caste and Scheduled Tribe households consume fewer calories on an average than their counterparts in non Scheduled Caste and Scheduled Tribe category. Even in the Southern part of the country the per capita calorie intake is lower than the set norm, for Scheduled Caste and Scheduled Tribe households [Meenakshi and Viswanathan; 2003; Radhakrishnan et al; 2004b].

2.5.1. Intra-Household Bias and Undernutrition

It is often argued that there remains an intra-household bias in food allocation to individuals corresponding to their power/status within household hierarchy, which makes an individual nutritionally compromised despite the calorie adequacy of the household. Such intra-household bias makes women and elderly more vulnerable in Indian household. There is considerable literature on this count informing that the household calorie adequacy is not a guarantee for all individuals in the household to be well nourished.

Following Becker's; 1991, characterisation, the Indian household system has been described as uni-modal in nature. Sen describes it as *a despotic household* where one individual (head of the household who is generally a most senior male) usually decides the utility trajectory of all members in that household. In fact the household's utility

function is considered to be same as that of the particular individual[9] [Kynch and Sen; 1983]. Undeniably, it is logically absurd to conceptualise that the household preference is similar to an individual's preferences. Sen further points out that absence of 'individual entitlement' often leads to capability failure among individuals of a despotic household. On similar lines it could be argued that lack of sensitiveness towards individual food requirement indefinitely aggravates the problem of undernutrition in India. Some of the studies have comprehensively focused on the importance of intra-household distribution of food in ensuring nutritional outcome of its members, especially young children and women [Bird; 2004, Haddad et al; 1996]. The latter in a detailed review of literature on undernutrition, found household head always gets highest preference in allocation of food than any other members. It is also found that gender bias in nutrient allocation is higher for adults in age 18-60 years group compared to children in age 0-5 years. It indicates as the girls mature to women they face more and more discrimination in food allocation [Lancaster et al; 2006]. Female-headed households are also more likely to face poverty than male-headed households [Panda; 1997, Buvinic and Gupta; 1997]. Though it is found that female head households spend higher share of their income on food, their overall low economic status may result in higher vulnerability to low calorie consumption [Panda; 1997].

Some studies also found the gender discrimination were higher in the poor households particularly belonging to the disadvantageous social groups such as Scheduled Caste, mainly during the lean seasons [Beherman; 1988, Beherman and Deolalikar; 1988]. The study was undertaken in six ICCRISAT villages of Andhra Pradesh and Maharashtra. Similar findings are also confirmed from Bangladesh and in Calcutta, where prevalence of underweight among girl children was found to be higher than boys during flood [Sen and Sengupta; 1983]. The study from two Bengal villages also shows that the prevalence levels of underweight among girls are identical in both the villages where land reform is successful[10] and in other where it is not. But in case of boys, the village with successful land reform has also better outcome of undernutrition for them in contrast to boys from the village without land reform. This implies the economic benefit accrue to the household not necessarily benefit male and female children in similar way. The study also shows that in the villages where land reform is not successful, but there is some

[9] Here the term 'family and household' is used interchangeably. Though, conventionally 'household' is used in sense of economic decision making unit but some authors prefer to use family and household synonymously, for example see Sen; 1989.

[10] Successful land reforms implies that now poor families have some income generating asset with assumption that quality of distributed land is satisfactory mainly because in Bengal - which is in Gangetic Delta - quality of land does not differ much.

direct intervention through food supplementation programmes (albeit for tribal girls only), there is a marked difference in prevalence of underweight among them compared to their counterparts in the other village which had no feeding programme (though land reform is successful). It might indicate that state has a role to play or for that matter some agency arrangement, to reach the deprived individual in a given household. Household in this case is not considered as a 'rational' distributive mechanism, which could take care of 'individual needs' for nutrients [Kynch and Sen; 1983].

It is found that an adult rural women works for 12-16 hours a day with energy cost of 2200 calories or more, but the actual daily intake of calorie is much below than that [Edmundson and Edmundson; 1988, Swyam; 2008]. The cultural norm of 'women eating last and least' is common among agricultural population in developing countries including India. In case of food shortage the women sacrificed their share of food for their husband and children. This results in higher prevalence of undernutrition among women [Chatterjee and Lambart; 1989]. The prevalence of household bias and food intake in urban slums is no different in rural settings. Being knotted to cultural roles, a woman prefers (culturally forced preference) to eat only after feeding the rest of the household members, particularly males [Sudarshan and Bhattacharya; 2004]. Even during pregnancy women in India face inadequate food intake [Hutter; 1996].

The nutritional scenario among the elderly in India is also pathetic and needs immediate attention. Of late, this grappling problem has received paramount attention in the field of demographic health research, particularly due to the onset of the demographic phenomenon of population ageing. This is very important when 51.4 percent of the Indian elderly to be fully dependent on external support for their survival and comprising of large proportions of females among them. For urban India, the situation worsens with over 60 percent of elderly population identified to be fully dependent. Here also the gender dimension in dependency is starkly visible and there are more concerns here as this population is at more risk for calorie deprivation [Rajan; 2004].

2.5.2. Household Nutrition Security: Strategies and Interventions

Food security for the household is the necessary condition of nutrition security of the household. The most talked about programme that aims to ensure food security of the Indian household is 'Public Distribution System or PDS'. It is the largest food distribution network in the World. With a network of 4.75 lakh 'Fair Price' shops the essential food items like rice, wheat, sugar, iodised salt, dal (pulses) and kerosene. It is a major component of safety net for poor and over the years it has received political as

well as academic patronage despite strong argument to abolish it in some quarters, due to heavy subsidy incurred and leakages. But the programme is far from over and getting stronger in successive years [Ray; 2007, Radhakrishnan et al; 2005]. Though PDS involves providing major food items to poor, it often found that poor especially from marginalised communities have been either excluded or poorly benefited from the programme, especially in case of scheduled caste households and Tribals, especially in Northern states [Lee and Thorat; 2005]. But still the PDS is the major source of calorie for poor Indian households especially in rural areas, households from backward communities and female-headed households despite change in food consumption pattern and food basket diversification [Ray; 2007]. To make the programme benefit poor and exclude the non-poor from the food subsidy, the beneficiaries are divided in to 'Above poverty line or APL' and 'Below poverty line or BPL' from 1997 onwards. The PDS is re-christened into 'Targeted Public Distribution System or TPDS'. For each state the income criteria for determining BPL households are different. The below BPL families are offered rice/wheat at 50 percent of economic cost of PDS while the APL families are charged for the total economic cost. Currently both APL and BPL families are getting 35 Kg. of food grain per family per month but at two different prices. In recent years two different programmes but offshoot of main PDS scheme has been introduced. One is 'Antodaya Anna Yojana or AAY', started in Dec. 2000 where poorest one crore families from total 6.52 crore 'Below Poverty Line or BPL' families are provided with major source of calorie like rice or wheat at very nominal prices [ibid]. By 1st August 2004, the beneficiaries under this scheme are increased to 2.5 crore families, almost 38% of total BPL cardholders. Under this scheme wheat is provided with Rs. 2 per kilogram and rice per Rs. 3 per kilogram. . From 1st April 2002 onwards the monthly quota per family under 'AAY' has been increased to 35 Kg. from 25 Kg. allotted earlier. Another scheme called 'Annapurna scheme' started in 2000-01, for the poor elderly above the age of sixty-five, who do not have old age pension and lives below poverty line. They are provided with 10 Kg. of cereals (rice or wheat) per person per month free of cost. Several other schemes like 'National Rural Employment Guarantee Programme or NREG' lunched in 2006, and Food for work programme of 'FFW' has also provision of paying a part of wage in terms of food grain. Mid-day-meal scheme for school going children (which targets undernutrition among adolescents) and special feeding programmes for affected areas are also having strong food security component [GOI; 2007]. Despite all these implementations, still the beneficiaries of PDS distribution are judged by income criteria (i.e. by official poverty line for rural and urban areas for respective states). Thus the persons or households, who are near the BPL line but not below it, are excluded from the food subsidy. But these households also draws major calorie requirement from cereals like rice and wheat. In recent years the change in taste

leads to more dependence on rice and which are getting costlier over the years. Per-capita calorie expenditure is increasing for all the households. For rich section it is due to switching to costlier source of energy and protein like pulses, milk and milk products and animal protein. For poor and near poor households it is shifting from locally available cereals to rice and wheat, which marketing price is still increasing due to short supply and increasing demand along with hoarding etc. [ibid]. It is estimated that prevalence of undernutrition or POU will increase manifold without PDS for all the major states in India, especially rice eating belts of south as well as eastern India. [ibid]. Still the 76.7 percent of total calorie intake of rural poor comes from cereals. For urban poor the corresponding figure stands for 68.3 percent [Pradumna Kumar et al; 2007]. The persisting gap between income poverty and nutrition poverty in India indicates even reducing the calorie norm to 80 percent of the present level will leave vast households undernourished. Some researchers who argued that these norms are based on requirement of an adult male doing sedentary work needing more calories, but change in occupation structure may reduce the energy requirement. So they advocated for reduction in norm level.

Above may be true for some occupations like blue collar jobs, but still majority of workforce in urban as well as rural India depends upon energy-intensive work including those around BPL line but above it (in rural India the occupation structure is still agriculture based which needs higher physical energy as mechanisation of agriculture is restricted to few well irrigated areas.), justifying the present norm levels to be pursued [ibid]. At the same time, several researchers have suggested that the income criteria to select the beneficiaries of PDS should be abolished [Ray; 2007, Radhakrishnan et al; 2005, Pattnaik; 2004].

Another aspect of current household nutrition intervention is micro nutrient fortification. Since those persons who suffer from calorie deficiency are also like to suffer from micronutrient deficiency, because for majority of Indians cereals still provide major source of iron, riboflavin and other micronutrients [Pandey; 2005]. So increasing price of essential cereals like rice and wheat and still costlier items like milk and milk products, animal proteins and fruits which are virtually out of reach for vast majority of poor in India, needs that the crucial micronutrients and vitamins should be provided to these section at affordable prices. There is not better way but to add these micronutrients and vitamins which control the vital functions of human body and maintain the immune system against infections and ailments, to the widely used necessary food articles like wheat flour, rice, sugar, salt or oil. The experiments from Gujarat shows that fortified wheat flour has considerably decrease the prevalence of

iron deficiency anaemia and vitamin-A deficiency among users. Some states like Chattishgarh, Punjab, West Bengal, Andhra Pradesh and Haryana are also taking steps to add micronutrients in major food items of the population. 'Food and Nutrition Board or FNB' along with ministry of 'Women and Child Development', Health and Family Welfare, 'Indian Council of Medical Research' or ICMR, 'National Nutrition Mission', civil supplies department and women and child health department of various states and selected NGOs like 'Micronutrient Initiative', 'Child in Need Institute or CINI', are supervising the fortification of such food items in various states to eradicate various micronutrient deficiencies. Thus the 'food security' and 'nutrition security' are combined in such intervention strategies [FNB annual report; 2007]. But all these interventions are assuming that availability of fortified food items itself will ensure reduction in prevalence of undernutrition for all the members of the household alike. But the studies discussed earlier do not see such an automated process where household food availability will be available to each of it's members according to their requirements as long as distribution mechanism within the household remain biased towards male adults or male children. The benefit of such initiative can be adequately reached to all the members in two ways. First, ensuring adequate food availability at household level. Second making intra-household distribution sensitive to the requirement of women, children, old and sick members. While the latter to large extent depends upon the maternal autonomy as discussed earlier and sensitising the society to the needs of women, children and old, the availability at household level should itself determined by the requirement of the household. As discussed earlier the requirement of an household depends upon its activity level of its members and demographic composition. A household with large number of children, women and other dependents may face calorie inadequacy if the earning members are less or the household as a whole belong to poor socio-economic strata like that of tribal, scheduled castes or household earning livelihood from manual labour. A similar attempt has been made by Meenakshi and Ray (2002). Their finings indicate use of consumption economies of household size and of adult/child relativities in estimation of poverty will bring a different poverty scenario in Indian context. The household with more number of children may have different expenditure pattern than the household with more number of adults. This study also found 'Female headed households' and households from backward communities will have more prevalence of poverty both in terms of official poverty line and 'Behaviourally determined poverty line' or BPDL, (BPDL is based on the state specific consumption pattern and consumption economies given by adult/child relativities of the concerned household). But the above study uses the consumption expenditure to determine the impact of household size and composition on the poverty outcome [Meenakshi and Ray; 2002]. In the current study the impact of

occupation, social background, household size and household composition together will be looked into on the more direct outcome of poverty i.e. calorie deprivation of household. Generally average household size for households from poor economic status and coming from marginalized communities like scheduled caste and scheduled tribes is larger because of presence of more number of children. Households with the above characteristics have higher fertility level as well [IIPS, Macro; 2000]. So for these households while fixing the requirement of calorie, the income criteria alone will not suffice. Instead a combination of occupation structure of the household, socio-economic background with (without) income will be more meaningful while determining the food necessity of a household. That possibility is explored in the study by studying the nature of calorie deficiency households with respect to their occupation, household size and demographic break-up.

Based on the above discussion it could be argued that the existing literature on calorie deprivation for Indian households mainly focus on their household characteristics like income, poverty, social background, place of residence and occupation. But effect of Demographic composition of the household is not taken into account for many of the empirical studies though they identified vulnerable groups like women and, children and old age in the household who may face higher burden of the calorie deprivation. The present study will try to find out the vulnerability of the households to calorie deprivation, controlling for their household characteristics as well as their demographic composition (in terms of number dependent with respect to number of adult males in the household). Perhaps, it will help to widen the present intervention for household food security that is PDS, to identify beneficiaries on the basis of 'household need', and not 'household income' alone.

2.6. Measuring Undernutrition: Some Issues in Comparison and Interpretation

The measurement of nutritional deprivation in India and elsewhere is not much different from other measures of deprivation, especially income poverty. Head count Ratio and Aggregate Head count are widely used to determine the percentage of population undernourished as well as the aggregated number of nutritionally deprived people [See reports of NSSO, NFHS, DHS and reports of ACC/SCN of various years]. Whether the indicator used to measure undernutrition is anthropometric (in terms of body mass index, stunting, underweight or wasting) or calorie inadequacy (protein-energy undernutrition), figures are referred to aggregate head counts or Head count ratio. Quite often these two widely used methods give two different pictures for the same event. Subramanian (2005), tries to resolve the issue in case of income poverty

with help of blended measure of 'Head count ratio' and 'aggregate head count', which is unit free and give comprehensive picture on prevalence level of a phenomenon. The study tries to use the same idea to measure nutrition poverty.

Unlike income poverty the outcome of nutrition deprivation depends upon various non-economic factors like gender discrimination, poor hygiene, higher morbidity risk along with wide spread poverty. A true picture of undernourishment will only emerge if one takes in to account the intensity and severity aspect of undernutrition along with prevalence level reported by. Head count ratio method, widely used. In Indian context the prevalence of undernourishment varies among different states. The severity and intensity also vary differently in those states. For example in Kerala, the widespread calorie inadequacy is not serious because the intensity is very low though prevalence level is high. In other hand in Orissa calorie deprivation shows lower prevalence or prevalence but the intensity and severity is quite high. The possible conclusion is that in Kerala the prevalence of undernutrition in calorie terms is mild because majority of calorie inadequate household consume near suggest norms, where as in case of Orissa those who are consuming less are far below the norm. So Orissa is more disadvantageously positioned against Kerala in terms of calorie deprivation. So a rational intervention will focus more on Orissa than in Kerala [Mishra; 2003, NSSO; 2000]. An attempt has been made in the study to incorporate the intensity and severity aspect to nutritional measurement for drawing focusing strategy for the respective states. The study extends the standard FGT approach to measure intensity and severity of undernutrition as well [Foster et al; 1984].

Similarly gender discrimination, which is unfortunate reality in Indian context, needs to be incorporated while measuring child undernutrition, especially for children. Since the discrimination against female children started after her birth, the nutrition status measurement needs to be sensitive towards this particular aspect. Current reports on nutritional status of Indian children do not reflect the gender aspect in prevalence of undernutrition among children [NFHS-2; 1998-99, NFHS-3; 2005-06]. An attempt will be made in this regard with help of group-differential method proposed by Mishra and Subramanian (2006) in the current study.

Thus the present study will try to resolve the issues raised regarding nutritional deprivation among pre-school children, reproductive age women, household calorie intake and measurement of nutritional deprivation in the subsequent chapters. As regard nutritional deprivation among pre-school children, the study adopts an approach of emphasising immediate factors of intervention and in case of maternal

undernourishment the study deviates from the common set of individual characteristics to suggest operational attributes like autonomy helping translate individual attributes into outcome of better nourishment. While dealing with household undernourishment, the study observes socio-economic attributes as necessary but not sufficient on describing the outcome. Finally it closes on highlighting some issues relating to comparison and interpretation of the level of undernourishment owing to its dichotomous character.

CHAPTER 3

DATA AND METHODOLOGY

3.1. Selection of Data for the Study

The present study is a cross-section study without any temporal component as we are primarily interested in recognizing/identifying the social and economic correlates of undernutrition among children and women in India. In this regard, the data sources should allow us to study the problem of undernutrition from two different but complementary dimensions namely, anthropometry (direct measure) and calorie-intake (indirect measure). Further, it is also expected that the nature of information obtained in the data sources would be nationally representative and amenable to appropriate bivariate and multivariate analysis to test the robustness of the conclusions. For the present analysis we can identify four possible data providers on health and nutrition in India. These providers are National Nutrition Monitoring Bureau (NNMB), National Council of Applied Economic Research (NCAER), International Institute for Population Sciences (IIPS) and National Sample Survey Organization (NSSO). However, from an analytical perspective the health and nutrition data available from sources like NNMB and NCAER have more limitations as compared to the data provided by the other two agencies.

To elaborate, in the NCAER data the nutritional information is restricted to the children of age group 0-12 years [NCAER; 1994]. The data is also limited to rural India hence it is not feasible to study the advantages and disadvantages of place of residence in terms of rural or urban settings on the nutritional outcomes. In addition, it has only 33,000 households from 16 states. The NNMB data is collected in several rounds comprising different set of states and hence are not comparable to each other as the target group is different for each survey. In fact, in some of the surveys conducted by NNMB, information on anthropometric, calorimetric and other micronutrient deficiencies are available but it is very difficult to do a follow up survey. Although, NNMB does undertake separate follow-up studies for assessing intervention measures, it comprises of very small sample size in selected states[1]. However, the other two datasets provided by IIPS and NSSO do not have such limitations in terms of sample representation and information coverage. Also, unlike NNMB and NCAER the data provided by IIPS and NSSO are more or less easily accessible to researchers. IIPS is the nodal agency, which conducts the National Family Health Survey (NFHS). These surveys have emerged as

[1] For details on nature of data provided by NNMB, see Ramachandran; 2006, pp. 112-113.

an important demographic and health database available in India. The principal objective of NFHS is to provide state and national level estimates of fertility, the practice of family planning, infant and child mortality, maternal and child health and the utilisation of health services provided to mothers and children. NSSO conducts Consumer Expenditure Survey (CES) on a quinquennial basis wherein information is collected on quantity and value of household consumption of different goods and services. From this data, we can extract information regarding calorie consumption at the household level in relation to its socio-economic background. In the subsequent subsections we discuss the specific dataset used for this study and the structure, design and nature of information obtained through these surveys.

3.1.1. National Family Health Survey-2 (1998-99)

The National Family Health Survey-2 (NFHS-2) was conducted during November 1998 to March 1999 covering a representative sample of 90,000 ever-married women who are in the reproductive age group of 15-49 across all the Indian states. As discussed above, the NFHS-2 dataset provides information regarding reproductive and fertility profile, family planning, maternal and child health and health services utilisation. Also information is collected to understand aspects such as women's status in the household in terms of indicators such as occurrence of domestic violence and her decision-making power[2] as regards financial and health related decisions. Specifically, the survey provides indicators to assess maternal and child health, quality of health and family welfare services, women's reproductive health outcomes, respondent's educational status, occupation status, nature of the job etc. Along with this, particulars about the economic status of the household where respondent is living is also gauged through the reporting of household's ownership of agricultural land, irrigated land owned by the household, type of house, basic facilities available in the household such as toilet, source of drinking water and lighting, fuel used for cooking and durable assets owned by the household.

One of the important features of the NFHS-2 health information is that the survey provides height and weight measurements for all eligible women (women of age 15-49)

[2] The NFHS survey also enquires about the women's involvement in decision-making process in the household. It reflects the women's status in the household vis-à-vis other members in the household in terms of her contribution in deciding what to cook, about obtaining health care, while purchasing jewellery, regarding women's stay with the family, whether permission needed while going to market or while visiting relatives and whether she is allowed to have money set aside.

and pre-school children (children of age 0-35 months) included in the sample. Nutritional status of women and children is assessed in terms of anaemia and different anthropometric indicators such as Body Mass Index (BMI), stunting, underweight and wasting. Information is collected on their height-for-age (stunting), weight-for-age (underweight), weight-for-height (wasting) and their anaemia levels. However, in case of children, the anthropometric information is available only for those who are less than three years old at the time of survey. Altogether, there are 77,119 reproductive age women for nutritional indicator in terms of BMI, for children the number is 24,600 for stunting, underweight and wasting. The information about three important health problems of diarrhoea, fever and acute respiratory infection, which causes maximum mortality among young children were covered under the survey with reference to a specific period. Child immunisation and breast-feeding practices, which are crucial to the health outcome of the children, were also reported in the survey. Apart from the above information, details regarding antenatal checkups, place of delivery, post-partum care and dietary intake of women were also reported.

3.1.2. Consumer Expenditure Survey - 55th Round (1999-2000)

The National Sample Survey Organisation (NSSO) carries out all India household surveys on consumer expenditure with a large sample usually once in five years. 55th round was the sixth quinquennial survey in this line conducted during July 1999 to June 2000. The particulars of household consumer expenditure were collected from 1,20,309 households spread across 6,046 villages and 4,116 urban blocks with a moving reference period. It mainly collected information on quantity and value of household consumption of different goods and services. In addition to various details about the consumption expenditure of the household it also have information on household's of place of residence, demographic and social profile of the household, the major occupation of the household and calorie consumption for the household. This information is useful in tracking the nutrition adequacy in terms of calorie intake of the household by the occupation of the household. The present analysis intends to identify undernourished households according to their characteristics and composition. While characteristic identification with the available information on household characteristics facilitate targeting programmes aimed at addressing undernourishment, the composition analysis helps in identifying vulnerability of a household to undernourishment with a specific composition (age, sex, marital status and economic activity). Since NSSO does not give age-sex break up of the calorie intake, the significance of this approach lies in capturing the issue of intra-household distribution of available diet.

When these two datasets i.e., NFHS-2 and NSSO-55th Round, are compared regarding nutritional status indicators it is noted that they adopt different approaches to obtain the information. NFHS-2 provides information regarding direct measure of undernutrition of women and children through the anthropometric measures whereas NSSO provides an indirect measure of undernutrition through per capita calorie intake of households at all India and state levels. Nonetheless, from the following chapters it would be clear that the data is appropriately used for the study as per the different analytical requirements. For this study, we have considered only the 15 major states for the analysis, which accounted for more than 80 percent of the population of the whole country and different agro-climatic conditions.

3.2. Indicators of Undernutrition

Economists and planners understandably look for tidy methods of quantifying undernutrition in population groups. However, biologists recognise the inherent limitation and pitfalls of exercise to measure undernutrition with a mathematical precision. A reliable estimate of undernutrition in a community is mainly based on two approaches of indirect and direct method, which are practicable under the real life condition. These measures largely serve the needs of the public health scientists and development economists. Indirect method aims at tracing the diets of individuals of households in a community to derive information on the nutrient intake, especially the calorie intake. Direct method on the other hand relies on the anthropometric and clinical assessment of an individual. Anthropometric measures work much better for young children than for adults, and rather better for women of reproductive age than for men of the same age or for older people of either sex [WHO; 1995].

Body Mass Index (BMI)

Anthropometric measurement of Body Mass Index (BMI) is the direct method to measure the nutritional status of human beings. Decrease in food intake in combination with disease is the main cause of reduction in body weight. When energy intake is more than the energy expenditure, the excess of it is stored in fat mass. Both underweight and overweight are considered as malnutrition. The height of an adult is an outcome of several factors including nutrition during childhood and adolescence. Therefore, weight and height information are utilised to calculate BMI and it is defined as weight in kilograms divided by the height in meter square (Kg/m^2). According to expert committee on physical growth [WHO; 1995], the classifications of underweight are as follows: mild underweight (BMI = 17.0 to 18.49 Kg/m^2, moderate underweight (BMI =

16.0 to 16.99 Kg/m^2) and severe underweight (BMI < 16.0 Kg/m^2). These three groups are considered to be chronically energy deficient (CED). For over weight the categories are, Grade 1 (BMI = 25.0 to 29.99 Kg/m^2), Grade 2 (BMI = 30.0 to 39.99 Kg/m^2) and Grade 3 (BMI > 40.0 Kg/m^2).

Stunting

The anthropometric index of height-for-age reflects linear growth achieved in pre and post-natal periods with its deficits indicating long term, cumulative effects of inadequate nutrition and/or health. It happens due to lack of protein, which is necessary for growth of cells and enzymes. Short height refers to low height-for-age that may reflect either normal variation in growth or deficit. Stunting refers to shortness that is a deficit or a linear growth that has failed to reach the genetic potential as a result of poor diet and disease. Nutritional status of children calculated according to this index is compared with the nutritional status of an international reference population recommended by NCHS/WHO. Stunting is defined as low height-for-age at less than 2 standard deviation (SD) of the median value provided by the National Centre for Health Statistic/World Health Organisation's (NCHS/WHO) international growth reference. Severe stunting is defined as -3 standard deviation (SD) from the median reference of NCHS/WHO's growth reference [WHO; 1995].

Underweight

Weight-for-age represents the body mass relative to given age. It is considered to be sensitive to short-term changes in nutrition status because weight is very sensitive to current diet and health status. Low weight-for-age is defined at -2 Standard Deviation (SD) of the median value of the international reference. -3 Standard Deviation (SD) is considered as severe underweight. Moderate underweight occurs due to lack of calorie and fat. Severe underweight is more likely to occur due to infections, diarrhoea and other ailments along with inadequate diet [WHO; 1995, Haddad and Smith 2000)].

Wasting

It reflects substantial weight loss in immediate past due to acute shortage of food or severe illness. It is explained in terms of body weight with reference to height. Moderate wasting refers to -2 Standard Deviation (SD) and severe wasting refers to -3 Standard Deviation (SD) from the median value of internationally accepted weight-for-height reference. This indicator is used extensively in emergency settings. However, this

method has not been applied in the study due to very less number of cases in the sample.

Anaemia

Anaemia refers to low level of haemoglobin in the blood. Haemoglobin, which transfers oxygen from lungs to other tissues and organs from of the body, is a mixture of iron, foliate, vitamin B_{12} and some other micronutrients. In clinical literature anaemia refers to lack of adequate iron in the body, which reflects inadequate or nutritionally poor dietary intake of the person. Due to other reasons such as diseases, women who are pregnant, people who are fasting regularly are also likely to suffer from temporary anaemia. Anaemia among women is considered crucial for their own health and health of their children. Anaemia during pregnancy increases the risk of premature delivery and low birth weight for the babies [Seshadri; 1998]. The haemoglobin level is measured through HemoCue procedure (which reads the concentration of haemoglobin level in one drop of blood), which is considered to be one of the best available procedure and used through out the world for the purpose [Von Schenk et al; 1986, Krenzicheck & Tanseco; 1996]. Generally they use the third or fourth drop of the capillary blood to analyses the haemoglobin level, which is measured as concentration of haemoglobin, in terms of grams per decilitre of blood (g/dl is the notation, used to show haemoglobin level in a drop of blood). Then levels used to determine degree of anaemia are; mild anaemia; 10.0-10.9 mg/dl for pregnant women and 10.0-11.9 g/dl for non-pregnant women, moderate anaemia; 7.0-9.9 g/dl and severe anaemia; less than 7.0 g/dl. Further, adjustments following the guidelines from Centre for Disease control and Prevention [CDC; 1998] are made for the women who are smoking and living in high altitude, since they need higher-levels of haemoglobin in their blood.

Anaemia is not considered for our analysis because it is basically a clinical indicator. Anaemia levels can fluctuate in a relatively short period of time. For instance, mothers who have given birth in recent past and still breastfeeding are more likely to be anaemic [UNICEF/UNU/WHO/MI; 1999]. Anaemia results are also questioned by researchers on the fact that HemoCue method overestimates the haemoglobin level in the blood compare to alternative methods like blood cell count method (BCC) [Prakash et. al; 1999]. Anaemia indicators are also amenable to seasonal fluctuations. In India since agriculture is major source of income for majority of the population, especially in rural areas, it is likely that during lean seasons, especially monsoons, many households do not have adequate food, because of lack of employment or rise in food prices, which might result in low anaemia especially for women [ACC/SCN; 1993, Benteley and

Griffth; 2003]. Also, NFHS-2 under estimates the anaemia prevalence (which follows a HemoCue method) compared to the widely used BCC method (or blood cell concentration method) [Prakash; 1998]. NNMB reports reinforced Prakash's findings that NFHS-2 underestimates the haemoglobin levels, (they have used the cyanmethaemoglobin method) [NNMB; 2005]. Since different measure has different cut-off points, we choose to drop this indicator.

Calorie Measure of Undernutrition

The human body coverts the diet into energy through complex physical and chemical process known as 'digestion'. The energy required by the human body is measured in 'calorie' unit. A calorie is the amount of heat (energy) required to raise the temperature of 1 gram (g) of water by 1 degree Celsius (°C). The density of water is 1 gram per milliliter (1g/ml) therefore 1 g of water is equal to 1 ml of water. So calorie values of food are actually kilocalories (denoted by KCAL or capital C). There are 1000 calories in a kilocalorie. The concept of calorie intake could be used to assess the degree of poor and undernourished in a given country. Since lack of food implies poor energy availability to the human body, which may hamper its current as well as potential activity level and result in poor health. All these may lead to an individual in a state of increased morbidity, poor participation in economic activity and thereby resulting in a cycle of poverty and poor health for him. So poor dietary energy limits human capability and is recognised as one of the major factors that affects choice set of an individual [Dreze and Sen; 1989]. The Indian Council of Medical Research (ICMR) has brought out a nutrition chart, which has specified the calorie requirement of Indian population by taking in to account age, sex and activity level. So a male of age between 20-39 years doing sedentary works is considered as the reference unit, for whom the calorie intake is decided at 3500 Kcal per day. For other age and sex combinations the required calorie norm is computed as proportion of this reference male. At the household level, the calorie requirements of all its members are aggregated to get the calorie requirement of that household. Then the calorie actually consumed is derived from the observation of actual food intake of its members through 7-day or 30-day recall period. Using the figure from calorie conversion chart for selected food items for a given quantity, the actual calorie intake of the household is computed. If the calorie intake of the household is less than what is required, given it's demographic composition in terms of age and sex of it's members, the household is categorised as undernourished or calorie deficient or energy deficient household [Gopalan; 1978, NSSO; 2000]. It is called indirect method because it takes into account the availability of energy from dietary

consumption to assess the nutritional status of the individual rather than observing the physical feature of its members, which can be measured directly.

3.3. Framework of Analysis

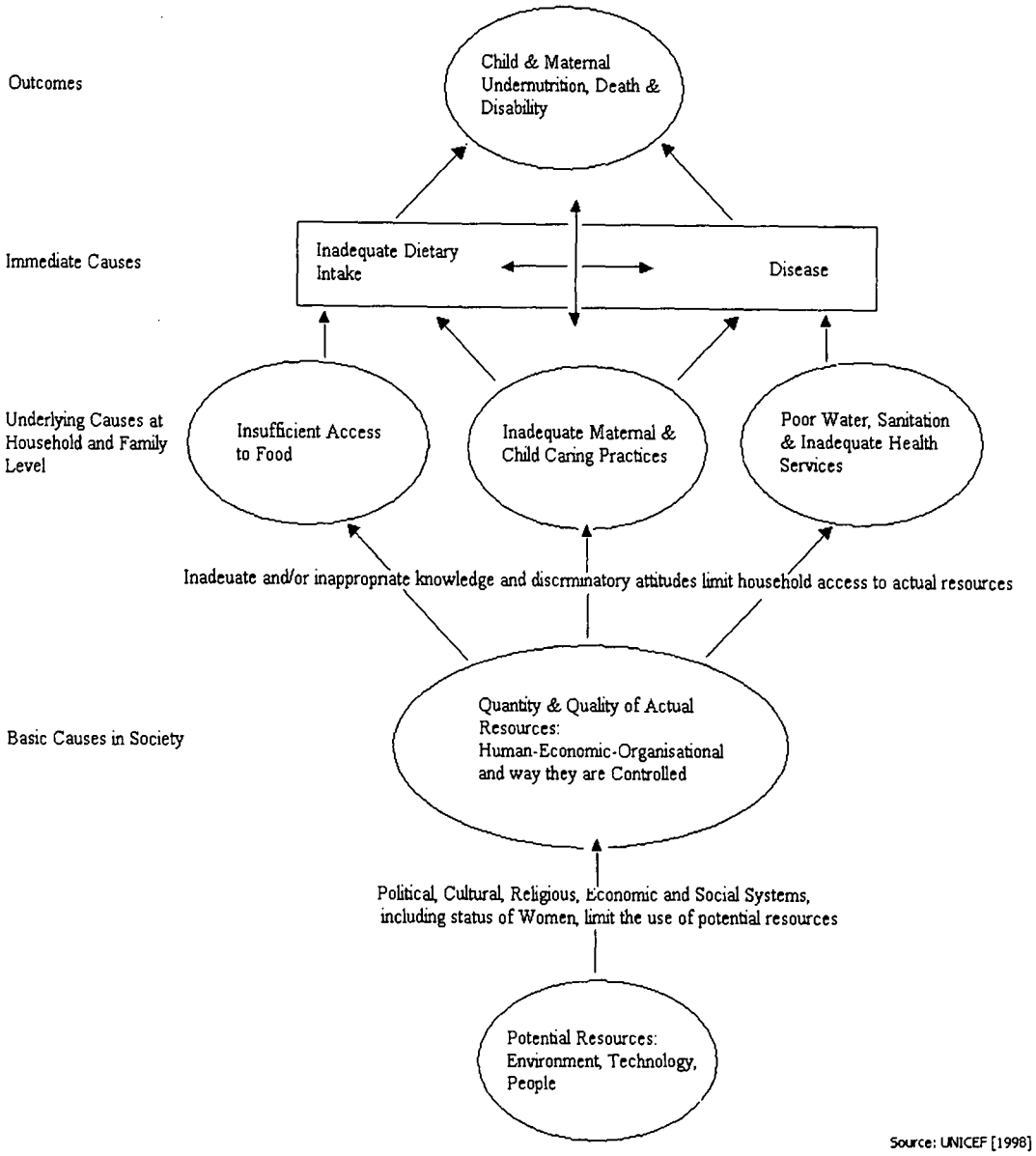
There are different approaches to analyse undernutrition. Life cycle approach to undernutrition depicts how poor nutrition starts in uterus and extends particularly for girls and women, into their adolescent and adult life. Thus it spans across generations. Undernutrition that is experienced during childhood, adolescence and pregnancy determine birth weight of infants. Low birth weight infants who have suffered intra uterine growth retardation or IUGR as fetuses are born undernourished and have higher risk of dying in the neo natal period or infancy. In case they survive, they fail to catch up lost growth and are more likely to experience a variety of developmental deficiencies. A low birth weight infant has higher risk of being stunted or underweight in early part of her life. Epidemiological evidence from developing as well-developed countries suggests a link between foetal undernutrition and higher risk of various chronic diseases during adult ages. It is known as foetal origin of disease hypothesis [Barker; 1998].

Life cycle approach shows how various nutrition problems, its causes and consequences change and interact over time. However, understanding the correlates of undernutrition for a cross section of individuals may well is in terms of analysing the operation of various determinants of undernutrition at different stages of the human life cycle. Food-health-care framework is one such approach, which categorises causal factors and their interaction at three levels. They are 'immediate factors' (Dietary intake and disease), 'intermediary factors' or underlying causes at household level (education, care practices, basic sanitary facilities, poor access to food) and 'basic factors' i.e. socio-economic hierarchy, pattern of governance, level of economic development, status of women, religious and cultural factors, regional disparity, environment, availability of infrastructure etc. [See Figure 3.1].

The advantage of food-health-care framework over life cycle approach lies in the fact that it can capture the individual as well as aggregate impact of different household as well as community level factors on the nutritional outcome. It characterises a host of determining factors of undernutrition as immediate, intermediary and basic in terms of their hierarchy of association with nutritional outcome (or proximity to the outcome). This hierarchy recognises factors that influence nutritional make-up towards revealing clues as regards factors of focus and intervention. This framework can be easily adapted

to all age groups and all types of nutritional outcomes, though originally it was envisaged for conceptualising child undernutrition [ACC/SCN; 2000]. Food-health-care framework is also useful when information is available for only one reference period. In that case only a cross-section study is possible. The life cycle framework needs follow-up approach where a case under study needs observation for more than one time period. For above reasons current study adopts the food-health-care approach.

Figure 3.1: Food-Health-Care Framework



Source: UNICEF [1998]

While all factors are of significance in their own right, immediate factors are those worthy of intervention. From an intervention and policy perspective, it is worth tracing the factors which can be targeted for better outcomes in a short time period for improvement in nutritional status of children and mothers. Causal relationship between

outcome variable and possible correlates can be asserted through application of different statistical tools. This approach requires the factors to be grouped for individuals. One such widely used statistical technique is cross-tabulation of outcome and possible correlates of outcome. So the study carries out cross-tabulation to list the possible correlates of the nutritional outcome for women and pre-school children prior to any in depth enquiry.

3.4. Group Differentials as a Means of Recognising Correlates

One of our prime concerns in this study is to identify the nutritionally vulnerable groups. To assess the association between nutritional outcome and selected correlates the cases are divided in to two mutually exclusive groups for outcome variable as well as selected correlates. The advantage of this particular method is that, it calculates group differentials in terms of risk of undernutrition, independent of the effect of over all prevalence of undernutrition, which might affect the group differential. This concept of group inequality and its measurement is proposed by Chakraborty (2001). This technique is used to recheck the findings from one-way association (cross-tabulation) of undernutrition with childhood ailments, immunisation, mushy food supplementation and breastfeeding. These four correlates are treated as 'immediate correlates' of nutritional outcome for children in India.

Group inequality approach has not been adopted for determining correlates of maternal undernutrition given the nature of the information at hand. There is lack of information on immediate correlates for women. The information on selected diseases for women has very few cases at all India level. Similarly, information on food is partial as it only gives frequency of consumption of six-selected broad category of food items (Milk and milk products, pulses, vegetables, green leafy vegetables, fruits and egg/fish/meat) not the quantity as such. Information on these items is not dichotomous in nature to be categorised as groups. An index for all the six food items is used to comprehend categorised association between diet and nutritional outcomes of women measured in terms of the body mass index. Further, we have recoded the scores to some range (preferably dividing the entire range into three categories) for describing worst to best scenario following which we examine the association between BMI and this index or composite variable. The exercise remains similar for assessing the association between women's autonomy and nutritional outcome of women in terms of their BMI score. The construction of the various indices is further elaborated in the following chapters.

We have examined the calorimetric dimension of undernourishment from NSSO 55th round. This source provides information at the household level in terms of per capita intake of calorie. The proposed analysis pertains to identify undernourished households according to their characteristics and composition. While characteristic identification with the available information on household characteristics facilitate targeting programmes aimed at addressing undernourishment, the composition analysis helps in identifying vulnerability of a household to undernourishment with a specific composition (age, sex, marital status and economic activity). Such a composition analysis could help in deriving on the individual characteristic based vulnerability to undernourishment. The significance of this approach lies in capturing the issue of intra-household distribution of available diet. Literature does show that in underdeveloped societies the age-sex composition and relation of household members with the head of the household is an important factor for deciding the available food basket among different members of the household [Deolalikar and Beherman; 1988, Harris; 1995]. Since NSSO does not give age-sex break up of the intake, the above said approach will help us to know whether the households having more dependent population have more risk of undernourishment. A study on micronutrient deficiency is avoided (which is possible from NSSO though at household level only), because the sources of macronutrients like calorie, protein and fat, are also major source for micronutrients in Indian context. In other words the cereals and pulses are major source of both calorie and micronutrients [Gopalan; 1978]. Group inequality measurement is applied here to ascertain the association between calorie deficiency at household level and the demographic composition of the household.

3.5. Statistical Techniques for Multivariate Analysis

From a methodological viewpoint, this work tries to explore simple but comprehensive techniques. We deliberately avoid any sophisticated technique to keep the arguments meaningful, simple and easily understandable. First part of our analysis is based upon descriptive. We have made bivariate cross-tabulations to know whether any significant association exists between two events and if so does it qualify for further multivariate analysis. The Pearson's chi-square is used to determine statistical significance of the association.

Later, a multivariate analysis of binomial logistic regression is carried out to get the focused factor's determining influence on nutritional outcome (both at individual level and household level). The logistic models also controls for other relevant socio-economic variables like place of residence, maternal education, household standard of

living, ethnicity etc. The logistic regression is more apt compared to other procedures like principal component factor technique or Ordinary Least Squares (OLS) because the latter cannot efficiently handle categorical variables. However, some of the studies have used ordered probit technique. We have not used the probit because it is more or less similar to logit analysis. The difference between the two techniques lies in their distributional assumption. The tail end of the logit distribution is more flat than the tail end of the probit distribution. The probit curve does approach the centre of the distribution quicker than the logit. Ordered probit is widely used for the case controlled studies. In our binary logistic method we have used the odds ratio or expected beta coefficients to explain the likelihood risk of undernutrition associated with different characteristics. The standard error for each odd shows their consistency. If the value of standard error is low it means the odds value is consistent to draw meaningful conclusions. The 'partial contribution coefficient or R' is used to quantify each explaining variables contribution to the variation in dependent variable. We also include possible interaction terms to determine whether the combined effect of the two explaining factors (confounding) have any influence on the outcome of the dependent variable. If it is so then we drop one of the explaining factors.

The analysis is performed using SPSS software, which facilitates logistic regression exercise by allowing model specification based on three different methods. Specifically, these three methods are: 1) The *forced entry method* which is the same as multiple regression technique where all of the covariates are placed into the regression model in one block and parameter estimates are calculated for each block. 2) The *forward stepwise method* begins with a model that includes only a constant and then adds single predictors into the model based on a specific criterion. This criterion is the value of the score statistic, the variable with the most significant score statistics is added to the model. The computer proceeds until none of the remaining predictors have a significant score statistic (the cut-off point for significance being .05). 3) The *backward stepwise method* of model specification is the opposite of forward method. In this method the computer begins with a model that includes all the predictors and a constant. The computer then tests whether any of these predictors can be removed from the model without having a substantial effect of how well the model fits the observed data. The first predictor to be removed will be the one that has the least impact on how the model fits the data (the cut-off point for significance being .05).

Here, the analysis is carried out by using the *backward stepwise method* of model specification, with likelihood-ratio[3] being the criteria for including correlates in the model. The backward stepwise method is preferred over the forward method because of the suppressor effects, which occurs when a predictor has a significant effect but only when another variable is held constant. Forward selection is more likely than backward elimination to exclude predictors involved in suppressor effects. As such, the forward method runs a higher risk of making a Type II error that is excluding a desired variable when it should be not [Field; 2005].

Furthermore, the analysis is performed with five different binomial logit models where each of these models assumes different contrast (reference) categories. The rationale for applying these five alternative contrasts is that they provide better insights regarding intra-category impact on nutritional status. For instance, while considering any predictor, generally we compare odds of the reference group visà-vie other categories but such an approach does not highlight the intra-categories likelihood of an event. Therefore, in the present analysis different contrasts are employed which not only provides intra-categories likelihood scenarios but also helps to overcome the bias involved in specifying the reference category for the analysis. To elaborate, Model 1 has *'indicator'* as the method of contrast for categories of a given correlate against a pre-determined reference category, to determine the influence of that correlate on the outcome of undernutrition. This method indicates the presence or absence of category membership. The reference category is represented in the contrast matrix as a row of zeros. Model-2 uses *'Difference'* as the contrast, wherein each category of a selected correlate is compared to the average effect of previous categories of these correlates, except the first category. Model-3 works with the *'Helmert'* contrast and here each category of the respective correlates is compared with the average effect of subsequent categories except the last category. It is the opposite of *'Difference* approach'. In Model 4 *'repeated'* contrast is used which compares each category of the correlate with the subsequent category, except the last one. Model 5, uses *'deviation'* as the contrast and compares the effect of each category of the correlate with the overall effect of the correlate on the nutrition outcome of women. Use of these five different contrasts would help us to compare the inter-group vulnerability among women for low BMI. However, irrespective of the contrast specified, all the model specification parameters (Hesmor and Lemshow goodness of fit, Negerkelke chi-square, Cox and Snell chi-square, -2 log likelihood and percentage predicted) remain unaltered. In the final portion of this

[3] In terms of the test statistic used in stepwise methods, the Wald statistic has a tendency to be inaccurate in certain circumstances and so the likelihood ratio method is best.

multivariate analysis, the impact of different correlates across the major Indian states is analysed and these results are compared with the results obtained at the national level.

3.6. Conclusion

In Table 3.1, few of the empirical studies are listed which have applied a range of methods in analysing determinants of undernutrition. Apart from the fact that we too have used similar methods in our analysis, our approach of identifying and interpreting the correlates has been quite different. This study differs from the existing studies on two counts; one it explores immediate factors that are worthy of intervention and the other; a regional exploration of this kind intimates on the influence of such immediate factors with varying nutritional outcomes. The stress on immediate factors and their being worthy of intervention is made sharper here against the existing finding of social group and economic status based differential in nutritional vulnerability. This is to say that neither poor can be made rich nor the caste hierarchy can be altered to address nutritional deprivation but immediate factors like disease or diet can be factored into intervention strategy to produce favourable outcomes. Similarly, the study based on NSSO survey will help us to identify the nutritionally vulnerable households on the basis of their household composition in addition to their social, economic or occupational background. Such characterization and compositional identification could largely facilitate targeting intervention programmes.

Table 3.1: Some Selected Empirical Studies from Literature on Methodologies Applied to Understand the Correlates of Undernutrition

Author's (Year)	Country of Study	Objective	Nature of the dependent variable	Multivariate models
Smith and Haddad; 2002	36 countries	To find the effect of growth on GDP on child health in terms of stunting	Z-score for stunting and under weight (Categorical variable)	OLS and factor analysis
Smith et al; 2004	36 countries	Rural-urban difference in child undernutrition	Z-score for stunting and under weight (Categorical variable)	Logit Model
Nandy et al; 2005	India	Poverty, Child Undernutrition and Morbidity	Incidence of diarrhoea for children having stunting, underweight and waisting	Logit Model
Dasgupta et al; 2005	India	To asses the impact of ICDS programme on Indian children	Stunting (Continuous variable)	Principle Component Analysis
Bredenkamp; 2005	India	To access the ICDS impact on nutritional outcome of the children	Z-score for stunting and under weight (Categorical variable)	Probit model
Agarwal et al; 2006	India	To access the determinants of anemia among Indian women	Dummy for anaemia (Categorical variable)	Logit model
Raman Kutty; 1998	Kerala	Determinants of low birth weight babies in India	Z-score for stunting and under weight (Categorical variable)	Logit model
Aromolarn; 2004	Nigeria	Impact of women's income on calorie intake	Calorie intake (continuous variable)	OLS model
Thomas Duncan; 1990	Brazil	Intra household distribution of available nutrients		Logit model

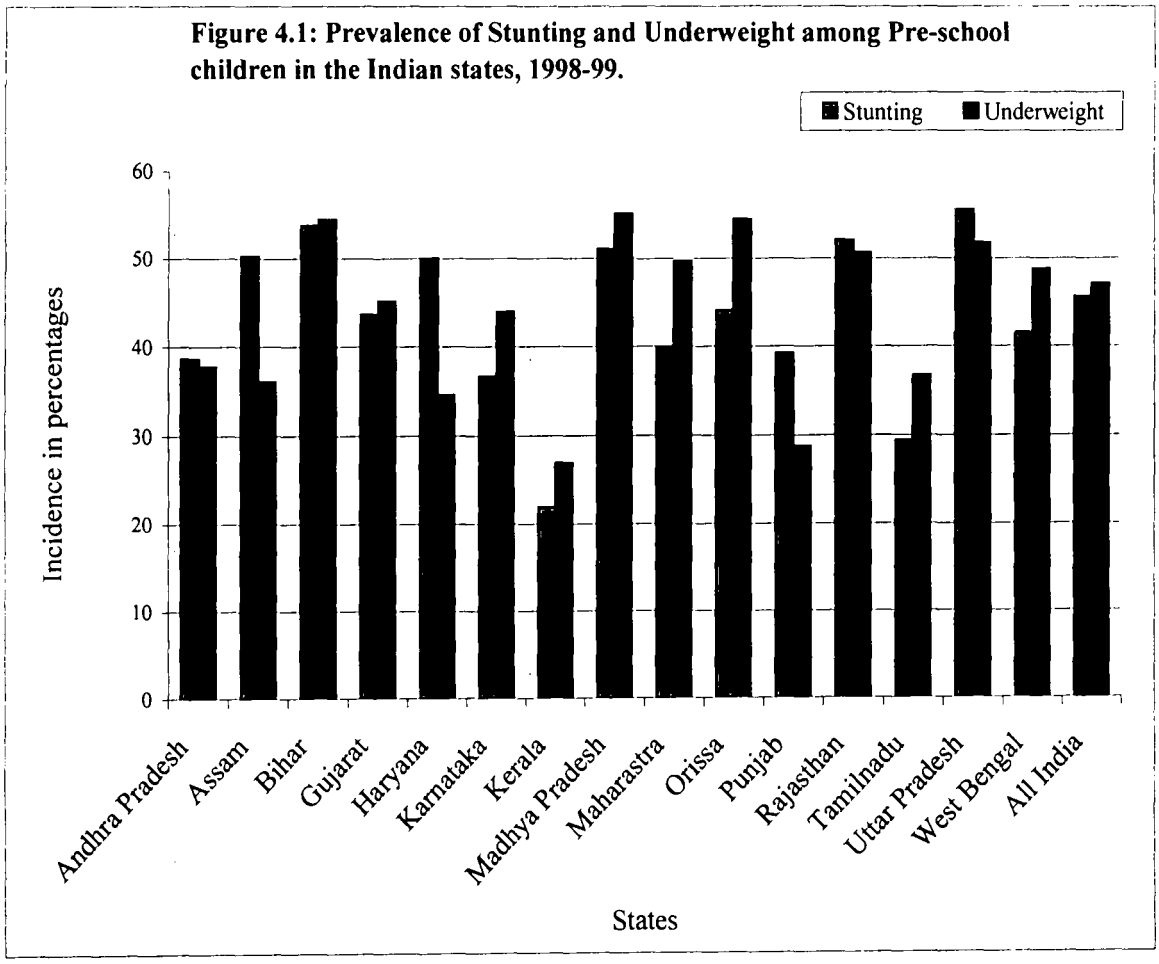
CHAPTER 4

CORRELATES OF CHILD UNDERNUTRITION IN INDIA

4.1. Introduction

Undernutrition among children poses a severe challenge in the pathway of human development. As such it leaves the quality of human life at risk because undernourished children tend to have poor cognitive skills, less interest in education and high morbidity risk. Undernourished female children are also likely to become undernourished mothers and thus it becomes an intra-generation phenomenon [Wagstaff and Watanabe; 2000, Barker; 1998, WHO; 1995, Scrimshaw and SanGiovanni; 1997, Ashworth; 1998, Alderman et al; 1996, Martorell et al; 1996, 1998]. Given the worrisome implications of child undernutrition, it is disconcerting to note that India shares the bulk of this global misfortune, where one in every two child is underweight and one in every three is stunted.

Figure 4.1: Prevalence of Stunting and Underweight among Pre-school children in the Indian states, 1998-99.



Source: NFHS-2

In India, the prevalence of child stunting (height-for-age) varies between 22 percent in Kerala and 56 percent in Uttar Pradesh and the prevalence of child underweight (weight-for-age) ranges between 27 percent in Kerala and 55 percent in Madhya Pradesh (see Figure 4.1). Uttar Pradesh, Bihar, Rajasthan and Madhya Pradesh show higher prevalence levels of stunting and underweight whereas states of Assam, Haryana, and Punjab show lower prevalence of underweight compared to stunting. Gujarat and Andhra Pradesh possess moderate levels of undernourishment and lower stunting compared to underweight. Rest of the major states report higher prevalence of underweight compared to stunting. In general, the overall levels of undernutrition in these two anthropometric indicators are lower in South India and higher in the Northern and Eastern regions. Especially in Northern region, states like Madhya Pradesh, Rajasthan and Uttar Pradesh and Bihar in Eastern region, every one out of two children in pre-school stage suffer from stunting or underweight. One can conclude from this graph that there are wide regional variations in concentration of undernourished children, especially in North-Eastern region.

In this regard, Government of India has designed several intervention programmes like Integrated Child Development Scheme (ICDS), Mid-Day Meal Scheme and universal immunisation programmes to enhance the nutritional well-being of children but unfortunately improvements in the nutritional scenario is negligible (or painstakingly slow). In fact several other countries, which are poorer than India have achieved phenomenal reduction in prevalence of undernutrition among their pre-school children [ACC/SCN; 2000, 2005]. Therefore, it becomes important to examine the principal elements of these prominent interventions and comprehend their effectiveness in reducing undernutrition among the Indian children. Specifically, this chapter studies the effectiveness of four different aspects of interventions in various ongoing child health programmes. Firstly, an analysis is performed to understand whether the prevalence of childhood ailments (diarrhoea, fever and cough) affects stunting and underweight among pre-school children. Secondly, the linkage between child immunisation and undernutrition among pre-school children is scrutinized. Thirdly, the chapter explores the role of mushy food supplementation in reducing undernourishment among children aged 6-35 months. Lastly, an attempt is made to study whether the introduction of early supplementation along with breastfeeding proves to be beneficial to the nutritional status of children below six months of age.

4.2. Data and Methodology

As discussed in Chapter 3, the information on various correlates and health indicators are obtained from the National Family Health Survey-2 (NFHS-2) conducted during 1998-99. The NFHS has a multi-stage stratified sampling design allowing for state level disaggregated analysis. Specific component of information relevant for analysis of child nutrition comprises of the details regarding children below the age of three years (who are alive at the time of survey), along with other particulars regarding their mothers as well as the households of these children. The information on nutrition outcome (defined in terms of underweight and stunting) as well as the prevalence of common childhood ailments (with a reference period of two weeks prior to the date of survey) like diarrhoea, fever and cough is provided for all children below the age of 3 years. The event of childhood ailment is collected for the time period of past two weeks before the survey.

Here, child undernutrition is measured in terms of stunting (measured in terms of height-for-age) and underweight (measured in terms of weight-for-age). Stunting refers to shortfall from median height for a given age and similarly underweight measures shortfall from median weight for given age. There is evidence from literature, which argues that stunting reflects cumulative growth failure in children and is useful to measure long-term effect of undernourishment. Underweight can capture short-term fluctuation in nutritional status. If the child suffers from some ailments it will lose certain amount of nutrients along with water, which is the major component of body mass. So underweight can reflect, whether the child suffers from weight loss due to inadequate food or ailment in immediate past. We avoid clinical indicators like anaemia and indicators like weight-for-height or wasting (though it is anthropometric indicator) for the reasons elaborated in Chapter-3.

This chapter adopts the analytical framework suggested by Smith and Haddad; 2000, which conceive the determinants of child undernutrition in terms of *immediate, underlying* and *basic* determinants. Dietary intake and healthcare are identified as the immediate determinants. These two factors are influenced by three underlying determinants namely, food security, care for mothers and children, and quality of health environment at household level. These underlying determinants are conceived in terms of four explanatory variables namely, per capita national food availability, women's education and status within the households and access to safe water. Basic determinants are those, which influence child nutrition through their effects on the underlying

determinants. These are economic resources available to the society in general and to the household in particular including the political environment.

So far the analysis indicates that children who have experienced diarrhoea (in recent past i.e. past two weeks before the survey) have higher risk of being undernourished. In order to elaborate upon this risk factor we here engage with the computation of simple risk (SR) and relative risk (RR) as suggested by Chakraborty (2001)[1]. For any region, simple risk is defined as the ratio of prevalence of Stunting among children who have diarrhoea (S_d) divided by aggregate prevalence of stunting (S_{total}).

$$\text{Simple risk} = SR = \frac{S_d}{S_{total}}$$

Relative risk is computed as follows;

$$\text{Relative risk} = RR = \frac{[(S_d/(1-S_d))]}{[S_{nond}/(1-S_{nond})]}$$

Where, S_d, denotes the prevalence of stunting among children who have diarrhoea and S_{nond}, is the prevalence among children who have not experienced diarrhoea. In the relative risk computation, we have removed the bias of existing overall risk in the sample for being stunted by using one or unity for calculating the individual group risk. Unity implies that this method combines the risk or probability of happening and the risk of not happening. For interpretative purposes, if the SR and RR values are greater than one then it indicates that any given intervention along the lines of the ailment under consideration might reduce the prevalence of undernutrition. This measure of simple risk and relative risk for the children is extended to all the immediate determinants of our study. Further, a multivariate analysis with the help of bivariate logistic regression is carried out to obtain robust determining influence of diarrhoea on nutritional outcome by controlling for relevant socio-economic correlates.

4.3. Childhood Ailments and Undernutrition

From the existing literature, it is evident that children who suffer from frequent illness have higher morbidity risk. It is found that children with higher morbidity risk also have poorer health outcome including nutrition [Black et al ; 2003, Tomkins et al; 1989]. Here we attempt to see, if in case of India whether ailments have any role to play in the

[1] Ratios of odds measure the relative degree of departure form homogeneity and qualify the desirability of scale independence.

outcome of nutrition among children. With this premise, we sift the NFHS-2 data and have considered three diseases, namely diarrhoea, fever and cough that contribute towards higher mortality among children in India. The information is collected on incidence of disease during the past two weeks prior to the survey for all pre-school children (alive) during the survey. We have restricted ourselves to the above three diseases as the sample for other ailments is inadequate.

Table 4.1: State-wise bivariate Association between Childhood Ailments and Undernutrition

Illness Episodes	States Reporting Significant Difference Between 'with' and 'without' Illness and Undernutrition	
	Stunting	*Underweight*
Diarrhoea	Uttar Pradesh, Orissa, West Bengal, Madhya Pradesh, Andhra Pradesh, India	Bihar, Orissa, Uttar Pradesh, Rajasthan, West Bengal, Punjab, India
Fever	Uttar Pradesh, West Bengal, India	West Bengal, Madhya Pradesh, Bihar, Orissa, Uttar Pradesh, Rajasthan, Kerala, Karnataka, Gujarat, Maharashtra, India
Cough	Madhya Pradesh, Bihar, Orissa, Uttar Pradesh, Haryana	Uttar Pradesh, Maharashtra, Tamil Nadu, India

Source: Table 4A.1 and 4A.3 (see Appendix)

Now, we turn to examine the bivariate association between childhood ailments, immunisation, early supplementation and exclusive breastfeeding with stunting and underweight. Firstly, while associating undernutrition with the episodes of illness (diarrhoea, fever, and cough) across the Indian states, it is observed that the incidence of diarrhoea and fever is significantly associated with stunting at the all India level (see Table 4.1). As regards underweight, its association is statistically significant with the incidence of diarrhoea, fever and cough at the national level. Nonetheless, states of Uttar Pradesh, Bihar, Orissa, and West Bengal indicate some degree of association between incidence of episodes of diarrhoea, fever, or cough and undernourishment but the South Indian states do not reveal any such relationship (Detailed results are presented in Table A 4.1 and A4.3 in the appendix). Further, we create two mutually exclusive groups namely, one group of children who have experienced diarrhoea and the other, who have not. Now it is found that children with diarrhoea have higher prevalence of stunting vis-à-vis the children who do not have the ailment. This perhaps reinforces that the incidence of diarrhoea is a crucial factor that distinguishes one sub-group from the other within a common sample. With this premise, the subsequent sections present an analysis of association between childhood ailments and stunting and underweight.

4.3.1. Childhood Ailments and Stunting

An analysis of the NFHS-2 suggests that the prevalence of stunting is significantly associated with childhood ailments, particularly diarrhoea and fever. This association when examined across different Indian states also reveals a similar relationship, indicating that children having disease are more prone to stunting than otherwise. However, the statistical significance of this association is limited to Uttar Pradesh and Madhya Pradesh, Orissa, West Bengal, Maharashtra and Andhra Pradesh in case of diarrhoea, Uttar Pradesh and West Bengal in case of fever and Uttar Pradesh, Bihar, Madhya Pradesh, Haryana and Orissa in case of cough. These results reveal clearly that diarrhoea has least influence on stunting while fever and cough have more to do with it as the difference in levels of stunting while differentiated according to fever. In case of cough, there is no definite association with stunting as in some cases it fails to qualify the expected direction of relationship with stunting [for details see Table A 4.1].

Following this examination of simple association, we present the degree of association between disease and stunting across varied levels of prevalence of stunting across different states of India. As discussed in the section 4.2 (data and methodology), these responses are presented in two types of risk; one defined as simple risk due to disease against a given overall prevalence of stunting and the other in a refined form, which is described as the relative risk which compares the ratio of odds of being nutritionally deficient between children with disease and without. This refinement intensifies the response as well as makes it free of the prevailing levels of stunting. Also, these responses are read in accordance with degree of stunting across states ranking them in descending order. The results based on this method are presented in Table A 4.2. One observation from this analysis is that there is no agreement between the degree of disease response and the levels of stunting in terms of ranks. In other words, the degree of disease response seems to be sensitive at the two extremes of the prevailing levels of stunting [see Table A 4.2 for details]. In terms of the diseases, the response of fever and cough is more compared with diarrhoea, which agrees with common knowledge that diarrhoea affects short-term fluctuations like weight, which does not reflect in stunting. Diarrhoeal response ranges between a maximum of 1.23 in West Bengal and a negative response 0.90 in Assam. Here negative response refers to a situation where the association between disease in question and stunting is not in the expected direction i.e. prevalence of stunting is higher among those without diseases compared with those with disease. However, it also indicates of a mismatch between stunting and incidence of diarrhoea. Diarrhoeal response to stunting is not only of lesser degree compared with other diseases but also is negative in 5 of the 18 states under study. This degree of

response when positive is reciprocal to the levels of prevalence of stunting [see Table A 4.2, column 3 and 4 for details].

With regard to the response of fever on stunting, the observed pattern of response is more or less similar, besides the degree of response being better. For instance in most cases, the degree of diarrhoeal response on stunting is lesser than that for fever [for details see Table A 4.2, column 7 and 8 for details]. The same is not true for cough, which perhaps could be due to cases being reported as derivatives of fever and other ailments [for details see Table A 4.2, column 11 and 12 for details]. We present two sets of disease response to show refinement in it as well as to make these responses to be free of the prevailing levels of stunting across states. This refinement naturally improves the degree of response compared with the simple one, however, the reciprocal association between disease responses with the levels of stunting holds. On the basis of this Table, it could perhaps be said that responses are indicative of the desirable intervention in terms of diseases or otherwise. For instance, in states with higher levels of stunting like Bihar, Uttar Pradesh and Rajasthan, these responses are pretty low where disease-specific intervention may not give as much result, as it will in case of states where responses are high. Also, disease responses being lower could be used in arguing for the cause of stunting being more due to other factors (basic or intermediate) and not due to diseases (immediate).

Our main focus being towards understanding the role of childhood diseases in determining stunting, we have analysed the presence or absence of diseases along with a set of covariates that is controlled in a bivariate logistic exercise to find the statistical odds of undernutrition due to different diseases. We do find the odd in case of fever is more compared with that of diarrhoea to influence stunting. The binomial logit model is controlled for other factors like household's standard of living, caste and religion along with mother's education and residential background, birth weight of the children, birth order and maternal age and also the nutritional status of the mother. Despite controlling all these variables, the role of disease being significant underlines the differential role of diseases in stunting across selected Indian states under examination [See Table A 4.2; column 6, 9 and 13 for further details]. While examining the situation across different states the odds of diarrhoea is below unity in case of Assam, Gujarat, Himachal Pradesh, Jammu & Kashmir, Punjab and Tamil Nadu in relation to stunting. This could either be due to these states having lesser levels of stunting (except in Assam and Gujarat) or diarrhoea may be less frequent among children in these states. However, as said earlier these odds for fever become more reasonable across states in terms of explaining the variation in the stunting phenomenon. Cough in any case does not seem to show clear

and consistent odds for stunting except in few states like, Uttar Pradesh [See Table A 4.2; column 6, 9 and 13 for further details].

4.3.2. Childhood Ailments and Underweight

Underweight is another dimension of undernutrition which is evaluated in terms of not qualifying a specific bodyweight given the age and sex of the children. The initial examination of association between diseases like diarrhoea, fever and cough show that experience of these diseases increases the vulnerability to undernutrition (underweight). Across all the states of India, the children suffering from either of these diseases disqualify in terms of desirable weight in relation to age and sex while compared with others in the absence of disease. These associations are statistically significant in case of diarrhoea in six out of sixteen states, for fever in eleven out of sixteen states and for cough 3 out of sixteen states [for details see Table A 4.3]. Such significance seems to depend on the prevailing levels of undernutrition according to underweight with poor performing states showing significant association vis-à-vis the better ones.

Similar to the exercise undertaken in case of stunting, here too disease response has been computed for underweight. Across the three diseases the disease response for underweight is relatively better in case of diarrhoea followed by fever and cough. In case of disease response of diarrhoea in the simpler version that is relative measurement in relation to the total prevalence of underweight. The response varies between 1.40 (Punjab) and 1.03 in Madhya Pradesh. This presents a contrast describing diarrhoeal response to be of a higher degree with lower prevalence of underweight. And with the revision of this response, the intensity rises further across the entire range. While examining fever response, we find the highest response in the state of Kerala as against the lowest being in Madhya Pradesh. The entire range of response is also observed to be limited [for details see Table A 4.4].

For a confirmatory exercise, experiences of all the diseases are modeled with underweight by controlling for other relevant variables, to get the most robust response. In this model, we find the occurrence of any of the diseases reflect stronger odds to the tune of 1.32 for fever followed by 1.25 for diarrhoea and 1.16 for cough in determining underweight in children. This is despite all other control variables, like Household's standard of living, mother's education, residential background as well as caste and religious identities being significant. However, deprivation in all of these control characteristics too explains vulnerability to underweight [For details see Table A 4.4, column 5, 9 and 13].

Table 4.2: Pattern of Revised Response and Odds, for Children Reported with Ailments and their Nutritional Outcome (0-35 months) for Selected States and all India; 1998-99

(1)	(2)	(3)	(4)	(5)	(6)
DIARRHOEA					
> 1.20	-	-	-	KER	AP, BI, WB
1.10-1.20	GUJ	-	HAR	RAJ, INDIA	OR
1.05-1.10	-	MP	-	MAH, UP	-
1.00-1.05	KAR	-	-	-	-
< 1.00	AS, TN, PUN	-	-	-	-
Stunting ↑ Underweight↓	**< 1.00**	**1-1.05**	**1.05-1.10**	**1.10 -1.20**	**>1.20**
< 1.00	-	MP	-	MAH, GUJ	-
1.00-1.05	-	-	-	-	KAR, TN
1.05-1.10	-	-	-	-	-
1.10-1.20		-	-	AP	RAJ, AS, INDIA
> 1.20	-	-	-	BI	OR, UP, WB, HAR, PUN, KER
FEVER					
> 1.20	-	-	-	-	UP, RAJ, MP, HAR, GUJ, WB, KAR, KER
1.10-1.20	-	-	AP	BI, INDIA	-
1.05-1.10	MAH	-	-	-	-
1.00-1.05	-	-	OR	-	-
< 1.00	AS, PUN, TN		-	-	-
Stunting ↑ Underweight↓	**< 1.00**	**1-1.05**	**1.05-1.10**	**1.10 -1.20**	**>1.20**
< 1.00	-	PUN	-	-	TN, AS
1.00-1.05	-	AP	-	-	-
1.05-1.10	-	-	-	-	-
1.10-1.20	-	--	-	-	WB, KAR
> 1.20	-	-	-	-	MP, BI, OR, UP, RAJ, MAH, GUJ, HAR, KER, INDIA
COUGH					
> 1.20	-	-	-	-	-
1.10-1.20	-	-	KAR	UP, BI	-
1.05-1.10	-	-	-	TN, KER	-
1.00-1.05	GUJ, AP	WB, INDIA	-	-	-
< 1.00	RAJ, MP, AS, HAR, OR, MAH, PUN	-	-	-	-
Stunting ↑ Underweight↓	**< 1.00**	**1-1.05**	**1.05-1.10**	**1.10 -1.20**	**>1.20**
< 1.00	MP, HAR				
1.00-1.05	PUN	WB	RAJ		
1.05-1.10			BI	OR	
1.10-1.20				AP	UP, KER
> 1.20	KAR		GUJ	TN, INDIA	MAH, AS

Source: NFHS-2

Note:

1. *Each cell in the table represents a combination of revised response from bi-variate exercise (column 2-6) and odds i.e. exp. β obtained from multivariate exercise (column 1), for the outcome of undernutrition among children with ailments.*
2. *AP =Andhra Pradesh, AS = Assam, BI = Bihar, GUJ = Gujarat, HAR = Haryana, KAR = Karnataka, KER = Kerala, MP = Madhya Pradesh, MAH = Maharashtra, OR = Orissa, PUN = Punjab, RAJ = Rajasthan, TN = Tamil Nadu, UP = Uttar Pradesh, WB = West Bengal, India = All India*

For making a relative assessment of this response pattern, the same model is replicated in all the states and differential odds for all the diseases are presented in Table A 4.4. The odds for diarrhoea across states reflect a similar magnitude but statistical significance is confirmed in two of the states i.e. Orissa and Uttar Pradesh. While observing the results for Fever, 8 of the fifteen states present significant odds and of a stronger magnitude ranging between 1.82 in Kerala and 1.01 in Punjab. In case of cough, there happens to be negative odds in case of three states namely, Madhya Pradesh, Haryana and Jammu and Kashmir. But other odds are also not as strong as it is in case of diarrhoea and fever and only three of them have come out to be significant in case of Uttar Pradesh and Tamil Nadu [See for details Table A 4.4 column 5, 9 and 13]. Summaries of above findings from our analysis on child undernutrition in terms of underweight and childhood ailments are presented in Table 4.2 below.

4.4. Immunisation and Child Undernutrition

This section will focus on the impact of immunisation on nutritional outcome of the children. A child is considered immunised if he has taken all the vaccines (in prescribed number of times) with in the prescribed period i.e. one year. Information on Immunisation is collected from the vaccination card or from the mother if there was no written record. For children whose information was based on the mother's report, the proportion of vaccinations given by 12 months of age is assumed to be the same as for children with a written record of vaccinations. Here a child is considered immunised if he has BCG, measles and three doses each of DPT and polio vaccines (excluding polio O) within 12 months from birth. We follow the methodology as discussed earlier but the single difference being that only those children who are 12 months old or above are included in the model. First, we carry out a simple cross-tabulation exercise between immunisation and anthropometric indicators. The cross-tabulation is done for each of the fifteen major states that we include in our analysis. Following which, we have calculated an assessment of degree of response of immunisation to undernutrition. Then immunisation response has been computed. To make the immunisation response to undernutrition more robust, we have computed it as a ratio of odds of experiencing undernutrition between children with immunisation against those without immunisation, as we have done it for childhood ailments. Finally we have done a multivariate analysis with the help of bivariate logistic regression to get the robust determining influence of immunisation and it's consequence on nutritional outcome after controlling for other standard correlates.

4.4.1. Immunisation and Stunting

The association between immunisation and experiencing stunting is found to be in the expected direction for all the fifteen major states and at all India level. In these states the children without immunisation have reported higher prevalence of stunting than those children who did not have immunisation. The gap in prevalence of stunting between those who have taken immunisation and those who did not have, are very high in states like Haryana, Maharashtra, Karnataka and Tamil Nadu, well above 10 to 18 percentage points approximately. The association between immunisation and stunting is statistically significant in states of Haryana, Gujarat, Maharashtra, Karnataka and Tamil Nadu. At all India level our results show that the children who had immunisation reported lower prevalence of stunting compared to those children who were not immunised [For detail see Table A 4.5, column 3 and 4]. Following this examination of simple association, we present the degree of immunisation response to stunting (both simple as well as revised) across varied levels of prevalence of undernutrition across different states of India. Also these responses are read in accordance with degree of undernutrition across states ranking them in descending order. One observation is that the ranks of the states do change for two methods of calculating immunisation response.

The immunisation response to stunting is highest for Punjab (1.24), when we calculate the response on the basis of over all prevalence. But when we calculate the response, excluding over all prevalence the Bihar shows the highest immunisation response to stunting (2.33) [for details see Table A 4.5, Column 5 and 6]. But across all the fifteen major states the non-immunised children are at greater risk for stunting compared to children who are immunised. The fact is reflected in both simple response as well as the revised response of the immunisation to the outcome of stunting. In both the response indicators the states do change their ranks. That also indicates immunisation's crucial role to ensure normal height-for-age, despite the fact it saves the child from fatality due to many diseases and reduce their morbidity risk. It is also found that ranks of the states do differ for simple response, revised response and odds from logit model. For example Bihar has second lowest response for immunisation for simple response method, but it has the highest rank (fifteen) for revised response and for logit odds. This refers to the possible linkage between high non-immunisation prevalence as well as high stunting in case of Bihar. Kerala has the lowest response for immunisation in the revised response as well as logit odds.

The multivariate model reconfirms the result from bivariate responses both at national as well as state level. The odds for stunting for non-immunised children found to be

greater than one for all the major states except Orissa and Tamil Nadu and Kerala [for details see Table A 4.5, column 7]. It is also found that the difference between revised response for immunisation (which is also a ratio of odds) and the odds from binomial logit model have positive numbers because odds from binomial logit are obtained after controlling for other correlates as well [for details see Table A 4.5, column 7].

4.4.2. Immunisation and Underweight

A similar exercise is also done for underweight where the simple bivariate response shows that in all major states the association between weight-for-age and reported immunisation moves in expected direction. That means immunised children have reported less prevalence of underweight compared to those who did not have immunisation [For details see Table A 4.6, column 3 and 4]. At all India level also the trend is in expected direction. Further, immunization response is calculated for underweight as well. The immunisation response is found to be in expected direction (greater than one) for all the states except Madhya Pradesh, Bihar, Gujarat and Punjab where it is all most twice that for non-immunised children. It is observed that for high prevalence states the simple risk calculated is very low (for example Madhya Pradesh, Bihar, Orissa, Uttar Pradesh Rajasthan and Maharashtra where more than 60 percent of children of age one year or more are reported to be suffering from under weight).

But in revised response and the multivariate model the odds for theses states are higher compare to the states where over all prevalence is comparatively low. However the ranks for the states do change widely for simple response, revised response as well as odds from the logit model. Only in case of Bihar and Kerala the ranks remain constant for revised response and odds from logit model [For details see Table A 4.6, column 5 and 6]. The binomial logit regression for multivariate analysis is run to assess the impact of immunisation on underweight, given other relevant correlates. We found odds for immunisation is greater than one for India as well as all the 15 major states, we have considered in our analysis.

For the states the logit models are run separately but the model constitution is same as it is presented for India as a whole [see Table A 4.6, column 7]. The model is statistically significant for states like Madhya Pradesh, Bihar, West Bengal, Karnataka, Andhra Pradesh, Assam Tamil Nadu and Kerala. Thus it shows child immunisation is crucial for child's normal weight-for-age [For details see Table A 4.6, column 7]. The findings on immunisation status of children and their nutritional outcome (in terms of stunting and underweight) are summarised in Table 4.3 below.

Table 4.3: Pattern of Revised Response and Odds, for Children without Immunisation on their Nutritional Outcome (of age 12-35 months) for Selected States and all India; 1998-99

(1)	(2)	(3)	(4)	(5)	(6)
> 1.20	-	-	-	-	UP, BI, MP, AS, HAR, WB, MAH, PUN, AP, TN, India
1.10-1.20	-	-	-	-	OR
1.05-1.10	-	-	-	-	-
1.00-1.05	-	-	-	-	GUJ
< 1.00	-	-	-	-	RAJ, KAR
Stunting ↑ **Underweight↓**	< 1.00	1-1.05	1.05-1.10	1.10 -1.20	>1.20
< 1.00	-	-	-	-	OR, KER
1.00-1.05	-	-	-	-	RAJ, GUJ, KAR, TN
1.05-1.10	-	-	-	-	MAH
1.10-1.20	-	-	-	-	AS
>1.20	-	-	-	-	MP, BI, UP, WB, AP, HAR, PUN, India

Source: NFHS-2

Note:

1. *Each cell in the table represents a combination of revised response from bi-variate exercise (column 2-6) and odds i.e. exp. β obtained from multivariate exercise (column 1), for the outcome of undernutrition among children without immunisation*
2. *Andhra Pradesh, AS = Assam, BI = Bihar, GUJ = Gujarat, HAR = Haryana, KAR = Karnataka, KER = Kerala, MP = Madhya Pradesh, MAH = Maharashtra, OR = Orissa, PUN = Punjab, RAJ = Rajasthan, TN = Tamil Nadu, UP = Uttar Pradesh, WB = West Bengal, India = All India*

4.5. Supplementation and Child Undernutrition

Child supplementation has tremendous impact on nutritional outcome of the children especially during their early ages. Clinical studies have advised to introduce semi-solid food for child along with breast milk from six months onwards to meet the nutrient requirement for children, which her mother's milk may not yields sufficiently. Also, the timing and type of supplementation has significant impact on child's nutritional outcome. Based on these insights, this subsection tries to find out the relationship between mushy food supplementation and nutritional outcome of Indian children in terms of stunting and underweight. Here the child supplementation refers to mushy food supplementation (semi liquid or hard) not supplementation of micronutrients like Vitamin-A, Zinc, Iron, etc. as sometimes the term supplementation is also associated with them. Like the preceding section, this section will also have two subsections i.e. one each on stunting and underweight.

4.5.1. Supplementation and Stunting

The result from bivariate analysis of association between stunting and supplementation of children indicates that children without supplementation have lesser prevalence of stunting. The pattern is confirmed across all states though at all India level the children without supplementation have marginally higher prevalence of stunting against their counterparts with supplementation, 52.7 and 51.5 percent, respectively [see for details Table A 4.7, column 3 and 4]. Thus the simple response, the revised response and the multivariate response all show negative values for stunting among children without supplementation [see for details Table A 4.7, column 5, 6 and 7]. In other words children without any mushy food supplementation have better nutritional outcome in terms of height-for-age than children with supplementation. This perhaps goes against the hypothesis that we started with and the reason for such an observation could be several. It could be argued that, supplementation for the child could be a double-edged sword. For instance, if children are consuming supplemented food, which is not hygienically prepared, then it is likely to put those children at the risk of ailments like diarrhoea. Similarly, the kind of supplementation also matters as to comprehend whether the child is getting a highly nutritive one or of poor nutritional quality. Likewise in India, children whose mother could not provide enough breast milk are given supplementation; on the other hand if these children are nourished with adequate breast milk then the initiation of supplemented mushy food could be delayed. The high cost of supplemented food also force parents to go for locally available cereals or pulses. However the results from our analysis raises more questions than it answers, regarding the supplementation of children and their nutritional outcome.

4.5.2. Supplementation and Underweight

The analysis for underweight shows some variations across states. Uttar Pradesh, West Bengal, Gujarat, Karnataka, Assam and Kerala show that the prevalence of underweight is higher among the children who do not have mushy food supplementation along with breastfeeding. In other states the children who are exclusively breastfed have less prevalence of underweight [see for details Table A 4.8, column 3 and 4]. Following the results from bivariate association the responses are found to be higher for states mentioned above [see for details Table A 4.8, column 5 and 6]. However the multivariate logit model results show only in two out of fifteen states (Assam and Kerala), lack of mushy food supplementation has resulted in higher risk or odds for underweight [see for details Table A 4.8, column 7]. Like stunting, it indicates that lack of mushy food alone may not be directly responsible (as for reasons discussed in case of

stunting) for the underweight among children. The findings from both the section are summarised in Table 4.4 below.

Table 4.4: Pattern of Revised Response and Odds, for Children with no Supplementation on their Nutritional Outcome (of age 6-35 months) for Selected States and all India; 1998-99

(1)	(2)	(3)	(4)	(5)	(6)
> 1.20	-	-	-	-	-
1.10-1.20	-	-	-	-	-
1.05-1.10	-	-	-	-	-
1.00-1.05	-	-	-	-	-
< 1.00	MP, BI, OR, RAJ, MAH, AP, TN, HAR, PUN			UP, GUJ	WB, KAR, AS, KER
Stunting ↑ **Underweight↓**	< 1.00	1-1.05	1.05-1.10	1.10 -1.20	>1.20
< 1.00	UP, BI, RAJ, MP, AS, HAR, OR, GUJ, WB, MAH, PUN, AP, KAR, TN, KER	-	-	-	-
1.00-1.05	-	-	-	-	-
1.05-1.10	-	-	-	-	-
1.10-1.20	-	-	-	-	-
>1.20	-	-	-	-	-

Source: NFHS-2

Note:

1. *Each cell in the table represents a combination of revised response from bi-variate exercise (column 2-6) and odds i.e. exp. β obtained from multivariate exercise (column 1), for the outcome of undernutrition among children with no supplementation.*
2. *AP =Andhra Pradesh, AS = Assam, BI = Bihar, GUJ = Gujarat, HAR = Haryana, KAR = Karnataka, KER = Kerala, MP = Madhya Pradesh, MAH = Maharashtra, OR = Orissa, PUN = Punjab, RAJ = Rajasthan, TN = Tamil Nadu, UP = Uttar Pradesh, WB = West Bengal, India = All India*

4.6. Breastfeeding and Child Undernutrition

Breastfeeding is another important determinant of child undernutrition because in early months it is the only source of food for the children. It is generally hygienic and rich in nutrients and also easy to digest for the child. Several clinical and demographic studies have also concluded exclusive breastfeeding is advantageous for the children up to six months. But in recent literatures, question is raised about the universality of this proposition [Choe and Anandiah; 2001]. The major argument against such universality is that, if the mother is undernourished then the milk for her child will be with fewer nutrients. Thus the practice of exclusive breast-feeding might have adverse impact on the nutritional outcome of the children, if he/she is completely dependent upon the mother's milk for survival. In fact, this issue is highly relevant in the Indian context where we have half of the mothers undernourished in terms of their Body Mass Index and around seventy percent are anaemic [IIPS Macro; 2000].

Given the premise, we want to look at the proposition whether the children with early supplementation along with breastfeeding fare better or children with exclusive breastfeeding fare better, as far as nutritional outcome is concerned. The information on breastfeeding practice is collected from the NFHS-2. We have restricted the analysis to the children who are six months old or less than that. Since we found that after six months the percentage of exclusive breast-feeding among the children is very low, below ten percent. The methodology adopted in this section remains same as for the other sections of the chapter. First we have had a one-way association between breastfeeding status and nutritional outcome of the children. Then we have computed simple and revised response of breastfeeding status to the nutritional outcome for the two groups.

4.6.1. Breastfeeding and Stunting

In case of very young children (below six months of age), it is observed that the overall prevalence of stunting for the states is very low. This is mainly because of the fact that growth failures become more prominent as the age of child increases. The one-way association across the major Indian states, however, presents a mixed scenario about association between breastfeeding status and stunting outcome. In states like Uttar Pradesh, Rajasthan, Assam, Haryana, Orissa, West Bengal and Kerala, children with exclusive breastfeeding have shown lower prevalence of stunting. In Karnataka, we notice that the difference between two groups is marginal as far as stunting outcome is considered. However, in remaining seven states (Madhya Pradesh, Bihar, Gujarat, Maharashtra, Punjab, Andhra Pradesh, and Tamil Nadu) it is found that the children with exclusive breastfeeding are more vulnerable to growth faltering (stunting) than children with breastfeeding and supplementation. However at all India level the difference does not appear to be robust [see for details Table A 4. 9, column 3 and 4].

The response computed for the two groups of children for their nutritional outcome shows simple risk response is greater than unity in states like Bihar, Madhya Pradesh, Gujarat, Maharashtra, Punjab, Karnataka, Andhra Pradesh and Tamil Nadu, because these are the states where children with exclusive breastfeeding are in disadvantageous position. In all other states it is below unity because in those states the children with exclusive breastfeeding are in advantageous position. The response is highest for Maharashtra, followed by Tamil Nadu and lowest in Orissa. The revised risk response further reconfirms the findings from the simple response [For details see Table A 4. 9,

column 5 and 6]. The ranks for the states only change marginally according to the revised response.

The results from binomial logit regression found that breastfeeding status does not affect the outcome of stunting. In other words, in the presence of other relevant correlates like childhood ailments, maternal education, socio-economic status of the household, child's birth order and own health status, the impact of exclusive breastfeeding on stunting is marginal. This finding is confirmed in the state level exercise as well (except for Gujarat, Maharashtra, Punjab, Andhra Pradesh, Karnataka and Tamil Nadu). The ranks on the basis of odds from binomial logit models remain same as the ranking on the basis of responses for states like Orissa. For others the ranks change marginally [see for details Table A 4.9; column 7].

4.6.2. Breastfeeding and Underweight

This section will focus on the relationship between underweight and breastfeeding status of the children. The methodology of analysis is same as the stunting section. Here we have found that underweight is higher among the children having breastfeeding with some amount of mushy food supplementation for almost all states except Gujarat and Karnataka, compared to the children having exclusive breast-feeding [for details see Table A 4.10, column 3 and 4]. Further, the simple risk response calculated for the children having exclusive breastfeeding shows that the risk of underweight is negative for almost all the selected states (except Gujarat and Karnataka). The revised risk response further confirms the results from simple response [for details see Table A 4.10, column 5 and 6 below]. This confirms the well-known fact that children below six months should be exclusively breastfed as they have better weight-for-age compared to those with mushy dietary intake. In order to understand whether the breastfeeding status affect the nutritional outcome of the weight-for-age for the children below six months of age, we have to control for other explanatory variables. For this purpose, we run a binomial logit model and thus obtained results hold well in case of this multivariate exercise as well [For details see Table A 4.10, column 7]. It points out that children who are fed mushy food along with breast milk in first six months of life are not better off than those children who are exclusively breastfed. The reason may be several. For instance, the exposure to pathogens is higher among children who are supplemented with mushy food, there by increasing the risk of diseases like diarrhoea, which in turn affects the weight of the children. For convenience, the findings from Table A 4. 9 and Table A 4.10 are summarised in Table 4.5 below.

Table 4.5: Pattern of Revised Response and Odds, for Children (below six months) with Exclusive Breastfeeding on Nutritional Outcome for Selected States and all India; 1998-99

(1)	(2)	(3)	(4)	(5)	(6)
> 1.20	-	-	-	-	MAH, PUN, TN
1.10-1.20	-	GUJ	-	-	AP
1.05-1.10	-	-	-	-	-
1.00-1.05	-	KAR	-	-	-
< 1.00	UP, RAJ, AS, HAR, OR, WB, KER, India	-	-	BI, MP	-
Stunting ↑ Underweight↓	< 1.00	1-1.05	1.05-1.10	1.10 -1.20	>1.20
< 1.00	MP, BI, OR, UP, RAJ, MAH, WB, TN, AS, HAR, PUN, KER	-	-	-	KAR
1.00-1.05	-	-	-	-	-
1.05-1.10	-	-	-	-	-
1.10-1.20	AP	-	-	-	-
>1.20	-	-	-	-	GUJ

Source: NFHS-2

Note:

1. *Each cell in the table represents a combination of revised response from bi-variate exercise (column 2-6) and odds i.e. exp. β obtained from multivariate exercise (column 1), for the outcome of undernutrition among children with exclusive breastfeeding.*
2. *AP =Andhra Pradesh, AS = Assam, BI = Bihar, GUJ = Gujarat, HAR = Haryana, KAR = Karnataka, KER = Kerala, MP = Madhya Pradesh, MAH = Maharashtra, OR = Orissa, PUN = Punjab, RAJ = Rajasthan, TN = Tamil Nadu, UP = Uttar Pradesh, WB = West Bengal, India = All India*

4.7. Discussion

On the whole, the analysis shows that among immediate correlates disease response to undernutrition during childhood among Indian children is phenomenal across variant levels of disease prevalence as well as extent of undernutrition (both stunting and under weight). In addition, the current exercise finds out that undernutrition, as an outcome is less responsive to diseases at worse levels than at relatively better levels. Such a finding suggests that focus on disease prevention need not be slackened in situations of relatively lesser degree of undernutrition. Rather, most of it could be related to diseases. Alternatively, in situation of higher prevalence of undernutrition as in case of few backward states in India, a multi-pronged approach may be necessary to address undernutrition along with disease control inclusive of ensuring minimum consumption levels in poor households and monitoring nutritional balance in dietary intake of children. Another interesting observation made here relates to strength of disease response in relation to the dual indicators of undernutrition e.g. stunting and underweight. It is seen that disease response is stronger in relation to underweight compared with stunting. If we compare Table A 4.2 and Table A 4.4, it is apparent that for all the three diseases, viz. diarrhoea, fever and cough the underweight has odds greater than unity for almost all the states compared with stunting. Particularly fever

and cough are very highly sensitive to under weight outcome for all most all the states. Stunting is relatively less sensitive to cough compared to diseases like diarrhoea and fever. Another reason could be for stunting being a long-term outcome indicator and hence less sensitive to disease events experienced in short term within a reference period of two weeks [Osmani; 1992, Haddad and Smith; 2000, Bariage et al 2003].

In this risk response analysis, the engagement with two measures is to justify the consistency in these responses and in particular the revised response indicator is intended to make it unconditional of the overall levels of undernutrition. However, presentation of these two indices and their being consistent in ranks across states justify their robustness for comparison across varying levels of undernutrition. These indices reflect sensitivity at the two extremes of prevalence of undernutrition. In all, it can be concluded that although childhood ailments are responsible for nutritional deprivation during childhood, it could be an immediate one preceded by a host of other factors, which predispose children to such ailments. Therefore, while nutritional vulnerability in childhood is largely implied by frequent morbidity/childhood ailments, disease vulnerability has its roots in the household conditionings as well as child rearing practices of the household. Furthermore, the analysis shows that immunisation does play an important role in child nutritional outcome across the states in both the long run and short run measures of child undernutrition. One of the reasons may be that immunisation reduces the risk of morbidity for children and thereby ensures unhindered growth for children both in terms of height and weight. On the other hand immunisation also reflects the knowledge about better care for children by parents. Thus the parents who immunised their children must likely to ensure a disease free environment and hygienic food supplementation for them, there by reducing the risk of ailments and infections for children.

The findings from mushy food supplementation and its impact on nutritional outcome found quite contrasting evidence. The finding from both bivariate response and multivariate response confirms negative association between stunting and mushy food supplementation. In case of underweight though the bivariate association shows some variation for states, in multivariate analysis except two states all other shows negative response between underweight and supplementation. It is found that children who are supplemented with mushy food have poor height-for-age and weight-for-age. The reason might be if the mushy food is not prepared hygienically then child will be exposed to water borne pathogens and it will cause ailments like diarrhoea. The net result will be poor physical growth of children. Some of the findings from NFHS-2

might have certain clues for explaining the negative association between nutritional outcome of children and their food supplementation status.

The same is also observed in case of introducing supplementation along with breast milk for children below six months of age. In most of the states the children below six months who are both breastfed and supplemented have higher prevalence of underweight, which confirms our findings from supplement section, where we found supplemented children are more likely to be underweight. One of the reasons could be in terms of exposure to water born pathogens, in absence of proper hygiene and safe drinking water. Thus the children are more likely to have ailments like diarrhoea and fever, which will hamper their growth as well as weight given their age. This might happen to the children, who are exposed to early supplementation. In those states where we found small gap between two groups of children in prevalence of stunting and underweight, indicates to the possibility that supplementation (both for children below six months and children between 6-11 months) as such might not directly affect the outcome, instead it can be better explained after controlling for other factors. Instead the exclusive breastfeeding seems beneficial to the children.

4.8. Conclusion

Thus this chapter has analysed the two immediate determinants (dietary intake and childhood ailments) of child undernutrition in India. The analysis shows that an ailment like diarrhoea is crucial determinant of underweight outcomes among the children while fever and cough could hamper long term growth of the child. It is also found that the impact of disease on nutritional outcome is robust in case of states with low overall prevalence and reverse is true for the states with high prevalence. One possible conclusion could be that, in low prevalence states the diseases like diarrhoea and fever have explicit bearing for child nutritional outcome, while in other states the effect of disease is overshadowed by other factors as well, such as high level of socio-economic deprivation. So one policy implication could be in the low overall prevalence states, nutrition programme for children must focus to contain these ailments among children, while in high over all prevalence states the child nutrition programme should include containing of diseases as well as intervention in improving household's socio-economic condition and maternal education. From immunisation analysis it could be concluded that immunisation coverage has to be universal to improve the nutritional status of the children across the states. Further, it is concluded that supplementation along with breast milk may not necessarily result in improvement of nutritional status of the children. However, it could be argued that supplementation should be made under

hygienic and safe conditions. The focus on maternal education and knowledge about better care practice could be crucial supplementary intervention to ensure better outcome from intervention in immediate correlates. However, the limitation of the investigation arises from the fact that it could focus on only three ailments like diarrhoea, fever and cough and could not capture adequately the quantity and quality of food intake for children. Nevertheless, this chapter throws some light on facts and challenges about the nutritional status of Indian children along with some crucial intervention issues.

APPENDIX TO CHAPTER 4

Table A 4.1: Prevalence of Stunting (height-for-age) by Disease among Pre-school Children across Selected States and all India

States in descending order of Prevailing levels of Undernutrition in Children with ranks in parenthesis (1)	Overall % of stunted children (2)	Pattern of Undernourishment in children					
		With Diarrhoea (3)	Without Diarrhoea (4)	With fever (5)	Without Fever (6)	With Cough (7)	Without Cough (8)
Uttar Pradesh (15)	55.5	58.01** (1217)	54.88 (3628)	60.88*** (1393)	53.09 (3445)	57.78*** (1831)	54.36 (3013)
Bihar (14)	53.7	58.85 *** (479)	52.76 (2117)	57.09 (818)	52.40 (1769)	56.16 * (974)	52.51 (1611)
Rajasthan (13)	52.0	54.76 (336)	51.36 (1291)	55.6 (422)	50.83 (1206)	51.95 (539)	52.11 (1088)
Madhya Pradesh (12)	51.0	51.82 (494)	51.03 (1558)	54.76 (641)	49.58 (1412)	49.63 ** (935)	52.46 (1117)
Assam (11)	50.2	45.24 (42)	50.95 (369)	45.90 (122)	52.08 (288)	43.26 (141)	54.07 (270)
Haryana (10)	50.0	52.11 (71)	49.65 (425)	55.37 (121)	48.53 (373)	47.92 * (144)	50.85 (352)
Orissa (9)	44.0	47.60 * (250)	42.63 (631)	45.28 (318)	43.19 (565)	40.63 ** (315)	45.76 (666)
Gujarat (8)	43.6	44.21 (233)	43.48 (890)	48.94 (235)	42.23 (888)	41.49 (315)	44.43 (808)
West Bengal (7)	41.5	50.98*** (153)	40.72 (1751)	46.46*** (579)	39.43 (1324)	42.0 (800)	41.16 (1103)
Maharashtra (6)	39.9	42.09* (632)	39.06 (1805)	39.31 (926)	40.17 (1511)	38.89 (995)	40.46 (1441)
Punjab (5)	39.2	36.54 (52)	39.42 (449)	38.40 (125)	39.47 (375)	36.42 (151)	40.4 (349)
Andhra Pradesh (4)	38.6	42.81* (278)	37.97 (1488)	40.16 (513)	38.17 (1255)	38.58 (648)	38.87 (1119)
Karnataka (3)	36.6	38.41 (164)	36.36 (957)	40.42 (287)	35.33 (835)	38.19 (254)	36.22 (867)
Tamilnadu (2)	29.4	28.57 (217)	29.45 (1246)	26.59 (331)	30.15 (1131)	31.73 (416)	28.37 (1047)
Kerala (1)	21.9	26.39 (72)	21.34 (539)	25.78 (256)	12.91 (354)	23.18 (220)	21.23 (391)
All India	45.5	49.13 *** (4942)	44.69 (19832)	48.03*** (7437)	44.39 (17334)	46.26 (9069)	45.17 (15715)

Source: NFHS-2

Notes:

****, ** and * refers to statistical significance for bivariate association between different childhood ailments and nutritional outcome in chi-square test for respective states at 1 percent level, 5 percent and 10 percent level respectively.*

Table A 4.2 Pattern of Bivariate and Multivariate Response of Childhood Ailments on Undernutrition (in terms of height-for-age) among Children across Selected States and all India; 1998-99

States in Descending order of prevailing Levels of stunting with ranks in parenthesis	Levels (Percentage of Under-nourished Children below age of 36 months)	Diarrhoeal Response	Diarrhoeal Response Revised	Exp (β) Or odds for diarrhoea from multivariate model	Difference between bi-variate odd and multivariate odd for diarrhoea (Col.5-Col. 4)	Fever response	Fever response Revised	Exp (β) Or odds for fever from multivariate model	Difference between bi-variate odd and multivariate odd for fever (Col.8-Col. 9)	Cough Response	Cough Response Revised	Exp (β) Or odds for cough from multivariate model	Difference between bi-variate odd and multivariate odd for cough (Col12-Col. 13)
1	2	3	4	5	6	7	8	9	10	11	12	13	14
Uttar Pradesh (15)	55.5	1.04 (8)	1.13 (10)	1.10 (8)	0.13	1.11 (12)	1.43 (14)	1.40 ***(15)	0.03	1.03 (10)	1.14 (13)	1.14 ***(14)	0.00
Bihar (14)	53.7	1.09 (12)	1.28 (14)	1.23** (13)	0.05	1.05 (7)	1.2 (7)	1.18**(7)	0.02	1.04 (11)	1.15 (14)	1.11** (13)	0.04
Rajasthan(13)	52.0	1.05 (10)	1.14 (11)	1.14 (9)	0.00	1.06 (8)	1.21 (8)	1.22*(8)	-0.01	0.99 (9)	0.99 (9)	0.98 (7)	0.01
Madhya Pradesh (12)	51.0	1.01 (5)	1.03 (6)	1.03 (6)	0.00	1.07 (9)	1.23 (9)	1.23** (9)	0.00	0.97 (6)	0.89 (6)	0.86 (4)	0.03
Assam (11)	50.2	0.89 (1)	0.79 (1)	0.68 (1)	0.11	0.91 (2)	0.78 (1)	0.74 (1)	0.04	0.85 (1)	0.64 (1)	0.63 (1)	0.01
Haryana (10)	50.0	1.04 (6)	1.10 (7)	1.15 (10)	-0.05	1.10 (10)	1.31 (12)	1.34 (13)	-0.03	0.95 (5)	0.89 (5)	0.92 (6)	0.03
Orissa (9)	44.0	1.08 (11)	1.22 (12)	1.16 (11)	0.06	1.03 (6)	1.08 (6)	1.04 (4)	0.04	0.92 (2)	0.81 (2)	0.79 (2)	0.02
Gujarat (8)	43.6	1.01 (4)	1.03 (5)	0.88 (3)	0.15	1.12 (14)	1.31 (11)	1.30 *(12)	0.01	0.95 (4)	0.88 (4)	1.01 (10)	-0.13
West Bengal (7)	41.5	1.22 (15)	1.51 (15)	1.26 (15)	0.25	1.11 (13)	1.33 (13)	1.26 (10)	0.07	1.1 (14)	1.03 (10)	1.01 (10)	0.02
Maharashtra (6)	39.9	1.05 (9)	1.13 (9)	1.08 (7)	0.05	0.98 (3)	0.96 (4)	1.08 (5)	-0.08	0.97 (7)	0.93 (7)	0.87* (5)	0.06
Punjab (5)	39.2	0.93 (2)	0.88 (2)	0.81 (2)	0.07	0.98 (4)	0.95 (3)	0.83 (3)	0.12	0.92 (3)	0.84 (3)	0.81 (3)	-0.03
Andhra Pradesh (4)	38.6	1.10 (13)	1.23 (13)	1.22 (12)	0.01	1.03 (5)	1.08 (5)	1.15 (6)	-0.07	0.99 (8)	0.98 (8)	1.01 (10)	-0.03
Karnataka (3)	36.6	1.04 (7)	0.94 (4)	1.02 (5)	-0.08	1.10 (11)	1.24 (10)	1.27* (11)	-0.03	1.04 (12)	1.08 (13)	1.15 (15)	-0.07
Tamilnadu (2)	29.4	0.97 (3)	0.91 (3)	0.89 (4)	0.02	0.90 (1)	0.83 (2)	0.77** (2)	0.06	1.88 (15)	1.17 (15)	1.10 (12)	0.07
Kerala(1)	21.9	1.20 (14)	1.13 (8)	1.25 (14)	-0.12	1.17 (15)	1.46 (15)	1.38 (14)	0.08	1.05 (13)	1.12 (12)	1.08 (11)	0.04
All India	45.6	1.08	1.19	1.13***	0.06	1.06	1.17	1.15***	0.02	1.02	1.05	1.02***	0.03

Source: NFHS-2; 1998-99

Notes:

1. *Here the multi-variate model is controlled for the diseases like diarrhoea, fever, cough, socio-economic indicators like household status, caste, mother's education, religion and place of residence.*
2. ****, ** and * refers to statistical significance of odds for respective states at 1 percent level, 5 percent and 10 percent level respectively .*

Table A 4.3: Prevalence of Underweight (weight-for-age) by Disease among Pre-school Children across Selected States and all India; 1998-99

States in descending order of Prevailing levels of Under-Nutrition in Children (1)	Overall Percentage of underweight Children (2)	Pattern of Undernourishment in children					
		With Diarrhoea (3)	Without Diarrhoea (4)	With fever (5)	Without Fever (6)	With Cough (7)	Without Cough (8)
Madhya Pradesh (15)	55.1	56.8 (495)	54.7 (1558)	61.0 (641)***	52.6 (1415)	54.8 (936)	55.5 (1120)
Bihar (14)	54.4	58.4* (469)	53.5 (2117)	58.4** (818)	52.6 (1769)	55.9 (976)	53.6 (1609)
Orissa (14)	54.4	60.8** (250)	52.0 (631)	59.6** (317)	51.5 (565)	56.2 (315)	53.4 (567)
Uttar Pradesh (12)	51.7	57.8*** (1218)	49.8 (3628)	59.0 (1397)***	48.8 (3442)	55.0*** (1836)	49.9 (3010)
Rajasthan (11)	50.6	55.1** (336)	49.5 (1293)	56.5 (423)***	48.6 (1208)	52.4 (540)	49.8 (1090)
Maharashtra (10)	49.6	51.8 (631)	48.09 (1806)	54.9 (926)***	46.5 (1510)	53.4** (995)	47.1 (1441)
West Bengal (9)	48.7	57.5** (153)	48.1 (1752)	52.5** (579)	47.2 (1327)	49.5 (800)	48.4 (1105)
Gujarat (8)	45.1	47.2 (233)	44.6 (890)	50.0** (234)	43.9 (889)	46.2 (314)	44.7 (810)
Karnataka (7)	43.9	48.2 (164)	43.4 (955)	50.5 (287)**	41.9 (832)	46.9 (254)	43.2 (865)
Andhra Pradesh (6)	37.7	41.2 (279)	37.0 (1493)	38.2 (513)	37.4 (1258)	39.1 (652)	36.7 (1119)
Tamilnadu (5)	36.7	40.2 (214)	36.2 (1246)	38.1 (331)	36.3 (1128)	44.4*** (413)	33.9 (1047)
Assam (4)	36	43.9 (41)	35.3 (368)	39.5 (124)	35.0 (286)	34.6 (269)	39.4 (142)
Haryana (3)	34.6	40.0 (70)	33.6 (425)	39.7 (121)	33.0 (373)	34.0 (144)	34.7 (352)
Punjab (2)	28.7	40.4** (52)	27.5 (448)	29.6 (125)	28.4 (373)	28.5 (151)	28.9 (349)
Kerala (1)	26.9	33.3 (72)	26.2 (539)	33.6** (256)	22.0 (354)	29.5 (220)	25.5 (392)
All India	47.0	52.5*** (4943)	45.7 (19838)	52.0 *** (7444)	44.9 (17334)	49.6*** (9068)	45.6 (15713)

Source: NFHS-2

Notes:

1. ****, ** and * refers to statistical significance for bivariate association between different childhood ailments and nutritional outcome in chi-square test for respective states at 1 percent level, 5 percent and 10 percent level respectively.*

Table A 4.4 Pattern of Bivariate and Multivariate Response of Childhood Ailments on Undernutrition (in terms of weight-for-age) among Children across Selected States and all India; 1998-99.

States in Descending order of prevailing Levels of Underweight with ranks in parenthesis	Levels (Percentage of Under-nourished Children below age of 36 months)	Diarrhoeal Response	Diarrhoeal Response Revised	Exp (β) Or odds for diarrhoea from multivariate model	Difference between bi-variate odd and multivariate odd for diarrhoea (Col.5-Col. 4)	Fever response	Fever response Revised	Exp (β) Or odds for fever from multivariate model	Difference between bi-variate odd and multivariate odd for fever (Col.8-Col. 9)	Cough Response	Cough Response Revised	Exp (β) Or odds for cough from multivariate model	Difference between bi-variate odd and multivariate odd for cough (Col.12-Col. 13)
1	2	3	4	5	6	7	8	9	10	11	12	13	14
Madhya Pradesh (15)	55.1	1.03 (1)	1.08 (1)	0.97 (2)	0.11	1.1 (9)	1.41 (12)	1.56*** (14)	-0.15	0.99 (4)	0.97 (3)	0.94 (1)	0.03
Bihar (14)	54.4	1.07 (4)	1.2 (5)	1.27 (11)	-0.07	1.07 (4)	1.26 (6)	1.28** (6)	-0.02	1.02 (6)	1.09 (7)	1.07 (5)	0.02
Orissa (14)	54.4	1.11 (9)	1.43 (13)	1.25** (10)	0.18	1.09 (7)	1.39 (11)	1.36* (13)	0.03	1.03 (8)	1.11 (10)	1.10 (7)	0.01
Uttar Pradesh (12)	51.7	1.11 (10)	1.38 (10)	1.32*** (13)	0.06	1.13 (12)	1.5 (14)	1.35*** (12)	0.15	1.061 (12)	1.22 (13)	1.19*** (9)	0.03
Rajasthan (11)	50.6	1.08 (5)	1.25 (8)	1.20* (8)	0.05	1.11 (11)	1.37 (9)	1.34*** (10)	0.03	1.03 (9)	1.1 (9)	1.01 (6)	-0.09
Maharashtra (10)	49.6	1.04 (3)	1.12 (3)	0.97 (3)	0.15	1.1 (10)	1.39 (10)	1.34*** (9)	0.05	1.07 (13)	1.28 (15)	1.22** (12)	0.04
West Bengal (9)	48.7	1.17 (12)	1.46 (14)	1.31 (12)	0.15	1.07 (5)	1.23 (5)	1.16 (5)	0.07	1.01 (5)	1.04 (5)	1.03 (4)	0.01
Gujarat (8)	45.1	1.04 (2)	1.11 (2)	0.82 (1)	0.29	1.1 (8)	1.27 (7)	1.30 (7)	-0.03	1.02 (7)	1.06 (6)	1.21 (11)	-0.14
Karnataka (7)	43.9	1.09 (7)	1.24 (7)	1.01 (4)	0.23	1.05 (3)	1.15 (3)	1.35* (11)	-0.20	0.98 (2)	0.95 (1)	1.23 (13)	-0.28
Andhra Pradesh (6)	37.7	1.09 (6)	1.19 (4)	1.22 (9)	-0.03	1.03 (1)	1.03 (1)	1.05 (4)	-0.02	1.04 (10)	1.1 (8)	1.17 (8)	-0.07
Tamilnadu (5)	36.7	1.09 (8)	1.21 (6)	1.05 (5)	0.16	1.14 (14)	1.41 (13)	0.82 (1)	0.59	1.06 (11)	1.15 (11)	1.46*** (15)	-0.31
Assam (4)	36	1.21 (13)	1.43 (12)	1.14 (6)	0.29	1.08 (6)	1.21 (4)	0.98 (3)	0.23	1.08 (14)	1.23 (14)	1.36 (14)	-0.13
Haryana (3)	34.6	1.15 (11)	1.31 (9)	1.33 (14)	-0.02	1.14 (13)	1.33 (8)	1.34 (8)	-0.01	0.98 (1)	0.97 (2)	0.96 (2)	0.01
Punjab (2)	28.7	1.4 (15)	1.79 (15)	1.75* (15)	0.04	1.04 (2)	1.05 (2)	0.94 (2)	0.11	0.98 (3)	0.97 (4)	1.03 (3)	-0.06
Kerala (1)	26.9	1.23 (14)	1.41 (11)	1.17 (7)	0.24	1.25 (15)	1.79 (15)	1.82 (15)	-0.03	1.09 (15)	1.22 (12)	1.19 (10)	0.03
All India	47	1.15	1.31	1.15***	0.06	1.16	1.33	1.26***	0.07	1.09	1.17	1.15***	0.02

Source: *NFHS-2; 1998-99*

1. *Here the multi-variate model is controlled for the diseases like diarrhoea, fever, cough, socio-economic indicators like household status, caste, mother's education, religion and place of residence.*
2. ****, ** and * refers to statistical significance of odds for respective states at 1 percent level, 5 percent and 10 percent level respectively .*

CHAPTER 5

UNDERNUTRITION AMONG WOMEN OF REPRODUCTIVE AGE

5.1. Introduction

It is widely acknowledged that diet and healthcare are the two crucial components for a safe and successful motherhood and have an immediate influence on maternal (and child) health outcomes [ACC/SCN; 2000]. Unfortunately, most of the Indian women in their reproductive ages are largely deprived of these two basic requirements[1]. The non-trivial consequences of such deprivations are apparent in the form of disquieting proportions of maternal and infant deaths in the country. In view of such outcomes, it becomes important for researchers and policymakers to identify the channels through which dietary intake and healthcare access could be promoted to reduce maternal health vulnerabilities. The central issue raised here is to precisely identify the factors that govern a woman's dietary behaviour and her outlook towards healthcare. The economic literature suggests that choices pertaining to dietary intake and health care utilisation by women are seldom independent of other vital factors. Although, most of these factors are directly related with the household characteristics like its socio-economic status, geographical accessibility to health care services, educational status, and occupation, individual-specific factors such as age of the woman, age at marriage, fertility preferences and childbirth also has significant impact on maternal health [see, among others, Waterhouse and Neville; 2004].

Undoubtedly, a detailed analysis of these crucial factors can pave the way for successful action for reducing the misfortunes associated with maternal health in India. However, apart from these factors, it is argued that nutritional outcome of Indian women are also affected by the patriarchal nature of the society, which allows other household members to undertake decisions on several immediate and household factors [Yinger et al; 2002]. This decision-making power in relation to the key life course events is often bestowed with other members of the household (including husband) and these decisions are often inconsiderate towards the woman's choice or preference. Nonetheless, the degree of such apathy largely depends upon the status of women in the household and it appears to be a crucial link to comprehend the different aspects of maternal health.

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[1] For instance, Figure A 5.1 in appendix depicts the heavy burden of nutritional compromise among Indian women. What is immediately discernible from the figure is that the prevalence of undernutrition is by no means insignificant, even among the better performing Indian states.

The present chapter is an attempt to comprehend the principal determinants of maternal health in India. As brought out in the foregoing section, this empirical endeavour would highlight the association between women's autonomy and nutritional outcomes. With this backdrop, the rest of the chapter is organised as follows. In section 5.2 a brief discussion of data and methodology is provided. Section 5.3 discusses the role of immediate correlates (like dietary intake) on the nutritional outcome of women. Section 5.4 deals with healthcare seeking behaviour and nutritional performance of women. As limited information is available on ailments, like tuberculosis, jaundice, asthma, malaria and HIV-AIDS for women, and as the sample size is inadequate, the analysis does not explore disease patterns among women and its association with nutritional outcomes. Section 5.5 highlights the role of women's autonomy in her nutritional outcome. Section 5.6 analyses the individual characteristics (including reproductive factors) other than diet, that affect women's nutritional outcome. Section 5.7 focuses on the characteristics that are primarily related to the household where the woman resides. Section 5.8 concludes.

5.2. Data and Methods

As discussed earlier, the information on women's nutrition is filtered from the NFHS-2, 1998-99. The information is limited to women of 15-49 years of age, otherwise addressed as *'women of reproductive age'* in the survey. Along with the nutritional status of women, the information is also available on the reproductive health, fertility and other household related characteristics like socio-economic status, ethnicity and religion. The outcome of undernourishment is measured in terms of the widely employed indicator of Body Mass Index or BMI. The BMI score of below 18.5 kg/m^2 for reproductive age women are considered as an indicator of undernourishment. Following the food-health-care framework, the correlates are selected by simple cross-tabulation with the outcome of undernourishment and are tested for statistical significance (on the basis of chi-square test). If the association is found to be statistically significant, then the correlates are accepted for the multivariate analysis. In order to comprehend the significant determinants of women's nutritional status the multivariate analysis here employs the standard technique of binomial logit regression. For analytical purposes, the nutritional status of women is classified into a binary variable that assumes a value zero for those with low BMI score (below the cut-off of 18.5 kg/m^2) and a value of one, otherwise. As discussed in Chapter 3, the analysis is performed using SPSS software, which facilitates logistic regression exercise by allowing model specification, based on three different methods. Specifically, these three methods are: *forced entry method, forward stepwise method, backward stepwise method* of model specification. Here, the analysis is performed

using the *backward stepwise method.* Further, five different binomial logit models are interpreted where each of the model assumes different contrast (reference) categories (see Chapter 3 for detail discussion on multivariate models used in the study).

5.3. Dietary Intake and Nutritional Outcome of Indian Women

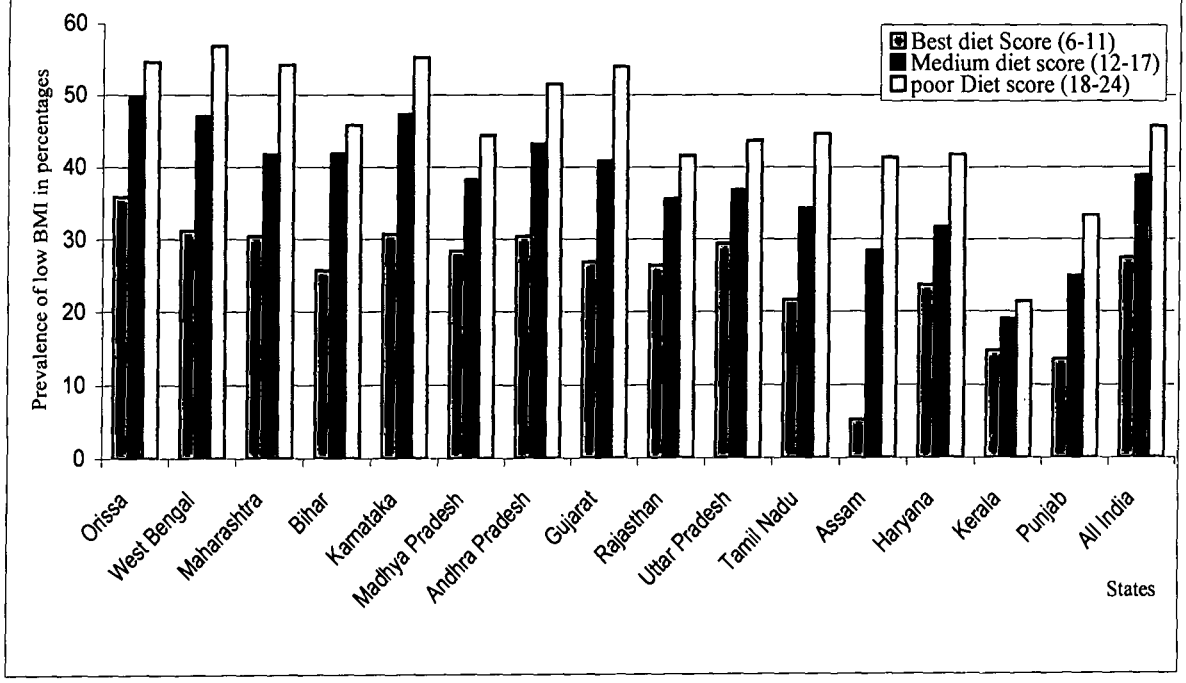
The NFHS-2 dataset provides information on frequency of consumption of seven food item(s), which are considered to be rich in protein, fat and other micronutrients. They are (i) Milk and curd, (ii) Pulses and beans, (iii) Green-leafy vegetables, (iv) Other vegetables, (v) Fruits, (vi) Eggs and (vii) Chicken/meat/fish. However, between categories (iii) and (iv) the former category (Green-leafy vegetables), which is one of the richest sources of Vitamin-A and other vital minerals, is of analytical interest whereas the latter category (Other vegetable) looses its analytical relevance primarily because of its negligible impact on maternal health [Gopalan et al; 1989, Swaminathan et al; 1981]. Not only that, a higher frequency of category-iv (Other vegetable) intake may not be able to provide any further insights owing to the fact that it is common in India to have one or the other types of vegetables in the diet. Now that the category (iv) of Other vegetables is excluded what remains is the dietary information on six food items and its pattern of intake. Further, the information regarding the frequency of intake of these seven items is coded as (1) Daily intake, (2) Weekly intake, (3) Occasional intake, (4) No intake. Based on the selected information on dietary intake and its frequency, a diet score for all the women is computed by adding the intake frequencies (as per the coding mentioned above) for each food category. Specifically, a woman is given a score of '6' if her diet consists of all the six items on daily basis (Daily intake code (1)). Similarly a woman will get score of '24' if she is not taking (No intake code (4)) any of these six items. The score ranges between '6 and 24' and is divided into three broad categories with equal intervals. A score ranging between '6 to 11' constitutes a *'good-diet'*, while a range of '12 to 18' constitutes *'medium-diet'* and a score of '19 to 24' is considered *'poor-diet'*[2]. Thus obtained diet-score categories are used to comprehend whether the nutritional status of women (of reproductive age) vary according to the differences in intake.

Figure 5.1 presents the proportion of women of reproductive age reporting low body mass index (BMI) by the diet score range. It is clear from the figure that the percentages

[2] However the problem with this approach is that the frequency of intake does not reflect what quantity reaches women as in Indian households the intra-household distribution of food is always skewed against women [Beherman; 1987, 1988 and Beherman and Deolalikar; 1987].

of women with low BMI are observed to be greater in the *poor-diet* category. Although, this pattern appears to be similar across all the 15 states there are variations in the proportion of women across different diet-score categories. It is interesting to observe that for each diet category the proportion of women with low BMI shows wide variation across the states. In fact, for *poor-diet* category the difference between the lowest (Kerala) and highest (West Bengal) value of prevalence of undernutrition is around 31 percent. Moreover, the states reporting the lowest and highest prevalence of undernutrition are not the same.

Figure 5.1 Prevalence of Low BMI by Diet Score among Women across Selected States and all India



Source: NFHS-2

In the *good-diet* category, Assam reported the lowest prevalence of undernutrition (5.2 percent) and Orissa reported the highest prevalence of undernutrition (35.9 percent). In the *poor-diet* category, Kerala reported the lowest prevalence of undernutrition (21.4 percent) and West Bengal the highest prevalence (58.1 percent). However, there is a caveat in the adopted diet-score based approach because it ignores the quantity of intake of food items owing to nonavailability of information on intake quantity in NFHS-2. Nevertheless, it could not be denied that a worsening of the diet-score is a sure indicator of poor nutrition. The multivariate exercise also conforms and complements the conclusion that dietary intakes have a significant impact on nutritional outcome of women. For each diet score range, the prevalence of low BMI shows very little variation among the Indian states, leaving out Kerala and Punjab. For the poor diet score the prevalence of low BMI ranges between 42% and 55% and the Indian average is close to

50%. In the best diet score the range is between 22% and 38% leaving only Assam, Kerala and Punjab. It would be interesting to see what matters to discrepancies in Assam, Kerala and Punjab.

All the odds for diet-score categories are statistically significant and have small standard error thus indicating a substantial influence of diet on BMI outcome for women. For the all-India level analysis, in model 1 the *indicator* method is used as contrast, which shows that women with *poor-diet* score are 1.27 times more likely to have a low BMI compared to women with *good-diet* score. Women with *medium-diet* score are found to be 1.14 times more likely to have low BMI than their counterparts with good diet score. Model 2, also offers similar conclusions. In model 3, it is found that women with *poor-diet* score are 1.19 times more likely to have low BMI than both their counterparts. The model 4, which compares the effect of each category to the subsequent category, found that women from *poor-diet* category are 1.11 times more likely to have low BMI than women with *medium-diet* category. Similarly, women from medium diet score are 1.14 times more likely to have low BMI than their counterparts having good diet score. These findings are supportive of the major conclusions from the previous models and confirm that women with *poor-diet* score have higher vulnerability for low BMI than their other two counterparts. Model 5, further shows that women with poor diet score and medium diet score have higher likelihood for low BMI compared to the average effect of the diet score (which means the average effect of all groups taken together). So all five models confirm that women with poor diet score have higher likelihood to have low BMI than their counterparts in other diet groups [See Table 5.1 for details].

For state level multivariate exercise, the study found that the only six states (West Bengal, Maharashtra, Karnataka, Madhya Pradesh, and Rajasthan) women from *poor* and *medium-diet* categories have higher likelihood of low BMI compared to women from good diet score but in case of other nine states the correlate of diet-score categories is dropped from the final model [see Table A 5.1 in appendix]. Thus, it suggests that the effectiveness of the index of diet-score varies considerably across states and hence renders importance at the national level but fails to offer a clearer understanding of the phenomenon at the regional level. Perhaps, quantity-based intake data would be essential to reassess the bivariate significant associations between diet-score categories and nutritional status of women at the regional level.

Table 5.1. Results from Binomial Logit Regression to Determine the Correlates of Low BMI among Indian Women

BMI (≥ 18.5 kg/m²) = 1	Mod.1 (Indicator)	Mod.2 (Difference)	Mod.3 (Helmert)	Mod.4 (Repeated)	Mod.5 (Deviation)
	Coeff. (std. err.)	Coeff. (std. err.)	Coeff. (std. err.)	Coeff. (std. err.)	Coeff. (std. err.)
1. Women's Age					
14-19 years	1.74 (0.05)***	-	1.40 (0.04)***	0.98 (0.05)	1.34 (0.04)***
20-24 years	1.77 (0.04)***	1.02 (0.05)	1.54 (0.02)***	1.17 (0.03)***	1.36 (0.02)***
25-29 years	1.51 (0.03)***	0.86 (0.03)***	1.40 (0.02)***	1.24 (0.03)***	1.16 (0.02)***
30-34 years	1.22 (0.03)***	0.73 (0.03)***	1.18 (0.02)***	1.16 (0.03)***	0.94 (0.02)***
35-39 years	1.05 (0.04)	0.68 (0.03)***	1.02 (0.03)	0.99 (0.03)	0.81 (0.02)***
40-45 years	1.06 (0.04)	0.74 (0.03)***	1.06 (0.04)	1.06 (0.04)	0.81 (0.02)***
45-49 years	1	0.74 (0.03)***	-	-	1
2. Women's Diet intake score					
Poor-Diet score	1.27 (0.03)***	-	1.19 (0.03)***	1.11 (0.03)***	1.12 (0.02)***
Middle-Diet score	1.14 (0.02)***	0.90 (0.03)***	1.14 (0.02)***	1.14 (0.02)***	1.01 (0.01)
Good-Diet score	1	0.83 (0.02)***	-	-	1
3. Women's Education					
No education	1.69 (0.05)***	-	1.34 (0.02)***	1.08 (0.02)***	1.25 (0.02)***
Primary	1.56 (0.05)***	0.92 (0.02)***	1.38 (0.03)***	1.22 (0.03)***	1.15 (0.02)***
Secondary	1.28 (0.05)***	0.79 (0.04)***	1.28 (0.05)***	1.28 (0.05)***	0.95 (0.02)***
Higher	1	0.67 (0.05)***	-	-	1
4. Women's Marital Status					
Widow/Divorced/Deserted	1.15 (0.04)***	-	1.15 (0.04)***	1.15 (0.04)***	1.07 (0.02)***
Married	1	0.87 (0.04)***	-	-	1
5. Women's Occupation					
Not working	1.26 (0.05)***	-	0.96 (0.04)	0.90 (0.03)***	0.96 (0.02)
Manual (skilled/unskilled) work	1.40 (0.06)***	1.12 (0.03)***	1.08 (0.05)	0.92 (0.04)**	1.07 (0.04)*
Agriculture	1.53 (0.05)***	1.15 (0.02)***	1.25 (0.06)***	1.02 (0.08)	1.17 (0.03)***
Household and Domestic sector	1.50 (0.09)***	1.08 (0.08)	1.35 (0.10)***	1.22 (0.15)	1.15 (0.07)*
Service sector	1.23 (0.14)	0.86 (0.13)	1.23 (0.14)	1.23 (0.14)	0.94 (0.11)
Professor/technician/Sales	1	0.73 (0.06)***	-	-	1
6. Women's Place of Residence					
Born and staying in rural	1.61 (0.03)***	-	1.32 (0.02)***	1.08 (0.04)*	1.23 (0.02)***
Born rural but move to urban	1.50 (0.05)***	0.93 (0.04)*	1.35 (0.04)***	1.21 (0.04)***	1.14 (0.03)***
Born urban but move to rural	1.24 (0.04)***	0.80 (0.03)***	1.24 (0.04)***	1.24 (0.03)***	0.94 (0.02)***
Born and staying in urban India	1	0.70 (0.03)***	-	-	1
7. Women's Autonomy Index					
Poor score (0-2)	1.09 (0.04)**	-	1.07 (0.03)**	1.06 (0.03)*	1.05 (0.02)**
Middle score (3-4)	1.03 (0.02)	0.95 (0.03)*	1.03 (0.02)	1.03 (0.02)	0.99 (0.01)
High score (5-6)	1	0.94 (0.03)**	-	-	1
8. Household's Living Standard					
Low SLI	2.50 (0.03)***	-	1.87 (0.02)***	1.4 (0.02)***	1.52 (0.02)***
Medium SLI	1.79 (0.03)***	0.72 (0.02)***	1.79 (0.03)***	1.79 (0.03)	1.09 (0.01)***
High SLI	1	0.47 (0.03)***	-	-	1
9. Household's Ethnicity					
SC	1.17 (0.03)**	-	1.17 (0.02)***	1.21 (0.03)***	1.13 (0.02)***
ST	0.96 (0.03)	0.83 (0.03)***	0.95 (0.03)*	0.94 (0.03)*	0.93 (0.02)***
OBC	1.03 (0.02)	0.97 (0.02)	1.03 (0.02)	1.03 (0.02)	0.99 (0.02)
Others	1	0.95 (0.02)	-	-	1
10. Household's Religion					
Hindu	1.96 (0.05)***	-	1.61 (0.03)***	1.16 (0.03)***	1.43 (0.19)***
Muslim	1.69 (0.06)***	0.87 (0.03)***	1.64 (0.04)***	1.58 (0.05)***	1.23 (0.03)***
Christian	1.07 (0.06)	0.59 (0.05)***	1.07 (0.06)	1.07 (0.06)	0.78 (0.04)***
Other religions	1	0.66 (0.05)***	-	-	1
11. Household Size					
Large (8 or more members)	1.09 (0.03)***	-	1.07 (0.02)***	1.04 (0.02)*	1.04 (0.01)***
Medium (4-7 members)	1.05 (0.02)**	0.93 (0.02)**	1.05 (0.02)**	1.05 (0.02)**	1.00 (0.02)**
Small (four or less members)	1	0.80 (0.02)***	-	-	1
12. Household Head					
Female	1.09 (0.04)**	-	1.09 (0.04)**	1.09 (0.04)**	1.04 (0.02)**
Male	1	0.92 (0.04)**	1	-	1
N: 69340; Model classification (predicted) = 68.1%; -2 log likelihood = 80298.90; Cox and Snell chi-square test = 0.091; Negerkelke chi-square test = 0.127; Heshmor & Lemshow goodness of fit = 124.78*** (with 8 degrees of freedom)					

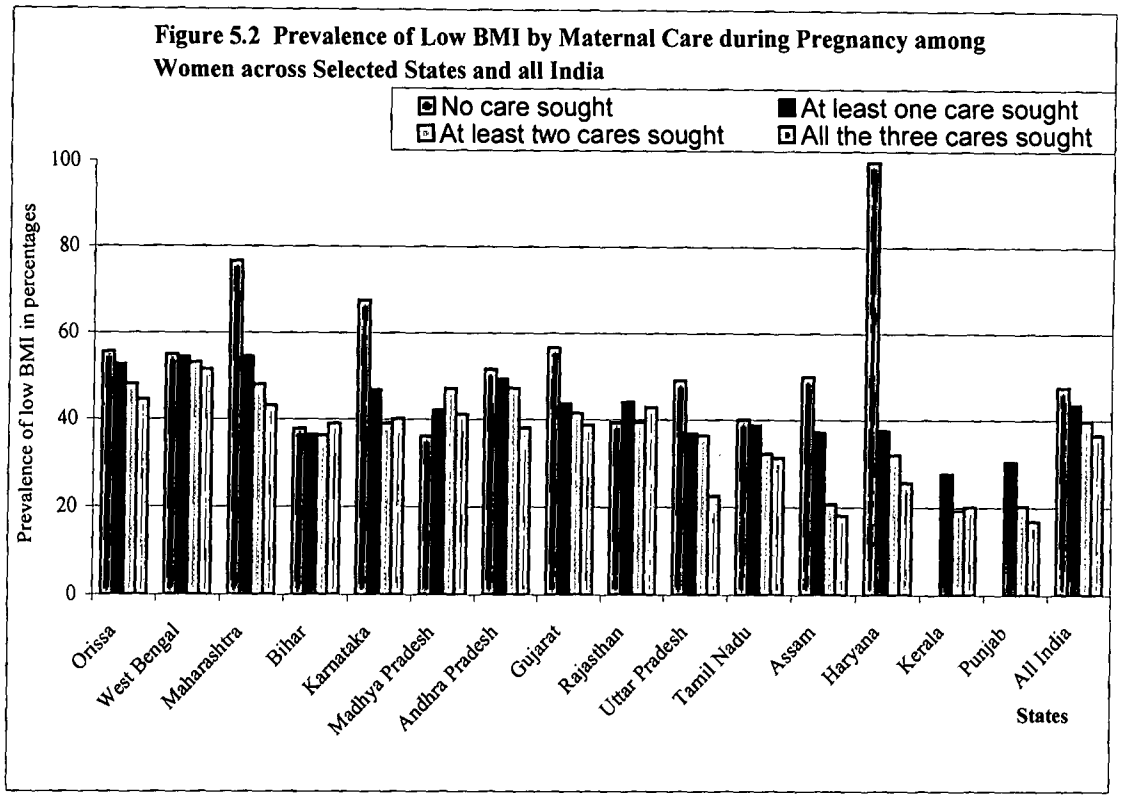
Source: NFHS-2, 1998-99.

*Notes: Here ***, ** and * refers to statistical significance at 1 percent level, 5 percent and 10 percent level, respectively. A separate exercise to determine the effect of 'maternal care during pregnancy' on the outcome of nutrition for women is done for all five models, with different contrasts. In view of reduced number of observations i.e. 16432 for the above correlate, the separate exercise was required. However, in all the models the concerned correlate is dropped at step 4.*

5.4. Maternal Health Care and Nutritional Outcome of Indian Women

Three types of care are very crucial for safe delivery of the child and to protect the mother from risks such as health complications and dangers of maternal mortality during pregnancy. First among this is, antenatal care (include regular health check up for mother and fetus, supplementation of iron tablets against anaemia and vaccination against deadly infections), second; institutional delivery or delivery attended by a trained mid wife/doctor/nurse either at any public or private health care provider and third is post-partum care or neo-natal care i.e regular health check ups and vaccination for both mother and new born child. Needless to say that the newborn child also receives health benefits from such interventions. Absence of these basic healthcare facilities might put the mother in a trap of poor health and subsequent pregnancies may prove to be detrimental to her life.

Here an attempt has been made to see the association between health care during pregnancy and nutritional status of women at the time of survey. This analysis is based on the sample of women that gave birth during the three years preceding the survey (from January 1995 onwards) and only last two births are taken into consideration for 15957 women across the country. An index has been developed on the basis of three indicators of health care needed during pregnancy. These are antenatal care, natal and post-natal care. The construction of index for maternal care during pregnancy included; having prenatal care, delivery and postnatal care at any recognised health care centre in both public and private sector. It gives a score of '1' for care taken and '0' for care not taken. Thus if all the three types of cares are taken, the score will be '3', i.e. the best score and if all the three care are not taken then the score will be '0', the worst score. If only one care is noted then the score will be '1' and if two out of three cares are sought, the score will be '2'. The analysis based on this index shows mixed pattern for the association between maternal health care during pregnancy and outcome of undernutrition among women in terms of prevalence of low BMI. It can be observed from Figure 5.2 that for Andhra Pradesh, Assam, Gujarat, Haryana, Karnataka, Maharashtra, Orissa, Tamil Nadu, West Bengal and Uttar Pradesh, the prevalence of low BMI is higher for women with no maternal care during pregnancy. In Kerala and Punjab, there are no women in the category of no care. Interestingly, in Bihar and Rajasthan, women with all the care taken during pregnancy shows higher prevalence of low BMI compared to women with no care or at least one (or two) of three cares.



Source: NFHS-2

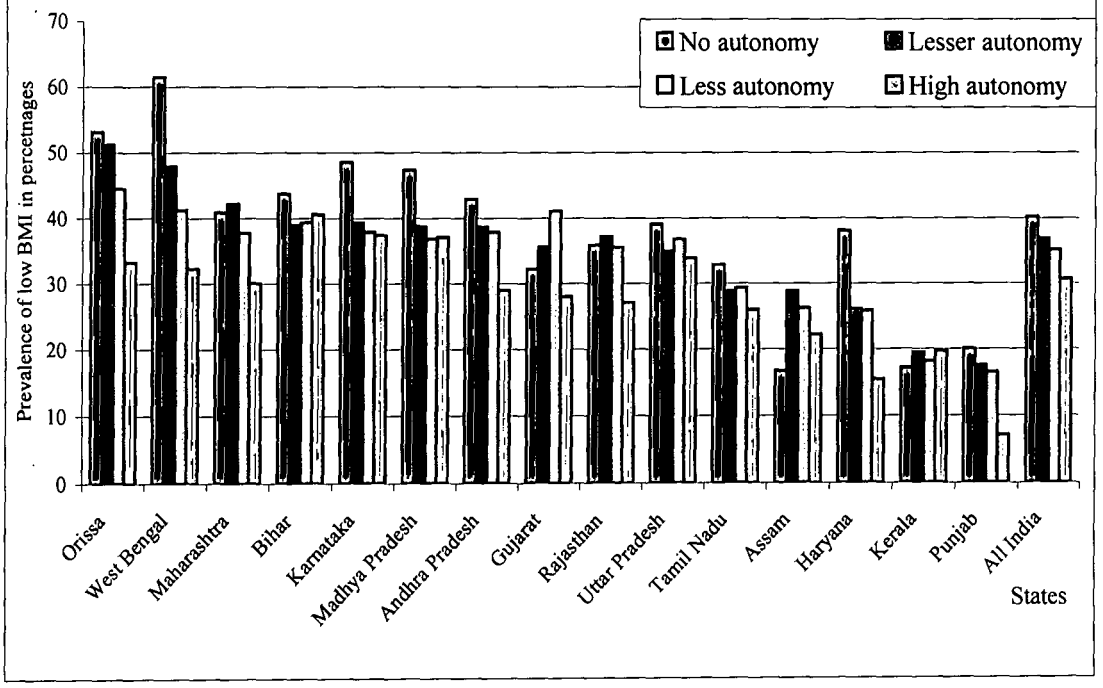
One possible reason for the absence of any clear pattern for the states above, could be that in the scenario of very poor utilisation of 'institutional deliveries' and 'ante-natal care check-ups', the difference between nutritional status of women who accessed these services and their counterparts who did not, will be very low. On the other hand these states also have higher prevalence of undernutrition among women in terms of 'BMI' score. So it also can be inferred that in states where prevalence of undernutrition is so wide, provision of health care may help them to survive but may not show any substantial improvement in their nutritional outcome. Perhaps, because of the above reasons, the multivariate exercise for all India level excludes the variable 'maternal care' from all the models. The state-wise multivariate exercise also found similar pattern, where maternal care is dropped from the model in each selected state.

5.5. Women's Autonomy and Nutritional Outcome

In recent discourse on nutritional status of women, 'autonomy of women' is considered to be one of the most important determinants. This is because a fair degree of financial and decision making autonomy invariably helps women to have better access to household food basket as well as to health care [Crown et al; 2005] and both of these are considered to be the 'immediate correlates' of undernutrition. In the present study, women's autonomy and its impact on nutritional outcome is measured in terms of an

'autonomy index'. This index is calculated by taking into account the information on women's access to financial resources, autonomy regarding mobility (for seeking health care, meeting relatives and going to shop) and her participation in decision-making process of the household. Based on a simple addition of the scores for each variable a composite index is computed ranging from 0 to 6. Since we have six variables to judge autonomy status of the women the highest autonomy (when women alone decides about the functions) in each variable is given value '1' and for least autonomy value '0' (when women do not take part in decision-making process concerning her, even if the decision is taken jointly with her husband and family members also included in the category, because very often this is just a formality as she might not have enough power to put forward her needs before other members). So a score range of 5 to 6 is accorded a 'high autonomy' status, whereas '0', '1 to 2' and '3 to 4' refers to 'no autonomy', 'lesser autonomy' and 'less autonomy' respectively.

Figure 5.3 Prevalence of Low BMI by Women Autonomy among Women across Selected States and all India



Source: NFHS-2

The analysis shows that women having high autonomy i.e. score between '5 to 6' in the index have lesser prevalence of BMI than women of any other category [see Figure 5.3]. The pattern is identical across states selected in the study. Highest prevalence of 'low BMI' is observed for women with value '0' in the index implying no autonomy because in none of the indicators they take decision. This brings out the fact that ensuring better autonomy will enable the women to have better access to the needed resources, crucial for their nutritional outcome like diet and health care. The lowest prevalence of

undernutrition in 'highest autonomy category' is recorded for states of Punjab (7.1 %) followed by Haryana (15.4 %) and Kerala (19.6 %). On the other hand, West Bengal has highest prevalence of undernutrition among women with 'no autonomy' (61 %), followed by Orissa (53.2 %), Karnataka (48.5 %), Madhya Pradesh (47.3 %), Bihar (43.7 %), Andhra Pradesh (42.9 %) and Maharashtra (40.9 %).

Another noticeable pattern is that, at state level the aggregate prevalence of 'low BMI' and the prevalence of low BMI observed among women with 'no autonomy' has some linkage. To elaborate, states where the overall prevalence of 'low BMI' is very high are the states where the prevalence of 'low BMI' is higher among women with 'no autonomy'. For instance take the case of Punjab, where the overall prevalence of 'low BMI' is very low, at the same time it has the lowest prevalence for women with 'no autonomy' among all the states. In Kerala, on the other hand women of different autonomy levels show less differential in prevalence of 'low BMI'. So one inference could be that in those states where overall prevalence of 'low BMI' is very high for the women, the prevalence of 'low BMI' for women with degree of autonomy will be also higher, though the women with 'no autonomy' have the highest prevalence. In states where the aggregate state level prevalence is very low, the prevalence will be lower even among the women with 'no autonomy', compared to their counterparts in other states. This observation suggests that 'women autonomy' probably is not the sole determinant of nutritional status for women, but the nutritional outcome is influenced by several other correlates as well. Nonetheless, the central point in this analysis is that 'autonomy of women' does make a difference to the nutritional outcome with varying degree, given the overall prevalence at aggregate level.

The multivariate exercise for all India found that women with poor autonomy have higher risk of low BMI (see Table 5.1). Model 1 based on *indicator* contrast shows women with poor autonomy score have marginally (1.09) higher odds for low BMI against their counterparts with high autonomy score. Similarly women with medium autonomy score are 1.03 times more likely to have low BMI than their counterparts in with high autonomy score. In *Helmert* contrast model (Model 3) the findings show that women with poor autonomy score have marginally higher odd of (1.07) against the average effect of medium and high autonomy score. The Models 4 and 5 based on *repeated* and *deviations* contrast also show that women with poor autonomy score have higher odds for low BMI compared to women with medium autonomy score. Thus, one can conclude that women's autonomy is crucial to outcome of nutritional status of women at the all India level [see Table 5.1 above]. However, from state specific multivariate exercises (see Table A 5.1 in appendix), models for Madhya Pradesh, Andhra Pradesh,

Gujarat and Uttar Pradesh retain the women's autonomy variable in the final outcome. In all other states the variable gets excluded from the final model. Interestingly, in Madhya Pradesh, odds for maternal autonomy for BMI outcome are in reverse direction. From the analysis presented in this section, one could see the contradiction between all India findings and state specific findings from multivariate models regarding the effect of women's autonomy on outcome of low BMI. One reason could be that in all India analysis the effect of maternal autonomy on BMI outcome was marginal. Secondly, for a given state, other correlates could be of far more importance than the maternal autonomy for the outcome of low BMI.

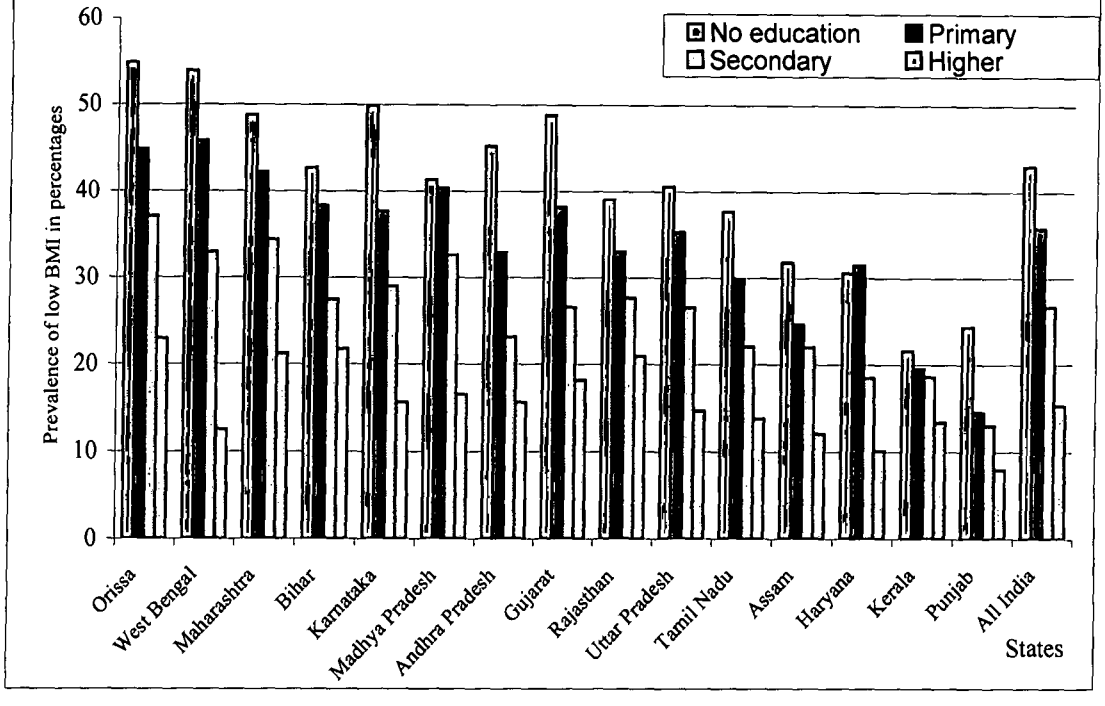
5.6. Individual Characteristics and Nutritional Outcome

Individual-specific features such as age of women, age at marriage, age at first child birth, total number of children, total household size and current marital status are known to have considerable influence on maternal nutritional status [Arnold et al; 2004]. The study also observes significant association between these individual specific features and nutritional status of the women. It is noted that across the different states (except Bihar and Uttar Pradesh) a more or less uniform pattern of prevalence of undernutrition is observed among women from younger age groups, especially, 15-20 and 20-25 (see for details Table A 5.2 in appendix). The prevalence of undernourishment is primarily among women who are younger in age (below 30 years of age), irrespective of their aggregate prevalence of low BMI. Further, the analysis suggests that women across the selected states in India have better nutritional status if their reproductive life begins after 18 years of age. In other words, it is observed that women, who become mothers at a younger age, are likely to be undernourished if they are deprived of a nutritionally rich diet and adequate health care. Specifically, the results indicate that women who are mothers before the age of 18 are more vulnerable to undernourishment in contrast to women who attain motherhood after 18 years of age. Such pattern is more or less commonly observed across all the states.

The association between total number of children ever born to a woman and her nutritional outcome does not show any definite pattern thus contradicting the common notion that having more number of children actually deteriorates women's nutritional status. Instances of such contradictions are to be found in states like Maharashtra, Karnataka, Andhra Pradesh, Gujarat, Tamil Nadu and Punjab, which rather show higher prevalence of undernourishment among women with no children. Nevertheless, some states like Bihar, West Bengal, Madhya Pradesh, Rajasthan, Uttar Pradesh and

Haryana confirm to the common notion of vulnerability exemplifying along with greater number of children than with no children.

Figure 5.4 Prevalence of Low BMI by Education Status among Women across Selected States and all India



Source: NFHS-2

Other pertinent individual characteristics like education, marital status and occupation of the women also have an influence on the nutritional outcome of Indian women. For instance, it could be observed from Figure 5.4 that women with 'no education' have higher prevalence of undernutrition in terms of low BMI than their counterparts having better educational achievements. In fact, the prevalence of undernutrition is observably the lowest among 'highly educated women'. Moreover, there are no regional exceptions to this pattern of association between education and nutritional status and in all the cases the results are in the expected direction. However, Kerala's case emerges to be of greater interest and is worthy of a little elaboration. It could be noted that in Kerala, the prevalence of low BMI is higher for women with no education compared to women from other educational categories but still the prevalence of undernutrition is lesser than their counterparts in other states (even compared to Punjab which has lowest prevalence of low BMI at aggregate level). It proves two points; one, educated women have definitely some advantage over their uneducated counterparts to achieve better nutritional status, even in a scenario where overall prevalence is comparatively lower among the states. Second, even if women are uneducated, provision of basic healthcare and spread of awareness through public action for healthcare can improve the

nutritional status of women who are uneducated. For instance, Kerala is well known for it's initiative in providing basic health care and creating awareness about better health and sanitation practices.

Exploring further along the individual specific features, it is imperative to argue that marital status emerges as an important variable and the customarily socio-economic discrimination towards widowed/separated/deserted women renders its own adverse impact on their nutritional status. This disconcerting evidence largely comes from Bihar, Gujarat, Kerala, Madhya Pradesh, Orissa, Tamil Nadu and Uttar Pradesh where the differentials between married and widowed/separated/deserted women ranges between four to ten percentage points. The pattern is less prominent in Andhra Pradesh, Assam, Haryana, Himachal Pradesh, Jammu and Kashmir, Karnataka, Punjab, Rajasthan and West Bengal and the differentials between the respective groups vary between zero and three percentage points. Such distressing observations grade India as a poor performer in terms of women's social security. It also corroborates the evidence that marital status in isolation of social status and economic independence is a serious concern for the nutritional status of a woman.

Recognising the importance of economic independence, occupational characteristics of the women can also have its own impact on her nutritional outcome. In this regard, it is observed that women working in agricultural sector have higher prevalence of undernutrition in states of Andhra Pradesh, Gujarat, Karnataka, Kerala, Maharashtra, Punjab, Tamil Nadu and West Bengal, whereas in case of Assam, Bihar, Haryana, Madhya Pradesh and Rajasthan, undernutrition is higher among women engaged in household and domestic sector. In Bihar, Madhya Pradesh, Maharashtra and Orissa women working in 'service sector' also show very high prevalence of 'undernutrition in terms of low BMI'. As a matter of fact, in Orissa around 50 percent of women who have reported their occupation in 'service sector' have 'low BMI' followed by Bihar (where 45 percent of women having occupation in 'service sector' have 'low BMI') and Madhya Pradesh, Maharashtra, Karnataka and Rajasthan (where approximately 35 percent women having job in 'service sector' have 'low BMI' score). In all the states, except Andhra Pradesh, Assam and Uttar Pradesh, women engaged as 'Professors/Technician/Sales' have the lowest prevalence of undernutrition. This reiterates the fact that job-security in the form of a more stable and regular occupation has better impact on nutritional health.

The multivariate analysis more or less confirms the findings obtained in the bivariate analysis of individual specific factors [see Table 5.1]. However, certain differences in the

significance of the different correlates are noted while performing the all India and state specific analysis. To elaborate, the multivariate exercise for all India as well as state level analysis excludes the variable of total number of children of women in the final step of the respective models to suggest its insignificant association with a woman's nutritional status. But the all India model retains age of woman to be a significant determinant of BMI. Model 1 for all India, shows women at age group of 14-19, 20-24, 25-29 and 30-34 years have very high and significant (at one percent) odds of having low BMI than their counterparts in age 45-49. If we contrast the effect for each correlate with reference to the mean effect (*Difference* and *Helmert* contrast) of the previous categories (as in Model 2 and 3, respectively) we find that as one moves to older age groups, the women have lesser likelihood of having low BMI [see Table 5.1 above]. The findings across the states are also on similar lines and higher vulnerability for young women for having low BMI is observed for most of the states (Bihar, Uttar Pradesh and Assam are the exceptions). Women's age at first birth is found to be insignificant at the national level as well as among many of the states [see Table A5.1 below].

Unlike the age-related factors, education status of a woman emerges to be of greater relevance in determining her nutritional status. In this regard, all the models at the national level (based on different contrasts) lend similar conclusions that illiterate women have higher odds for low BMI compared to their educated counterparts. Using the *Helmert* contrast (model 3) it is noted that illiterate women are 1.34 times more likely to have low BMI against the women of all subsequent categories taken together. Similar higher odds (1.38) are found for women with primary education against their counterparts in secondary and higher education category taken together. Use of repeated contrast (model 4) finds that women with no education have marginally higher odds for low BMI (1.08) compared to primary-educated ones and each subsequent educational category has a higher odd of facing undernutrition compared to its superior educational category. This model perhaps reinforces the finding from bivariate association, that with increasing education level, risk of undernutrition comes down for women [see Table 5.1 above]. At the state level, Maharashtra, Andhra Pradesh, Gujarat, Uttar Pradesh and Tamil Nadu, are exceptions to the pattern of education-nutrition association observed at the national level while in other states the relationship is found to be in the expected direction. This perhaps indicates that in the excluded states, education *per se* does not have direct effect on the nutritional outcome of women [see Table A 5.1 below].

The correlate of marital status of women demonstrates a mixed pattern across the states but turns out to be significant at the national level [see Table 5.1 above]. The pattern is

evident across all the five models with different contrasts. In most of the state level analysis the correlate of 'martial status of women' gets dropped in the final step of the backward stepwise method of logit regression. However in Madhya Pradesh, Gujarat, Uttar Pradesh, Tamil Nadu and Kerala women who are not currently married have higher odds for low BMI than their counterparts (with statistical significance at 1 percent). This finding is of interest because all five states possess different level of prevalence of low BMI at aggregate level, (from relatively higher to one of the lowest) [see Table A 5.1 below].

Further from the multivariate exercise (see Table 5.1) it emerges that occupation of a woman has a significant bearing on her nutritional outcome. For instance, in Model 2 (*difference* contrast), women with occupation category as manual work have higher odds of low BMI than their counterparts who are not working. Similarly, women from agriculture sector have higher odds of low BMI, than their counterparts who are not working and those who are manual workers. *Helmert* contrast (Model 3) shows that women who do not work have lesser risk for low BMI against the average effect of women from other occupation groups whereas women working in manual sector have marginally higher odd (1.08) against average effect of women in subsequent categories. Similarly women working in agriculture and household and domestic sector also have higher odds of low BMI against the average effect of women in subsequent occupation categories. Model 4 (*repeated* contrast) shows that those women who are not working have lesser odd for low BMI than their counterparts in manual work category whereas women from service sector have higher odds for low BMI than their counterparts in professor/technician/sales category, a fact also evident from Model 1. In Model 5 (*deviation* contrast), it is found that women with no work and women in service sector have lesser odds for low BMI against the average effect of occupation on BMI outcome. However women from manual, agriculture and household and domestic service sectors have higher odds for low BMI against the average effect of occupation on BMI outcome itself. From these results, one can conclude that at all India level, with the exception of high-end jobs such as the category of professor/technician/sales; women not engaged in paid-employment have lesser risk for low BMI than their counterparts in other occupation categories [see Table 5.1 above]. For state level exercise, occupation of women is found to be affecting women's nutrition status in states like Maharashtra, Karnataka, Andhra Pradesh, Gujarat, Tamil Nadu and Assam, though the pattern of association is not uniform. Except Karnataka and Assam, women who are not working have higher prevalence of low BMI than their counterparts who are working as professor/technician/salesman (mostly salaried workers). Similarly women from manual work category (both skilled and unskilled) and agriculture (self-employed as

well as agricultural labour), have higher odds for low BMI against their counterparts from professor/technician/sales category in all the six states mentioned above. Except Karnataka in the other five states, women engaged as households and domestic worker have higher prevalence of low BMI compared to their better-off counterparts. In Maharashtra and Karnataka, women from service sector have very high odds (3.51 times and 1.85 times, respectively) for low BMI against their better of counterparts i.e. women from reference category [see Table A 5.1 below]. However, in other states this particular variable is dropped in the final step of the model exercise.

5.7. Household's Socioeconomic Features and Nutritional Outcome of Women

This section explores the data to comprehend the association between women's nutritional status and the household's socioeconomic characteristics. First of all, the relationship between household's economic status and women's nutritional status is examined. For analytical purposes, household's economic status is classified as 'low', 'medium' and 'high' as per an index[3] of material standards of living (SLI) provided in NFHS 2. From such a comparison it was clear that the prevalence of undernutrition is primarily higher among women belonging to households with 'low' economic status and this pattern is consistent across all the major states of the country. Even in states like Kerala and Punjab, where the aggregate prevalence of undernutrition is lowest among all the selected major states, one finds very high difference in prevalence of undernutrition among women from households with low SLI score vis-à-vis the women from households with high SLI score. Similar observations could be made from the multivariate analysis (see Table 5.1) as well. For instance at the national level, in the *repeated* contrast (Model 4), which compares each category with the subsequent category, it is noticed that women from low SLI households are 1.40 times more likely to be undernourished than their counterparts in medium SLI households [see Table 5.1 above]. Further, the state level exercise finds that in all selected states, the women from low household standard of living and medium standard of living have higher odds for low BMI against their counterparts in high standard of living households. The state specific odds for women from low standard of living households for low BMI are found to be twice higher (with statistical significance at 1 percent level) than their counterparts in high standard of living for most of the selected states, except Madhya Pradesh and Rajasthan [see Table A 5.1 below].

[3]For details see pp. 40-41of NFHS-2, all India report, for detail discussion on how the standard of living index is constructed [IIPS, Macro; 2000].

Household size is yet another element which could influence nutritional outcome of women. But in this regard, perhaps excluding Uttar Pradesh, no other Indian state presents any concrete support to hypothesis of a positive relationship between household size and nutritional outcome of women. For a detailed analysis three types of household size are considered namely, households with seven or more members *as large households*, households with five to seven members as *medium size households* and households with four or less members as *small household.* What emerges from the analysis is that in states like Orissa, West Bengal, Maharashtra, Andhra Pradesh, Gujarat, Tamil Nadu and Kerala, women from small households (1-4 members) have higher prevalence of undernutrition than their counterparts from large households (8 members or more than that). This probably could be due to the fact that the economic status of the household, largely determines the availability of diet and health care to women and not 'household size' per se. This line of reasoning finds support when the analysis controls for 'household economic status' to determine the relationship between household size and nutritional status of women (see Table 5.2).

Table 5.2: Prevalence of Low BMI by Household Size and Household Economic Status taken Together, among Women across Selected States and all India (in percentages)

	Low Standard of Living			Medium Standard of Living			High Standard of Living		
States	*Small HH Size*	*Medium HH Size*	*Large HH Size*	*Small HH Size*	*Medium HH Size*	*Large HH Size*	*Small HH Size*	*Medium HH Size*	*Large HH Size*
Orissa	47.9***	52.3	50.1	31.9	38.2	35.6	10.2	15.9	18.0
West Bengal	32.9***	32.2	30.5	27.0	25.5	24.8	13.0	17.9	13.9
Maharashtra	47.4***	43.6	44.0	33.2	38.1	38.0	12.3	21.0	22.6
Bihar	59.2***	64.9	61.8	35.1	39.9	43.2	13.4	15.7	26.3
Karnataka	37.5***	45.5	56.0	30.3	30.8	28.6	12.0	17.1	22.3
Madhya Pradesh	54.5***	47.3	55.2	34.9	41.0	48.3	9.0	14.7	25.4
Andhra Pradesh	32.6***	33.3	33.8	15.3	19.1	23.0	8.1	8.1	14.9
Gujarat	47.3***	46.3	40.9	42.0	38.5	39.3	14.0	21.4	26.9
Rajasthan	53.5***	57.2	56.0	38.3	40.3	39.8	13.2	17.3	30.9
Uttar Pradesh	57.2***	54.7	51.7	48.2	44.3	47.2	12.5	16.7	27.5
Tamil Nadu	33.3***	44.7	20.0	25.5	23.3	27.2	8.6	9.6	14.1
Assam	42.7***	42.1	40.7	40.7	40.5	38.5	19.4	21.7	27.4
Haryana	40.2***	41.3	37.0	24.8	26.8	28.7	6.3	9.0	13.0
Kerala	57.1***	59.7	51.2	33.6	39.8	45.6	8.8	14.6	27.1
Punjab	44.3***	48.4	40.7	39.7	36.9	36.4	11.3	19.7	23.4
All India	48.5***	49.2	45.6	33.0	36.1	37.4	10.9	15.6	23.2

Source: NFHS-2; 1998-99

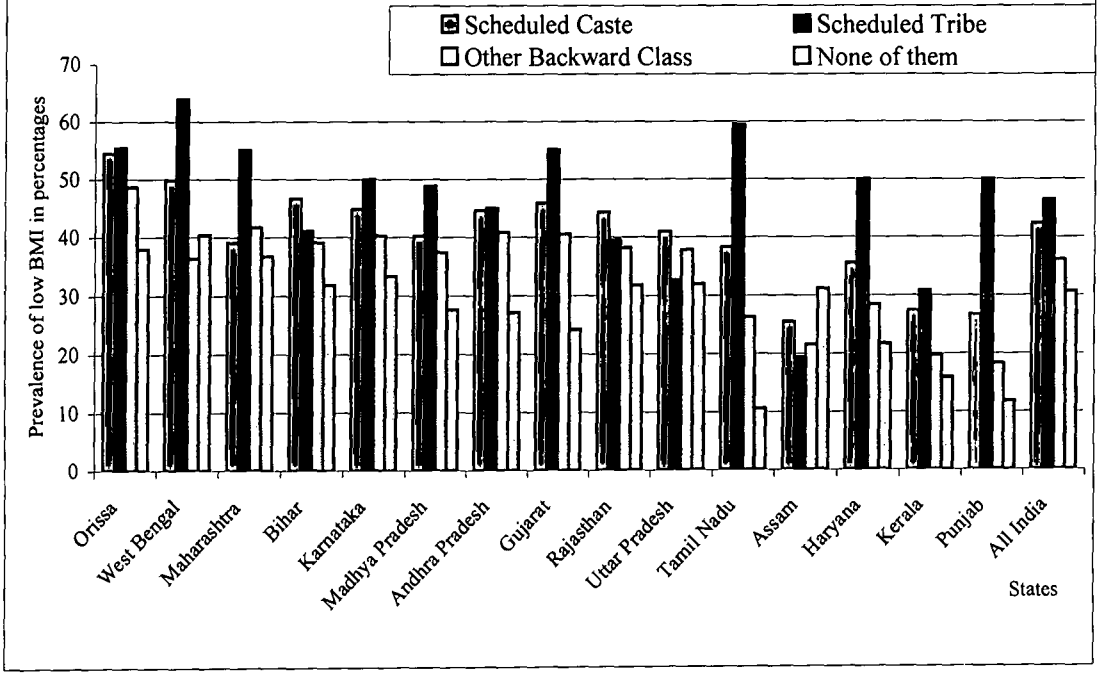
*Notes: States are ordered according to declining prevalence of low BMI among women. All India figure includes all the 25 states. Here *** refers to statistical significance at 1 percent level (in chi-square test) for bivariate association between age at first birth and outcome of low BMI among women.*

On the one hand, it is found that women from the poor households irrespective of the family size (large, medium and small) are likely to have higher prevalence of low BMI than the women from other two economic categories. On the other hand, it is noted that

within 'high standard of living' households, large size households have higher prevalence of 'low BMI score' for their women. The pattern is more or less similar across all the states thus implying that the impact of household size on nutritional outcome of women becomes clear only in the absence of economic poverty.

As per the multivariate analysis (see Table 5.1 above) women from large and medium household size have marginally higher odds for low BMI outcome against their counterparts from small household size. In fact in the state level analysis only in case of Karnataka, Andhra Pradesh and Gujarat, the household size was retained in the final step of the backward stepwise exercise for the binomial logit model. In these states it is found that women from small household size have lesser likelihood of having low BMI than their counterparts in medium and large household size. Women from female-headed households have marginally higher odds for low BMI compared to women from male-headed households. But the state level exercises show that, excepting Karnataka, Andhra Pradesh, Gujarat and Tamil Nadu, in all other states the correlate 'sex of the household head' is dropped in the final step of the model. Leaving Gujarat, all other three states show higher odds for low BMI among women from female-headed households [see Table A5.1 below].

Figure 5.5: Prevalence of Low BMI by Ethinicity of Women across Selected States and all India



Source: NFHS-2

Further, when the households are classified according to social groups, it is observed in most of the states that women coming from 'Scheduled Tribe' households have relatively higher prevalence of undernutrition. But in states like Assam (19.4 percent), Rajasthan (39.5 percent) and Uttar Pradesh (32.6 percent) nutritional deprivation is noted to be higher among women from 'Scheduled Caste' households [See Figure 5.5]. In many other states, women from 'Scheduled Caste' households are relatively better performers compared to women from 'Tribal households' and 'Other Backward Class' households. These results put women from 'Others' category in an advantageous nutritional position and revalidates the fact that socioeconomic characteristics of the household does influence nutritional outcome of women in India.

An interesting result is obtained in case of social group contrasts where the odds for low BMI for women from 'Scheduled Tribe' are less than that of women from 'Other' households. This finding is in contrast to the bivariate finding, which shows that the prevalence of low BMI is higher among women from Scheduled Tribe households than their counterparts from 'Other' social category. In the *difference* contrast model as well (Model 2), it is found that women from Scheduled Tribe households have lesser odds for low BMI than their counterparts from 'Scheduled Caste' category. The *Helmert* contrast model (Model 3), which compares the effect of each category of the correlate to the average effect of subsequent categories shows that women from Scheduled Caste households have higher odds (1.17 times more) of low BMI than their counterparts from the rest of the categories. However, Scheduled Tribe households have lesser odds for low BMI (less than 1) against their counterparts in Other Backward Class and 'Other' categories. Models 4 and 5 also offer similar conclusions. It must be noted that the outcome for Scheduled Tribe women is against the accepted notion that Tribal women have poor nutritional status than others [see Table 5.1 above]. For state level exercise, the correlate of ethnicity is dropped in the final step of backward stepwise method in states like Orissa, West Bengal, Karnataka, Uttar Pradesh, Haryana, Kerala and Punjab. Thus it could be argued that the effect of ethnicity on outcome of low BMI among women across selected states does not show any uniform pattern [see Table A 5.1 below].

Furthering the analysis of household specific characteristics, it is observed that the nutritional status of women shows some variability by religion of the household and moreover, it presents different scenarios across the states. In Assam, Himachal Pradesh,

Karnataka, Kerala[4], Maharashtra, Orissa and Punjab, women from 'Hindu households' have higher prevalence of undernutrition in contrast with women from other religion while 'Muslim women' in states of Haryana, Rajasthan and Uttar Pradesh have higher prevalence of low BMI compared to women of other religions. In Andhra Pradesh, Bihar, Gujarat, Jammu and Kashmir and Madhya Pradesh, women from 'Christian households' have higher prevalence of low BMI than their counterparts in other religions. Only in the states of West Bengal and Tamil Nadu women from 'Other religions' (i.e. excluding Hindu/Muslim/Christian) have highest prevalence of undernutrition. Such differences across states is observed mainly because the concentration of population differs according to states and often those religion which form the major part of the poverty laden section of the state turn out to be of greater disadvantage. In other words, it could be argued that these figures largely drive at the point that women from poor socio-religious background will have poor nutritional outcome because of their low spending capability and religion *per se* may not have a direct impact on the nutritional outcome of women in India. In terms of religion, the multivariate analysis (based on *indicator* contrast) shows that women from 'Hindu' (1.96 times), 'Muslim' (1.69 times) and Christian (1.07 times) are more likely to be undernourished than their counterparts in 'other' religion category. The *deviation* contrast model (Model 5) is also indicative of the fact that women from Hindu and Muslim households have higher odds of low BMI against the mean effect of religion (considering all categories together itself) on nutritional outcome of women [see Table 5.1 above]. However, for state level exercise one could see that in 10 out of 15 selected states the correlate is dropped from the final step of the logit exercise. And in the remaining states where it is retained the effect of religion of women's household and their nutritional outcome eludes any uniform pattern (even against the finding at all India level). This might be largely due to the differences in the distribution of population by religion across selected states, which affect the outcome for state level exercise [see Table A 5.1 below].

Moving ahead with the socioeconomic background, it could be argued that place of residence also forms a crucial determinant of nutritional status of Indian women. Particularly, rural areas primarily lack basic health and sanitation facilities, which coupled with a conservative social outlook, tend to induce nutritional imbalances. When these social factors are combined with poor individual features (such as low female education) the health consequences can prove to be more detrimental. Unfortunately,

[4] In case of Kerala and Madhya Pradesh, odds for given religious categories against 'other religions', for the outcome of low BMI among women are found to be very high because of insufficient sample for the reference category. Hence figures are not reported in the respective Table A 5.1.

this analysis reveals such worrisome trends (see Table 5.3). It is observed that women who are born in rural areas and also staying in rural areas (at the time of interview) have poor nutritional status in terms of BMI.

Table 5.3 Prevalence of low BMI by Place of Residence among Women across Selected States and all India (in percentages)

States	*Born rural living rural*	*Born rural living urban*	*Born urban living rural*	*Born urban living urban*
Orissa	50.7***	35.7	37.4	25.5
West Bengal	51.5***	35.6	28.4	22.3
Maharashtra	51.1***	38.5	28.5	25.0
Bihar	40.7***	36.6	37.0	24.9
Karnataka	48.5***	38.7	32.3	18.3
Madhya Pradesh	41.9***	40.3	31.9	24.7
Andhra Pradesh	44.7***	30.9	24.3	15.6
Gujarat	49.4***	40.3	29.4	17.8
Rajasthan	39.1***	37.0	33.0	24.6
Uttar Pradesh	39.8***	31.9	25.9	22.0
Tamil Nadu	36.6***	24.9	17.8	16.9
Assam	28.0*	24.6	19.2	17.9
Haryana	31.4***	24.4	18.0	8.6
Kerala	19.9**	20.3	15.1	12.9
Punjab	20.8***	15.9	13.6	6.4
All India	41.5***	33.2	26.6	19.6

Source: NFHS-2; 1998-99

*Note: States are ordered according to declining prevalence of low BMI among women. All India figure includes all the 25 states. Here *** refers to statistical significance at 1 percent level (in chi-square test) for bivariate association between age at first birth and outcome of low BMI among women. ** and * refers to statistical significance at 5 percent and 10 percent level respectively, for the same.*

The pattern is identical across states, except for Kerala. In contrast, it is also found that those women who were born in urban set up and also lived there have lower prevalence of undernutrition. These results indicate that moving to urban areas in later parts of life may not really improve the nutritional status of women. The reasons may vary. Perhaps, one of these may be the fact that majority of those who move to urban set up actually end up in squatters and slums as they or their households are engaged in low-paid jobs in cities and towns. Lack of better housing condition, sanitary facilities, healthcare and high price of food items can pose adversities to their health. Another explanation could be if early part of their life is spent in rural set up amidst inadequate dietary intake and health care, then in latter years their movement to urban areas may not really help them to catch up on the lost health. The fact can be verified from the results for those women who are born in urban areas but are in rural areas at the time of interview, as they have better nutritional status in terms of BMI against their

counterparts who were born in rural areas and staying in rural areas and those who were born in rural areas but moved to urban areas.

These findings of the bivariate analysis are further supported by the multivariate results (see Table 5.1 above) indicating that women who are born and are staying in rural areas have greater likelihood of being undernourished than their counterparts who are born and staying in urban areas. Even women who have been born in rural areas and move to urban areas in latter life have higher odds for poor BMI compared to those who were born in urban areas and continue to stay there. Even women, who were born in urban areas and later have moved into rural setting, are more likely to be undernourished than their counterparts who are born and continue to stay in urban areas. In general, the all India findings show that women from rural areas have higher odds of being undernourished against their urban counterparts. It is also observed that except Bihar, Assam and Kerala, in all other Indian states, place of residence of women has an effect on nutritional outcome. The odds ratios indicate that (see Table A 5.1 below) rural women have higher risk of being undernourished than their counterparts who were born in urban areas and continue to stay there. Another crucial factor identified in literature to influence maternal nutritional outcome is the sex of the household head. It is argued that in a female-headed household, good nutritional outcome for the women is expected as she has relatively better access to 'diet and health care', than in household 'headed by male'. But the present analysis does not lend any support to this hypothesis. Perhaps, inadequate sample size in several states restricts the analysis to draw any robust conclusion.

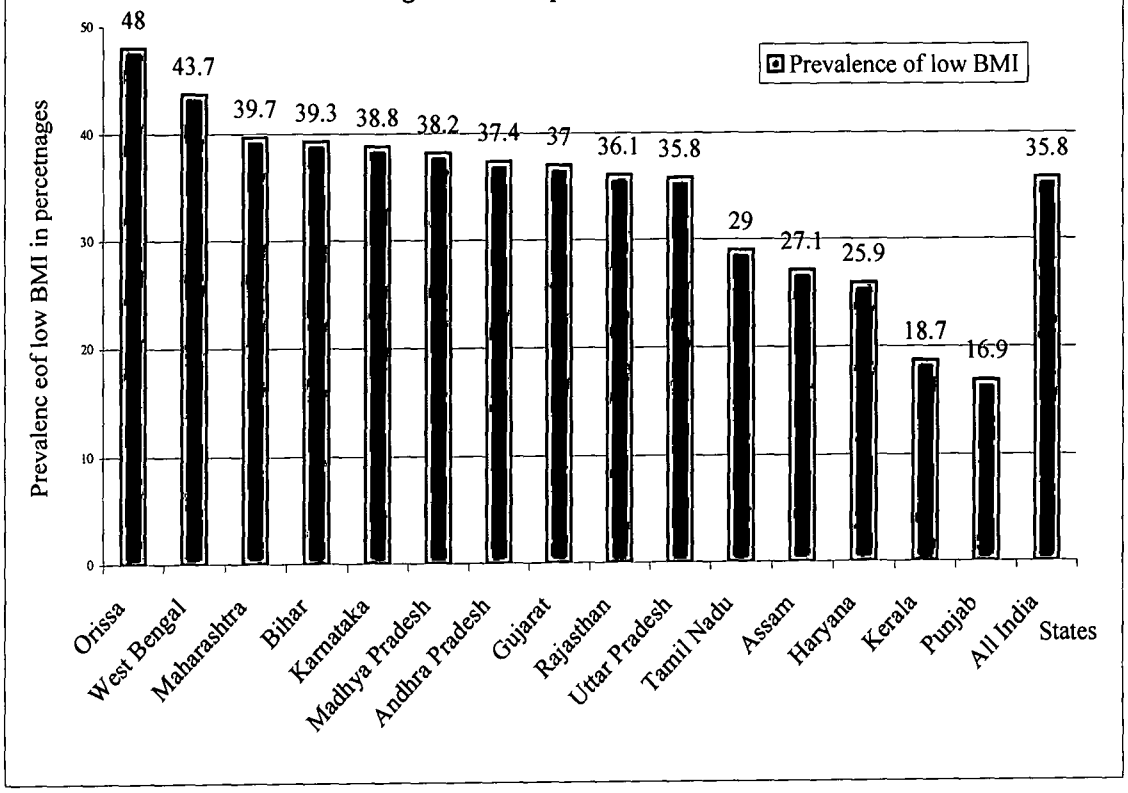
5.8. Conclusion

The analysis in this chapter focused on certain important variables that are easy to target and would bring about improvements in the nutritional status of women. First and foremost is that regular intake of some of the crucial food items such as green-leafy vegetables could improve the nutritional status. Health care utilisation, especially prenatal and postnatal care, has an impact on the nutritional outcome of women. The study finds that improving women's autonomy within the household could be one of the effective ways to improve their nutritional status because it sets intra-household distribution of available resources for the household in her favour or at least ensures a fair share. It is also observed that regular intake of crucial food items and adequate health care also results in better nutritional outcomes. Expansion in female education and awareness regarding reproductive life could also be the means for nutritional well-being. In fact, educational deprivation is a major stumbling block that has to be

dismantled to empower women's status in the society. Given the slow progress of various ongoing health interventions (Srinivasan et al; 2007), it would be worth reconsidering these interventions in terms of the identified correlates as it could lead to effective reduction in the overall burden of undernourishment among reproductive age women in backward regions and among socio-economically disadvantaged groups.

APPENDIX TO CHAPTER 5

Figure A 5.1: Prevalence of Low BMI among Women in Selected Indian States in Decending Order as Reported in NFHS-2; 1998-99



***Source**: NFHS-2*

Table A 5.1: State-wise Results from Binomial Logit Regression to Determine the Correlates of Low BMI among Women

	ORI	WB	MAH	BIH	KAR	MP	AP	GUJ	RAJ	UP	TN	ASS	HAR	KER	PUN
1.Women's Age															
14-19 years	1.89**	1.46**	3.79**	-	1.66**	1.55**	2.54**	2.95**	1.33	-	2.18**	-	1.59	4.19**	3.05**
20-24 years	1.68**	1.89**	3.03**	-	1.99**	1.70**	2.30**	2.63**	1.45*	-	1.70**	-	2.59**	5.56**	4.62**
25-29 years	1.49**	1.62**	2.27**	-	1.37*	1.55**	1.69**	2.55**	1.32*	-	1.24	-	1.82**	4.47**	3.34**
30-34 years	1.29**	1.33	1.57**	-	1.18	1.28**	1.07	1.85**	1.12	-	1.07	-	1.30	2.83**	1.87**
35-39 years	1.34*	1.05	1.20	-	0.99	1.090	0.87	1.26	0.94	-	0.91	-	1.15	1.78**	1.96**
40-45 years	1.06	1.17	0.90	-	0.99	1.16	0.88	1.33	1.00	-	0.86	-	0.90	1.77**	1.50
45-49 years	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
2.Women's Diet intake score															
Poor Score	-	1.43*	1.67**	-	1.32	1.23	-	-	1.41**	-	-	-	-	-	0.97
Middle Score	-	1.16	1.25**	-	1.19*	1.01	-	-	1.27*	-	-	-	-	-	1.40**
Good score	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
3.Women's Age at First Child birth															
Less than 18 yrs	-	-	-	1.16*	-	-	0.86	-	0.89	-	-	-		0.79	
More than 18 yrs	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
4.Number of Children															
More than two	-	-	-	-	-	-	-	-	-	2.25**	-	-	-	0.40	-
One to two	-	-	-	-	-	-	-	-	-	2.39**	-	-	-	0.29	-
No children	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
5.Women's Education															
No education	1.76*	2.62**	-	1.49	1.85**	1.59**	1.40	-	-	1.94**	-	-	1.67*	2.44**	1.94*
Primary	1.38	2.47**	-	1.47	1.48	1.70**	1.09	-	-	1.81**	-	-	1.98**	1.36	1.28
Secondary	1.17	1.99**	-	0.99	1.34	1.66**	0.85	-	-	1.48**	-	-	1.06	1.28	1.36
Higher	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
6.Women's Marital Status															
Widow/Separated	-	-	-	-	-	1.41*	-	1.67**	-	1.34	1.39*	-	-	2.03**	-
Married	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
7.Women's Occupation															
Not working	-	-	1.51**	-	0.92	-	1.11	1.27	-	-	1.25	0.89	-	-	-
Manual work	-	-	2.01**	-	1.35	-	1.62	1.45	-	-	1.54*	1.03	-	-	-
Agriculture	-	-	2.54**	-	1.48	-	1.96	1.68*	-	-	1.99**	1.43	-	-	-
HH/Domestic	-	-	2.09**	-	0.78	-	1.09	2.57*	-	-	1.56	3.03*	-	-	-
Services	-	-	3.51**	-	1.84	-	0.87	0.59	-	-	0.83	0.00	-	-	-
Prof./Tech./Sales	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
8.Women's Place of Residence (Born, Stay)															
Rural, Rural	1.81**	2.07**	2.00**	-	2.17**	1.31**	2.27**	2.50**	1.76**	1.70**	1.66**		2.68**		2.10**
Rural, Urban	1.53	1.49**	1.43**	-	1.92**	1.65**	1.60**	1.99**	1.77**	1.41*	1.12		2.86**		1.96*
Urban, Rural	1.28	1.08	1.20**	-	1.75**	1.16	1.51**	1.53**	1.50**	1.21	0.94		1.62**		1.75*
Urban, Urban	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
9.Women's Autonomy Index															
Poor	-	-	-	-	-	0.77	1.44*	1.26	-	1.19	-	-	-	-	-
Middle	-	-	-	-	-	0.86*	0.98	1.35**	-	1.25**	-	-	-	-	-
High	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
10.Household's Living Standard															
Low SLI	3.09**	3.66**	2.56**	2.21**	2.42**	1.83**	2.99**	3.63**	1.62**	2.19**	3.71**	3.12**	2.69*	3.37**	2.60**
Medium SLI	2.48**	2.17**	1.82**	1.91**	2.36**	1.58**	2.11**	2.05**	1.63**	1.69**	2.35**	2.35**	1.41**	1.88**	1.83**
High SLI	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
11.Household's Ethnicity															
SC	-	-	1.23*	1.41**	-	1.20	1.21**	1.76**	1.54**	-	1.83	0.66**	-	-	-
ST	-	-	1.31*	1.01	-	1.57**	0.98**	1.91**	1.10**	-	3.13*	0.49**	-	-	-
OBC	-	-	1.21*	1.09	-	1.16	1.25**	1.55**	1.17*	-	1.51	0.72**	-	-	-
Others	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
12.Household's Religion															
Hindu	-	-	-	-	-	2.02*	-	-	1.05	2.31*	-	-	-	-	-
Muslim	-	-	-	-	-	2.36*	-	-	1.75*	2.81*	-	-	-	-	-
Christian	-	-	-	-	-	3.83**	-	-	1.03	0.00	-	-	-	-	-
Other religions	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Household Size (Members)															
Large (>8)	-	-	-	-	1.26*	-	1.07	1.30	-	-	-	-	-	-	-
Medium (4 to 7)	-	-	-	-	0.94	-	1.23*	1.12	-	-	-	-	-	-	-
Small (<4)	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Household Head															
Female	-	-	-	-	1.27	1.56**	-	0.75	-	-	1.50**	-	-	-	-
Male	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

Source: from NFHS-2, 1998-99

*Note: Here ** and * refers to statistical significance at 1 % and 5 % level respectively, for odds of correlates determining the outcome of low BMI.*

Table A 5.2 Prevalence of Low BMI by five-year age Group among Women across Selected States and all India (in percentages)

States	*15-19*	*20-24*	*25-29*	*30-34*	*35-39*	*40-44*	*45-49*	*Cases*
Orissa	51.8***	53.2	50.9	47.6	48.3	42.2	42.3	2771
West Bengal	46.3***	50.2	49.5	42.9	39.9	39.4	36.8	6749
Maharashtra	55.7***	50.8	45.4	38.2	32.5	29.1	29.8	7502
Bihar	37.2***	39.7	40.2	38.8	39.2	42.4	38.3	7689
Karnataka	51.3***	49.3	40.0	37.3	33.1	33.1	33.2	4214
Madhya Pradesh	38.6***	45.1	42.4	36.8	33.0	34.5	31.3	5965
Andhra Pradesh	49.1***	45.7	41.9	33.9	29.5	30.1	30.5	7173
Gujarat	54.4***	46.3	44.5	37.1	30.4	29.9	24.3	3845
Rajasthan	33.3***	40.7	40.1	36.8	31.9	33.5	32.7	3970
Uttar Pradesh	34.4***	37.4	35.9	38.4	34.5	35.2	34.1	11771
Tamil Nadu	42.9***	36.8	29.9	27.6	24.6	24.5	27.6	5294
Assam	28.0	28.2	31.5	23.5	25.2	27.5	24.8	1865
Haryana	29.1***	35.8	29.7	25.1	21.3	18.3	19.6	1493
Kerala	10.6***	27.0	24.7	19.4	15.6	15.9	11.4	2783
Punjab	34.1***	26.2	22.6	14.2	13.9	12.4	8.3	1684
All India	41.6***	42.2	39.2	34.9	31.5	31.4	29.9	77716

Source: NFHS-2; 1998-99

*Notes: States are ordered according to declining prevalence of low BMI among women. All India figure includes all the 25 states. Here *** refers to statistical significance at 1 percent level (in chi-square test) for bivariate association between age at first birth and outcome of low BMI among women.*

CHAPTER 6

NUTRITIONAL DEPRIVATION AT HOUSEHOLD LEVEL

6.1. Introduction

It is commonly observed that its social background and occupational class condition a household's economic status. For instance, in India, higher incidence of poverty is found among social groups such as Scheduled Castes and Scheduled Tribes and among occupational categories such as agricultural labourers. Given such socio-economic anomalies, does it imply that households belonging to underprivileged social groups would also bear a higher burden of nutritional deprivation than the better of sections of the population? And, whether occupational distinctions between households engender higher risk of nutritional deprivation for some households than for others? In fact, studies have indicated that nutritional achievement of households, measured in terms of calorie, invariably depicts differential achievement levels with differing socio-economic background. Notwithstanding the household's socio-economic disadvantages, it is also possible that nutritional deprivation could be unequally shared among the household members because the intra-household distribution of food may be biased. For instance, within a household such calorie differentials could be expected between girls and boys or among employed and unemployed persons. There exists ample empirical evidence for such intra-household calorie intake differentials. Some of the studies have pointed out that these differentials are observed mainly due to intra-household bias in food (calorie) distribution against the economically dependent members, mainly women, children and elderly. In fact, under circumstances of income-poverty, it is highly probable that the larger share of available food would be provided to the most productive members of the household, especially to income-earning adult males. Because of such an underlying preference relation, other dependent household members apparently receive food, which is not only less than their basic requirement but also unmatched with an ideal share otherwise.

Besides, in a poverty-laden country such as India, gender bias is a strong deterring factor shaping the resource distribution at household level. It implies that a poor woman or female child is likely to be doubly deprived, first in terms of household poverty and second, on grounds of gender disadvantage [Sudarshan and Bhattacharya; 2004, Meenakshi and Viswanathan; 2003; Radhakrishnan et al; 2004a, 2004b, Borooah; 2004]. In this regard, it is of some relevance to examine whether household composition plays any role in shaping the nutritional make-up at the household level. In other words, is calorie deprivation higher among households having more number of female

children or dependent population? If these households have higher number of children and women (or dependents), it is most likely that they would have disproportionate share of the misery. A related issue here is to understand how household size is crucial to the outcome of undernourishment at household level given the extent of dependency within the household. With the motivation to study these issues, the rest of the chapter is organised as follows. Section 6.2 briefs on data and methods used. Section 6.3 and section 6.4 present an analysis of calorie deprivation among rural and urban households by social categories (ethnicity) and occupation. Section 6.5 analyses calorie deprivation by sex composition of households and dependency of members across rural and urban India. Section 6.6 concludes.

6.2. Data and Methodology

The scope and approach of this chapter is constrained by the lack of availability of data in the sense that data on calorie deficiency is available only at the household level and therefore a direct study of intra-household distribution of available calorie is ruled out. Instead an attempt can be made to assess the characteristics and composition of these calorie deficient households to make suitable interventions. The methodology of calorie-based nutritional deprivation is used in this chapter, which is complementary to the methods (anthropometry score based) adopted in the earlier chapters. This household calorie deprivation analysis is based on the information from the National Sample Survey Organisation's (NSSO) 55th round Consumption Expenditure Survey (CES). This data pertains to the period 1999-2000 and provides information on the calorie deprivation at household level. Given the fact that the information on calorie consumption is reported at household level, there is a limitation in undertaking an analysis of intra-household distribution of calorie intake of the household members. However, the required minimum norm of calories consumption at the household level is based on the given adult equivalents for 12 different age and sex combinations. This altogether inhibits the identification of a particular individual in the household to be undernourished and therefore disqualifies the required norm of per-capita calorie consumption by which a household identifies it to be undernourished. In turn, it makes all individuals in the household to be counted as undernourished and for this very reason, one cannot study the distribution of calorie intake at household level, for example, among married woman compared to widow, or between boy and girl child.

This NSSO (1999-2000) data, however, provides information on the age and sex composition of the members of the given household, which allows us to develop a composite indicator to verify whether the large households comprising of more number

of children, women and elderly are vulnerable to calorie deprivation. As argued earlier, the distribution of available food in typical Indian household is determined by perceived importance of a member in the household and therefore it is more likely that female children and old people might get neglected at the cost of the earning adult male members of the household and others. To gain some insights we can categorise the households according to total dependent members (children, women and elderly) being more or less than the number of adult male individuals in the household. Another classification adopted relates to splitting households on the basis of number of female children. Such categorisation would help us to understand whether in order of preference the girl children come next to their male counterparts. Further, a distinction could be made among women on the basis of their employment status i.e. working women - those who are employed in gainful employment (formal or informal) and non-working women.

Here an attempt is also been made to ascertain the concentration of calorie deprivation on the basis of occupational status and social category[1]. The nutritional outcome is defined in terms of a dichotomous variable where a household consuming below the recommended calories in accordance with it's age and sex composition. The household calorie requirement is computed in the following manner. NSSO collects information on food consumption of the households in quantities. All the food items consumed by a given household converted into calories it obtained, following the chart provided by Indian Council for Medical Research; 1978, known as 'Nutritive Value of Indian Foods'. Taking the calorie requirement of an adult male of age 20-39 years, doing sedentary work as the reference (determined at 2700 calories per day), it calculates the calorie requirement of other population groups. The calorie norm of 2700 calorie per day is applicable to rural as well as urban India [NSSO; 2000]. The total population is divided into 12 such groups (based on their age and sex) and calorie requirement of each group is expressed in terms of calorie requirement coefficients in relation to male's calorie requirement (i.e. 2700 calorie per day)[2] and the household's calorie requirement per day

[1] Here social groups are divided broadly into Scheduled Caste (SC), Scheduled Tribe (ST), Other Backward class (OBC) and Others. The classification is taken from NSSO. While SCs and STs are considered both socially and economically backward and discriminated, the OBCs are mostly distinguished in terms of their economic and educational backwardness. SCs are discriminated on the basis of their birth and occupations (mostly menial works termed as polluted), while the STs by their very social structure remain in a closed society distanced from the mainstream. Though both are most disadvantaged groups of Indian society, both socially and economically; the reasons are different.

[2] These individual coefficients of calorie requirement for population of different age and sex groups in relation to reference male are determined by Indian Council of Medical Research [ICMR; 1989] which is followed till today. It is also presented in Gopalan et al (1978). Also See pp. 9 and 14 in NSSO Report number 417 and pp. 112 of Ramachandran (2006) for the same.

will be calculated as the aggregate requirement of all members of the household (known as consumer units). For example, a four-member household having a male of age 26 years (with coefficient of 1.0), a female of age 25 years (with coefficient of 1.71), male children of age 5 years (with coefficient of 0.72) and female children of age 10 years (with coefficient of 0.93) will have 11,772 calories requirement per day (2700 calories multiplied with 4.46 consumer units), instead of 10,800 calories (2700 multiply with 4 household members)[3]. NSSO 55th round provides calorie intake for each household for 7 days (and 30 days) and from here one can calculate the weekly[4] (monthly) calorie requirement of the household by multiplying each day's calorie requirement of the household with 7 number of days (or 30). These normative calorie intake values are then compared with the observed calorie intake information available for each household in order to determine which houses are consuming less than the normative calorie requirements.

Based on the above formulation we obtain calorie deprivation status as a dichotomous variable. For further analysis on prevalence of undernourishment at the household level, we employ a measure of group-inequality similar to that is adopted in chapter 4 to assess the association between the presence of more girl children or total dependent population and calorie deprivation [Chakraborty; 2001][5]. Since the household categories are mutually exclusive therefore such a measure of group inequality gives us a ratio of odds or risk probability for the affected group vis-à-vis the better one, independent of the overall prevalence level. This measure of ratio of odds comprehends the relative degree of departure from homogeneity and qualifies the desirability of scale independence.

Keeping in view the categorical nature of dependent variable and explanatory variables, binomial logit model has been used to determine the significant correlates of calorie deprivation in a household in a multivariate framework[6]. Binomial logit model (with

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[3] The differences in calorie intake requirements based on a simple multiple and calorie-coefficient weighted multiple clearly indicates that the total number of household members is not equal to total number of consumer units in the household.

[4] There is a huge debate about appropriateness of the two recall periods (7 and 30 days) in NSS 55th round (1999-2000) as it is observed that the 7 days information overestimates the consumption of household and 30 days information underestimates it. Nevertheless, we have preferred to use the 7-day recall period because the variation between original consumption and reported consumption is likely to be lower.

[5] This measure is applicable if the phenomenon under observation is a dichotomous one [Chakraborty; 2001].

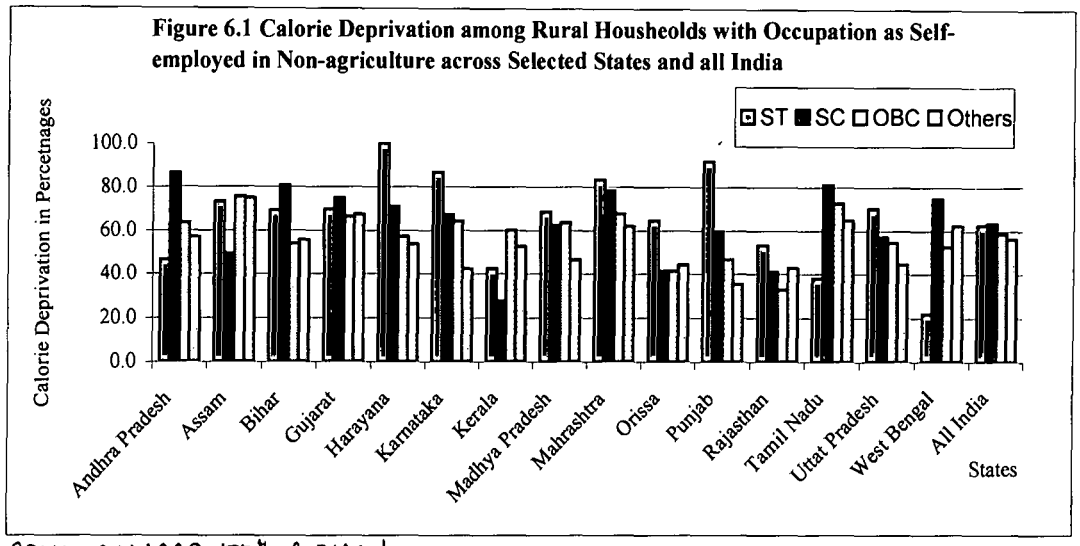
[6] In such a scenario the use of binomial logit model is preferred over other multivariate models [Field; 2005].

backward stepwise method) is adopted for multivariate exercise to determine the correlates of household undernutrition. The reason behind the choice of backward stepwise method is detailed in earlier chapters (3 and 5). Similar to the analysis done in the previous chapter, five different 'contrasts', namely; *indicator, difference, Helmert, repeated* and *deviation* are used in all backward stepwise binomial logit models. These contrasts help us to know the likelihood of calorie deprivation for households in a given category with a pre-determined reference category and also facilitate inter-group comparison. However, this exercise is done only at the all India level. Though the same binomial logit framework (for multivariate exercise) is repeated for the selected states, the result is presented for the model with contrast set as indicator only.

6.3. Calorie Deprivation among Rural Households by Social Category (Ethnicity) and Occupation

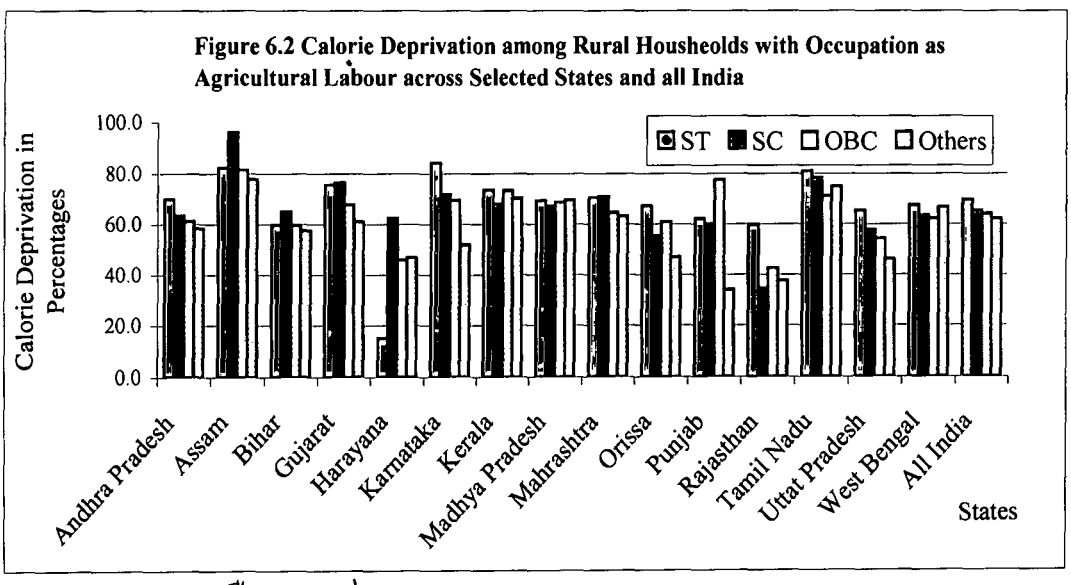
The vulnerability of households for calorie deprivation has been defined by a set of relevant characteristics e.g. household place of residence, social background and their occupation status. Table A 6.1 presents the exact figure for prevalence level of calorie deprivation for different social and occupational categories with different occupations, for the rural residents in India. However apart from the well known disadvantageous categories like rural residence, backward castes and primary sector occupation as regard calorie undernourishment, an attempt is made here to observe the same with one characteristic nested within the other.

Considering the occupational vulnerability and caste categories among rural residents, it is found (Figure 6.1) that calorie deprivation among rural households with occupation as self-employment in non-agriculture is highest for Scheduled Tribe among all social categories, in Bihar, Haryana, Karnataka, Madhya Pradesh, Maharashtra, Orissa, Punjab, Rajasthan and Uttar Pradesh. Scheduled Caste households report higher calorie deprivation than any other social categories, for states like Andhra Pradesh, Gujarat, Kerala, Tamil Nadu and West Bengal. In Assam, Other Backward Class households have the highest prevalence of calorie deprivation for the same occupation category among all other social groups. At all India level, the Scheduled Caste households have highest prevalence of calorie deprivation compared to any other social category for the occupation of self-employment in non-agriculture.



Source: NSSO 55th round

For households with occupation as 'rural agricultural labour', Scheduled Tribe households have higher prevalence of calorie deprivation among all social categories for Andhra Pradesh, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Orissa, Tamil Nadu, Uttar Pradesh and West Bengal whereas Scheduled Caste households have disadvantage in Assam, Bihar, Gujarat and Haryana [See Figure 6.2]. Interestingly households for the same occupation in states like Haryana, Madhya Pradesh and West Bengal from 'Other' as a social category, have higher prevalence of calorie deprivation than their counterparts in 'Other Backward Class'.

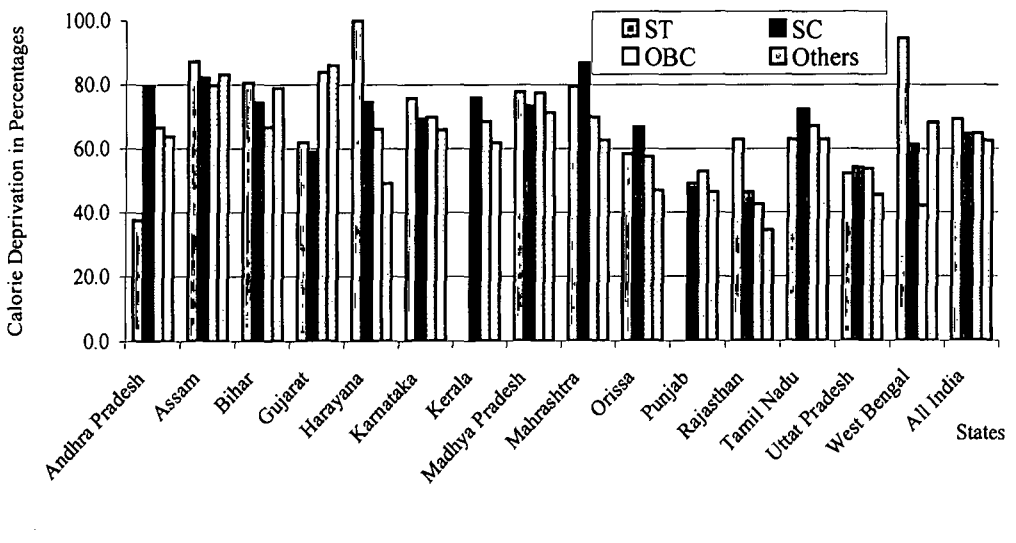


Source: NSSO 55th round

Households with 'other labour' as occupation, shows Scheduled Tribe households having highest prevalence of calorie deprivation for Assam, Bihar, Haryana, Karnataka, Madhya Pradesh, Rajasthan and West Bengal (In Haryana and West Bengal, Scheduled Tribe households have higher than 80 percent prevalence of calorie deprivation for the

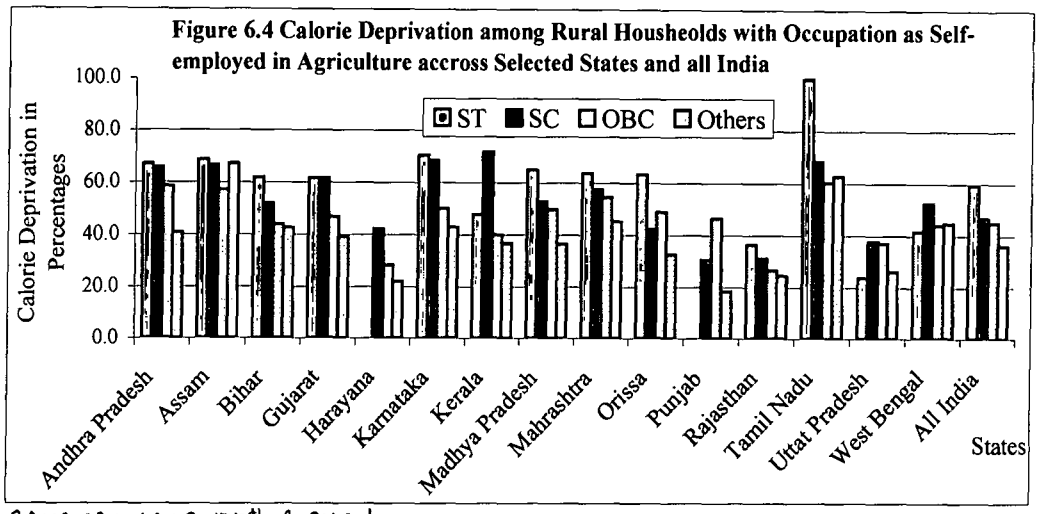
given occupation). In case of Haryana, it is found that all rural households from Scheduled Tribe category, for the occupation as 'other labour', are calorie deprived. Scheduled Caste households record highest prevalence of calorie deprivation for the above occupation in Andhra Pradesh, Kerala, Maharashtra, Orissa and Tamil Nadu (which ranges between 70-80 percent of all households for Scheduled Caste category, except Orissa, where it falls below 60 percent). In Assam, Gujarat and West Bengal, 'Others' have higher prevalence of calorie deprivation than their counterparts in 'Other Backward Class' category. For all other states 'Others' have the lowest prevalence calorie deprivation among all social groups for the occupation as 'other labour' [See Figure 6.3].

Figure 6.3 Calorie Deprivation among Rural Households with Occupation as other Labour across Selected States and all India



Source: NSSO 55th round

For the occupation as self-employment in agriculture, Scheduled Tribe households in Andhra Pradesh, Assam, Bihar, Karnataka, Madhya Pradesh, Maharashtra, Orissa, Rajasthan and Tamil Nadu, have the highest prevalence of calorie deprivation among all social categories. At all India level, the Scheduled Tribe households have higher prevalence of calorie deprivation for the given occupation. Haryana, Kerala and Uttar Pradesh report higher prevalence of calorie deprivation for Scheduled Caste households. Households engaged in as self-employed in agriculture, from all social categories in the states like Haryana, Punjab, Rajasthan and Uttar Pradesh have prevalence of calorie derivation below 50 percent [See Figure 6.4].

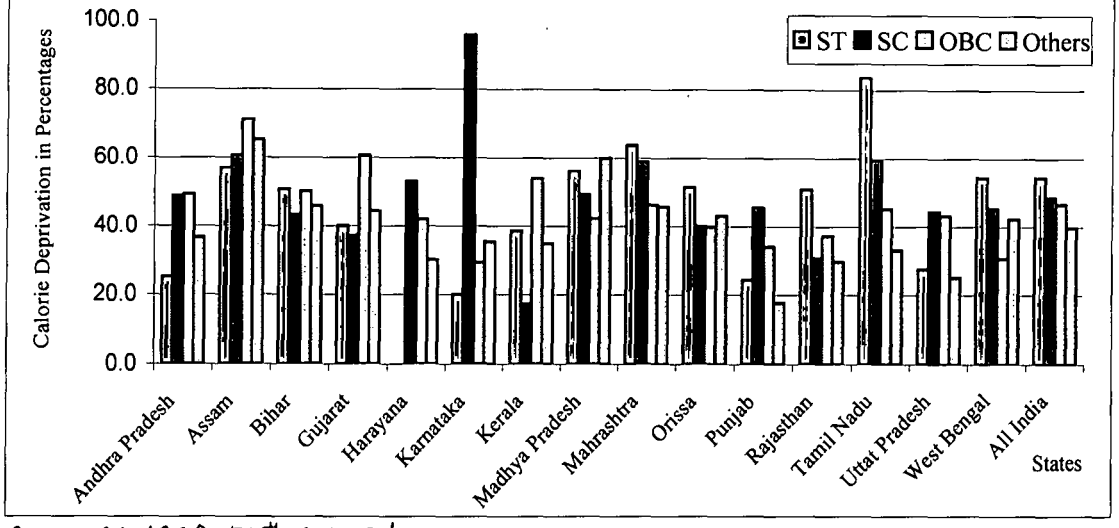


Source: NSSO 55th round

As regard to the occupation as 'other', Scheduled Tribe households in Maharashtra, Orissa, Punjab, Tamil Nadu and West Bengal have higher prevalence of calorie deprivation among all social groups. In rural all India, also Scheduled Tribe households have highest prevalence of calorie deprivation among all social groups whereas for Haryana, Karnataka, Punjab and Uttar Pradesh, Scheduled Caste households have higher prevalence of calorie deprivation among all social categories. In Andhra Pradesh, Assam, Gujarat and Kerala 'Other Backward Class households' have highest prevalence of calorie deprivation. In Madhya Pradesh, Other households, among all other social categories, have highest prevalence of calorie deprivation for the given occupation. Except Haryana, Madhya Pradesh and West Bengal, for all other states, 'Other' households have lowest prevalence of calorie deprivation across social categories (for the above three states Other Backward Class households have lesser prevalence of calorie deprivation than their counter parts in 'other') [See Figure 6.5].

It is evident from the discussion above that Schedules Caste and Scheduled Tribe households have relatively higher prevalence of calorie deprivation across states for any occupation category, with minor exceptions. Further, the binomial logit result shows that Scheduled Caste and Scheduled Tribe households and households receiving a major share of earning from agricultural labour have higher likelihood of becoming undernourished in terms of low calorie intake. This pattern is clear across all the models run for rural India, with statistical significance confirmed at 1 percent level [see Table 6.1 below].

Figure 6.5 Calorie Deprivation among Rural Housheolds with Occupation as Other acorss Selected States and all India



Source: NSSO 55th round

In model-2 where contrast is set to 'Difference', it is found that Scheduled Tribe households have less likelihood to be calorie deprived compared to Scheduled Caste households. Similarly Other Backward Class households have lesser likelihood than Scheduled Caste and Scheduled Tribe taken together. 'Other' households have lesser likelihood of being calorie deprived in comparison to all other social groups taken together, proving their advantage in having relatively higher nutrition security among all social groups [see Model-2, in Table 6.1 below]. In model-3, where the contrast is set to Helmert, Scheduled Caste households in rural India as a whole are found to be 1.59 times more likely to have calorie deprivation than all other communities grouped together. However, for the Scheduled Tribe and other backward class the likelihood are 1.27 and 1.37 times respectively in the same model for rural India. Which again shows Scheduled Caste households have higher calorie deprivation than all other social groups taken together followed by households from Other Backward Class and Scheduled Tribe households. Similarly for Muslims and Christian households in rural India, the likelihood of being calorie deprived is 1.44 and 1.66 times higher respectively against all other communities [see Model-3, in Table 6.1 below].

From model 2 and 3, it is also evident that the households, whose major earning comes from agricultural labour or any other form of labour, are likely to have higher odds of being calorie deprived than all other occupation taken together (in terms of average effect of other occupation). From model-4, where the contrast is set to Repeated, it is found that Scheduled Tribe households are 1.36 times more likely to be calorie deprived than their schedule caste counterparts. Interestingly households from 'other' as a social group, has higher odds of being calorie deprived compared to Other Backward Class households [see Model-2 and 3, in Table 6.1 below].

6.1 Estimated Odd Ratios from Logistic Regression Models for Households in Rural India					
Correlates of household undernutrition	*Model 1 (Indicator)*	*Model 2 (Difference)*	*Model 3 (Helmet)*	*Model 4 (Repeated)*	*Model 5 (Deviation)*
Ethnicity					
Scheduled Caste	2.021 (0.027)***	-	1.594 (0.025)***	-	1.043 (0.016)***
Scheduled Tribe	1.484 (0.025)***	0.734 (0.030)***	1.267 (0.022)***	1.362 (0.030)***	0.964 (0.013)***
Other Backward Class	1.373 (0.020)***	0.793 (0.020)***	1.373 (0.020)***	1.081 (0.023)***	0.702 (0.014)***
Others	1	0.624 (0.019)***	-	1.373 (0.020)***	1
Religion of the household					
Hindu	1.481 (0.034)***	-	1.029 (0.022)***	-	1.268 (0.024)***
Muslim	1.839 (0.046)***	1.248 (0.027)***	1.444 (0.038)***	0.805 (0.022)***	1.119 (0.030)***
Christian	1.622 (0.052)***	0.983 (0.040)***	1.622 (0.052)***	1.134 (0.046)***	0.690 (0.030)***
Others	1	0.609 (0.040)***	-	1.622 (0.052)***	1
Status of household for dependent population					
Less than the adult males	1	-	0.794 (0.016)***	-	1
More than adult males	1.259 (0.016)***	1.259 (0.016)***	-	0.1.235 0.016)***	1.122 (0.008)***
Household size					
Small	1	-	0.416 (0.018)***	-	1
Medium	2.32 (0.025)***	2.32 (0.018)***	0.932 (0.023)***	2.259 (0.016)***	1.293 (0.011)***
Large	2.489 (0.023)***	1.634 (0.022)***	-	1.094 (0.018)***	1.387 (0.015)***
Occupation of the household					
Self-employed in non-agriculture	1.417 (0.030)***	-	0.992 (0.023)***	-	1.585 (0.016)***
Agricultural labour	2.260 (0.027)***	1.595 (0.026)***	1.845 (0.021)***	0.627 (0.023)***	1.582 (0.024)***
Other labour	2.256 (0.037)***	1.260 (0.031)***	2.498 (0.032)***	1.717 (0.026)***	0.572 (0.014)***
Self employed in agriculture	0.816 (0.026)***	0.422 (0.019)***	0.816 (0.026)***	0.667 (0.033)***	0.701 (0.019)***
Other	1	0.642 (0.024)***	-	0.816 (0.032)***	1
Number of observations	71385	71385	71385	71385	71385
Percentage predicted	63.5	63.5	63.5	63.5	63.5
Initial log likelihood	98327.11	98327.11	98327.11	98327.11	98327.11
-2 log likelihood	91076.33	91076.33	91076.33	91076.33	91076.33
Model chi-square	7250.777	7250.777	7250.777	7250.777	7250.777
Cox and Snell R^2	0.097	0.097	0.097	0.097	0.097
Nagelkerke R^2	0.129	0.129	0.129	0.129	0.129
Hoshmer and Lemeshow R^2	31.037	31.037	31.037	31.037	31.037

Source: NSSO 55th round.

Notes:

1. ****, ** and * refers to statistical significance at 1 percent level, 5 percent and 10 percent level, respectively*
2. *1 refers to the reference category for model 1 and model 5*
3. *Dependent variable or outcome variable is 'undernutrition at household level', 0 refers to households who are undernourished and 1 refers to group of households not undernourished.*
4. *The respective contrasts are indicated in parenthesis for each model of multivariate analysis.*

Other Backward Class households also have a marginally higher odd (1.08) against their counterparts from Scheduled Tribe households for calorie deprivation. This fact cannot be captured in widely used model 1, where households from 'Other' form the reference category for other social groups. Similarly for occupation of the household, as self-employed in agriculture, have higher odds (1.717 times more) for calorie deprivation against their counterparts in other labour category. This fact can not be revealed from

Model 1 to Model 3, which can not measure likelihood of being undernourished for a given occupation category vis-à-vis the other occupation category. It shows intra-group variability in odds for the outcome of calorie deprivation among households with different occupation [see Model-4, in Table 6.1 below].

Model-5, which compares each category of the predictor with the overall effect of the predictor minus the reference category, shows that households from Scheduled Caste, Hindu households, households having higher number of dependent population, self employed in non-agriculture and agricultural labour are most likely to have higher odds (with statistical significance at 1 percent level) for calorie deprivation. It shows that households from Scheduled Castes have higher likelihood of being undernourished against the overall effect of the correlate 'ethnicity'. This strengthens the argument from Model 1 and 3 that Scheduled Caste households have higher vulnerability to calorie deprivation than any other given social groups or other social groups taken together. Likewise, households from self-employed in non-agriculture and agricultural labour have higher likelihood of calorie deprivation than the overall effect of occupation itself [see Model-5, in Table 6.1 below].

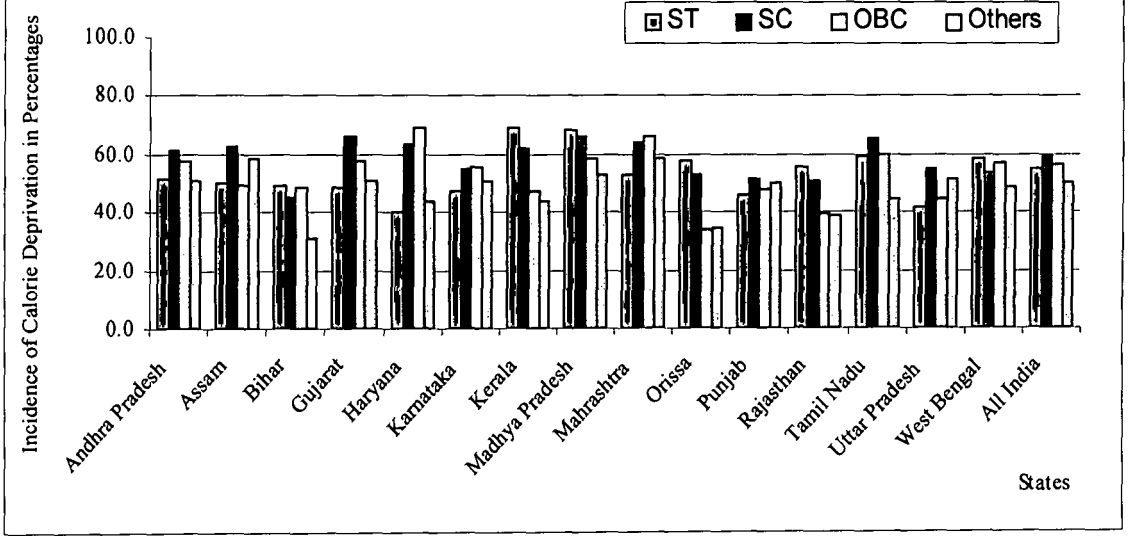
Thus one can conclude that using different contrasts bring out the fact that risk of calorie deprivation is not restricted to households from Scheduled Caste and Scheduled Tribe alone. Households from 'Other', can also experience higher calorie deprivation vis-à-vis their nearest lower social groups (in this case households from Other Backward Class). Likewise for occupation it is found that, apart from households having engaged in agricultural labour or other labour, the households who are self-employed in non-agriculture activity can have higher risk of calorie deprivation.

For major states, only the model-1 is run for the multivariate exercise to determine the correlates of calorie deprivation at household level. Across fifteen major states it is found that Scheduled Caste and Scheduled Tribe households have higher risk of being undernourished in the rural areas. The result also shows that only in West Bengal Scheduled Caste households have odds of less than one, for the outcome of undernourishment in terms of low calorie intake at household level. Religion of the household has odds of less than one for states like Andhra Pradesh, Gujarat, Madhya Pradesh, Tamil Nadu and west Bengal. Across all the states, rural households having occupation as self-employed in non-agriculture, agriculture labour and other labour have higher odds of being undernourished than their counter parts in respective reference categories [for details see Table A 6.5].

6.4. Calorie Deprivation among Urban Households by Social Category (Ethnicity) and Occupation

Coming to urban India, a similar exercise is repeated as was done of rural India. The occupation categories are different for urban India than rural India. The results are given in Table A 6.2, with summaries in figures being presented in the text. Let us consider occupation of the household, 'regular wage salary' [See Figure 6.6]. Scheduled Tribe households in Bihar, Kerala, Madhya Pradesh, Orissa, Rajasthan and West Bengal have higher prevalence of calorie deprivation than other social categories for the above occupation. Scheduled Caste households in Andhra Pradesh, Assam, Gujarat, Punjab, Tamil Nadu and Uttar Pradesh have the highest prevalence of calorie deprivation than their counterparts in other social category. In Haryana, Karnataka and Maharashtra households from Other Backward Class, for the same occupation have the highest prevalence of calorie deprivation among all other social groups. However, in this occupation category, in all major states no social group has calorie deprivation above 70 percent, which is observed in other occupation categories. The reason may be the better and stable income for the households in this occupation group than other occupation groups.

Figure 6.6 Calorie Deprivation among Urban Households with Occupation as Regular Wage Salary across Selected States and all India

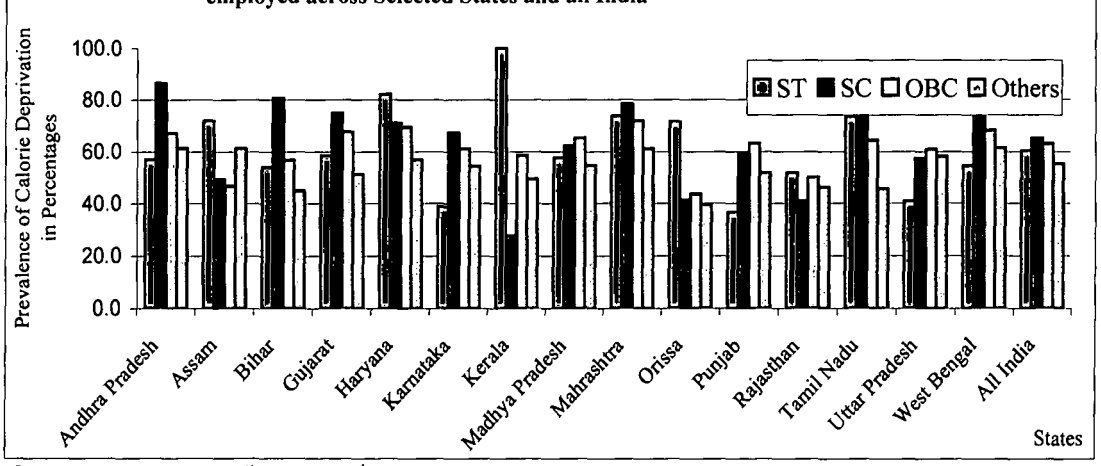


Source: NSSO 55th round

In urban India, for occupation as 'self employed' it is found that Scheduled Tribe households have higher prevalence level of calorie deprivation for Assam, Haryana, Kerala, Orissa and Rajasthan compared to any other social category. Whereas for states like Andhra Pradesh, Bihar, Gujarat, Karnataka, Maharashtra, Tamil Nadu and West Bengal, Scheduled Caste households have highest calorie deprivation than any other

social category. The Other Backward Class households have higher prevalence of calorie deprivation in Madhya Pradesh, Punjab and Uttar Pradesh. Interestingly for the given occupation, households from Scheduled Tribe in Andhra Pradesh, Karnataka, Punjab, Uttar Pradesh and West Bengal have lowest prevalence of calorie deprivation than any other social categories [See Figure 6.7].

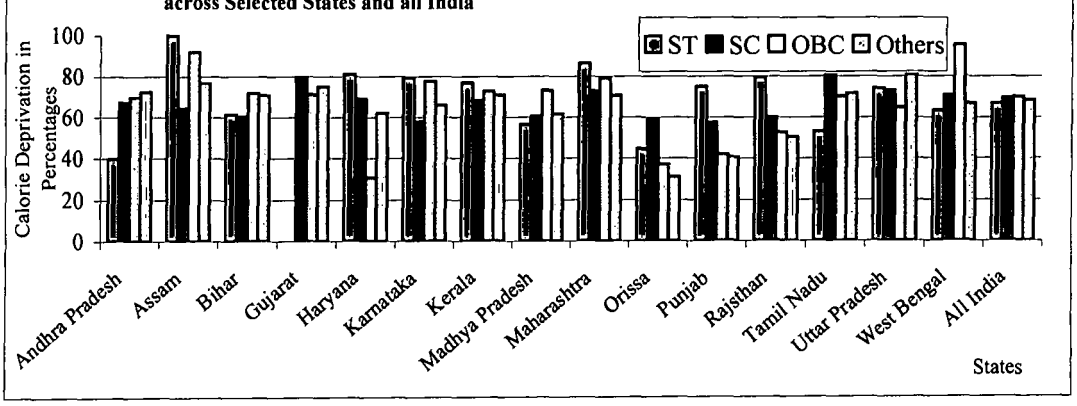
Figure 6.7 Calorie Deprivation among Urban Households with Occupation as Self-employed across Selected States and all India



Source: NSSO 55th round

For occupation as casual labour, households from Scheduled Tribe households have higher prevalence of calorie deprivation in Assam, Haryana, Karnataka, Kerala, Maharashtra, Punjab and Rajasthan, than any other social groups [See Figure 6.8]. In states like Gujarat, Orissa and Tamil Nadu, Scheduled Caste households have higher prevalence of calorie deprivation than their counterparts in other social category. In Bihar, Madhya Pradesh and West Bengal, households form Other Backward Class have higher prevalence of calorie deprivation whereas for Andhra Pradesh and Uttar Pradesh, households from 'other' have highest prevalence of calorie deprivation among all social groups for the above occupation.

Figure 6.8 Calorie Deprivation among Urban Housheolds with Occupation as Casual Labour across Selected States and all India

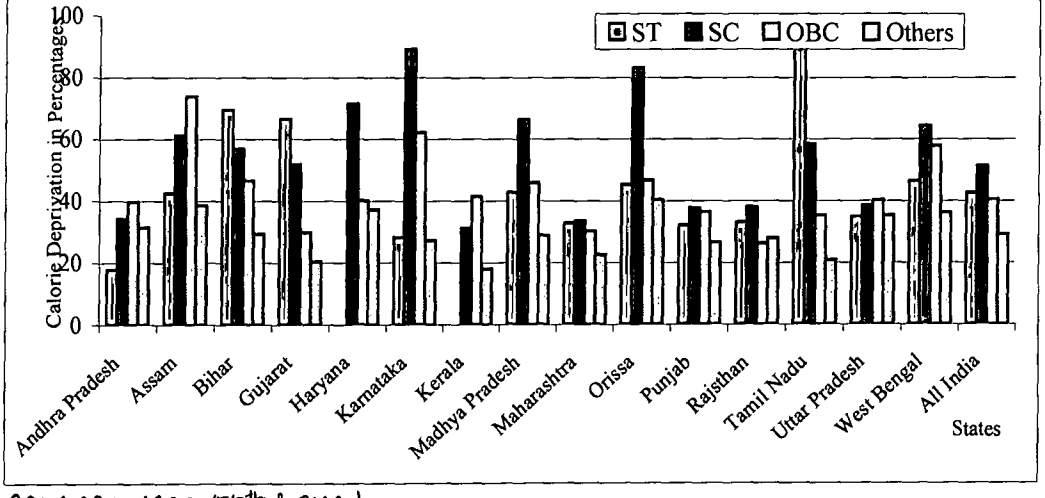


Source: NSSO 55th round

In states like Assam and Kerala, households from 'other', with occupation as casual labour have higher prevalence of calorie deprivation than their Scheduled Caste counterparts but below Scheduled Tribe and Other Backward Class households. In Haryana, Gujarat and Tamil Nadu, the households from 'other' social groups have higher calorie deprivation than their counterparts in Other Backward Class households. Thus among all occupation categories, among states, variation for calorie deprivation is high for 'casual labour' households.

For occupation as 'other', Scheduled Tribe households have higher prevalence of calorie deprivation in Bihar, Gujarat and Tamil Nadu among all social categories. For Tamil Nadu, all Scheduled Tribe households in the sample show calorie deprivation. In Haryana, Karnataka, Madhya Pradesh, Maharashtra, Orissa, Punjab, Rajasthan and West Bengal, Scheduled Caste households have higher prevalence of calorie deprivation than any other social groups. In Andhra Pradesh, Assam, Kerala and Uttar Pradesh have highest prevalence of calorie deprivation for other back ward categories than any other social groups. In states like Andhra Pradesh, Kerala, Maharashtra, Punjab, Rajasthan and Uttar Pradesh, all social categories have less than 40 percent of calorie deprivation at household level. At all India level, the Scheduled Caste households have highest calorie deprivation among all social groups [See Figure 6.9].

Figure 6.9 Calorie Deprivation among Urban Housheolds with Occupation as Other across Selected States and all India



Source: NSSO 55th Round

From above discussion for urban India it is found that the picture of urban India is complex. As the results of bivariate association between social groups and household calorie deprivation, conditioned upon the occupation of the household, shows varying picture of vulnerability for calorie deprivation for the given social groups. However one possible conclusion can be summerised from the findings, that for households with

'regular wage salary' and 'other occupation' the over all prevalence level of calorie deprivation across states is lesser than the households from other occupation categories (like casual labour and self employed). In case of casual labour households maximum situation for social categories for prevalence of calorie deprivation varies widely from states to states. Especially in some states, where households from 'other' social category report highest calorie deprivation, indicated nature of occupation is crucial to household nutritional outcome.

Following this bivariate analysis, the multivariate exercise with contrast set as 'indicator' for urban India shows that Scheduled Caste, Scheduled Tribe and Other Backward Class households have higher likelihood (odds which are statistically significant at 1 percent level) of being deprived of required calorie vis-à-vis households from 'Other' [See below Table 6.2, model-1]. Model-2 shows that Scheduled Tribe households have 1.07 times higher risk of calorie deprivation than their counter parts from 'Scheduled Caste'. Likewise households with occupation as casual labour, 1.65 times more likely to have calorie deprivation than their counterparts in self-employed category [See below Table 6.2, model-2]. Model-3 highlights that households from Scheduled Caste are 1.09 times more likely to experience calorie deprivation than their counterparts in other 3 social categories. Similarly households from Scheduled Tribe are 1.27 times more likely to have calorie deprivation than their counterparts in Other Backward Class and Other taken together. Households with occupation as casual labour are 2.758 times more likely to experience calorie deprivation than their counterparts in 'Other occupation' category [See below Table 6.2, model-3].

Model-4 shows that 'Other Backward Class' households have 0.901 times less likely to be undernourished than their counterparts in 'Scheduled Tribe' Category. Households from 'Other' also have higher likelihood (0.764 times) for calorie deprivation than their counterparts in 'Other Backward Class'. This fact could not be found form the model-1, which uses, the households in the 'Other' as the reference category to determine the likelihood of calorie deprivation for households in other social groups. Interestingly, households from occupation as 'casual labour' are also 1.717 times more likely to be undernourished than their counterparts in self-employed category [See below Table 6.2, model-4].

Model-5 shows that Scheduled Tribe households have highest likelihood of calorie deprivation (1.147 times) than the average effect of 'Ethnicity' on the outcome of calorie deprivation. Again the households with occupation as 'other' have highest risk of calorie deprivation than any other social groups (1.658 times more). This confirms the

findings from Model-4 and go against Model-3, that households with occupation as 'other' have higher likelihood of calorie deprivation than their counterparts in 'casual labour' category and the overall effect of occupation on the outcome. The odd for respective categories of correlates, 'ethnicity' and 'occupation' shows the outcome for calorie deprivation is statistically significant at 1 percent level [for details see Table 6.2].

Table 6.2 Estimated Odd Ratios from Logistic Regression Models for Households in Urban India

Correlates of household undernutrition	*Model 1 (Indicator)*	*Model 2 (Difference)*	*Model 3 (Helmet)*	*Model 4 (Repeated)*	*Model 5 (Deviation)*
Ethnicity					
Scheduled Caste	1.345 (0.002)***	-	1.091 (0.002)***	-	1.067(0.001)***
Scheduled Tribe	1.446 (0.001)***	1.075 (0.001)***	1.270(0.001)***	0.930(0.002)***	1.147(0.001)***
Other Backward Class	1.296 (0.001)***	0.930 (0.001)***	1.296 (0.001)***	0.901 (0.001)***	1.029(0.001)***
Others	1	0.735 (0.001)***	-	0.764 (0.001)***	1
Religion of the household					
Hindu	1.277 (0.002)***	-	0.954(0.001)***	-	0.965(0.001)***
Muslim	1.716 (0.002)***	1.344(0.001)***	1.453(0.002)***	0.744(0.001)***	1.298(0.001)***
Christian	1.395 (0.002)***	0.943(0.002)***	1.395(0.002)***	1.230 (0.001)***	1.055(0.001)***
Others	1	0.689(0.002)***	-	1.395(0.002)***	1
Status of dependent population in the household					
Less than the adult males	1	-	0.721(0.001)***	-	1
More than adult males	1.388(0.002)***	1.388(0.002)***	-	1.409 (0.001)***	1.122(0.001)***
Household size					
Small	1	-	0.350 (0.002)***	-	1
Medium	2.602 (0.001)***	2.602 (0.001)***	0.832 (0.002)***	2.261 (0.002)***	0.497(0.001)***
Large	3.130 (0.001)***	1.940(0.001)***	-	1.298(0.002)***	1.293 (0.001)***
Occupation of the household					
Regular wage salary	1	-	1.062***	-	1
Self-employed	1.742***	0.919***	0.964***	1.088***	1.046***
Casual labour	1.601***	1.651***	2.758***	1.717***	0.961***
Other	2.758***	0.507***	-	0.667***	1.656***
Number of observations	71385	71385	71385	71385	71385
Percentage predicted	63.5	63.5	63.5	63.5	63.5
Initial log likelihood	98327.11	98327.11	98327.11	98327.11	98327.11
-2 log likelihood	91076.33	91076.33	91076.33	91076.33	91076.33
Model chi-square	7250.777	7250.777	7250.777	7250.777	7250.777
Cox and Snell R^2	0.097	0.097	0.097	0.097	0.097
Nagelkerke R^2	0.129	0.129	0.129	0.129	0.129
Hoshmer and Lemeshow R^2	31.037	31.037	31.037	31.037	31.037

Source: NSSO 55th round.

Notes:

*Reference Category indicted by 1, *** significance at 1 percent level, ** significant at 5 percent level, *significant at 10 percent level.*

Dependent variable or outcome variable is 'undernutrition at household level', 0 refers to households who are undernourished and 1 refers to group of households not undernourished.

Here all the multivariate models are of 'backward stepwise bi-nomial logit model' with different contrasts.

The respective contrasts are indicated in parenthesis for each model of multivariate analysis.

Like rural areas of states, multivariate exercise for urban areas of state is also restricted to Model-1. Multivariate exercise for urban areas of selected states show that social categories like Scheduled Caste, Scheduled Tribe and Other Backward Class households have higher odds for calorie deprivation at household level, in contrast to 'Other' households. But unlike rural India, the Hindu and Muslim households have odds of greater than one for the outcome of under nourishment across all states, except Kerala. Here also casual labour households, self employed households, and even regular wage households show higher odds (with statistical significance of 1 percent) of being calorie deprived. One reason might be the difference in food pattern in urban areas towards low calorie but high fat food items and the declining share of pulses etc. Statistical significance for these odds varies between 1 percent to 5 percent levels for respective states. But one has to go further to see the exact reason behind this outcome. [For details see Table A 6.6].

6.5. Calorie Deprivation by Sex Composition of Households and Dependency of Members across Rural and Urban India

Analysis of NSSO 55th round (1999-2000) shows that households with more number of girl children and dependent individuals experience higher prevalence of calorie deprivation. The gap in prevalence of calorie deprivation between households having predominance of female children and male children in the rural setting is the largest in Andhra Pradesh (16.97 percent) followed by Maharashtra (16.64 percent) and Tamil Nadu (16.44 percent). Among other states like Madhya Pradesh, Karnataka, Kerala and Punjab, this gap hovers around 12 to 13 percentage point [See Table A 6.3 for details]. The simple group inequality measurement (in terms of ratio of prevalence of calorie deprivation among households with more girl children than boys to the aggregate prevalence of calorie deprivation at the state level) also confirms the findings. The revised version of simple group inequality measurement shows that in Andhra Pradesh, Maharashtra and Tamil Nadu, the risk of calorie deprivation for the households having more number of girl children is twice that of the households having more number of male children. The ranks for states (for rural areas) at aggregate prevalence level and in revised measure of group inequality shows that the states, which are on top of the order in aggregate prevalence level reported to be at the bottom of in the revised method [See for details Table A 6.3, column 2 and 7 for rural India]. The Table below shows that except Haryana, all other states have higher difference in prevalence of undernutrition for households with more number of girl children than the household with less number of girl children.

As mentioned elsewhere the revised measure of group inequality pronounces the difference between two groups at lower prevalence level. Thus low prevalence states of Rajasthan, Punjab and Uttar Pradesh have identical figures for revised group inequality measurement to that of states like Assam and Tamil Nadu, which have highest prevalence of household undernutrition [See Table A 6.3 for details]. This is reflected in the Table below where the inequality in rural areas of selected states in simple measure of group inequality, does not go beyond 1.5 but in revised measure of group inequality, for 5 out of 15 states are in range of 1.5-2.0 and for three state, it is more than 2.0 (Andhra Pradesh, Maharashtra and Tamil Nadu.) [See Table 6.3 below for details].

Table 6.3 Prevalence of Calorie Undernourishment among the Households having more Number of Girl Children than Household with less Girl Children in Selected States and all India

	Simple Measure of group Inequality			Revised Measure of Group inequality			
Rural							
Gap	*< 1.0*	*1.0 - 1.10*	*1.10 -1.5*	*< 1.0*	*1.0 - 1.5*	*1.5 - 2.0*	*> 2.0*
< 10	HAR	AS, BI, GUJ, OR, WB	RAJ, UP	HAR	AS, BI, GUJ WB, OR, UP, WB	RAJ	
10 - 15			KAR, KER, MP, PUN. India			PUN, KAR, KER, MP, India	
15 and above			AP, MAH, TN				AP, MAH, TN
Urban							
Gap	*< 1.0*	*1.0 - 1.10*	*1.10 and above*	*< 1.0*	*1.0 - 1.05*	*1.05 - 2.0*	*> 2.0*
< 10	AS	KAR, UP		AS	KAR, UP		
10 - 15			HAR, MAH, OR, RAJ			HAR, MAH, OR, RAJ	
15 and above		WB	AP, BI, GUJ, KER, MP, PUN, TN			AP, GUJ, MP	BI, KER, PUN, TN, WB

Source: *NSSO 55th round*

Note:

1. *Each cell represents the gap between households with low depended population compared to adult males and households with high dependent population compared to adult males for calorie deprivation in one hand and the simple and revised measure of group differential between these two households in the other for the same outcome.*
2. *Gap refers to the difference between prevalence of calorie deprivation in households having less girl children compared to households with more girl children.*
3. *For details on the figures for 'simple measure of group inequality' and 'revised measure of group inequality analysis, please see notes in Appendix 6.3.*
4. *AP = Andhra Pradesh, AS = Assam, BI = Bihar, GUJ = Gujarat, HAR = Haryana, KAR = Karnataka, KER = Kerala, MP = Madhya Pradesh, MAH = Maharashtra, OR= Orissa, PUN = Punjab, RAJ = Rajasthan, TN = Tamil Nadu, UP = Uttar Pradesh, WB = West Bengal and India = Rural all India*

In undernutrition indicator, urban India also shows a pattern similar to its rural counterparts. Except Uttar Pradesh and Karnataka, the gap between these two groups of urban households is more than 10 percentage points. For instance in West Bengal the gap between the households having more girl children than their male counterparts and

the households having more male children than their female counterparts is highest i.e. 18 percentage points [See for details Table A 6.3 column 5, for urban India]. Like rural India, the revised measure of group inequality also confirms less distance between two groups of households in higher prevalence level, as indicated by the ranks of the states. [For details see Table A 6.3 for details column 2 and 7, for urban India].

The revised group inequality measurement shows that in states like Bihar, Kerala, Punjab, Tamil Nadu and West Bengal, the risk of undernutrition for the households with more girl children are twice that of households having less number of girl children. It is also observed that in 9 out of 15 states (rural areas) have revised group inequality falling above 1.5. Same for urban India is confirmed for 12 out of 15 states. [See Table 6.3 below for details].

Coming to the more dependent population in the households and its association with undernutrition, our analysis shows that the gap between the households with more dependents than that of adult males[7] and the households with less dependants is found to be highest in West Bengal (17.75 percentage points), followed by Orissa (16.58 percentage points), Madhya Pradesh (16.60 percentage points), Karnataka (16.27 percentage points), and Andhra Pradesh (15.65 percentage points) [See column 5 of Table A 6.4, for rural India]. It is evident from the analysis that the states where the overall prevalence is lower, the risk for the households with more dependent population in calorie deprivation is not necessarily low.

The revised version of group inequality (risk) measurement pronounces the difference between these two groups of households at lower level. So Rajasthan (36.0 percent), Punjab (41.5 percent) and Uttar Pradesh (43.9 percent), which have some of the lowest over all prevalence of calorie deprivation, have identical scores in revised group inequality measurement with the states like Assam and Tamil Nadu (having highest and second highest calorie deprivation of 73.6 percent and 69.6 percent respectively at aggregate level). Except Punjab, Rajasthan and Uttar Pradesh appears along with Assam and Tamil Nadu in the same range of 1.5-2.0, in the revised measure of group inequality

[7] Here we have assumed that all male adults earn unless they are sick or disabled, about which no information is available in NSSO 55th round. We also assume the children are not working as child laborers and female members do not earn. Households are divided in to three categories depending upon number of members of the household. Small households consist of four members, while medium size consist five-seven members and eight plus members consists the large households.

[See Table 6.4 below, for rural India]. For most of the states, it is confirmed that households with more dependent population have the higher risk of calorie deprivation. As the Table 6.4 below shows, in rural areas of 13 out of 15 states (except Punjab and Kerala) revised measure of group inequality exceeds 1.5. That indicates that in all these states risk of calorie deprivation among households with more dependent population is at least 1.5 times higher than that for households with lesser dependent population.

Table 6.4 Prevalence of Calorie Under Nourishment among the Households having more Dependent Members Compared to Number of Adult male Members in Selected States and all India

	Simple Measure of group Inequality			*Revised Measure of Group inequality*			
Rural							
Gap	*< 1.0*	*1.0 - 1.10*	*1.10 -1.5*	*< 1.0*	*1.0 - 1.5*	*1.5 - 2.0*	*> 2.0*
< 10	-	AS, KER, PUN	RAJ, TN	-	KER, PUN	AS, RAJ, TN	-
10 - 15	-	MAH	BI, GUJ, HAR	UP	-	BI, GUJ, HAR, MAH, UP	-
15 and above	-	-	KAR	AP, MP, OR, WB	-	AP, MP, KAR, OR	WB
Urban							
Gap	*< 1.0*	*1.0 - 1.10*	*1.10 and above*	*< 1.0*	*1.0 - 1.05*	*1.05 - 2.0*	*> 2.0*
< 10	AS				AS		
10 - 15			KAR, RAJ, TN	GUJ, KER, OR, PUN, WB, India		KAR, KER, OR, PUN, RAJ, TN, WB, India	GUJ
15 and above				AP, BI, HAR, MP, MAH, UP		MP, MAH, UP	AP, BI, HAR

Source: NSSO 55th round

Note:

1) *Each cell represents the gap between households with low depended population compared to adult males and households with high dependent population compared to adult males for calorie deprivation in one hand and the simple and revised measure of group differential between these two households in the other for the same outcome.*
2) *Gap refers to the difference between prevalence of calorie deprivation in households having less girl children compared to households with more girl children.*
3) *For details on the figures for 'simple measure of group inequality' and 'revised measure of group inequality analysis, please see notes in Appendix 6.4.*
4) *AP = Andhra Pradesh, AS = Assam, BI = Bihar, GUJ = Gujarat, HAR = Haryana, KAR = Karnataka, KER = Kerala, MP = Madhya Pradesh, MAH = Maharashtra, OR= Orissa, PUN = Punjab, RAJ = Rajasthan, TN = Tamil Nadu, UP = Uttar Pradesh, WB = West Bengal and India = Rural all India*

In case of urban India it is found that Bihar has the highest gap (21.25 percentage points) as far as calorie deprivation is concerned, between the households with more dependent population and households with lesser dependent population. Andhra Pradesh, Haryana, Maharashtra and Madhya Pradesh follow Bihar for gap between prevalence levels of undernutrition between households with less number of dependent population and the households with more number of dependent population. Interestingly in Assam where the overall calorie deprivation is higher at aggregate level, the gap between the households with more dependent population and the households with less dependent

population is lowest; in fact it emerges to be negative (-0.87 percentage points). [See Table A 6.4, column 5]. Thus households with more dependent population than the adult male members, have higher prevalence of calorie deprivation. Here also for both rural and urban India, the states with higher prevalence of calorie deprivation show lesser distance between two groups of households (households with more dependent population vis-à-vis households with less dependent population) as indicated in respective rank orders [See Table A 6.4, column 2 and 7 for rural and urban India separately].

The revised measure of group inequality indicates except Assam, in urban areas of all other states, the revised measure of group inequality is above 1.5 [for details see Table 6.4 below, for urban India]. The result shows that households in 15 major states with high dependent population invariably have higher level of calorie deprivation as compared to households with low dependent population. It holds across all household size and both in urban and rural India [see below, column 5 and 8 of Table 6.5 for rural India and column 5 and 8 of Table 6.6 for urban India separately].

In case of rural India it is found that small sized households have lesser prevalence of calorie deprivation irrespective of the number of dependent individuals within the household. This pattern is evident for all states except Kerala and Uttar Pradesh, where calorie deprivation is higher for households with small family size in category of households with less dependent population compared to small size household from category of households with more dependent population [See below, column 2 and 6 of Table 6.5].

For other household size with in the given dependent population of the household, it is observed that households from medium and large household size from with in the category of households having less number of dependents, have less prevalence of calorie deprivation for their counterparts in category of more dependent population households [Compare column 3 with 7 and 4 with 8 for Table 6.5].

In case of urban India, it is found that except Assam, the calorie deprivation is higher for households of small size with more number of dependents, compared to the small size households with less number of dependents. The trend is visible across all states included in the analysis except for Assam, where the small households with lesser number of dependents have higher prevalence of calorie deprivation than their counterparts in households with more dependents [See column 2 and 6 of Table 6.6].

Table 6. 5 Prevalence of Calorie Deprivation in Rural Indian Households by their Dependency Characteristics and Size (in percentages)

	Low dependency households				High dependency households			
States	*Small*	*Medium*	*Large*	*Aggregate Prevalence*	*Small*	*Medium*	*Large*	*Aggregate Prevalence*
(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*	*(9)*
Andhra Pradesh	33.7	58.1	64.8	42.0	44.1	67.8	71.0	57.1
Assam	48.8	63.8	70.0	57.8	51.7	70.2	74.8	66.6
Bihar	33.6	49.6	49.3	40.1	39.7	58.3	52.6	52.0
Gujarat	33.2	55.1	63.2	43.9	40.7	65.3	70.7	58.5
Haryana	23.8	25.2	18.8	23.9	34.4	42.8	39.4	40.1
Karnataka	33.0	50.0	57.6	40.6	45.5	63.7	69.5	57.4
Kerala	34.6	65.1	81.5	47.8	32.3	67.6	83.7	57.9
Madhya Pradesh	34.0	51.2	54.7	42.3	42.2	65.0	62.4	58.7
Maharashtra	35.3	62.3	60.8	46.4	39.3	68.6	66.0	58.0
Orissa	33.9	44.8	48.5	38.3	40.6	61.9	51.9	53.6
Punjab	19.0	32.4	39.8	27.5	22.2	41.6	38.4	35.8
Rajasthan	17.3	29.2	37.3	24.6	24.7	34.5	38.1	33.3
Tamil Nadu	48.9	74.4	78.2	57.0	53.3	81.0	81.8	66.5
Uttar Pradesh	61.3	22.8	32.9	28.0	36.1	24.9	47.2	48.9
West Bengal	31.4	45.9	48.9	38.1	45.0	62.1	54.3	55.8
All India	33.1	50.2	51.8	40.7	39.6	57.9	53.6	51.4

Source: NSSO 55th round

Note:

1) *'Low dependency household' refers to the fact whether the number of dependent members in the household (like children, women, old, widow and other non earning members) are higher (or lower) than the number of adult male. In typical Indian household adult male (s) contribute the major proportion of earning for the household. The underlying assumption here is that if number of adult male higher than the dependent population; the household will have adequate resources to have adequate calorie. Similarly 'high dependency household' refers to those households where dependent members (like children, women, old, widow and other non earning members) are higher (or lower) than the number of adult male in the household.*
2) *Households sizes are categorised as follows; 1-4 members constitute small household, 5-7 members medium and more than 7 constitute the large households.*

However, for medium size households the households with lesser number of dependent populations have advantage over their counterparts with more number of dependents in terms of less prevalence of calorie deprivation. But the picture for households with large size is not clear for two groups of households. Large households with less dependent population have lesser calorie deprivation than their counterparts with more dependent population in urban areas of states like Assam, Bihar, Gujarat, Kerala, Madhya Pradesh, Orissa, Rajasthan, Tamil Nadu and Uttar Pradesh. In remaining six states, large households with lesser number of dependents have higher prevalence of calorie deprivation than their counterparts with more number of dependents [see below, column 4 and 8 of Table 6.6].

Thus Table 6.5 and 6.6 shows that given the total dependency, household size does matter to the calorie availability of the household, except few exceptions observed. In other words if the household is large but the income earning adults are more than the

other dependent members then it is likely to have less impact on the availability of calorie. On the contrary, irrespective of the household size and the dependents are more than the earning members then we will have a situation where availability of food might lead to a compromise in calorie intake.

Table 6. 6 Prevalence of Calorie Deprivation in Urban Indian Households by their Dependency Characteristics and Size (in percentages)

	Low dependency households				High dependency households			
States	*Small*	*Medium*	*Large*	*Aggregate Prevalence*	*Small*	*Medium*	*Large*	*Aggregate Prevalence*
(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*	*(9)*
Andhra Pradesh	36.5	67.4	84.5	47.6	48.8	75.3	83.9	63.3
Assam	46.4	64.3	60.5	51.0	44.4	65.1	75.0	56.2
Bihar	26.9	39.9	57.6	34.2	31.6	56.6	66.8	53.1
Gujarat	34.4	68.7	78.4	47.5	43.7	72.3	81.0	62.5
Haryana	29.4	57.1	65.5	42.4	48.7	69.3	56.4	61.0
Karnataka	30.5	63.7	77.6	41.8	44.4	70.8	66.7	58.2
Kerala	32.3	67.6	82.7	44.6	40.1	64.8	86.8	55.8
Madhya Pradesh	30.6	56.8	72.4	43.6	40.3	66.2	73.3	60.3
Maharashtra	35.6	67.1	75.7	47.6	45.0	73.5	74.9	62.8
Orissa	27.1	40.4	53.8	32.5	36.8	49.5	61.4	45.8
Punjab	30.8	56.7	72.2	41.1	39.6	64.3	62.1	55.3
Rajasthan	25.4	48.0	55.6	36.9	33.2	57.5	68.0	51.5
Tamil Nadu	43.4	75.0	75.0	51.6	49.2	78.8	79.3	62.4
Uttar Pradesh	29.1	52.1	67.2	41.6	37.5	60.3	68.7	56.6
West Bengal	39.2	62.5	68.8	46.0	46.1	63.4	66.7	55.4
All India	33.2	57.9	67.2	42.7	41.4	63.9	69.3	56.1

Source: NSSO 55th round

Note:

3) *'Low dependency household' refers to the fact whether the number of dependent members in the household (like children, women, old, widow and other non earning members) are higher (or lower) than the number of adult male. In typical Indian household adult male (s) contribute the major proportion of earning for the household. The underlying assumption here is that if number of adult male higher than the dependent population; the household will have adequate resources to have adequate calorie. Similarly 'high dependency household' refers to those households where dependent members (like children, women, old, widow and other non earning members) are higher (or lower) than the number of adult male in the household.*

4) *Household sizes are categorised as follows; 1-4 members constitute small household, 5-7 members medium and more than 7 constitute the large households.*

The multivariate exercise confirms the findings from the bivariate analysis that households with higher dependent members or large household size have higher likelihood (odds of higher than 2) of calorie deprivation at all India level (for rural as well as urban India). These odds are also confirmed to the statistical significance at 1 percent level for both rural and urban India. Households in rural India with more dependent populations are 1.26 times more likely to be consuming less than the required calorie where as for urban India the odds stands 1.39 for the same [See above Model-1 in Table 6.1 for rural India and Model 1 in Table 6.2 for urban India]. In model 2 where contrast is set to 'Difference' which tells about the risk for a particular category against the average effect of previous categories, it is found that the medium size households in urban India are 2.60 times more likely to have calorie deprivation than

their counter parts in 'small family size. This is same as model 1, because, in our order of category of there is only one category preceding the medium size households. In case of rural India also, the model-1 and model- 2 have same figure for odds for likelihood of calorie deprivation for households with higher dependent population than their counterparts in households with less dependent population. However for large size households in urban India, it is shown that the likelihood for calorie deprivation is 1.94 times more than the average effect of small family size and medium family size. It implies in urban India large household size are have higher risk of being calorie deprived than any other household size [See Table 6.2, model-2]. The same pattern is observed from model-2 for rural India as well, where the odds for calorie deprivations is 1.63 times more likely for large households against average effect of the small and medium size households [See Table 6.2, model-1].

In model 3, where the each category of predictor is contrasted with the average effect of subsequent categories, it is found that rural households with less dependent population have lower odds (0.79 i.e. less than 1) for the outcome of calorie deprivation than their counterparts with more dependent population. For household size it is evident from model 3, that small household size (against the average effect of small and medium household sizes) and medium household size have lesser odds for calorie deprivation compared to larger household size, 0.41 and 0.93 respectively [see model-3, Table 6.1]. For urban India also the same pattern is found for households with less dependent population (odd is less than 1) against the average effect of households with high dependent population as that of rural India. Urban households from small and medium size also have odd of less than (indicating likelihood for calorie deprivation is less) one against the average effect of medium and large households (for small size households) and average effect of large households alone (for medium size households), respectively [see model-3, Table 6.2]. Model-4 having contrast repeated shows that the rural households with more dependent population have higher risk for calorie deprivation (1.235) than their counterparts in households with more dependent population. Likewise the households with medium and large household size also have higher calorie deprivation with respect to small household size and large household size respectively [See Table 6.1, model 4]. The same pattern is observed for rural India as well [See Table 6.2, model 3]. Model 5, where the back ward stepwise binomial logit exercise is based on deviation contrast, in which each category of the predictor is compared with the overall effect of the predictor, show odds greater than 1 for the likelihood of calorie deprivation in rural households with more dependent population or larger household size [see model-5, Table 6.1]. For urban households a similar pattern could be seen [see model-5, Table 6.2].

For rural state level exercise of 15 major states, the odds of being calorie deprived, is found to be higher for households with more than two dependent population (against the households with less than two dependents) and households having medium and large size (against the households having small size). The statistical significance for the above exercise is confirmed for all states from 1 percent to 5 percent level [see Table A6.5 for detail]. In urban India the similar pattern could be observed at all India level as well as 15 major states, where the odds for calorie deprivation is higher for households with more dependent population or household are of larger size, in the multivariate framework. These odds are also statistically significant (at 1 percent level for all India and 1 percent to 5 percent for 15 major states) for all India as well as for selected states [See Table A 6.6 for details]. Thus it can safely be concluded that Indian households having more dependent members and of larger size have higher risk for calorie deprivation.

6.6. Conclusion

The study concludes that the calorie deprivation in India could be better understood if the focus will be on household characteristics and composition. Instead of studying the isolate characteristics one should look at more composite characteristics of the household, which comprises of social backwardness, occupation and place of residence. The composition of household helps us to identify the section of population with higher vulnerability. Undernourished household with more aged members; children especially female members are more likely to face calorie deprivation. Therefore, any intervention programme for the reduction of nutritional vulnerability should have special focus on the households belonging to Scheduled Caste and Scheduled Tribe and involved in agricultural labour activities. In urban areas, households depending upon causal or other forms of labour should be given priority. Also the households belonging to marginalised sections of the society like Scheduled Caste and Scheduled Tribe should be given special attention to ensure the desired level of calorie for a healthy life. Further among these socially deprived and occupationally disadvantageous households special attention is needed for the households with more girl children and other dependent population.

APPENDIX TO CHAPTER 6

Table A 6.1 Prevalence of Calorie Deprivation at Household Level for Rural Households across Social Groups Conditioned upon the Occupation for Selected States and all India

States	Scheduled Tribe					Scheduled Caste					Other Backward Class					Other					Total				
	Occ. I	Occ. II	Occ. III	Occ. IV	Occ. V	Occ. I	Occ. II	Occ. III	Occ. IV	Occ. V	Occ. I	Occ. II	Occ. III	Occ. IV	Occ. V	Occ. I	Occ. II	Occ. III	Occ. IV	Occ. V	Occ. I	Occ. II	Occ. III	Occ. IV	Occ. V
AP***	46.5	70.0	37.5	66.9	25.3	86.5	63.5	79.5	65.6	48.7	63.3	61.3	66.5	58.5	49.3	57.0	58.4	63.8	40.9	36.6	60.9	62.2	68.1	53.4	42.8
AS***	73.1	82.3	87.2	68.6	56.9	49.2	96.2	82.3	66.6	60.6	75.4	81.6	79.8	57.2	71.1	74.9	77.9	83.2	67.1	65.2	74.9	80.8	82.6	65.9	65.2
BI***	69.1	59.8	80.5	61.9	50.8	80.7	65.0	74.3	51.9	43.2	53.9	59.6	66.7	43.9	50.1	55.6	57.5	79.0	42.6	45.7	55.4	61.5	72.4	46.2	47.9
GUJ**	69.7	75.6	61.8	61.5	40.0	74.8	76.5	58.7	61.6	37.1	66.2	67.9	83.8	46.9	60.6	67.3	61.1	86.1	39.1	44.4	67.9	70.1	76.3	46.0	47.0
HAR*	100.0	15.2	100.0	0.0	0.0	71.0	62.3	74.4	42.2	53.1	57.1	46.0	66.0	28.4	41.9	53.7	46.7	49.0	22.0	30.2	57.3	55.1	67.5	23.6	38.0
KAR*	86.9	84.3	75.8	70.5	20.1	67.3	71.9	69.4	68.5	95.9	64.2	69.6	69.8	50.1	29.4	42.5	51.8	65.9	43.0	35.4	58.5	69.4	69.3	50.7	38.6
KER**	42.6	73.6	0.0	47.9	38.5	27.7	68.1	75.9	71.8	17.3	60.1	73.4	68.5	39.9	54.0	52.7	70.3	61.8	36.8	34.8	57.9	71.3	66.4	39.2	42.0
MP***	68.5	69.4	77.6	64.9	56.1	62.3	67.1	73.3	52.8	49.3	63.7	68.7	77.4	49.8	42.2	46.3	69.5	71.3	36.7	60.1	60.7	68.7	76.4	51.5	51.6
MAH	83.4	70.6	79.5	63.6	63.7	78.5	70.9	86.7	57.6	58.9	67.7	64.6	69.8	54.6	46.3	61.9	63.2	62.7	45.3	45.7	65.8	66.8	70.4	51.1	50.1
OR***	64.5	67.2	58.3	63.4	51.4	41.4	55.4	66.6	42.4	40.1	41.2	61.0	57.3	48.8	39.9	44.3	46.9	46.8	32.6	43.1	47.4	60.3	58.1	48.1	42.9
PUN*	92.0	62.0	0.0	0.0	24.3	59.6	60.1	49.0	30.7	45.5	46.6	77.6	52.7	46.5	34.1	35.5	34.0	46.2	18.5	17.8	47.4	59.9	48.8	21.8	29.5
RAJ**	53.4	59.9	63.1	36.6	50.8	40.9	34.6	46.2	31.1	30.6	32.8	42.6	42.4	26.5	37.2	42.9	37.6	34.3	24.5	29.6	38.8	43.1	50.3	28.3	34.8
TN***	38.1	81.0	63.0	100.0	83.6	81.3	78.4	72.4	68.3	59.5	72.6	71.3	67.1	60.5	45.3	64.9	74.8	63.0	62.7	33.2	73.4	74.6	68.2	61.6	47.3
UP***	70.3	65.4	52.1	23.7	27.5	57.1	57.8	54.0	37.8	44.4	54.6	54.4	53.7	37.1	43.3	44.5	46.2	45.4	26.2	25.2	54.0	55.3	52.5	33.2	35.7
WB***	21.8	67.6	94.5	41.7	54.5	74.5	63.5	61.2	52.3	45.3	52.7	62.2	42.1	44.0	30.7	62.4	66.7	68.2	44.8	42.4	61.4	65.5	65.3	46.1	42.4
India*	62.7	69.7	69.3	59.6	54.5	63.3	65.5	64.5	46.8	48.6	58.7	64.1	64.7	45.0	46.7	56.3	62.1	62.4	36.2	39.7	58.9	65.0	64.6	43.5	44.5

Source: NSSO 55th round

Note:

1) **** refers to statistical significance of bi-variate tabulation between calorie deprivation and occupation of the household for selected states at 1 percent level in pearson's chi-square test.*
2) *AP = Andhra Pradesh, AS = Assam, Bi = Bihar, GUJ = Gujarat, HAR = Haryana, KAR = Karnataka, KER = Kerala, MP = Madhya Pradesh, MAH = Maharashtra, OR= Orissa, PUN = Punjab, RAJ = Rajasthan, TN = Tamil Nadu, UP = Uttar Pradesh, WB = West Bengal and India = All India*
3) *Occ. I = Self-employed, Occ. II = Regular wage, Occ. III = Casual labour and Occ. IV = Other occupation*

Table A 6.2 Prevalence of Calorie Deprivation at Household Level for Urban Households across Social Groups Conditioned upon the Occupation for Selected States and all India

	Scheduled Tribe				Scheduled Caste				Other Backward Class				Other				Total			
States	Occ. I	Occ. II	Occ. III	Occ. IV	Occ. I	Occ. II	Occ. III	Occ. IV	Occ. I	Occ. II	Occ. III	Occ. IV	Occ. I	Occ. II	Occ. III	Occ. IV	Occ. I	Occ. II	Occ. III	Occ. IV
AP***	51.7	57.0	39.7	17.8	61.4	86.5	67.3	34.2	57.5	67.1	69.7	39.8	50.5	61.4	72.7	31.4	57.5	86.5	72.7	33.2
AS***	49.7	71.9	100.0	42.4	62.8	49.2	64.4	61.2	49.1	46.7	91.9	74.0	58.2	61.3	76.8	38.6	49.1	49.2	76.8	46.6
BI***	49.2	54.0	61.5	69.5	44.8	80.7	60.4	56.9	48.3	56.7	72.1	46.6	31.2	44.8	70.8	29.4	48.3	80.7	70.8	41.7
GUJ***	48.8	58.5	0.0	66.6	66.5	74.8	79.8	51.8	58.0	67.7	71.3	29.8	51.0	51.3	75.2	20.5	58.0	74.8	75.2	28.1
HAR***	40.1	82.1	81.2	0.0	63.5	71.0	69.1	71.5	69.3	69.5	30.6	40.2	43.5	56.8	62.1	37.2	69.3	71.0	62.1	42.8
KAR***	47.4	38.9	79.5	28.3	54.6	67.3	57.9	89.3	55.6	61.1	77.8	62.0	51.0	54.2	65.9	27.2	55.6	67.3	65.9	43.4
KER***	69.0	100.0	76.9	0.0	61.7	27.7	68.3	31.1	47.2	58.4	72.9	41.4	43.8	49.3	71.0	18.1	47.2	27.7	71.0	27.8
MP***	68.1	57.4	56.5	42.7	66.1	62.3	60.6	66.4	58.3	65.3	73.2	45.9	52.5	54.8	61.8	28.9	58.3	62.3	61.8	40.4
MAH***	52.7	73.8	86.4	32.8	64.3	78.5	72.9	33.5	66.4	71.8	79.4	30.2	58.4	61.2	70.7	22.6	66.4	78.5	70.7	25.7
ORI***	57.5	71.5	44.7	45.2	52.7	41.4	58.9	83.2	34.1	43.5	36.9	46.6	34.2	39.5	31.0	40.3	34.1	41.4	31.0	45.9
PUN***	46.1	36.7	75.0	32.1	51.4	59.6	57.2	37.6	48.0	63.1	42.0	36.4	50.3	51.7	40.6	26.4	48.0	59.6	40.6	29.7
RAJ***	55.5	51.8	79.4	33.1	51.0	40.9	60.0	38.0	39.4	50.1	52.7	26.3	38.8	46.2	50.5	27.9	39.4	40.9	50.5	29.1
TN***	59.0	73.5	53.0	100.0	65.5	81.3	80.5	58.5	59.9	64.4	70.2	35.3	44.5	45.7	71.9	20.8	59.9	81.3	71.9	36.3
UP***	41.7	40.9	74.2	34.8	54.7	57.1	73.1	38.4	44.2	60.9	64.9	40.3	51.6	58.1	80.6	35.2	44.2	57.1	80.6	37.0
WB***	58.7	54.5	63.3	46.3	53.5	74.5	70.7	64.4	56.7	68.1	95.5	57.9	48.8	61.4	66.9	36.1	56.7	74.5	66.9	39.9
India***	54.7	60.3	67.0	42.6	59.0	65.1	69.5	51.4	56.2	62.8	69.9	40.5	50.1	55.4	68.3	29.1	56.2	65.1	68.3	35.4

Source: NSSO 55th round

Note:

1. **** refers to statistical significance of bi-variate tabulation between calorie deprivation and occupation of the household for selected states, at 1 percent level in pearson's chi-square test.*
2. *AP = Andhra Pradesh, AS = Assam, Bi = Bihar, GUJ = Gujarat, HAR = Haryana, KAR = Karnataka, KER = Kerala, MP = Madhya Pradesh, MAH = Maharashtra, OR= Orissa, PUN = Punjab, RAJ = Rajasthan, TN = Tamil Nadu, UP = Uttar Pradesh, WB = West Bengal and India = All India*
3. *Occ. I = Regular wage salary, Occ. II = Self-employed, Occ. III = Casual labour and Occ. IV = Other occupation*

Table A 6.3 Prevalence of Calorie Undernourishment among the Households Having more Number of Girl Children

States	Over all Prevalence of undernutrition (in %)	Prevalence of under nutrition among households having lesser number of girl children (in %)	Prevalence of under nutrition among households having more girl children (in %)	Gap between Column 3 and 4 (in %)	Simple Measure of group inequality column 4/ column 2	Revised Measure of Group inequality (((Column 4/1-column 4)) / ((column 3/ 1-column 3)))
(1)	(2)	(3)	(4)	(5)	(6)	(7)
Rural						
Andhra Pradesh	59.1 (8)	53.59***	70.56	16.97	1.19	2.08 (3)
Assam	73.6 (1)	70.95***	76.65	5.70	1.04	1.34 (14)
Bihar	56 (10)	52.01***	61.24	9.24	1.09	1.46 (9)
Gujarat	61.2 (5)	58.01***	66.71	8.70	1.09	1.45 (10)
Haryana	43.1 (13)	42.99***	38.49	-4.50	0.89	0.83 (15)
Karnataka	62.5 (3)	56.57***	68.61	12.03	1.10	1.68 (7)
Kerala	58 (9)	53.70***	66.43	12.74	1.15	1.71 (5)
Madhya Pradesh	61.1 (6)	56.00***	69.14	13.15	1.13	1.76 (4)
Maharashtra	61.9 (4)	56.13***	72.78	16.64	1.18	2.09 (2)
Orissa	54.9 (11)	50.80***	59.98	9.19	1.09	1.45 (11)
Punjab	41.5 (14)	36.86***	49.67	12.81	1.20	1.69 (6)
Rajasthan	36 (15)	32.26***	41.95	9.69	1.17	1.52 (8)
Tamil Nadu	69.6 (2)	65.10***	81.54	16.44	1.17	2.37 (1)
Uttar Pradesh	43.9 (12)	40.09***	48.16	8.08	1.10	1.39 (13)
West Bengal	59.3 (7)	55.49***	63.79	8.30	1.08	1.41 (12)
All India	55.8	51.80***	62.20	10.40	1.11	1.53
Urban						
Andhra Pradesh	59.50 (4)	54.38***	69.77	15.40	1.17	1.94 (6)
Assam	60.00 (2)	57.56***	59.29	1.73	0.99	1.07 (15)
Bihar	50.70 (13)	45.34***	63.05	17.71	1.24	2.06 (4)
Gujarat	59.50 (5)	53.81***	68.85	15.04	1.16	1.90 (8)
Haryana	57.40 (7)	53.19***	63.85	10.66	1.11	1.55 (11)
Karnataka	59.80 (3)	53.70***	61.20	7.51	1.02	1.36 (13)
Kerala	54.70 (10)	48.97***	68.11	19.14	1.25	2.23 (1)
Madhya Pradesh	54.70 (11)	54.37***	69.46	15.09	1.27	1.91 (7)
Maharashtra	59.50 (6)	57.56***	71.05	13.11	1.19	1.78 (9)
Orissa	44.50 (15)	57.94***	50.43	10.73	1.13	1.55 (12)
Punjab	51.80 (12)	39.70***	66.01	18.82	1.27	2.17 (3)
Rajasthan	47.10 (14)	47.20***	54.17	12.98	1.15	1.69 (10)
Tamil Nadu	60.60 (1)	41.19***	72.05	15.82	1.19	2.01 (5)
Uttar Pradesh	56.30 (8)	56.23***	60.14	6.73	1.07	1.32 (14)
West Bengal	56.3 (9)	53.41***	71.08	18.35	1.26	2.20 (2)
All India	57.2	52.73***	62.20	9.60	1.09	1.48

Source: NSSO 55th round

Notes

1) **** refers to statistical significance of bi-variate tabulation a 1 percent level in pearson's chi-square test*

2) *Figures in parenthesis are ranks for states for calorie deprivation in descending order.*

Table A 6.4 Prevalence of Calorie under Nourishment among the Households Having more Number of Dependent Population

States	Over all Prevalence of undernutrition (in %)	Prevalence of undernutrition in the less dependent household (in %)	Prevalence of under nutrition in high dependent household (in %)	Gap between Column 3 and 4 (in %)	Simple Measure of group inequality column 4/ column 2	Revised Measure of Group inequality (((Column 4/1-column 4)) / ((column 3/ 1-column 3)))
(1)	(2)	(3)	(4)	(5)	(6)	(7)
Rural						
Andhra Pradesh	59.1 (7)	50.08***	65.73	15.65	1.11	1.91 (5)
Assam	73.6 (1)	68.09***	76.37	8.28	1.04	1.51 (12)
Bihar	56 (10)	47.40***	59.35	11.95	1.06	1.62 (9)
Gujarat	61.2 (4)	54.06	65.73	11.67	1.07	1.63 (8)
Haryana	43.1 (13)	34.54***	46.65	12.11	1.08	1.66 (7)
Karnataka	62.5 (6)	51.56***	67.83	16.27	1.09	1.98 (3)
Kerala	58 (5)	53.35***	60.30	6.95	1.04	1.33 (15)
Madhya Pradesh	61.1 (8)	49.95***	66.56	16.60	1.09	1.99 (2)
Maharashtra	61.9 (3)	54.55***	64.81	10.27	1.05	1.53 (11)
Orissa	54.9 (11)	44.50***	61.08	16.58	1.11	1.96 (4)
Punjab	41.5 (12)	35.50***	43.33	7.83	1.04	1.39 (14)
Rajasthan	36 (15)	29.31***	38.49	9.18	1.07	1.51 (13)
Tamil Nadu	69.6 (2)	64.16***	73.68	9.52	1.06	1.56 (10)
Uttar Pradesh	43.9 (14)	33.47	46.99	13.52	1.07	1.76 (6)
West Bengal	59.3 (9)	48.36***	66.11	17.75	1.11	2.08 (1)
All India	55.8	48.40***	59.30	10.90	1.06	1.55
Urban						
Andhra Pradesh	59.5 (8)	49.43***	68.43	19.00	1.15	2.22 (2)
Assam	60 (1)	58.25***	57.38	-0.87	0.96	0.96 (15)
Bihar	50.7 (130	38.79***	60.03	21.25	1.18	2.37 (1)
Gujarat	59.5 (6)	50.69***	65.21	14.52	1.10	1.82 (8)
Haryana	57.4 (11)	46.46***	65.37	18.91	1.14	2.17 (3)
Karnataka	59.8 (7)	50.49***	63.75	13.25	1.07	1.72 (11)
Kerala	54.7 (9)	47.07***	61.88	14.80	1.13	1.82 (7)
Madhya Pradesh	54.7 (5)	50.81***	66.10	15.30	1.21	1.89 (5)
Maharashtra	59.5 (30	54.32***	69.78	15.47	1.17	1.94 (4)
Orissa	44.5 (14)	37.68***	49.23	11.55	1.11	1.60 (13)
Punjab	51.8 (12)	44.45***	59.24	14.79	1.14	1.82 (9)
Rajasthan	47.1 (15)	37.43***	51.00	13.57	1.08	1.74 (10)
Tamil Nadu	60.6 (2)	54.48***	66.49	12.02	1.10	1.66 (12)
Uttar Pradesh	56.3 (10)	47.00***	62.47	15.47	1.11	1.88 (6)
West Bengal	56.3 (4)	52.82***	63.45	10.63	1.13	1.55 (14)
All India	57.2	49.30***	63.70	14.40	1.11	1.80

Source: NSSO 55th round

Notes

1) **** refers to statistical significance of bi-variate tabulation a 1 percent level in pearson's chi-square test*

2) *Figures in parenthesis are ranks for states for calorie deprivation in descending order.*

Table A 6.5 Result of Multivariate Exercise for Selected Indian States to Determine the Correlates of Undernutrition for Rural Households

States→	Andhra Pradesh	Assam	Bihar	Gujarat	Haryana	Karnataka	Kerala	Madhya Pradesh	Maharashtra	Orissa	Punjab	Rajasthan	Tamil Nadu	Uttar Pradesh	West Bengal
Ethnicity															
SC	1.864***	1.358***	2.697***	1.740***	2.427***	2.473***	1.829*	2.713***	1.883***	2.940***	3.108	2.082	2.482**	2.162***	.931
ST	1.717***	1.216***	1.796***	1.536***	1.952***	2.316***	1.349	1.628***	1.509***	1.493***	2.342***	1.399***	1.720***	1.860***	1.278
OBC	1.489***	1.036***	1.386***	1.277***	1.374***	1.250***	1.061	1.517***	1.329***	1.427***	1.432***	1.193***	1.231	1.458***	.080
Others	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Religion															
Hindu	.729	2.096	1.744	.631	2.415	1.539	1.141	.761	.921	1.086	1.417***	1.431	.735**	1.430	.621
Muslim	.974	3.080**	2.215	.402	1.631***	1.737	1.876***	.976	1.319	1.287	.983	2.461***	.517***	1.689***	.921
Christian	.800	2.105	1.994	1.068	.000	1.369	-	.560	.625	.846	1.112	.000	-	.625	.627
Others	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Number of dependent Population in the Household															
<= two	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
> two	1.467***	1.151***	1.272***	1.412***	2.127***	1.599***	1.354***	1.484***	1.173**	1.554***	1.120***	1.226***	1.240***	1.313***	1.615***
Household Size															
Small (1-4)	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Medium (5-7)	1.248***	1.182***	1.340***	1.218***	1.071***	1.138***	1.054***	1.310***	1.454***	1.215***	1.220***	1.112***	1.389***	1.313***	1.268***
High (7+)	1.798***	1.599***	1.303	2.063***	1.286	1.874***	2.440***	1.590***	1.630	1.450	1.854***	1.587***	1.919	1.423	1.235
Occupation of the household															
Self-employed in non agriculture	1.854***	1.568***	1.029	1.352	1.843***	1.521*	1.317**	1.201	1.357**	1.430***	1.375*	1.013	1.615***	1.453***	1.740***
Agricultural labour	2.096***	2.432***	1.566***	2.082***	1.977***	2.096***	3.076***	1.784***	1.851***	2.256***	2.108*	1.414	2.455***	1.764***	2.548***
Other Labour	2.711***	2.838***	2.201***	1.845***	2.175***	2.925***	2.571***	2.646***	1.739***	1.841***	1.332***	1.460***	2.406***	1.786***	2.777***
Self-employed in Agriculture	1.094***	.996***	.736***	.592***	.544***	.803	.807	.676***	.804**	1.161***	.467***	.561***	1.029	.660***	1.006***
Other	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

Source: *NSSO 55th round*

Notes:

1) *For states, only backward state wise bi-nomial logit method with 'indicator' contrast has been used. For all states the first stage of model run for logit exercise, gives the most appropriate model, retaining all the correlates.*

2) *Dependent variable or outcome variable is 'undernutrition at household level'.*

3) *Odds indicate the likelihood of a household being undernourished. Standard errors for odds are not reported for lack of space. However odds without statistical significance have higher standard errors than those with statistical significance.*

4) *Reference Category is indicted by 1.*

5) **** refers to statistical significance of respective odds 1 percent level while ** and * refers to 5 percent and 10 percent respectively.*

Table A 6.6 Result of Multivariate Exercise for Selected Indian States to Determine the Correlates of Undernutrition for Urban Households

States→	Andhra Pradesh	Assam	Bihar	Gujarat	Haryana	Karnataka	Kerala	Madhya Pradesh	Maharashtra	Orissa	Punjab	Rajasthan	Tamil Nadu	Uttar Pradesh	West Bengal
Ethnicity															
ST	0.991	1.339	3.332***	1.204**	0.775	1.381	506.023**	1.159***	1.391*	2.203***	1.118	1.920	2.181***	0.994	0.984
SC	1.551***	1.818**	2.273***	1.801***	1.615	1.640***	0.909	1.344***	1.718***	1.460***	1.215***	1.395***	2.228***	1.337***	1.107***
OBC	1.353***	1.165	1.929***	1.351***	1.099	1.307	0.966	1.414***	1.472***	1.001	1.364*	1.141	1.748	1.486***	0.905***
Others	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Religion															
Hindu	1.197	1.454	1.453	2.217***	2.481**	0.432	-	0.739	1.163	-	1.536***	1.014	3.543	0.937	1.316***
Muslim	1.946	1.810	1.915	2.663***	6.040	0.569	-	1.211***	1.751***	-	2.019**	1.674**	4.702*	1.557***	1.691***
Christian	0.959	1.018	2.158	1.231***	14.708	0.280	-	0.709	1.085	-	1.894	1.246	3.208	2.096	1.092***
Others	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Number of dependent Population in the Household															
<= two	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
> two	1.563***	-	1.248***	1.384***	1.451***	1.502***	1.397***	1.408**	1.441***	1.069**	1.345***	1.451***	1.226***	1.306***	1.898***
Household Size															
Small	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Medium	2.543***	2.654***	2.583***	3.232***	4.258***	3.355***	3.020***	2.676***	3.209***	1.991***	2.734***	2.350***	3.974***	2.034***	2.159***
High	5.375***	1.787**	4.558***	5.485***	2.505***	4.018***	6.187***	3.276***	3.530***	4.237***	3.833***	2.816***	4.190***	2.368***	2.684***
Occupation of the household															
Regular wage	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Self-employed	1.319***	1.296	1.818***	0.981	1.347	0.808	1.219	0.930	0.995***	1.098	0.840**	1.048***	1.056***	1.671***	1.181***
Casual labour	1.252	2.651	2.902	2.259***	0.777	2.004***	3.122	1.499	1.376***	1.096	0.972**	1.476***	1.790***	1.790***	2.208***
Others	0.549	0.707***	1.521	0.414***	1.481**	0.517	0.953***	0.876***	0.376***	1.622***	0.425**	0.487***	0.590***	0.752***	0.724***

Source: NSSO 55th round

Notes:

1) For states, only backward state wise binomial logit method with 'indicator' contrast has been used. # For all states the first stage of model run for logit exercise, gives the most appropriate model, retaining all the correlates, except Assam.
2) For Assam, In second stage it excludes the variable 'number of dependent population in the household'.
3) Dependent variable or outcome variable is 'undernutrition at household level', Odds indicate the likelihood of a household being undernourished. Standard errors for odds are not reported for lack of space. However odds without statistical significance have higher standard errors than those with statistical significance.
4) 1 indicts reference category.
5) *** refers to statistical significance of respective odds 1 percent level while ** and * refers to 5 percent and 10 percent respectively.

CHAPTER 7

UNDERNUTRITION AS A DICHOTOMOUS MEASURE: ISSUES IN COMPARISON AND INTERPRETATION

7.1. Introduction

In a federal polity, such as India, discussions of deprivation often centre around dichotomous measures deprived vis-à-vis not deprived, or the proportion deprived [Planning Commission; 2007]. Such a measure misses out on the number deprived. While for policy interventions the numbers are important, one cannot do without proportions when comparison across social groups and spatial groups is involved. The issue is, how to combine the proportion and absolute number to arrive at some comprehensive measure. Similarly, differentials across social groups are often used. There are various ways of viewing them, often taking them independent of levels, as ratios and differences, again throwing up the issue of combining the levels with differentials. An equally important issue is that of distribution - intensity and inequality - below the norm as well as above. How to bring the distributional aspects into the measure? These issues have attracted the attention of researchers concerned with poverty.

Measurement of undernutrition has a lot in common with the measurement of poverty head count. This dichotomy in measurement presents itself as a proportion similar to that of head count measure of poverty wherein the proportions could very well compare across situations as regards magnitude but not the extent of severity. Between two different population sizes, the proportion of this deprivation could very well be the same but the number of deprived may vary. Such deprivation in absolute terms and proportion terms represents the principle of agency and principle of likelihood respectively. There is no doubt that both these measures assume significance in their own right for comparison across situations on the one hand and intervention on the other. On this count, a combined measure of proportion and absolute numbers in the context of poverty headcount is proposed [Subramanian; 2005]. A similar reasoning applies to the measurement of undernutrition given its dichotomy conforming to a norm similar to that of poverty line.

Another conflict in comparison of dichotomous measurement of undernutrition conditioned by a norm relates to overlooking the distribution of nutritional outcome on either end of the distribution, which is a common oversight in any dichotomous

measurement. In case of nutritional deprivation such an oversight may have serious implications as regards comparison. For instance, two situations of similar degree of nutritional deprivation may have different range of distribution of deprivation as against the norm. Hence, there arises the need to adjust the head count equivalence in undernutrition (i.e. the proportion or percentage) along with the intensity and inequality of this deprivation as is computed in case of FGT measures of poverty (Foster-Greer-Thorbecke; 1984, henceforth FGT) with α= 1 and 2. The adjustment of proportion measure with intensity as well as both intensity and inequality might present a valid comparison of nutritional deprivation.

It is the common practice of analysts to differentiate deprivation measures across groups with a simple differential like that of a ratio between male and female, rural and urban to reflect upon the group disparity. However, this simple ratio measure may often be not sensitive to the overall level of deprivation (better or worse) rendering differential comparison always in favor of the best as against the worst situation. Given the limitation of the simple ratio measure, the suggested revision needs to be qualifying the principle of reciprocal sensitivity i.e. the differential being pronounced at lesser level of deprivation as against worse level of deprivation. A measure of this kind is proposed and illustrated in case of comparison of sex differential in mortality [Mishra and Subramanian; 2006]. An application of the same in examining group differential in nutritional deprivation is attempted here.

The proposed adjustment of deprivation measure (here undernutrition) to account for the intensity and inequality is possible with availability of unit level information. But, it is often observed that distribution of such deprivation is made available in a grouped manner in reports and government publications. Hence, there arises a need for an alternative approach of accounting for intensity and inequality in case of grouped data. So, distribution of the deprived in two situations having same level of nutritional deprivation cannot be compared. Any comparison will only be limited to comparing head count ratio, aggregate number of deprived or at best a possible use of blended measure. The alternative proposed here is in keeping with the principle of the standard FGT measure that accounts for the nature of distribution of the deprived (for undernourished), with information available at the aggregate level.

7.2. Objectives

Based on the three sets of issues elaborated above this chapter has the following objectives.

(i) To illustrate the comparison of a blended measure (combination of proportion and absolute numbers in case of undernutrition) with the simple proportion across Indian states.

(ii) To verify whether the group differential in undernutrition (in this case male/female) adjusted for the level of undernourishment exposes the gender differential in nutritional deprivation better across the Indian states.

(iii) To examine the differential in ranks as regards nutritional deprivation across Indian states with adjustment for intensity and inequality in line with the FGT measures computed in case of poverty.

(iv) To demonstrate if the nutritional deprivation reported at aggregate level across Indian states could be similarly adjusted for intensity and severity in the absence of information at the unit record level.

7.3. Data and Methods

This chapter presents an empirical illustration of each of the concerns raised regarding comparison of nutritional deprivation. Solutions have largely been based on the principles of dimensional adjustment, sensitivity of differentials across varying levels of outcomes/deprivations as well as assessing deprivations accounting for intensity and inequality. Here dimensional adjustment relates to combination of multiple dimensions of a single deprivation (as reflected in various types of measures). For instance, the illustration here will demonstrate the combination of absolute and proportional dimension of nutritional deprivation. Similarly sensitivity of differential across varying levels of deprivation is addressed with a comparison of group-differential in nutritional deprivation. Often simple ratio- based or difference-based measures of differential do not account for the changing levels of a deprivation (temporal or cross-section) and hence the need for making it sensitive based on the principle of pronouncing the differential at better levels of deprivation vs. worse levels of the same. Another aspect of comparison addressed here relates to accounting for intensity and inequality of this deprivation in line with the FGT measure of poverty.

The data sources are primarily National Sample Surveys Organization (NSSO) and the National Family Health Survey (NFHS-2) for Indian states. The NSSO provides information on the calorie intake at household level to compute a head count ratio of the households, which consume below the required norm of 2700 calories per capita per day. The present exercise uses data from the NSSO 55th round surveys, held during the year 1999-2000. This information is used to illustrate how head count ratio and aggregate head count differ and a blended measure of the two describe nutritional deprivation, otherwise referred to as calorie poverty, better.

NFHS-2 is used for computation of gender differential in child undernutrition with a simple ratio and a refined measure towards making such differential level sensitive with pronouncement at lower levels of deprivation. NFHS-2 has information on the height and weight for 27065 children altogether. Considering the corresponding reference height (weight) from the 'Measuring change in Nutrition Status' published by WHO in 1983 one can measure the exact departure in height and weight for each (taking male/female difference into account) child represented in NFHS-2. This information is used to compute the prevalence level of stunting and underweight separately for female and male children across the states, and differential measures are computed to illustrate level sensitivity in these differential measures. Also the standard FGT measure is obtained in case of nutritional deprivation in children as regard the intensity and severity (inequality) of the stunting and underweight across the states. Following which the prevalence measure of nutritional deprivation is adjusted for intensity as well as intensity and inequality together while comparing deprivation across fifteen major Indian states. The use of both calorimetric and anthropometric indicators will help us to show that each dimension of undernourishment has to be readjusted to make them comparable across states and groups. Nonetheless all the three agreements (of FGT i.e. prevalence, intensity and inequality) can be advanced to any single dimension of undernourishment (either calorimetric or any anthropometric indicator) like stunting and underweight.

The theoretical construct for adjusting head-count ratio and aggregate head count of undernourished household is adopted from Subramanian (2005), where it is shown that a blended measure of the two is more sensible to give comprehensive picture of a particular deprivation for a given set of observations. The idea of adjusting group differentials to the prevalence level for particular characteristics in a given set of observations is borrowed from [Mishra and Subramaninan; 2006]. The application of FGT criterion to nutritional poverty is made again for sensible comparison of prevalence levels in case of dichotomous measures. The logic is while going for the comparison of

achievements (or failure) in a given dimension of deprivation (in this case undernutrition), it will be more meaningful to include the exact distance between the deprivation in the concerned group and the fixed norm (which they should reach to break free from the deprivation) and the distribution of the deprived.

7.4. Simple Proportion v/s Blended Measures

As mentioned above the nutritional deprivation is measured in terms of conventional measures like 'Head Count Ratio' and 'Aggregate Head Count'. While the first one helps to assess the percentage of households in the given sample consuming below the prescribed norm of calorie intake, the other one gives the definite figure for the number of people/household whose calorie consumption is below the prescribed norm. Such measurement gives rise to two indicators; the number of households nutritionally compromised according to calorie intake as well as the proportion of them as against the total number of households for a defined population of a state or locality. Both of them have independent connotation in the sense that one provides a count in absolute sense and the other provides a proportion that enables comparison across population with different number of surveyed households in the sample. These two measures may not be ordinally even with a population having smaller number of nutritionally compromised households accounting for a higher proportion among all households and vice versa.

The two measures -aggregate and proportionate- are meant to serve different purposes with the former informing the absolute magnitude handy for intervention while the later is meant for comparing the situation between two populations. But as regards imagining the severity of the phenomenon, the duos have equal significance and hence a combination of the two may be more desirable. While prioritizing intervention it may be worthwhile to go by the absolute count rather than the proportion, which is conditioned by the size of the population. A similar comparison in poverty literature concerning head count and proportion below poverty line has been suggested with a combination of the two which is replicated here in the comparison of calorie based nutrition status of Indian states [Subramanian, 2005]. Following which, we have computed a composite index (henceforth the blended measure) of the two stated dimensions for each state. This blended measure (M) is the product of the square root of the 'aggregate head-count (A)' multiplied by 'one plus the head-count ratio (H)'. Formally, blended measure (M) = $A^{1/2}[1+H]$[1].

[1] For it's mathematical properties and derivation please look at the Subramanian (2005), Economic Political Weekly; October 2005, pp. 4625-28

Though the final product is expressed in the unit which the aggregate head count is measured (like hundreds, thousands or millions), the index is a value lying between the two conventional indices. This blended measure helps in accounting for variation in ranks as regards undernourishment depicted by the two dimensions i.e. the absolute and the proportion and therefore provides a more comprehensive picture of deprivation in simple terms. Here we make a comparison of the absolute count of households with calorie deprivation with the corresponding proportion across states of India. The varying population size of Indian states makes the denominator to be different in the computation of the proportion of households facing calorie deprivation. While these proportions convey the differential levels of calorie deprivation, the absolute numbers of calorie-deprived households are more in large population sized states as against the states with small population size. Such a comparison in Table-7.1 indicates that the state of Assam (a state representing lesser number of households) has the highest prevalence of rural calorie deprivation in terms of head count (the proportion measure) i.e. 73.6 per cent. However, in terms of the aggregate number of households with calorie deprivation, the state of Assam ranks eighth among the fifteen major states considered with the state of Bihar being at the bottom. In this comparison, it is apparent that the proportion measure may represent comparative magnitude of the phenomenon of calorie deprivation, but absolute count may always be preferred as regard the numeric magnitude of the phenomenon. The absolute measure is definitely conditional with the population size but the real magnitude ultimately lies in the number of deprived than their proportion. This mismatch in ranks between proportion based measure and the absolute one is found in case of urban India as well. Given this conflict between these two measures, the suggested blended measure of the two puts Assam and Bihar in second and third rank in order of calorie deprivation.

Table 7.1 Undernourishment (in terms of calorie deprivation) among Households across Selected Indian States by Aggregate, Proportion and Blended Measure

	Rural India			Urban India			All India		
States (1)	*Rural Headcount Ratio* (2)	*Rural Aggregate Headcount (in millions)* (3)	*Blended measure for Rural household* (4)	*Urban Headcount Ratio* (5)	*Urban Aggregate Headcount (in millions)* (6)	*Blended Measure for urban household* (7)	*Total Headcount Ratio* (8)	*Total Aggregate headcount (in millions)* (9)	*Blended Measure for total household* (10)
Andhra Pradesh	59.10 (8)	3062 (4)	3325.64 (5)	59.50 (6)	2265 (4)	2879.04 (4)	59.30 (7)	5329 (4)	4402.02 (3)
Assam	73.60 (1)	2548 (8)	3765.66 (2)	55.50 (10)	473 (13)	1228.61 (13)	64.55 (2)	2785 (10)	3459.08 (9)
Bihar	56.00 (10)	4094 (1)	3647.18 (3)	50.70 (13)	1155 (9)	1757.38 (10)	53.35 (10)	5116 (5)	3887.55 (6)
Gujarat	61.20 (5)	1517 (11)	2422.73 (10)	59.50 (5)	1645 (7)	2453.48 (7)	60.35 (5)	3164 (9)	3450.99 (10)
Haryana	43.10 (12)	488 (15)	974.09 (15)	57.40 (8)	435 (15)	1218.16 (14)	50.25 (11)	950 (15)	1579.40 (15)
Karnataka	62.50 (3)	1727 (10)	2638.79 (8)	59.80 (3)	1477 (8)	2336.70 (8)	61.15 (4)	3200 (8)	3515.72 (8)
Kerala	58.00 (9)	1510 (12)	2292.91(11)	54.70 (11)	1102 (10)	1849.21 (9)	56.35 (9)	2603 (11)	2925.87 (11)
Madhya Pradesh	61.10 (6)	3143 (3)	3481.47 (4)	59.50 (4)	1871 (6)	2617.12 (6)	60.30 (6)	4998 (6)	4333.81 (4)
Maharashtra	61.90 (4)	2551 (7)	3176.85 (6)	62.0 (1)	3245 (1)	3588.83 (1)	61.95 (3)	5795 (2)	4792.24 (2)
Orissa	54.90 (11)	1919 (9)	2442.31 (9)	44.50 (15)	467 (14)	983.53 (15)	49.70 (12)	2250 (12)	2404.87 (12)
Punjab	41.50 (13)	893 (14)	1270.09 (13)	51.80 (12)	975 (11)	1649.01(11)	46.65 (13)	1882 (14)	2067.33 (13)
Rajasthan	36.00 (15)	1162 (13)	1261.50 (14)	47.10 (14)	935 (12)	1470.74 (12)	41.55 (15)	2166 (13)	1980.48 (14)
Tamil Nadu	69.60 (2)	2904 (5)	3804.82 (1)	60.60 (2)	2552 (3)	3112.16 (2)	65.10 (1)	5459 (3)	4883.64 (1)
Uttar Pradesh	36.90 (14)	3480 (2)	2235.91 (12)	56.30 (9)	2611 (2)	2928.02 (3)	46.60 (14)	6557 (1)	3854.31 (7)
West Bengal	59.30 (7)	2698 (6)	3132.21 (7)	58.60 (7)	2011 (5)	2672.81 (5)	58.95 (8)	4705 (7)	4112.32 (5)

Source: NUTRITIONAL INTAKE IN INDIA, NSSO 55TH ROUND (1999-2000); Statement-7
Note: In column 4, 7 and 10 reported blended measures are not expressed in any units.

As can be seen from Table-7.1, the blended measure ranks the states differently from that in terms of absolute measure or the proportional measure. This observation implies that as regards prioritisation, a blended measure is more desirable than either of the measures, namely absolute or proportion. Although the absolute measure is more or less in tune with the denominator size of households representing different states, their count is conditioned by the proportional measure describing the prevalence of calorie deprivation. The reason for blending is primarily to weigh proportions and absolute numbers to prioritise based on the combined ranks. These combined ranks will be midway between the two and will represent suggestive ranking of the deprivation for comparison. The differential ranking observed in the blended measure across states is suggesting that there is a larger mismatch between proportions and absolute measures as regard calorie deprivation and moderation is no doubt achieved in combination of the two. Details of differential ranking can be observed in Table 7.1.

7.5. Sensitivity of Differential across Levels of Deprivation

Sex-differential in stunting among children across Indian States is found to be in either direction with a few states demonstrating male advantage and the others with female advantage. The states with female advantages in stunting are Assam, Bihar, Haryana, Kerala, Maharashtra, Orissa, Punjab, Tamil Nadu, and West Bengal. Whereas for the weight-for-age, the same is observed for Bihar, Haryana, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Punjab, West Bengal and Uttar Pradesh. This advantage/disadvantage is primarily based on a measure like male-female ratio, which has no bearing with the overall level of the phenomenon. Such a ratio measure might provide a similar value irrespective of the overall level of the phenomenon. For instance, with an overall level of stunting being 50 per cent (male 60 and female 40) the male-female ratio gives a value of 1.50, which remains same with the overall level of 40 percent (male 45 percent and female 30 percent). In this example female disadvantage is visibly higher in the later situation as against the former given that there is overall betterment in the phenomenon of stunting. This shows the insensitivity of the simple ratio measure in exposing the differential across levels.

The computation presented in Table 7.2 and Table 7.3 regarding the sex-differential in stunting and underweight respectively using four differential measures d_1, d_2, d_3 and d_4 are as follows

$d_1\ (a, b) = I_a - I_b$ (Difference between male and female children in prevalence of undernutrition)

$d_2\ (a, b) = Ia / Ib$ (Ratio of prevalence of undernutrition for male children with respect to female children)

$d_3\ (a, b) = Ia^{\delta} - Ib^{\delta}$, $0 < \delta < 1$ (Difference based group differential measure where 'δ' refers to groups weights)

$d_4(a, b) = Ia^{a}/Ib^{a+1}$, $\alpha > 0$ (Ratio based group differential measure where α refers to group weights)

Here Ia and I_b represent the male and female nutritional deprivation levels across Indian states. The value of 'δ' in d_3 is assumed to be 0.5, because we have assigned equal weight to children from both sexes. In d_4, α is assigned value of 1, for the same reason mentioned for d_3. The above set of four differential measures is proposed to illustrate the sensitivity of differential measures to the overall prevailing level of the phenomenon. These measures are intended to pronounce differentials at better level of an outcome vis-à-vis worse level of the same. Simple difference or ratio based differential measure fails to pronounce differentials with bettering levels of the phenomenon which leads to a simplistic observation of differentials narrowing down with bettering levels of the outcome. The suggested differential measures $d_3\ (a, b)$ *and* $d_4\ (a, b)$ conform to the premise of pronouncing differentials at better levels of the phenomenon as can be observed from the comparison of gender differentials in child undernutrition made across Indian states with varying prevalence levels.

Considering the gender differential measures computed for stunting among children, we find the states of Andhra Pradesh, Gujarat, Karnataka, Madhya Pradesh, Rajasthan and Uttar Pradesh displaying a male advantage as against the rest of the nine major states displaying female advantage. In either case the extent of advantage or disadvantage indicated by the $d_1\ (a, b)$ *or* $d_2\ (a, b)$ do not seem to have any bearing on the overall prevalence of stunting across these states. This can very well be observed in matching the corresponding ranks of overall levels of stunting and the ranks of the differential measures. Further, the differential measure $d_3\ (a, b)$ does indicate some rank shift between the differential measure and the overall levels of stunting in keeping with the pronouncement of differentials at better levels of the phenomenon. Finally, the differential measure $d_4\ (a, b)$ depicts ranks of the measure of differential quite in contrast with the ranks of the levels of the phenomenon excepting an alteration when better levels are near similar. A similar computation of gender differential carried out for the nine states with female advantage too demonstrate the refinement in differential measure where in the final differential measure $d_4\ (a, b)$ represents contrasting ranks against the ranks of the prevailing levels of undernourishment in terms of stunting. Here too there are some alteration in rank pattern observed like the differential measure rank of 8

corresponds to the level rank of 3 which otherwise should have been 2. However, the better levels of the phenomenon are systematically give rise to a higher magnitude of gender differential as against the worse level of the phenomenon [For details see Table 7.2; column 2 and 8]. The same set of illustration on computing gender differential in undernutrition is also made for underweight as well. Here too six of the states manifest male advantage against the other nine states with female advantage. States with male advantage as regards underweight have a varying range of the phenomenon between 54.4 per cent for Orissa and 36.1 in Assam. The gender differential in this indicator not being numerically wide depicts a very little differential when compared across level of the phenomenon. With the proposed indices for refinement in the differential measure the improvement is apparent in the sense that $d_3\ (a, b)$ brings in a substantial variation in the differential measure despite the numeric difference in the prevalence among male and female children being minimal. However, it does not serve the purpose of making this differential reciprocally responsive to the levels of the phenomenon. Finally, $d_4\ (a, b)$ does make a pattern reversal in the sense that better prevalence levels are accompanied with greater gender differential when compared with the numeric differences. In this exercise, one needs to recognize that the pronouncement of gender differential would be in keeping with the observed differential. For instance, in the case of Orissa, a higher prevalence level is accompanied with a near gender balance but the refined differential measure does indicate comparable measure of differential with Assam and Andhra Pradesh. The gender differential in underweight for the states with female advantage show wider variation in levels as well as the gender gap. This facilitates the alteration in ranks of differential measure and the levels of the phenomenon more in conformity with the proposed premise of differential pronouncement [For details see Table 7.3].

Table 7.2 Gender Differentials in Stunting among Pre-school Children in Different Differential Measures across Selected Indian States, 1998-99

States (1)	*Overall prevalence of stunting (in percent)* (2)	*Stunting among male children (in percent)* (3)	*Stunting among female children (in percent)* (4)	d_1 *(Simple Difference)* (5)	d_2 *(Ratio based Difference)* (6)	d_3 *(Difference based Level Sensitivity)* (7)	d_4 *(Ratio based Level Sensitivity)* (8)
States where male children have advantages over female children in prevalence of stunting							
Andhra Pradesh	38.7 (5)	38.45	39.04	-0.59 (1)	0.985 (2)	-0.047 (2)	0.025 (1)
Gujarat	43.6 (4)	43.30	43.98	-0.67 (3)	0.985 (2)	-0.051 (3)	0.022 (3)
Karnataka	36.7 (6)	35.22	38.15	-2.92 (6)	0.923 (6)	-0.242 (6)	0.024 (2)
Madhya Pradesh	51.1 (3)	50.33	51.97	-1.64 (4)	0.968 (4)	-0.115 (4)	0.019 (4)
Rajasthan	52.1 (2)	51.16	53.08	-1.92 (5)	0.964 (5)	-0.133 (5)	0.018 (5)
Uttar Pradesh	55.6 (1)	57.36	58.0	-0.64 (2)	0.989 (1)	-0.042 (1)	0.017 (6)
States where female children have advantages over male children in prevalence of stunting							
Assam	50.4 (2)	51.08	49.44	1.64 (6)	1.033 (7)	0.116 (6)	0.021 (7)
Bihar	53.9 (1)	55.22	52.40	2.82 (5)	1.054 (5)	0.191 (4)	0.020 (9)
Haryana	50.0 (3)	50.58	49.37	1.21 (8)	1.025 (9)	0.086 (9)	0.021 (8)
Kerala	21.9 (9)	25.15	18.31	6.84 (1)	1.374 (1)	0.736 (1)	0.075 (1)
Maharashtra	39.8 (6)	40.39	39.14	1.24 (7)	1.032 (8)	0.099 (8)	0.026 (5)
Orissa	44.0 (4)	45.47	42.26	3.21 (4)	1.076 (4)	0.242 (3)	0.026 (6)
Punjab	39.2 (7)	41.35	36.75	4.60 (2)	1.125 (2)	0.368 (2)	0.031 (3)
Tamil Nadu	29.3 (8)	29.80	28.72	1.08 (9)	1.037 (6)	0.100 (7)	0.036 (2)
West Bengal	41.5 (5)	43.56	39.26	4.30 (3)	1.110 (3)	0.116 (5)	0.028 (4)

Source: *NFHS-2 (1998-99)*

Notes:

1) *Incase of states like Andhra Pradesh, Gujarat, Karnataka, Madhya Pradesh, Rajasthan, and Uttar Pradesh female children have higher prevalence of stunting than their male counterparts. So the d_1 and d_3 shows negative figures, since the differential are calculated for male over female children, for all the four differential measures. But in d_4, the ratio-based differential is calculated with equal weight for both the sex, as suggested by the value of a, which is equal to 1.*
2) *It should also be noted that the rankings for all the sates are done according to the descending order of the figures. So in those states where female children have higher disadvantage, the rankings actually refers to better to worse, because figures are in negative. For other states, the similar ranking refers to worse scenario to better.*
3) *The underlying assumption behinds such an approach lies with the fact that male children always have better nutritional status than female children given the socio-cultural context in India, where boys are favored over girl children in allocation of food and other resources, crucial to the nutritional outcome.*

Table 7.3 Gender Differentials in Underweight among Children in Different Differential Measures across Selected Indian States, 1998-99

States (1)	Overall Prevalence of underweight (in percent) (2)	Underweight among male children (in percent) (3)	Underweight among female children (in percent) (4)	d_1 (Simple Difference) (5)	d_2 (Ratio based Difference) (6)	d_3 (Difference based Level Sensitivity) (7)	d_4 (Ratio based Level Sensitivity) (8)
States where male children have advantages over female children in prevalence of underweight							
Andhra Pradesh	37.6 (5)	36.61	38.70	-2.09 (5)	0.946 (5)	-0.170 (5)	0.024 (2)
Assam	36.1 (6)	34.78	38.12	-3.34 (6)	0.912 (6)	-0.277 (6)	0.024 (3)
Gujarat	45.1 (3)	44.17	46.08	-1.91 (3)	0.959 (3)	-0.142 (3)	0.021 (4)
Orissa	54.4 (1)	53.47	55.42	-1.95 (4)	0.965 (2)	-0.132 (2)	0.017 (5)
Rajasthan	50.6 (2)	50.46	50.79	-0.32 (1)	0.994 (1)	-0.023 (1)	0.020 (6)
Tamil Nadu	36.8 (4)	35.94	37.68	-1.74 (2)	0.954 (4)	-0.143 (4)	0.025 (1)
States where female children have advantages over male children in prevalence of underweight							
Bihar	54.4 (2)	54.93	53.90	1.04 (7)	1.02 (8)	0.070 (8)	0.019 (8)
Haryana	34.5 (7)	36.72	32.22	4.50 (2)	1.14 (2)	0.383 (2)	0.033 (3)
Karnataka	44.1 (6)	45.36	42.67	2.69 (5)	1.06 (5)	0.203 (5)	0.025 (4)
Kerala	27.0 (9)	30.49	22.61	7.87 (1)	1.35 (1)	0.767 (1)	0.060 (1)
Madhya Pradesh	55.2 (1)	55.45	54.89	0.56 (9)	1.01 (9)	0.038 (9)	0.018 (9)
Maharashtra	49.7 (4)	51.27	47.81	3.46 (4)	1.07 (4)	0.246 (4)	0.022 (5)
Punjab	28.8 (8)	29.06	28.21	0.85 (8)	1.03 (7)	0.079 (7)	0.037 (2)
West Bengal	48.8 (5)	49.85	47.65	2.20 (6)	1.05 (6)	0.158 (6)	0.022 (6)
Uttar Pradesh	51.8 (3)	55.55	51.23	4.32 (3)	1.08 (3)	0.296 (3)	0.021 (7)

Source: NFHS-2 (1998-99)

1) *In case of states like Andhra Pradesh, Assam, Gujarat, Orissa, Rajasthan, and Tamil Nadu, female children have higher prevalence of underweight than their male counterparts. So the d_1 and d_3 shows negative figures, since the differential are calculated for male over female children, for all the four differential measures. But in **d_4, the ratio-based differential is calculated with equal weight for** both the sex, as suggested by the value of a, which is equal to 1.*

2) *It should also be noted that the rankings for all the sates are done according to the descending order of the figures. So in those states where female children have higher disadvantage, the rankings actually refers to better to worse, because figures are in negative. For other states, the similar ranking refers to worse scenario to better.*

3) *The underlying assumption behinds such an approach lies with the fact that male children always have better nutritional status than female children given the socio-cultural context in India, where boys are favored over girl children in allocation of food and other resources, crucial to the nutritional outcome*

This exercise can be considered as a beginning towards questioning simplified measures like that of a ratio in terms of folly in comparison across changing levels of any phenomenon. The relevance of this exercise points towards robustness of differential measures not only for its interpretation but also its role in level correction. Often levels of a phenomenon are compared ignoring all possible characteristic differential like gender, residence, caste, ethnicity, but the valuation of this level need to account for these differentials in ultimate terms. Hence, a differential measure responsive to the level of the phenomenon is most desirable for proper comparison and valuation of a phenomenon.

7.6. Adjusting the Prevalence of Undernutrition with Intensity and Inequality

An application of Foster, Greer and Thorbecke (FGT) criterion to the prevalence of undernutrition is illustrated here considering the headcount of undernutrition in children as the prevalence. This application is made with two dimensions of undernutrition, namely stunting and underweight. The purpose here has been to demonstrate the significance of FGT criterion in comparison of prevalence level that is based on a simple dichotomy. While prevalence of undernutrition is always compared and evaluated, the inherent bias in such comparison involves overlooking the intensity and inequality of such deprivation. This attempt is primarily aimed at adjusting the prevalence of undernutrition with adverse weighing of intensity and inequality. Similar to the FGT application in measurement of poverty to account for intensity and inequality component, the undernourishment too is appropriate for similar adjustments given that it is defined against a norm like that of poverty.

Normally, the assessment of undernourishment among children is based on the comparison of observed weights or heights in accordance with age and sex of children against a median weight or height of an international sample of children. While this assessment designates nutrition status or deprivation, it does not consider the extent of this deprivation from the given norm. Thus it resembles the head count measure of poverty. Given this resemblance, this measure poses a problem of discounting intensity and inequality of nutritional deprivation within it and suffers from the limitation of a valid comparison across situations/circumstances. Such a comparison could very well be representative of the magnitude of the phenomenon but without the two vital attributes of intensity and inequality (computed based on the distance from the normative height and weight), its valuation may not be robust. Apart from comparison or valuation of the phenomenon, another pertinent aspect relates to intervention, which depends on the extent of severity. It may become easier in case of lesser severity as

against a more severe situation. With observed outcomes like height and weight, the application of FGT measure of nutrition is proposed here similar to that of poverty measurement.

The FGT measure of nutrition is given by

$$P(\alpha)=\frac{1}{N}\sum_{i=1}^{k}\left(\frac{z-y_i}{z}\right)^{\alpha}$$

Where yi is the observed height or weight of individual i; z is the normative (median) weight of the individual for the age and sex of the individual, N is total number of children, k is the number of children ill nourished and α is a parameter which represents the degree of aversion to inequality among the undernourished.

If α=0 $P_0=\frac{k}{N}$,

the proportion undernourished (Prevalence): the proportion of children disqualifying or below the normative height or weight in relation to their age and sex.

If α=1 $P_1=\frac{1}{N}\sum_{i=1}^{k}\frac{z-y_i}{z}$,

the undernourishment Gap Index (Intensity) which is the average shortfall of the undernourished from the desired norm of height or weight, averaged over the entire sample of children. It gives us the per capita cost of eliminating undernourishment (ignoring incentive effects, inefficiency etc).

If α=2 $P_2=\frac{1}{N}\sum_{i=1}^{k}\left(\frac{z-y_i}{z}\right)^2$,

Severity Index, sometimes called the squared undernourishment Gap or just FGT2 (Inequality). This weights, height or weight below the normative prescription convexly capturing the inequality in degree of undernourishment among the undernourished. Height or weight farthest from the normative line carries more weight.

Following the computation of the FGT measure of nutrition, it is contrasted with head-

count equivalence of it to comment on the robustness of comparison of nutritional deprivation across situations and circumstances. Here the comparison is made across the Indian states to illustrate the difference in ranking as regards nutritional deprivation in terms of the intensity and inequality. Following this illustration, the head count equivalent of the nutrition measure is adjusted with the FGT measure (with α=1 i.e. intensity as well as both intensity and inequality). To carry out such an adjustment, the prevalence, intensity as well as inequality measures are normalised into a unit scale with the best assuming a value of one against the worst assuming a value of zero. The normalised equivalents are averaged sequentially first with prevalence along with intensity and later with all the three taken together. These averaged normalised values are contrasted against the normalised value of prevalence to locate the corresponding prevalence value for the averaged normalised values. In the first case, we consider prevalence and intensity and later we consider prevalence, intensity and inequality together. This adjustment is made by considering the average of the normalised values of both the measures/ and all the three measures to rework the original measure of prevalence. While reworking the original minimum and maximum values fixed of the prevalence is kept fixed. For instance, the state of Andhra Pradesh has a prevalence of stunting of 38.7 per cent along with intensity and inequality measures being 7.4 and 1.1 per cent respectively. The normalized equivalent of these values is 0.499, 0.518 and 0.115 respectively. While adjusting the prevalence with intensity the average of the normalised value for prevalence and intensity (0.509) is replaced against the original normalised value of 0.499 to work out the revised prevalence as (0.509*0.337)+0.219)=0.390.or 39.0. In this computation, 0.337 represents the range of prevalence across states and 0.219 represents the best or lowest prevalence value, which is for Kerala State. Similar adjustments are made to the original level of stunting on replacing the averaged normalised values of the three dimensions together, which is shown in col. 6 of Table A 7.2.

As can be seen from the Table 7.4, prevalence, intensity and inequality level of stunting are varied across Indian states. The state of Kerala has the lowest prevalence of stunting among Indian states, but ranks differently when it comes to intensity and inequality. The same is true for states with worse levels of prevalence but not intensity and inequality. In fact the range in prevalence values are reasonably wide while considering the distance between the best and the worst performing states. As regards intensity and inequality the scenario is pretty different in the sense that intensity and inequality does concord with prevailing levels of prevalence. It is particularly observed that lower prevalence levels are sometimes accompanied with worse intensity and inequality. Given such differences there remains every reason to adjust the prevalence

measure with intensity and inequality.

Table 7.4: Reported and Revised Prevalence of Stunting among Indian Pre-school Children for Selected Indian States, first Accounting for Intensity of Deprivation and then Intensity and Inequality taken Together

	Prevalence of stunting adjusted for intensity and inequality (in percentages)				*Prevalence of stunting adjusted for intensity (in percentages)*			
Adjusted→ / **Unadjusted ↓**	**< 30**	**30-40**	**40-50**	**50 & above**	**< 30**	**30-40**	**40-50**	**50 & above**
< 30	Keral a	Tamil Nadu			Kerala	Tamil Nadu		
30-40		Andhra Pradesh, Karnataka, Maharashtra, Punjab				Andhra Pradesh, Karnataka, Maharashtra , Punjab		
40-50		Gujarat, West Bengal			Gujarat		West Bengal,	
50 & above			Assam, Bihar, Haryana, Madhya Pradesh, Orissa, Rajasthan, Uttar Pradesh				Assam Madhya Pradesh, Haryana Orissa, Rajasthan, Uttar Pradesh	Bihar

Source: NFHS-2, unit record data

On adjustment of prevalence with intensity at first instance gives rise to mismatch in rank levels of this deprivation across states. Some of the states better their ranks following adjustment and some others loose in their ranks. At the same time some of the states namely Kerala, Karnataka and Tamil Nadu do not alter in their ranks. Such an adjustment is further attempted with inclusion of intensity and inequality simultaneously. On this occasion there has been further reversal of ranks. This reversal has been moderate in the sense that excepting few states like Kerala and Tamil Nadu the change in ranks has been moderate either way of worsening or bettering (See Table 7.4). A similar exercise of illustration is made in Table 7.5 in case of underweight and the results more or less depict similar patterns [see Table 7.5].

Table 7.5: Reported and Revised Prevalence of Underweight among Indian Pre-school Children for Selected Indian states, first Accounting for Intensity of Deprivation and then Intensity and Inequality taken Together

Adjusted→ / Unadjusted ↓	*Prevalence of stunting adjusted for intensity and inequality (in percentages)*				*Prevalence of stunting adjusted for intensity (in percentages)*			
	< 30	30-40	40-50	50 & above	< 30	30-40	40-50	50 & above
< 30		Kerala, Punjab			Kerala	Punjab		
30-40		Tamil Nadu	Andhra Pradesh, Assam, Haryana			Andhra Pradesh, Haryana, Tamil Nadu	Assam	
40-50			Gujarat, Karnataka, Maharashtra West Bengal		Gujarat	Karnataka, Maharashtra West Bengal		
50 & above			Uttar Pradesh	Bihar, Madhya Pradesh, Orissa, Rajasthan			Bihar, Madhya Pradesh, Orissa, Rajasthan, Uttar Pradesh	

Source: NFHS-2, unit record data

7.7. Adjusting the Prevalence of Undernutrition with Intensity in the Absence of Unit Record Data

However, in the absence of individual scores an attempt is made here towards making FGT-like adjustment to the measure of calorie under-nourishment. This adjustment could be termed as distributional adjustment to the measure of dichotomy. Such a distributional adjustment adopts a value judgment similar to that of FGT in the sense that it values the distribution on either end of the dichotomy such that larger deprivations below the norm are discounted and better distribution of the privileged is accounted for. However, the focus here will be on the distribution of undernourished or calorie-deprived households/individuals. This valuation is primarily made on the basis of median values wherein a closer value of the median to 100 per cent normative mark is favorably weighed as against a median distant from the same. Given this valuation, an adjustment can be made to the dichotomous measure to entail a sound comparison accounting for the distribution of the deprived.

Consider the distribution of individuals/households by calorie intake against the desired norm of cent percent. The distribution that emerges reveals the pattern of 1000 individuals/households according to the calorie intake in proportion to the norm of cent percent. This gives rise to those undernourished in terms of well nourished or ill nourished per 1000 individual/households which assign equal weights to each

individual irrespective of their being located at any distance from the norm. The adjustment proposed here weighs this distance in terms of a measure like median, which is valued depending on its location from the norm. The median point of the deprived may vary across situations and the best median is the one closest to the norm of hundred percent when one accounts for the distribution of deprived. Following the computation of the median, it becomes necessary to order them in terms of best to worst where the best assumes the value of one as against the worst in relative terms. Such a conversion is based on the principle of normalization as illustrated below.

Across situations, say Y_i (i =1, 2, ...n, situations) the distribution of the calorie consumption among the deprived or privileged persons/households gives rise to a median, M_i (the median level of the deprived), and the aggregate cases under each situation as N_i (the prevalence of deprivation). But these M_i and N_i represent two different parameters; one of the phenomenon and the other is regarding the intensity of the phenomenon. Hence a combination of the two can be made based on their normalised equivalent. The required normalization therefore is made in the following manner

Here, δ in, refers to the normalised values of N_i and δim refers to the normalised median values M_i.

$$\delta_i^n = \frac{N_{max} - N_i}{N_{max} - N_{min}} \quad \text{and} \quad \delta_i^m = \frac{M_i - M_{min}}{M_{max} - M_{min}} \qquad \ldots(1)$$

These two normalised values represent two dimensions, one of prevalence dimension (N_i) and the other the intensity or distributional dimension (M_i). Now we could bring in a certain value judgement regarding the importance of these two dimensions and can actually weigh (using ω) the two components in the following manner to arrive at δ_i,

$$\delta_i = \omega\delta_i^m + (1-\omega)\delta_i^n \qquad (where, 0 \le \omega \le 1) \qquad \ldots(2)$$

However, here equal weights for both the dimension is considered. Hence

$$\delta_i = \frac{\delta_i^m + \delta_i^n}{2}$$

Next, is to obtain the prevalence values for the adjusted degree of prevalence (N_i^*), and for this the following technique is used.

$$\delta_i = \frac{N_{max} - N_i^*}{N_{max} - N_{min}} \qquad \ldots(3)$$

$$\Rightarrow N_i^* = \delta_i N_{min} - (1-\delta_i)N_{max} \qquad (where, 0 \le \delta_i \le 1)$$

For an empirical illustration[2] the nutritional status of the population is measured in terms of calorie compliance and account for the distribution of undernourishment. The calorie intake one represents the required norm. The data for the distribution of nutritional status across region and states of India were obtained as reported in a discrete fashion. To elaborate, the data was a simple cross tabulation of the number of persons under different class intervals of calorie compliance. A level of 2700 calories per individual per day was considered to be the norm for 100 percent calorie intake as required for the particular individual and data was reported for number of individuals meeting up to 70 percent of the ideal requirements, 70-80 per cent of the required and so on.

The intensity of the undernourishment is calculated as follows. Firstly, the number of individuals (N_i) who were unable to meet the required calorie level is aggregated and then the median (M_i) of the distribution of (N_i) is calculated for the respective states of India. Thereafter, the normalised measure is computed as given by equation (1) to obtain the normalised values across states, δ_i^n and δ_i^m for N_i and M_i respectively. As it has been mentioned above that these two estimates provide information regarding the prevalence and intensity of the calorie deprivation there remains a scope to weigh the two domains (if necessary) in case one dimension has to be weighed differently against the other. However, any presumptive judgment is avoided about the importance of prevalence or intensity and provides equal weights (or simple average) to the two dimensions as in equation (2) and obtain δ_i. Finally, using (3) the adjusted prevalence estimates across the different states is obtained which are reported in Table 7.6.

[2] The data was reported in the following format, state-wise per 1000 distribution of households by level of calorie intake (per consumer unit) as per the percentage norm of 2700 calories per consumer unit per day.

State/ % of norm	<70	70-80	80-90	90-100	100-110	110-120	120-150	>150	all
Andhra Pradesh	173	165	172	169	115	78	92	36	1000

The N_i for Andhra Pradesh's lower tail, i.e. cases with less calorie norm is 679 and M_i is 80.09. After normalisation using the described technique across states, δ_i^n and δ_i^m for Andhra Pradesh are obtained as 0.526 and 0.255 respectively. Then we take a simple average of these two normalised values (δ_i), which comes to 0.390. Using the final equation, we obtain the adjusted prevalence level (N_i^*) as 620 against an unadjusted estimate of 679.

Table 7. 6: Reported and Revised Calorie Deprivation (per 1000 individuals) Across Indian States Accounting for Intensity of Deprivation and Related Adjustment of Prevalence for the Corresponding Intensity

	Rural India				*Urban India*			
States	*Reported N*	*Revised N*	*Adjustment without deprivation intensity*	*Adjustment with deprivation intensity*	*Reported N*	*Revised N*	*Adjustment without deprivation intensity*	*Adjustment with deprivation intensity*
(1)	(2)	(3)	(4)	(5)	(6)			
Andhra Pradesh	679	620	-8.25	-2.63	678	598	-0.29	-3.10
Assam	770	682	-12.86	-13.01	640	543	-9.53	-13.78
Bihar	607	567	-3.79	0.29	593	451	-12.65	-12.46
Gujarat	681	636	-1.32	2.77	677	569	-5.61	-6.93
Haryana	445	433	10.79	19.62	639	551	-4.69	-7.70
Karnataka	680	649	8.82	11.06	675	601	-0.44	-2.33
Kerala	653	636	-7.96	1.15	650	617	-12.0	-1.94
Madhya Pradesh	669	619	5.98	7.75	662	563	1.06	-1.44
Maharashtra	689	620	-1.31	10.42	701	625	4.99	5.17
Orissa	602	535	3.49	15.62	499	202	10.02	15.25
Punjab	459	450	8.93	14.08	598	467	-7.69	-11.73
Rajasthan	398	377	28.89	33.42	531	276	12.43	14.08
Tamil Nadu	775	775	-10.84	-7.68	691	689	-7.09	-5.03
Uttar Pradesh	489	461	3.48	11.48	630	528	-9.52	-9.66
West Bengal	642	594	-2.49	1.76	652	539	-1.69	-3.17

Source: NSSO 55th round; 1999-2000
Note: The same exercise can be repeated for calorie consumption distribution of 1000 households given statement-7 of same report.

An inter-state reading of calorie deprivation by taking into account the distributional aspect indicates that there has been change in undernutrition scenario universally across states among both rural as well as urban residents. The reported as well as revised levels of calorie deprivations according to the NSSO 55th round indicates a downward revision for rural residents across all states indicating that the deprivation levels are overestimated without accounting for the intensity of such deprivation from the norm. This is indicative of the fact that the intensity of deprivation is more in those states compared with others where the revised levels are lower when compared with the reported levels of deprivation. The urban scene is also more or less the same as regards the 55th round where the revised levels depict lesser deprivation as compared with the reported levels although the degree of disparity varies across states.

7.8. Conclusion

This exposition on comparison of a dichotomous measure of deprivation cautions regarding the treatment required prior to comparison of any kind. While proportions and absolute may be two dimensions, they need to be considered depending on the purpose of evaluation of deprivation. Similarly, differential comparison accounting for level of deprivation may contest the normative of differentials narrowing down with bettering levels of deprivation. Finally, adjustment of intensity and inequality in a dichotomous deprivation measure may make it more robust not only for comparison but also for representing welfare in strict sense of the term.

APPENDIX TO CHAPTER 7

Table A 7.1 Reported and Revised Prevalence of Stunting Among Indian Pre-school Children For Selected Indian States, first Accounting for Intensity of Deprivation and then Intensity and Inequality taken Together

States	*Prevalence level (in percentages)*	*Intensity Level*	*Inequality level*	*Intensity adjusted prevalence level*	*Intensity and inequality adjusted prevalence level*
(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*
Andhra Pradesh	38.7 (4)	7.4 (7)	1.1 (3)	39.0 (5)	34.6 (5)
Assam	50.4 (11)	14.1 (15)	3.2 (13)	53.0 (15)	46.3 (14)
Bihar	53.9 (14)	11.1 (14)	5.1 (14)	51.1 (14)	47.3 (15)
Gujarat	43.6 (8)	0.1 (1)	0.0 (1)	32.7 (2)	29.1 (2)
Haryana	50.0 (10)	9.2 (11)	1.6 (10)	46.9 (10)	40.5 (49)
Karnataka	36.7 (3)	6.7 (5)	1.0 (3)	37.1 (4)	33.3 (4)
Kerala	21.9 (1)	5.8 (2)	0.9 (2)	28.8 (1)	27.6 (1)
Madhya Pradesh	51.1 (12)	10.4 (13)	2.3 (12)	48.9 (13)	42.6 (12)
Maharashtra	39.8 (6)	7.3 (6)	1.1 (4)	39.5 (6)	34.8 (6)
Orissa	44.0 (9)	6.5 (4)	9.6 (15)	40.6 (8)	45.6 (3)
Punjab	39.2 (5)	7.8 (9)	1.2 (6)	39.8 (7)	35.3 (7)
Rajasthan	52.1 (13)	9.5 (12)	1.7 (11)	48.3 (12)	41.5 (11)
Tamil Nadu	29.3 (2)	6.2 (3)	1.4 (9)	32.9 (3)	31.3 (3)
West Bengal	41.5 (7)	8.2 (10)	1.3 (8)	41.4 (9)	36.4 (8)
Uttar Pradesh	55.6 (15)	7.6 (8)	1.2 (7)	47.7(11)	40.6 (10)

Source: NFHS-2 (1998-99)
Note: Figures in bracket are ranks for corresponding states.

Table A 7.2 Reported and Revised Prevalence of Underweight Among Indian Pre-school Children For Selected Indian States, first Accounting for Intensity of Deprivation and then Intensity and Inequality taken Together

States (1)	*Prevalence level (in percentages)* (2)	*Intensity Level* (3)	*Inequality level* (4)	*Intensity adjusted prevalence level* (5)	*Intensity and inequality adjusted prevalence level* (6)
Andhra Pradesh	37.6 (6)	17.9 (7)	5.5 (4)	41.8 (7)	34.6 (5)
Assam	36.1 (4)	18.8 (8)	9.2 (9)	41.6 (6)	46.3 (14)
Bihar	54.4 (13)	26.3 (15)	12.2 (11)	54.8 (15)	47.3 (15)
Gujarat	45.1 (8)	0.3 (1)	0.1 (1)	36.1 (3)	29.1 (2)
Haryana	34.5 (3)	16.7 (5)	5.7 (5)	39.6 (5)	40.5 (9)
Karnataka	44.1 (7)	19.6 (10)	6.3 (7)	46.0 (8)	33.3 (4)
Kerala	27.0 (1)	14.4 (3)	3.7 (2)	34.7 (1)	27.6 (1)
Madhya Pradesh	55.2 (15)	22.7(14)	26.2 (4)	53.2 (14)	42.6 (12)
Maharashtra	49.7 (10)	21.7 (12)	6.5 (8)	49.9 (11)	34.8 (6)
Orissa	54.4 (13)	20.8 (11)	28.4 (15)	51.8 (13)	45.6 (3)
Punjab	28.8 (2)	14.2 (2)	4.6 (3)	35.4 (2)	35.3 (7)
Rajasthan	50.6 (11)	21.9 (13)	9.6 (10)	50.5 (12)	41.5 (11)
Tamil Nadu	36.8 (5)	14.5 (4)	23.9 (13)	39.6 (7)	31.3 (3)
West Bengal	48.8 (9)	19.1 (9)	18.8 (12)	48.1 (9)	36.4 (8)
Uttar Pradesh	51.8 (12)	17.5 (6)	6.1 (6)	48.7(10)	46.6 (10)

Source: NFHS-2 (1998-99)
Note: Figures in bracket are ranks for corresponding states.

CHAPTER 8
SUMMARY AND CONCLUSION

8.1. Summary

The thesis titled 'Undernutrition in India: Dimensions and Correlates' has analysed the anthropometric and calorimetric dimensions of undernourishment. While the anthropometric account describes outcomes, the calorimetric assessment can be considered an input measure. The primary motivation of this thesis is to discover correlates of undernourishment that are modifiable (otherwise termed as immediate correlates) as well as those which help in recognizing characteristic groups for intervention. On this count the thesis adopts the food-health-care framework of UNICEF, which divides the correlates of nutritional outcome into three major categories depending upon their proximity to the outcome. These categories are immediate, intermediate and basic wherein the immediate ones are not only modifiable but also responsive to the outcome of undernourishment. The two said dimensions of undernourishment are examined by considering children below three years of age, women of reproductive age and households as the unit of analysis using data from National Family Health Survey-2 and National Sample Survey (55^{th} round). Given the coverage and representativeness of these surveys, the analysis presents interesting differences and contrasts among the Indian states bringing out regional patterns for the two dimensions as well as their correlates.

The major argument of this thesis relates to locating the proximate correlates of nutrition outcome for intervention. The present approaches of intervention for improving nutrition status of children does include a set of focus parameters surrounding food and health care as manifested in the services provided under the Integrated Child Development Scheme (ICDS). In fact, these services remain limited in terms of effectiveness due to varied reasons like accessing the Aanganwadi centers as they cater only to children who are at least three years old. The recent findings from six sate study by *'FOCUS'*, shows that in states of Maharashtra, Tamil Nadu and Himachal Pradesh, ICDS is working satisfactorily in areas selected for the study whereas in Uttar Pradesh, Chattishgarh and Rajasthan, the implementation of ICDS is abysmally poor in the study areas. Another study found the five states with highest prevalence of child underweight, such as Madhya Pradesh, Uttar Pradesh, Rajasthan, Bihar and Orissa, are among the bottom 10, ranks for ICDS coverage in terms of a village with 'Aanganwadi' center [Gragonolati et al; 2006]. Tamil Nadu has long been lauded as the braizetrailer for ICDS implementation for children under six years of age, under title 'Tamil Nadu

Integrated Nutrition Programme' or *TNIP*. The programme is distinguished from ICDS programmes in other states on many counts, but primarily, it has a targeted approach for children less than six months who are undernourished and then followed with 'service at door step' approach, which effectively provides ready-to-eat food for them in their house. It also identifies and provides nutritious food supplementation for pregnant mothers who are undernourished to prevent low birth weight and intra-uterine growth retardation or IUGR [FOCUS; 2006]. The recent findings from National Family Health Survey show high mismatch between ICDS coverage for children below the age of six years and the children who actually receive any service from the scheme [IIPS, Macro; 2006]. In most of the states, considered in our study, reported ICDS coverage is 75 percent or above, (except for Punjab and Rajasthan, where it is below 65 percent). However the utilisation of ICDS among these states, shows, Orissa has the highest utilisation of 60 percent, whereas in Bihar it is mere 8.8 percent. In southern states the utilisation of ICDS varies from 27.5 percent for Andhra Pradesh to 41.6 percent for Tamil Nadu [IIPS, Macro; 2006]. In no state all the eligible children are covered under the scheme. The major limitation of ICDS lies in its failure to reach children below age of three years who cannot come to the 'Anganwadi' center on their own and too much emphasis on providing supplementary food to children, neglecting other objectives [Gragonolati et al; 2006]. In some states few Non Government Organisations or NGO have collaborated with the administration to increase the coverage and better implementation of ICDS. 'Dular' of Bihar, M.V. Foundation of 'Andhra Pradesh', 'Mitanin' of Chattishgarh, 'Spandan' of Madhya Pradesh, and 'SEWA' in Gujarat are good examples of community participation to improve implementation of ICDS [Focus; 2006].

Similarly there are several intervention schemes to improve women's health in India, especially nutrition. One such strategy is 'Reproductive and Child Health Services'. Various maternal and child health programmes are combined into one programme titled 'Reproductive and Child Health Services' or RCHS in 1997 [See Srinivasan et al; 2007 for A detailed discussion]. The aim of the programme is to shift from an individual vertical approach of maternal health interventions to a life cycle approach [Ministry of Health and Family Welfare; 2001]. However, the major drawback of RCH approach is, that it mainly depends upon the Anganwadi workers and Accredited Social Health Activists (ASHA), for implementation of the programme who are already over burdened with other responsibilities and lack of motivation because of their status and poor remuneration [Srinivasan et al; 2007]. There is provision for supplementation of nutritious diet and micronutrients like iron, iodine and zinc provided through 'Supplementary Nutrition Programme' or SNP for pregnant women or lactating

mothers through 'Anganwadis'. It includes distribution of iron-folic acid tablets or fortified flour or a mixture of cereals and pulses in the form of 'Take home rations', mainly through Anganwadi centers for pregnant and lactating mothers. Tamil Nadu provides Take home rations' of nutritious diet, especially during pregnancy under TNIP [Rajivan; 2008]. However the coverage of ICDS for women in terms of utilisation (receiving supplemented food from the Anganwadi worker) by the mother during pregnancy and during lactation, presents a different picture than that of children. Chattishgarh has registered very high utilisation for mothers in both cases (above 60 percent), followed by Tamil Nadu (above 50 percent) [IIPS; Macro; 2006].

At household level the nutrition intervention is made through provisioning of essential cereals like rice and wheat at subsidised prices, which form the major source of calorie and protein for large masses of Indian population. But the criterion of designating households for such subsidised food provisioning is based on income of the household rather than it's requirements according to its size and composition. However according to the guideline issued in 2000 by Department of Food Distribution, the beneficiaries under PDS are to be selected by the poverty line determined by the Planning commission of India for the respective states and they should be identified with help of respective Gram Panchayats and Nagar Palikas. In 2000, through 'Antodaya Anna Yojana', it tries to include the really poor and vulnerable sections of the society identified by their occupation such as landless agricultural labourers, marginal farmers, rural artisans/craftsmen such as potters, tappers, weavers, black-smiths, carpenters etc. in the rural areas and slum dwellers and persons earning their livelihood on daily basis in the informal sector like potters, rickshaw-pullers, cart-pullers, fruit and flower sellers on the pavement etc. in the urban areas in the PDS scheme with heavily subsidised food grains. It also intended to include the households headed by widow/ terminally ill persons/old age person with no social assistance and all primitive tribal households. In 'Annapurna' scheme the elderly population above 65 years from poor households without any social support or family support are entitled for 10 Kg. of food grains at BPL price [Department of Food Distribution; 2000, Singh; 2006]. This indicates that Government of India is concerned about covering the households from weaker sections, vulnerable occupations, scheduled tribe households and poor households with elderly under PDS to ensure food security for them. All theses schemes are unsuccessful to eradicate food insecurity of the household because of urban bias in PDS, diversion of subsidised food grains especially in states with high poverty, lack of political commitment in certain backward states and irregular off take from the FCI by concerned states [Singh; 2006]. However, there are exception like Kerala, Gujarat and Tamil Nadu, who are successful in reaching substantial number of poor through the

PDS scheme, but Bihar, Uttar Pradesh, Madhya Pradesh, Rajasthan, Orissa and Jharkhand are far behind in PDS coverage compared to the national average [Planning Commission; 2006]. Provision and distribution of fortified rice, wheat, pulses and salt as being made (in some states like Andhra Pradesh, Gujarat, Punjab and Haryana fortified flours are provided whereas in most of the states idozied salt is made mandatory through fair price shops), through PDS scheme can effectively reduce the risk of micronutrient deficiency among different population groups [Ministry of Women and Child Development, Government of India; 2006].

Given the current state of intervention in place, this thesis attempts an examination of correlates of nutritional outcome among children, women as well as household level by using suitable data sets. The probable correlates are selected through bivariate analysis comprising of cross tabulation between nutrition outcomes and selected correlates. Then a group inequality measurement is applied to verify the bivariate findings from cross tabulation between Undernutrition outcome and selected correlates. The basis of using such a method is felt due to the fact that outcome from simple cross tabulation are influenced by aggregate prevalence level of the phenomenon of undernourishment. Since all outcome variables and some correlates in our study are dichotomous in nature, application of group inequality measurement proposed by [Chakraborty; 2001], helps us to refine the association between outcome variables and selected correlates by not considering the risk of affected and non-affected groups vis-à-vis the aggregate prevalence level but by taking the ratio of odds for affected groups vis-à-vis non-affected group. The new figure is free from bias generated by aggregate prevalence level and the figures of ratio of odds simply reflects ratio of individual group risks. This method is used to comprehend the association between immediate correlates like dietary intake and childhood ailments and the nutritional outcome of pre-school children in terms of stunting and underweight. The method is again applied in studying the correlates of nutrition at household level where the calorie deficient households are contrasted by household size and number of dependents. These bivariate findings are again confirmed from multivariate analyses involving backward-stepwise binomial logit models. This particular model is adopted because outcome indicators in the study are dichotomous and most of the correlates are also categorical. Backward stepwise approach helps to discard the statistically irrelevant correlates from the final model.

In Chapter-4 it is found that for improving nutritional status of pre-school children in India, intervention schemes must be focused on immediate correlates like dietary intake and childhood ailments. As regards dietary intake, the results suggest a positive nutrition outcome in children by exclusive breast-feeding during the first six months

and supplementary feeding thereafter. Though many argue for exclusive breastfeeding during the first six months of life (as per WHO directive), given the poor nutritional status among large number of mothers in India, there arises a need for early supplementation. However, our analysis suggests that, providing supplementation along with breast milk during the first six months may not always boost the nutritional make-up for the children in terms of their height and weight. One possible explanation could be that while food supplementation makes up for the gap in required intake for child's normal growth; the exposure to pathogens might offset the positive gain from additional nutrient intake. This is infirmed by the observed higher prevalence of stunting and underweight among children who receive mushy food supplementation vis-à-vis children who do not during the first six months of life. This finding remains similar for children older than six months as well. Therefore one intervention strategy could be that of reducing the risk of exposure to pathogens among the children. Since majority of Indian mothers are themselves undernourished, the early supplementation alongside the breastfeeding could be effective for improving nutritional outcome of pre-school children in India, provided the supplementation does not expose the children to pathogens. Programmes like ICDS should cover all the pre-school children, especially from poor and underprivileged households and provide them with high nutrient food supplements.

As regards the impact of ailments on the nutritional outcome among pre-school children in India, it is found that incidence of diarrhoea and fever (respiratory diseases) among young children does influence their anthropometric outcome. These are diseases for which vaccination is not available. The findings from bivariate group analysis as well as multivariate results indicate diarrheoa to be responsive to the weight-for-age outcome, fever is largely responsible for outcome of stunting among Indian pre-school children. Across the selected fifteen major states the impact of diarrhoea and fever on nutritional outcome of stunting among children are robust in case of Kerala with low prevalence and the states with high prevalence (Uttar Pradesh, Madhya Pradesh, Bihar, Rajasthan, Haryana and Orissa and West Bengal). Similarly the impact of diarrhoea and fever on nutritional outcome of underweight among children are found to be robust in 14 out of 15 states (except Madhya Pradesh) in case of diarrhoea and underweight and 13 out of 15 states (except Punjab and Andhra Pradesh) in case of fever and underweight i.e. an odd ratio above 1.10, in both bivariate and multivariate exercises. One explanation could be that in states with low prevalence of undernutrition, diseases like diarrhoea and fever have explicit bearing on child nutritional outcome, while in other states the effect of disease is overshadowed by other factors as well, such as high level of socio-economic deprivation and inadequate diet. So in low prevalence states, nutrition programme for

children should largely focus on reducing the morbidity risk from diseases for which vaccination is available and diseases without vaccination, while in high prevalence states the child nutrition programme should include containing of diseases as well as intervention towards improving household's socio-economic condition and maternal education.

While diarrheoa has it's origin in poor hygiene and lack of safe drinking water, fever can be associated with households not having clean environment, especially light and fresh air. Further, the diarrheoa prevalence is found to be associated with early age at food supplementation and consequently supplementation too is found to be associated with nutritional make-up among pre-school children. Since the immediate reason of under weight among children is prevalence of diarrheoa, its control would bring about a change in the underweight situation. However means of controlling diarrheoa prevalence may include delaying age at supplementation as well as ensuring food supplementation under hygienic conditions. The other immediate indicator like complete immunisation was also verified against the nutritional make-up in children, which does not demonstrate a visible association. But considering immunisation as a proxy to health seeking behaviour, we do expect its instrumental role in hygienic supplementation and in turn control of diarrhoeal prevalence. In both cases, role of ICDS is very crucial and it should reach the toddlers who cannot come to nearest 'Aanganwadi' centres. Along the intervention to contain the risk of disease, provision of nutritious 'ready-to-eat' food for young children should be universalised across all the states, for better nutritional outcome.

The maternal undernutrition unlike child undernutrition has been verified with two distinct immediate correlates namely diet and autonomy. These two indicators depict a systematic association with undernutrition in reproductive age women. The bivariate and multivariate findings at all India level does show that women with best diet score and higher autonomy having better nutritional outcome in terms of BMI score. The national level findings for association between diet and BMI outcome are confirmed for all selected fifteen major states in bivariate analysis, where as for multivariate analysis the confirmation of above relationship is found for West Bengal, Maharashtra, Karnataka, Madhya Pradesh and Rajasthan. As elaborated in Chapter 5, the qualitative information based 'diet score index' for few selected food items, may not be fully reflecting the regional variation in women's diet and failed to show it's impact on nutritional outcome of women of respective states in a multivariate model.

Similarly the significant association between women's autonomy and their nutritional outcome is confirmed at national level in bivariate as well as multivariate analysis. A similar pattern for association between women's autonomy and BMI outcome is observed for selected major states, except Assam and Kerala in bivariate exercise. However the multivariate exercise confirms the association between women's autonomy and nutritional outcome only for Andhra Pradesh, Gujarat and Uttar Pradesh. Here also the discrepancy between all India finding and state level finding in the multivariate model could be attributed to the nature of information related to women's autonomy used to construct the 'women's autonomy index'. Thus the multivariate exercise fails to capture the association between women's autonomy and their nutritional outcome for a given state. Still the bivariate and multivariate exercise for all India level and the bivariate exercise for selected fifteen major states show that increasing maternal autonomy within the household may help to improve women's nutrition. Better autonomy for women will improve her access to food as well as health care. Since the availability of diet to the members of the household of different age and sex combinations in the Indian context depends upon their status in the power hierarchy of a given household, it is the earning male members who generally get preferential treatment in distribution of available food, especially nutritionally reach food items like milk, vegetables, animal proteins and fruits. The women of the household generally take food after serving the same to other members. Mostly they are deprived of these nutritionally rich food items by compulsion, though it may appear voluntary. The situation further worsens when the household belongs to marginalized and poor section of the society where economic resources are inadequate to meet the dietary requirement of the household as a whole.

Lack of access to any economic assets and autonomy in decision making hinders women's access to health care and thereby may affect her reproductive life. Thus, lack of adequate nutritionally rich diet, lack of access to economic resources and absence of decision-making power related to her own health leads to poor nutritional outcome as well. It is surprising to observe that irrespective of household's social and economic status or individual attributes like education and occupation, diet and autonomy has a systematic association with the nutritional outcome in women. Hence undernutrition in women need not necessarily be linked with poverty. Emphasis on women's diet and autonomy will go a long way in ensuring nutritional make-up in reproductive age women. The present maternal nutrition programmes targeted at women need to cover women of all age, not the women during or after the pregnancy alone.

Findings from Chapter-6, which focuses on characteristic and composition of households having calorie deprivation in India, shows that households from Scheduled Tribe and Scheduled Caste categories are having higher burden of calorie deficiency compared to other social groups. In rural India, in four out of five occupation categories Scheduled Tribe households have highest prevalence of calorie deprivation among all social groups. In three out of five occupation categories, Scheduled Caste households follow them. For occupation as 'self-employed in non-agriculture', Scheduled Caste households have highest prevalence of calorie deprivation followed by Scheduled Tribe households. In case of occupation as 'other labour', Other Backward Class households have highest calorie deprivation following Scheduled Tribe households. For fifteen major states some variation is observed in the pattern that is found at all India level. But in most states the Scheduled Tribe and Scheduled Caste households change their positions for highest calorie deprivation for a given occupation with few exceptions. The pattern for rural sector of the selected states indicates, few variations in state level outcome of association between calorie deprivation and social background or ethnicity of the households, in contrast with the all India findings.

For example, for occupation of the household as 'self-employed in agriculture', Kerala, Andhra Pradesh and Assam show, Other Backward Class households have highest calorie deprivation than other social groups whereas other households have higher calorie deprivation after Scheduled Tribe households in Orissa and Rajasthan and Scheduled Caste in West Bengal. For occupation as 'agricultural labour' in rural areas, Other Backward Class households have highest calorie deprivation among all social groups in Punjab, whereas in Madhya Pradesh, calorie deprivation for households are almost similar for all social groups.

Similarly for occupation as 'other', Other Backward Class household in Andhra Pradesh, Assam, Gujarat and Kerala have highest calorie deprivation among all social groups. In Madhya Pradesh, Other households have highest calorie deprivation among all social groups for occupation as 'other'. However the multivariate exercise for all states confirms the higher odds for calorie deprivation among Scheduled Caste and Scheduled Tribe households followed by other households. The multivariate exercise for rural households confirm the role of occupation of the household on the outcome of calorie deprivation in presence of other correlates including the ethnicity of the households, both for selected states as well as all India level.

The pattern for urban India shows Scheduled Caste households have highest prevalence of calorie deprivation at household level followed by Other Backward Class households

(for occupation as 'regular wage salary' and 'self employed') and Scheduled Tribe (for occupation as 'other'). For occupation as 'casual labour', Other Backward Class households have highest prevalence of calorie deprivation among all social groups, followed by Scheduled Caste households at all India level. The state wise variations for association between occupation of the households and household's calorie deprivation outcome are wide open. In most of the states, Scheduled Caste households are followed by Other Backward Class households for calorie deprivation in a given occupation category.

For occupation as 'regular wage salary', Other Backward Class households have highest calorie deprivation among all social groups in states of Haryana, Karnataka and Maharashtra where as in Andhra Pradesh, Bihar, Gujarat, Punjab, Tamil Nadu, Uttar Pradesh and West Bengal, they are next to Scheduled Caste households (except for Bihar and West Bengal). In case of occupation as 'self-employed', Other Backward Class households have highest calorie deprivation in Madhya Pradesh, Punjab and Uttar Pradesh. In remaining 3 out of 12 states they have second highest calorie deprivation (for Haryana, Maharashtra and Tamil Nadu) for the above occupation.

For occupation as 'casual labour', in states of Andhra Pradesh and Uttar Pradesh, other households have highest calorie deprivation among all social groups. In remaining 10 out of 13 states, it is either Scheduled Caste or Scheduled Tribe households, who have highest calorie deprivation for the above occupation (except for Bihar, Madhya Pradesh and West Bengal, where Other Backward Caste households have highest calorie deprivation). Thus for occupation as 'casual labour', the state wise variation for calorie deprivation at household level is relatively complex compared to other occupation categories, indicating it's the nature of occupation rather than the ethnicity of the household which is detrimental to the outcome. For occupation as 'other', Other Backward Class households have highest calorie deprivation in Andhra Pradesh, Assam, Kerala and Uttar Pradesh.

The multivariate exercise for urban India unlike rural India shows Scheduled Caste households and Scheduled Tribe households have higher odds for calorie deprivation compared to households from other category (except for Kerala). However for the impact of occupation on calorie deprivation, the multivariate exercise found varying result for different occupation categories for specific states. The analysis from this chapter confirms that occupation of the households along with it's ethnicity does play an important role for outcome of calorie deprivation at household level in rural as well as urban India. However while the 'ethnicity' of the households cannot be changed to

improve the calorie outcome of the households, focusing on certain vulnerable occupations for providing food security may help not only the households from disadvantaged social groups but also the disadvantaged households within the better off social groups.

The study found households having higher number of dependents and large household size having higher prevalence of calorie deficiency. Irrespective of number of dependents, the small size households have an advantage in having better calorie intake, in both rural as well as urban India (except Kerala and Uttar Pradesh for rural India). The fact is confirmed for both rural and urban India, in both bivariate as well as multivariate exercise. Since the data does not enable us to assess the nutrition deprivation from the perspective of intra-household distribution of available calories among different members of a given household on the basis of their age and sex, an indirect attempt is made to address the issue.

It is well recognised that in countries like India gender bias and patriarchal norms are part of social systems. One of the manifestations of such reality is intra-household distribution of available diet, economic resources and health care, which always favour earning male members and male children. It is the women, female children, old aged and members with different forms of physical disability and ill health, who are deprived of their entitlement. Here the concern is over distribution of available food basket, because that is what the study focuses on. If the household has a large number of dependents and it has resource constraints then the burden of less calorie intake will be disproportionate among non-earning members like women, children and old aged. This study validates this view with households having larger number of dependents to be calorie deficient compared with the households with lesser number of dependents. Not only the number of dependents but also size, composition and occupation characteristics of the household render them vulnerable to calorie inadequacy. Agricultural labour households in rural areas and casual labour households in urban areas have higher prevalence of calorie deficiency irrespective of their caste. Seasonality in employment coupled with poor wages in agriculture sector may be responsible for calorie inadequacy in agriculture labour households. Similarly, lower wages and casual nature of employment contributes towards calorie deficiency among casual labour households. Hence, apart from income, caste and type of occupation may be more meaningful along with the present income criterion while addressing nutritional vulnerability at the household level. Though Government of India is already having guidelines to incorporate some of the aspects discussed above, while providing food security to the household through PDS, the reasons mentioned above limits it's scope in

reducing calorie deprivation in India. Effective monitoring of PDS scheme across the length and breadth of the country is essential to ensure that food is reaching every needy household.

While examining the phenomenon of undernourishment, the application of group inequality measures has been appropriate given its dichotomous nature of measurement, but it poses certain issues relating to comparison and interpretation. An attempt is made in Chapter 7 towards addressing few relevant issues on this count, which relates to making comparison of levels of under nourishment robust along with the differential assessment of undernourishment across groups.

The measurement of undernourishment is basically a dichotomous measure where persons having lower score than the normative value in a given dimension of undernourishment are to be undernourished and others having score equal to normative value or more than that are stated to be well nourished. This nature of dichotomy is similar to the concept of income poverty where people below a particular income are termed poor and their counterparts as non-poor. There are two widely used measures called 'Head-count-ratio' and 'aggregate-head-count' to describe the extent of income poverty. These two measures are based on the principle of likelihood and the principle of agency respectively, which are important in their own right. While a headcount ratio conveys the intensity of the problem, the aggregate head count informs on the numeric magnitude of the same. An intervention proposed according to head count ratio may be just according to likelihood principle but as regard addressing the problem in accordance with its numeric magnitude, the aggregate head count need be preferred. Such a conflict remains even in case of assessing levels of undernourishment where in a proportion (representing head count ratio) and an aggregate number of undernourished (representing aggregate head count) may represent different scenes. Hence a combination of the two as proposed by Subramanian (2005), which makes the comparison of levels of undernourishment robust. Such a combination measure is warranted with a view to weighing principles of likelihood as well as agency. On computation of a composite measure of calorie undernourishment across Indian states it is found that the composite measure is closer to the rank of states according to aggregate headcount than head-count ratio. Thus composite measure reflects absolute magnitude better than the proportion and is to be preferred with regard to ordering priority for intervention across states. Comparison based on proportion, ignores population base and therefore is not sensitive to the absolute magnitude of the problem. These findings are consistent for urban as well as rural India across fifteen major states.

The second issue addressed is that of dichotomous nature of undernutrition measure regarding differential assessment between groups like sex, residence etc. The simple differential measures like difference or ratio is being questioned with regard to its insensitivity to the level of the phenomenon. The proposition made towards revising these differential measures is on pronouncement of differentials with betterment of the situation. An illustration of a set of differential measures are made with regard to sex differential in stunting and underweight across Indian states which demonstrate the proposed premise of pronounced differentials with better level of incidence. For example findings from Chapter 7, shows that Karnataka and Uttar Pradesh which have the rank of 6 and 1 respectively for aggregate prevalence of stunting in descending order, among states with male advantage, reverse their ranks after adjusting the aggregate prevalence according to the sex of the children. Similar observation of change in rank order is found for Bihar and Kerala among states having female advantage in aggregate prevalence of stunting. Bihar changes rank from 1 for aggregate prevalence to 9 in the revised differential measure, where as for Kerala reverse is true. The picture is similar for outcome of underweight as well. It demonstrates prevalence of stunting reported at aggregate prevalence level hides the distribution for sexes.

An application of FGT criterion to the incidence of undernourishment to account for intensity and inequality is attempted towards demonstrating the altering levels of undernourishment in children across Indian states. The findings form Chapter 7 is two fold. One, it shows that prevalence of stunting among Pre-school children remains in the range of 40-50 percentage, even after adjusting for the intensity and inequality of the undernourishment among the children in states like Bihar, Assam, Haryana, Madhya Pradesh, Orissa, Rajasthan and Uttar Pradesh. In case of underweight similar adjustment found, over 50 percent of those children remains undernourished in Bihar, Madhya Pradesh, Orissa and Rajasthan. This implies the theses states need urgent attention to issue of undernutrition among these children. Two, such an adjustment in the incidence of undernourishment in terms of height-for-age of Indian children gives rise to reversal of ranks excepting in case of Kerala and Rajasthan. This indicates that while ranking states on an aggregate incidence level (incidence or head count ratio) for a dichotomous parameter like undernourishment (where those below cutoff points considered deprived and those on the norm line or above being considered non-deprived), the reported incidence level must be adjusted to the intensity of such deprivation (i.e. the distance from the normative value) and inequality (or extent of such severity). So the states will be given priority for assistance not only on the basis of incidence level of undernourishment alone but the severity of undernourishment as well. So a state with low incidence level but high severity for given indicator of

undernourishment will have priority for intervention compared with a state where over all incidence is higher but severity is less. A similar pattern could be observed for outcome of underweight as well.

Finally, adjustment of similar kind is demonstrated in the absence of unit record information on a given deprivation like undernourishment. One can adjust the aggregate prevalence to the incidence level by taking into account the median distance of the deprived individuals from the norm value. From the illustration, it is evident that the reported as well as revised levels of calorie deprivations according to the 55th round indicates a downward revision for rural and urban residents across all states indicating that the deprivation levels are overestimated without accounting for the intensity of such deprivation from the norm.

Thus the measurement of undernourishment in India has to be more comprehensive and sensitive to the distribution of those who are undernourished, to mark the states where intervention is urgent.

8.2. Conclusion

The present study focuses on the issue of undernutrition in its two crucial dimensions. These dimensions are studied at the individual (for two most vulnerable section of the population; pre-school children and reproductive age women) as well as household level. It consistently focused on identifying correlates, which respond to interventions in relatively shorter time and with minimum resources, both at individual as well as household level. This is one of the major contributions of the present study to understand the issue of undernutrition in Indian context. It argues for reorganising the ICDS programme to cover pre-school children, who are currently left out of the system. To improve the undernutrition among women, it argues for improvement in their status within the household, which will enable them to have better access to diet and health care. The current approach of Reproductive and Child Health programme must go beyond its present scope, which mostly focuses on women who are pregnant. It must focus on later stage of women's life, where she might need food supplementation along with preventive care. Improving women's autonomy would also lead to better accessibility and utilisation of RCH programmes by the concerned women. The household level analysis calls for more inclusive targeting policy for providing food at household level. It argues for moving form 'minimum income approach' to 'need based approach' in public distribution system The study also argues measuring

undernutrition at aggregate level need a revision for prioritizing the states for better allocation of available resources.

Towards examining child and maternal undernutrition, we have chosen the anthropometric approach, considering the availability of data, but the household undernutrition is examined based on a calorimetric approach. While this is driven by the availability of information, such a verification on the correlates of undernourishment defined according to two dimensions offers interesting insights towards resolving the dilemma whether food or health care or both is the answer for undernourishment.

As regards child undernourishment according to two indicators underweight and stunting, there is substantial variation across states giving rise to a varying set of correlates across levels of the phenomenon. Although, our focus is on immediate correlates like diarrhoea, immunisation, breastfeeding and food supplementation, we have examined their roles with and without controlling for other relevant correlates. There remains a reasonable correspondence between the two with a few exceptions. However, a distinct observation made as regards the association between these immediate correlates and nutritional outcomes is that they are level responsive. It means that at a lower prevalence level of undernutrition, these responses are significant as against poor incidence level of undernutrition. Such an observation has the immediate policy bearing in terms of the kind of intervention strategy to be adopted for states with varying prevalence levels of undernutrition. The extremely poor performing states may require a holistic approach of intervention that goes beyond addressing the immediate correlates whereas the better performing states can bring about a further improvement by only stressing on these immediate correlates.

A similar exercise attempted at explaining maternal undernutrition identifies two prominent correlates in terms of diet and female autonomy. Despite computing a simple diet score and autonomy score, a systematic response pattern of under nourishment emerges as against these scores. This systematic pattern across varying incidence level of undernourishment (defined in terms of low BMI values) provides the initial assertion as regard the role of these two correlates in shaping nutritional make-up of reproductive age women. In fact, these two correlates too are level responsive in the sense that response of autonomy as well as diet score is relatively higher for states with lower incidence level of under nutrition and vice versa.

Apart from anthropometric assessment, the calorimetric evaluation of undernourishment of Indian household offers interesting insights. The characteristics

associated with household undernourishment goes beyond the conventional caste-class attributes as we discover occupation type holding the key to vulnerability in calorie deficiency in both rural and urban areas. This provides an additional clue as regards intervention to include occupational attributes.

The study found contradictory evidence on prevalence of undernutrition in two dimensions under observation i.e. anthropometric and calorimetric. According to the anthropometric dimension the states belonging to Southern region of the country have advantage over the states of Northern region, but in calorimetric dimension the states of Southern region are better off. This is with a few exceptions like the state of Punjab. Punjab has the second lowest prevalence of underweight children (behind Kerala) as well as second lowest prevalence of calorie deficiency at household level (behind Rajasthan). It also has the lowest prevalence of low BMI among reproductive age women. Though the contrast between the two regions in nutritional outcome at individual and households level is not examined in the present study, from existing literature few probable explanations could be given. First, relatively better intra-household allocation in southern states ensure all members of the household get better access to available food, especially women and children, compared to their counterparts in Northern states [Bird; 2004]. Second, relatively better access to primary health care and better awareness about preventive care (due to better maternal literacy) in Southern Indian states reduces the risk of morbidity, which in turn ensures better absorption by the individuals, of available food in contrast to North Indian states where delivery of primary health care is inadequate and care practice in household is poor (due to high maternal illiteracy) [Planning Commission of India; 2002]. Third, the share of cereals is very high in North Indian diets, where as on an average Southern Indian households have lower share for cereals in their diet [NSSO; 2000]. The per capita consumption of major food items reported by National Sample Survey Organisation's quinquennial survey for consumer expenditure does provide evidence on this observation. This may also be one of the reasons why North Indian households have better outcome in terms of calorie consumption at household level [ibid]. However this differential pattern between two dimensions of undernutrition across regions could be a topic for further investigation.

Finally, the issues in comparison and interpretation of the measure of undernutrition given its dichotomous character unfold a perspective that is relevant for all measures defined in dichotomy. Despite a whole enquiry made on acceptance of its dichotomous character, questioning its very construct at the end is motivated by the limited methods that could be used towards comprehending its correlates. Although our analysis reveals

the likelihood of being undernourished, it fails to recognize the influence of correlates on degree of undernourishment. This exercise of addressing issues of comparison and interpretation is primarily aimed at recognizing the importance *'how many', 'how much'* as well as *'how unequal'* is the phenomenon of undernourishment. Here we are able to demonstrate the difference it makes to accommodate these aspects in evaluating under nourishment. However, this adds meaning in terms of aggregate comparison of the phenomenon rather than at the individual level unless one is interested in adopting a cardinal nutrition measure (includes both the undernourished and well nourished).

On the whole, this thesis illustrates the possibility of exploration of available secondary data sets towards a meaningful understanding of the phenomenon of undernourishment. Such exploration could provide potential clues for policy intervention in terms of recognizing the vulnerable as well as modifiable factors responsible for undernourishment. For instance, this study recognizes the parallel role of income and non-income factors in shaping the nutritional outcome. It goes beyond the individual/household level attributes of undernutrition to focus on the correlates that are immediate proximates of the outcome.

Methodologically it experiments with the application of the idea of group inequality to confirm the association between nutrition outcome and immediate proximates in absence of aggregate prevalence of undernutrition. This removes the bias of aggregate prevalence level while determining the nature of the association between nutrition outcome and it's associative factors. It also highlights how the limited information can be used to draw meaningful conclusions. For example while explaining maternal nutrition, it uses limited qualitative data on diet of women and women autonomy, still it is able to show the role of these attributes or correlates on nutritional outcome of women. In understanding household level undernutrition, it relates household's demographic composition with the household's calorie intake, in absence of information on individual calorie intake. The study also attempted to include the different aspects of undernutrition like levels (prevalence), depth (gap) and inequality (severity) in analysing the issue of undernutrition. It demonstrates how dichotomous measurement of undernutrition can be made more realistic by adopting standard FGT criterion, with and without the unit record data on calorie intake information.

8.3. Limitations of the Present Study

Like any other study, this study too suffers from some limitations. Some of the limitations arise due to the inadequacy of information. The study could only focus on

the nutrition issues of pre-school children and reproductive age women, not other vulnerable groups such as adolescents and the elderly due to lack of information. Similarly, at the household level a direct analysis of intra-household distribution of calorie intake was not possible because calorie availability is only reported at household level and not at the individual level. Further, it could only focus on ailments like diarrhoea, fever and cough, for which sufficient cases are available in NFHS-2. The reference period for disease is only fifteen days. So the ailment history of children and its association with nutritional outcome of children remained limited to disease episodes experienced during the immediate past. Also due to the lack of information on quantity of diet taken by the children, the relationship between dietary intake and nutritional outcome of Indian preschool children can only be judged from the pattern of intake like whether having only breastfeeding or mushy-food supplementation. In case of reproductive age women, the study could not analyse the dietary quantity of selected food items for women and the analysis relied on frequency of consumption of these items. In the absence of any information on disease among reproductive age women, the nutritional make-up was related to diet and autonomy indicators. A life cycle approach of analysing nutritional outcome in reproductive age women was not viable given the cross section nature of the data collected at one point of time. Lack of time-series information in NSSO 55th round and NFHS-2, restricts the study to cross-section analysis only. A possible linkage between food intake and anthropometric outcome could not be explored given the absence of either in NSSO 55th consumption expenditure and NFHS-2. However, the study attempts to overcome these problems with the help of some simple techniques and generation of relevant variables from the given information and was able to point out the flaw in the present intervention approach to reduce undernutrition among different vulnerable groups in the country.

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