DOUBLE BURDEN OF MALNUTRITION IN INDIA: AN INVESTIGATION

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Abstract

In the context of the existing nutrition transition, this paper analyses the National Family Health Survey data to assess the possible existence of the double burden of malnutrition, that is, the simultaneous existence of underweight and overweight problems in Indian society. The results show that in India, the underweight problem seems to cut across all social and economic categories, whereas, the overweight/obesity problem seems to be more of a problem of wealthier, urban women. The paper also throws light on the evidence of the changing face of malnutrition in India, the likely shift in Indian society from the customary problems pertaining to energy deficiency to the problems of overweight/obesity. The likelihood of the simultaneous existence of underweight and overweight problems is also evident in Indian society especially among the urban well-to-do people. In states like Delhi, Punjab and Kerala the public health measures should pay greater attention to overweight problems and in the near future a few other states like Tamil Nadu and Jammu and Kashmir are going to join this group where the overweight problem will cause greater concerns than the problem of underweight in respect of both the urban and rural areas. The co-existence of underweight and overweight problems in the above mentioned three states is not only restricted to the urban richer sections but also trickled down to the poor, uneducated and rural people. Hence, the research on nutrition issues in India has to focus on the paradoxical co-existence of underweight and overweight problems among women and recommend appropriate policies to tackle this emerging issue.

Introduction

The primary focus of nutrition research in India has been on the problem of undernutrition, particularly with respect to vulnerable women and children. In the past, a number of studies tried to address the various dimensions of undernutrition and its determinants. These studies helped in understanding the issue of undernutrition and paved the way for several policy measures aimed at reducing undernutrition related problems in India (MoHRD, GoI, 1993). More recently the studies started focusing on the other side of malnutrition by addressing the issue of overweight and obesity among Indian adults, mainly because the data in the 1990s showed that the proportion of overweight women in India has been on the rise. These studies have confirmed that the overweight problems in India are mostly concentrated in certain regions and mainly remained a problem of the rich urban population (IIPS, 2007). Considering the close linkages between obesity and various health problems, studies have also tried to examine the impact of overweight problems on the occurrence of chronic diseases such as coronary heart disease, cancer, diabetes, hypertension and stroke (Jequier, 1997, WHO, 1997, 2003). Both undernourishment and obesity are listed among the top ten leading risk factors to the global burden of diseases as identified by WHO.

A more detailed analysis of the nutrition scenario carried out after the year 2000 clearly shows that although the incidence of undernutrition initially declined, it has remained stagnant in the recent

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years with a considerably higher representation. However, overweight or obesity among women continues to increase. This phenomenon has given rise to a particular situation of simultaneous existence of under and overnutrition within the same population. A few studies conducted thereafter (P. Ramachandran, 2006; IIPS, 2007; Subramanian, Kawachi and Smith, 2007; Subramanian, Perkins and Khan, 2009; Ramesh and Jareena, 2009; Ackerson *et al.* 2008) have tried to address the issue of the double burden of malnutrition, that is, the co-existence of over and underweight problems in the Indian context.

Theoretical Linkages

The double burden of malnutrition is defined as the simultaneous existence of under and overnutrition in the societies that are undergoing rapid socio-economic changes. Although the problem of undernutrition is still prevalent in most of the developing countries, the rates of overweight or obesity are steadily increasing, especially among adults.

The classic theory of the epidemiological transition (Omran, 1971) proposes that the undernutrition and the related problems of pestilence, famine and infectious diseases will be the problems of the past with the course of development, while man-made degenerative and non-communicable diseases will begin to dominate. It is expected that all countries pass through the phase of infectious diseases before entering the phase of chronic diseases during the course of development. However, a detailed analysis of the statistics on disease burden, malnutrition and causes of death from various countries has shown that many countries today have not gone through the classic stages of epidemiological transition. There are evidences of co-existence of infectious and chronic diseases over long periods of time, which is a modified pattern of epidemiological transition. Evidences have been documented on the double burden of malnutrition and diseases in countries as diverse as China (Cook and Dummer, 2003), Brazil (Monteiro *et al.*, 2004a) and South Africa (Chopra, 2004) along with a few other developing countries. These countries are said to be in a state of Nutrition Transition.

The double burden of malnutrition can be explained following the theory of nutrition transition as proposed by Popkin (1993), which is closely related to the demographic and epidemiological transition. Nutrition transition refers to changes in the composition of the diet, usually accompanied by changes in the physical activity levels. Popkin (1993) has classified nutrition transition into three stages: receding famine, degenerative disease and behavioural change. In the first stage, diets are primarily derived from plant-based food sources, tend to be monotonous and based more on home food production that requires high levels of physical activity related to planting, harvesting and processing. The second stage encompasses dietary changes that generally include more animal source foods, higher intakes of fat — both vegetable oils and saturated fat from animal products — increased use of sugar and other sweeteners and higher reliance on food produced and processed outside the home or immediate community. Mandatory physical activity including agricultural and household labour, such as to produce food or procuring water and fuel, is also reduced. The final stage involves the shift to a diet with less saturated fat and decreasing reliance on processed foods. Intensive physical labour related to agricultural production is not reintroduced while non-obligatory physical activity becomes more common. These changes are reflected in nutritional outcomes, such as changes in average structure,

body composition and morbidity. An in-depth analysis of the dietary pattern indicates that most of the world's population lie somewhere between the first and second stages of nutrition transition, while sub-sections of populations in North America and northern and southern Europe may be moving into the third stage (Kennedy, Nantel and Shetty, 2006). Thus, the more rapidly developing population that has moved beyond the first transitional period is at an immediate risk of facing the dual burden of malnutrition.

The double burden of under and overnutrition can also occur at different levels. There could be a co-existence of under and overnutrition within different sections of the population and even within a single household — between children and adults, between adult males and females and also across different socio economic categories. Whilst the dual forms of malnutrition across different population groups has been receiving attention over the last couple of decades, the co-existence of under and overweight problems in the same household is a subject of very recent concern.

Given this background, this paper aims to understand the magnitude of underweight and overweight problems across major states of India to explore the possibility of the existence of dual burden of malnutrition in the Indian society. Further, the paper also discusses the dynamics of dual burden of malnutrition across different socio-economic categories in India.

Data

Data for this study are drawn from the National Family Health Survey (NFHS) - 2 and 3, conducted in 1998-99 and 2005-06, respectively. NFHS-2 collected information from a sample of ever married women and children, whereas the next edition of the survey included men and never married women as well, covering 99 percent of India's population living in 26 states. The focus of this paper is only on women aged 15 to 49 years. The NFHS provides information on various demographic and health indicators along with the nutritional profile. The nutritional status of adults is given in terms of the Body Mass Index (BMI), which has been calculated basing upon the anthropometric measures of height and weight and this measure can be used to understand the prevalence of under and overweight population. The population with BMI below 18.5 kg/m^2 is considered as thin or underweight, whereas those with BMI ranging from 25 to 29.99 kg/m^2 and more than or equal to 30 kg/m^2 are considered overweight and obese, respectively. However, an attempt has been made to highlight the potential risk of being overweight, which is indicated by a BMI between 23 and 24.99 kg/m^2 because in view of an increasing evidence of overweight and obesity problems like abdominal obesity, type 2 diabetes and cardiovascular diseases among the Asian population, when the average BMI is below the standard overweight cut-off point (WHO, 2004). Hence, WHO recommends a new BMI classification for assessing the nutritional status among the Asian population where people with a BMI ranging between 23 to 26.9 kg/m^2 are classified as overweight and those with a BMI of more than or equal to 27 kg/m^2 are considered as obese. Bi-variate and multivariate analysis have been carried out for understanding the prevalence rate of under and overweight problems with respect to various background factors.

Since this study analyses the co-existence of under and overnutrition, initially the trends in underweight and overweight among women are presented and the simultaneous existence of these two problems is assessed for India as a whole. Further, to understand the issue in detail, the analysis has

been carried out for the states, where the proportion of overweight women exceeds that of underweight women.

Analysis and Discussion

Trends in Nutritional Status

According to data collected by the National Nutrition Monitoring Board (NNMB) in the nine 'NNMB states' (where they conduct their survey), the proportion of both men and women with a BMI below 18.5 kg/m2 has come down by 41 percent and 31 percent, respectively, over the period of 1975 to 2005. Even with this reduction, one-third of men and 36 percent of women in India suffer from chronic energy deficiency. Despite the decrease in undernourishment in India, the data from the Demographic and Health Survey (DHS) show that among 23 countries of Sub-Saharan Africa, only Eritrea was doing worse than India in 2005.

Data on the nutritional status of the adults reveal that the prevalence of overweight and obesity among adults is increasing in the developing countries, whereas underweight is apparently on the decline (Monteiro *et al.*, 2004b; Kennedy *et al.*, 2006). In many developing countries, the proportion of overweight population now exceeds that of the underweight (Mendez *et al.*, 2005). In 1975, for every overweight person there were nearly two underweight persons in Brazil, but by 1997 the trend reversed and for one underweight person there were more than two overweight persons (Monteiro *et al* 2004a). The populations of India, Malaysia, Bangladesh and Vietnam are also showing increasing trends of obesity in recent years, along with high prevalence of underweight related problems. In India, as a result of the nutrition transition, the prevalence of overweight is steadily increasing mainly in the urban areas while undernourishment continues to be a major concern in rural areas (Griffith and Bentley, 2001; Shetty, 2002; Ramachandran, 2006; Ray, 2007; Deaton and Dreze, 2009). These findings indicate that with the high level of underweight and the growing problem of overweight in the developing countries exposing them towards the dual burden of underweight and overweight simultaneously, although prevention of undernutrition is still an unfinished agenda in most of these countries including India.

Data on the levels and trends of underweight, pre-overweight and overweight among women aged 15-49 years in India are presented in Table 1. NFHS-2 (1998-99) collected information from ever married women aged 15-49 years, whereas NFHS-3 collected information from all women aged 15-49 years. Hence, to draw a proper comparison between the second and the third rounds of the NFHS, only ever married women have been considered. Overall, the data show that the proportion of underweight women in India declined over the last seven years while there was a steady increase in the proportion of overweight women. Although in aggregate there was a decline in the proportion of underweight women, the state-wise data show mixed results. Out of the 21 states, the proportion of underweight women declined in majority of states, while in four states (Assam, Bihar, Haryana and Madhya Pradesh) the proportion of underweight women was nearly stagnant or increased. Further, there existed huge variations in the proportion of underweight women across different states. It ranged between 41.5 percent (Jharkhand) and 10.7 percent (Delhi) during NFHS-3. However, the proportion of overweight women in India increased during this period. The state-wise data also show that except in Delhi, the

proportion overweight women in all other states increased. Here again one can observe sharp inter-state variations in the proportion of overweight women. The overweight proportion ranged between a wide margin of 37 (Punjab) and 5 (Bihar) percent. On the one hand we have states like Punjab, Kerala and Delhi with high proportions of overweight women (more than 30 percent) while on the other hand we have Bihar, Jharkhand and Chhattisgarh with lowest proportions of overweight women (less than 7 percent). The data on the proportion of overweight and underweight women shows that in majority of the states, underweight among women is still a major problem. However, in states like Kerala, Punjab and Delhi, (where prevalence of overweight exceeds the underweight prevalence) the problem of overweight is a major concern as compared to the problem of underweight.

Table 1: State-wise comparison of nutrition levels among ever-married women between NFHS-II and NFHS-III

States	Underweight (%)		Pre-overweight (%)		Overweight or Obese (%)	
	NFHS-2	NFHS-3	NFHS-2	NFHS-3	NFHS-2	NFHS-3
Delhi	12.0	10.7	16.0	15.2	33.8	32.1
Haryana	25.9	26.9	10.0	10.3	16.6	20.4
Himachal P	29.7	24.2	9.6	12.9	13.1	16.9
Jammu & Kashmir	26.4	20.6	10.8	12.6	13.8	22.6
Punjab	16.9	13.3	13.4	14.5	30.2	36.8
Uttaranchal	NA	25.0	NA	11.9	NA	15.9
Rajasthan	36.1	32.7	6.5	8.7	7.1	9.8
Madhya Pradesh	38.2	38.6	6.2	6.9	6.1	8.1
Chhattisgarh	NA	39.7	NA	5.7	NA	6.5
Uttar Pradesh	35.8	32.6	7.5	9.1	7.5	10.9
Bihar	39.3	41.1	5.0	6.6	3.7	5.3
Jharkhand	NA	41.5	NA	6.1	NA	5.8
Orissa	48.0	39.5	4.9	7.5	4.4	7.4
West Bengal	43.7	37.1	6.6	9.2	8.6	12.3
Assam	27.1	35.8	7.1	7.8	4.2	8.9
Gujarat	37.0	31.7	9.5	11.0	15.8	19.7
Maharashtra	39.7	32.1	8.4	10.6	11.7	16.6
Andhra Pradesh	37.4	30.3	8.4	10.3	12.0	17.5
Karnataka	38.8	30.6	8.2	10.0	13.6	17.8
Kerala	18.7	12.4	15.1	16.5	20.6	33.8
Tamil Nadu	29.0	23.2	11.0	12.7	14.7	24.2
India	**35.8**	**32.2**	**8.1**	**9.6**	**10.6**	**14.4**

Although the proportion of overweight and obese women is a little more than 14 percent in India, there are nearly 10 percent of women with a BMI of 23-24.99 kg/m^2, who can be considered as pre-overweight and surviving under the threat of becoming overweight soon unless proper remedial measures are taken. If the revised BMI classification for the Asian women is used to measure obesity in the India population, the magnitude of the problem will be much higher where nearly one out of every

four women in India could be classified as overweight or obese. If the underweight proportion remains stagnant and overweight proportion increases, India may find itself, in the near future, facing the appalling consequences of the dual burden of malnutrition, that is, the existence of under and overnutrition simultaneously in the country.

Table 2: State wise comparison of proportion of malnourishment levels among ever-married women between NFHS-II and NFHS-III

States	Overall malnutrition levels (UW + OW) (%)		OW/UW		(UW + OW) / Normal	
	NFHS-2	NFHS-3	NFHS-2	NFHS-3	NFHS-2	NFHS-3
Delhi	45.8	42.8	2.82	3.00	0.83	0.75
Haryana	42.5	47.3	0.64	0.76	**0.71**	**0.89**
Himachal P	42.8	46.7	0.44	0.93	0.72	0.70
J & K	40.2	37.5	0.52	0.82	**0.64**	**0.76**
Punjab	47.1	50.1	1.79	2.77	**0.86**	**1.01**
Uttaranchal	NA	40.9	NA	0.64	NA	0.69
Rajasthan	43.2	42.5	0.20	0.30	**0.71**	**0.74**
Madhya P	44.3	46.7	0.16	0.21	**0.76**	**0.88**
Chhattisgarh	NA	46.2	NA	0.16	NA	0.86
Uttar P	43.3	43.5	0.21	0.33	**0.73**	**0.77**
Bihar	43	46.4	0.09	0.13	**0.73**	**0.87**
Jharkhand	NA	47.3	NA	0.14	NA	0.90
Orissa	52.4	46.8	0.09	0.18	1.05	0.88
West Bengal	52.3	49.4	0.20	0.33	1.08	0.97
Assam	31.3	44.7	0.15	0.25	**0.45**	**0.81**
Gujarat	52.8	51.4	0.43	0.62	1.08	1.06
Maharashtra	51.4	48.7	0.29	0.52	1.01	0.95
Andhra P	49.4	47.8	0.32	0.58	0.95	0.91
Karnataka	52.4	48.4	0.35	0.58	1.06	0.94
Kerala	39.3	46.2	1.10	2.73	**0.63**	**0.86**
Tamil Nadu	43.7	47.4	0.51	1.04	**0.75**	**0.90**
India	**46.4**	**46.6**	**0.30**	**0.45**	**0.84**	**0.87**

Any form of nutritional disorder, whether undernutrition or overnutrition, can be treated as Malnutrition. Table-2 provides the trends in malnutrition, proportion of malnourished women to normal women and proportion of overweight women in relation to underweight women across states of India. By looking at the overall malnutrition levels, one can say that nearly half of the Indian women suffer from some form of malnutrition, either underweight or overweight problems. At a time when India experienced a decline in the proportion of underweight population, the programme managers misjudged the status of malnutrition in India to be on the decline as well. But on the contrary, the country experienced an increase in the proportion of overweight women over the years and thereby an increase in overall levels of malnutrition. Further, the statistics show fairly high levels of malnutrition across states with a variation between a narrow range of 51 to 43 percent during NFHS-3. Apart from this, in

six states the overall malnutrition levels have gone up over the last seven-year period indicating the need to review the existing nutritional policies in the country. Further, in India there are more underweight than overweight women, that is, for every underweight woman there are 0.45 overweight women. In a majority of the states this proportion remains less than one indicating a higher proportion of underweight women as compared to the overweight women. However in states like Delhi, Punjab Kerala and Tamil Nadu, this proportion is more than one indicating a higher proportion of overweight women than underweight women in the population. In Punjab, Delhi and Kerala for every underweight woman there are nearly three overweight women in the population, while in Tamil Nadu, the proportion of overweight women is slightly higher than that of underweight women according to NFHS-3. Further, in states like Himachal Pradesh, Jammu and Kashmir and Haryana, the proportion of overweight to underweight women may soon reach higher than one if proportion of overweight women continues to show an increasing trend.

This section clearly shows that the overall malnutrition level is as high as 50 percent in India. The declining under nutrition levels in India during the 1980s and 1990s provided a hope that malnutrition problems were under control. But the growing proportion of overweight among women and the stagnant proportion of underweight women in the recent years have thrown up new challenges to the country wherein one can observe an increase in the overall malnutrition levels. These findings establish the need for India to focus attention (both research and policy) on both the problems of undernutrition and overnutrition simultaneously. The stagnancy in the proportion of underweight women and a steady increase in the proportion of overweight women are clear indication of the simultaneous existence of both under and overnutrition problems in Indian society. If this trend remains unchanged for long, India may begin to feel the pressure of tackling both the problems simultaneously.

Differentials in Underweight among Women

After establishing the possibility of the existence of the dual burden of undernutrition and overnutrition in India, the next step is to understand the pattern of its existence across different populations. Analyses based on the data from various countries show that underweight is more common among women of low socio-economic status (SES) whereas overweight is significantly more common among women with a higher SES in all low-income economies. However, in all high income countries, the overweight problem is more widespread among women of lower SES. However, there exists a mixed relationship between obesity and SES in the lower middle income countries (Monteiro *et al.* 2004). For example, in Brazil obesity has increased intensely and continuously among adult women from the economically less developed regions and among lower-income women in the more developed regions. On the other hand, the richer section of Brazilian women from the developed regions did exhibit a significant increase in obesity in the earlier decades and then the prevalence of obesity among them declined significantly over time (Monteiro *et al.* 2002). These phenomena actually resemble the experiences from the developed countries regarding their movement within the stages of nutrition transition during the course of development. At the same time, in countries like Vietnam and Bangladesh, obesity is positively related to socio-economic wellbeing and is mostly concentrated in developed and urban regions (Nguyan, 2007, Khan and Kramer, 2009). These results indicate that in

most of the developing countries, well-to-do women are found to be more overweight while underweight is more of a problem among women from low socio-economic status. Further it also indicates that the high level of underweight and the growing problem of overweight in the developing countries are exposing them towards the dual burden of underweight and overweight simultaneously.

Variations prevailing in underweight, pre-overweight and overweight in India have been analysed across different background characteristics of women such as age, place of residence, wealth index, marital status, education, occupation, religion and caste. Table-3 shows variations in underweight and overweight among women across different socio-economic characteristics. This table clearly shows that underweight in India is more prevalent among younger and rural women, women with no education and those belonging to the lowest wealth quintiles. Further, the underweight proportion is higher among never married women and those who are agricultural labourers and live in the countryside. Hindu women and Scheduled Tribe women also exhibited higher levels of chronic energy deficiency in India. Although, the propensity to become underweight is more among women from lower SES, women from well-to-do groups are not free of the underweight problem. This indicates that the chronic energy deficiency is widespread in India and cuts across all social and economic categories. Barring women from the richest wealth quintile, on an average, more than one-fourth of women belonging to all the other groups experience chronic energy deficiency.

It has been generally observed that a population which suffers from the problems of chronic energy deficiency (underweight) is more likely to exhibit differential characteristics than the one suffering from overweight and obesity problems. In India, generally people with a low SES are expected to experience higher levels of chronic energy deficiency, whereas well-to-do people show a greater tendency towards obesity.

Differentials in Overweight/Obesity among Women

Although the underweight problem appears to cut across all social and economic groups, overweight/obesity seems to be more of a problem among wealthier groups, urban women and older women. Overall, nearly 13 percent of all women in India are either overweight or obese. However, this proportion is more than 30 percent among the richest group. Nearly one-fourth of urban women and one-fifth of women aged 35 to 49 years are overweight in India. Further, women who are not working, women from the capital cities and those belonging to Sikh religion are more prone to be overweight or obese in India as compared to the others. Women in the pre-overweight group also constitute nearly nine percent of the total number of women. The characteristics of pre-overweight women are the same as those of overweight women, i.e. it is seen more among older women, urban women and women from the richer sections. Apparently, these findings suggest that the underweight problem in India is experienced more or less by all, whereas overweight remains confined to economically better-off groups.

Table 3: Percentage distribution of women aged 15-49 years in India by level of Body Mass Index (BMI) across selected background characteristics, NFHS-III

Characteristics	Categories	Underweight	Pre-overweight	Overweight or obese
Age*	15-19	45.48	3.96	2.48
	20-29	36.11	8.09	8.27
	30-49	29.02	11.27	19.93
Place of Residence*	Urban	24.70	12.03	23.27
	Rural	39.47	7.16	7.32
Education*	No education	40.55	6.81	7.08
	Primary	34.23	8.83	11.81
	Secondary	31.67	9.68	15.78
	Higher	18.81	14.36	26.53
Wealth Index*	Poorest	49.37	3.68	1.90
	Poor	44.94	5.22	3.90
	Middle	37.39	8.10	7.32
	Richer	28.22	11.17	15.24
	Richest	17.96	14.01	30.33
Marital Status*	Never Married	44.86	5.11	4.50
	Currently Married	32.11	9.63	14.42
	Formerly Married	33.55	9.68	14.39
Occupation*	Not Working	31.33	9.67	15.23
	Non manual	24.04	12.89	21.95
	Agricultural	44.25	5.53	4.24
	Manual	38.71	8.02	9.48
De jure Place of Residence*	Capital, large city	21.24	13.26	26.92
	City	25.48	11.60	22.75
	Town	26.78	11.35	21.12
	Countryside	39.87	7.13	7.34
Type of Caste or Tribe*	Scheduled Caste	40.03	7.19	8.70
	Scheduled Tribe	45.23	4.80	3.48
	Other Backward Classes	34.82	8.53	11.48
	Others	28.71	10.78	18.26
Religion*	Hindu	35.56	8.45	11.60
	Muslim	34.25	8.92	13.80
	Christian	22.62	12.49	18.22
	Sikh	17.49	13.93	31.61
TOTAL		**34.75**	**8.72**	**12.42**

*: Chi-square estimates show that results are statistically significant at 0.5 percent level of significance

The table shows that the co-existence of under and overweight problems among the various groups in India is to be found more in urban areas, large cities and among the richer groups. Among

the poorer and poorest groups, almost half of the women are underweight with only a negligible proportion being overweight, whereas in respect to the richest section one out of every three women is overweight or obese and nearly one out of every five women is underweight. This clearly shows that the poor people in India have to mainly worry about the undernourishment problem whereas the wealthier groups have to deal with problems of overweight and obesity and simultaneously address the issue of undernutrition. Therefore the double burden of malnutrition, i.e., the co-existence of underweight and overweight in India is more prevalent among the richer sections than among the poorer segments of the population. Despite rapid economic growth, India, unlike the developed and other middle-income countries, is yet to experience the co-existence of underweight and overweight within the low-SES groups.

Double Burden of Malnutrition

India is on the verge of facing the dual threat of under and overweight related problems in view of a steadily growing overweight proportion with a stagnant underweight proportion In the initial stages of nutrition transition this double burden may be more prominent among the richer sections of the society because they adopt changes in diet and lifestyle first and as a result tend to be more overweight. However, going by the theories of nutrition transition and cultural diffusion, the obesity problem may even trickle down to the poorer urban section and the rural areas too in the near future. Once the trickle down starts, the gap existing between the richer and poorer segments may narrow down with respect to the proportion of overweight women as explained by the trickle down theory wherein benefits of economic development will first be manifested among the rich and then slowly trickle down to the poorer sections. In such a situation, obesity also becomes a problem among the poorer groups with the double burden occurring at all levels.

This phenomenon of trickle down effect in India can be studied by analysing data from a few select states like Delhi, Punjab and Kerala, where overweight problems among women pose a more serious threat than underweight problems. Further, with a substantially high incidence of overweight, it can be presumed that the gap in overweight proportions between rich and poor or rural and urban would have narrowed down in these states. Evidences of such a trickle down effect can be traced in many studies and has been linked to the theory of nutrition transition. Influenced by globalisation, urbanisation and mechanisation of occupations, the rural people also tend to change their dietary habits and activity patterns over time and eventually overweight and obesity becomes more prevalent even among them.

Table 4: Percentage distribution of women aged 15-49 years in Delhi, Punjab and Kerala, by level of Body Mass Index across selected background characteristics, NFHS-III

Characteristics		Underweight	Pre-overweight	Overweight or obese
Age*	15-19	36.27	6.30	5.98
	20-29	20.72	13.61	19.19
	30-49	9.63	16.32	41.54
Place of Residence*	Urban	15.39	13.65	32.13
	Rural	19.27	13.96	25.61
Education*	No education	19.62	12.65	26.10
	Primary	16.70	14.01	29.15
	Secondary	18.45	13.66	28.07
	Higher	12.80	15.54	31.92
Wealth Index*	Poorest	40.98	11.48	8.20
	Poor	32.32	11.59	12.80
	Middle	26.93	10.84	16.09
	Richer	20.86	12.86	22.96
	Richest	11.90	15.29	36.17
Marital Status*	Never Married	33.68	8.37	8.53
	Currently Married	12.41	15.48	34.75
	Formerly Married	14.69	16.43	34.27
Occupation*	Not Working	17.07	13.82	29.44
	Non manual	16.86	14.37	29.79
	Agricultural	22.58	13.17	20.43
	Manual	20.21	13.12	22.93
De jure Place of Residence*	Capital, large city	14.53	13.97	28.01
	City	15.70	13.81	36.41
	Town	16.44	13.11	33.56
	Countryside	19.37	13.92	25.48
Type of Caste or Tribe*	Scheduled Caste	24.73	11.60	21.16
	Scheduled Tribe	38.57	11.43	12.86
	Other Backward Classes	17.82	12.26	28.92
	Others	14.74	14.83	30.88
Religion*	Hindu	18.75	13.68	25.77
	Muslim	16.09	13.52	31.09
	Christian	13.64	17.20	31.78
	Sikh	16.79	13.11	32.14
TOTAL		**17.56**	**13.82**	**28.48**

*: Chi-square estimates show that results are statistically significant at 0.5 percent level of significance

The data presented in Table-3 has already shown that in India underweight still is a major problem both in rural and urban areas and that there is simultaneous existence of increasing obesity in urban India. Now to examine the issue of double burden of malnutrition in India through a further in-

depth analysis, we have considered the three states: Kerala, Punjab and Delhi; the reason has already been stated. Incorporating all the women into the analysis, more than 17 percent of women in these states are underweight whereas 40 percent can be considered overweight following the WHO's (2004) modified nutritional classification for Asian population or if we expect that all those women who are pre-overweight may soon find themselves in the overweight category.

Overweight or obesity in India is more a problem of the urban, richer and better educated women, whereas, in these three states, the overweight problem has trickled down even to the rural areas, illiterate women and women with lower wealth quintiles. Table-4 shows that one out of every four women from the rural areas of these three states is either overweight or obese whereas this proportion accounts for only seven percent with regard to rural India. At the same time, in India, the prevalence of overweight and obesity among urban women were thrice as compared to the rural women, whereas in Delhi, Punjab and Kerala, the rural-urban gap regarding the proportion overweight is quite narrow. The gap in overweight proportions across educational groups and wealth quintiles also is found to have narrowed down considerably in respect of these three states. This is a clear indication of the trickling down effect.

The proportion of overweight is quite high and has even penetrated into the rural, uneducated and poorer sections. The problem of underweight also cannot be ignored. The data show that overall, a little more than 17 percent of women in these states are underweight, indicating the magnitude of the problem. The variations in underweight proportion across different background characteristics presented in Table-4 also show that underweight proportions remain at 10 percent or more across categories. With an overall high level of overweight and a substantial proportion of underweight, the dual burden can be seen across almost all groups unlike in the case of India as a whole where it stands as only a problem among the richer and educated sections of the society. The dual burden of malnutrition is not only a manifestation among the urban, educated and richer sections, but it seems to have penetrated even among the rural, uneducated and the poorer sections of society. However, with respect to India as a whole, this problem is more visible in urban areas while the trickle down effect to the rural areas is yet to happen.

Overall, chronic energy deficiency is found to be widespread in India, cutting across all social and economic categories whereas the overweight problem has mostly remained socially confined as a problem of the richer sections than the poorer sections. The analysis shows the double burden of malnutrition in India mainly manifested among the richer sections of the society. However, the analysis based on the data from Kerala, Punjab and Delhi shows that the obesity related problems seem to have trickled down even to the rural areas, the less educated and even to the poorer sections. Thus, the dual burden of malnutrition is visible not only among the wealthier groups but also the poorer sections of the society. Therefore, the burden on health care is felt more by the poor because it is they who have to tackle both the problems of underweight and overweight with limited resources.

Multivariate Analysis

In the previous section, we have observed the gross differences in the proportion of underweight, pre-overweight and overweight problems among women with various socio-economic and demographic

characteristics, without controlling for the effect of background variables. In order to quantify the net effect of the background variables on underweight, pre-overweight and overweight problems in India, a Multinomial Logistic Regression analysis was carried out. In the present analysis the dependent variable is not dichotomous in nature; hence, the multivariate logistic regression is the best technique to assess the influence of explanatory variables on the dependent variables. The dependent variable consists of four categories of BMI levels for women — BMI less than 18.5 kg/m^2 (underweight), ranging between 18.5 to 22.99 kg/m^2 (normal), within 23 to 24.99 kg/m^2 (pre-overweight) and more than or equal to 25 kg/m^2 (overweight or obese). Women with a normal BMI level (18.5 kg/m^2) are taken as the reference category. The explanatory variables considered here include the type of place of residence, i.e., the rural and urban areas (urban area is the reference category), age of women ('15-19 years' is the reference category), wealth index as a variable indicating the individuals' socio-economic status (poorest is the reference category), level of education ('no education' is the reference category), marital status ('never married women' group is the reference category) and occupation ('non-working' is the reference category).

The results of multinomial logistic regression analysis are presented in Table-5. The table clearly shows that after adjusting for the effect of background variables, all the variables in the equation are significant in determining overweight or obesity. In the case of underweight, all the variables except the place of residence play significant roles in determining underweight while in the case of pre overweight, except age, wealth index and occupation, all the other variables are statistically significant. The propensity to be underweight, pre-overweight and overweight shows that, younger women are more likely to be underweight whereas older women have greater chances of being either pre-overweight or overweight. Women above 30 years of age are almost three times more likely to be pre-overweight and seven times more likely to be overweight or obese than their younger counterparts. Similarly, urban females are 12 percent more likely to be pre-overweight and show 34 percent higher odds for overweight or obesity. The relative odds of being underweight decreases and simultaneously the likelihood of being pre-overweight or overweight aggravates with an improvement in the SES of women. The linkage between educational attainment and BMI shows a negative relationship between women's education and underweight, whereas it has a positive relationship between overweight and obesity. The odds ratio of being underweight is much lesser for women representing the medium and richest socio-economic groups than their poorer counterparts. The middle income population is three times more likely to be overweight or obese than the poorest section, while the richest group of women is 11 times more likely to be overweight or obese as compared to the poorest. Never married women are less likely to be overweight, whereas, married women have higher chances of being pre-overweight, overweight or obese. Women engaged in manual labour demonstrate a higher likelihood of being undernourished while those who do not work are more vulnerable to be overweight or obese. Further, the odd ratios of underweight across background variables do not show sharp differences across categories excepting the case of wealth index, implying that the problem of underweight is more widespread, whereas in the case of overweight, sharp differences in odd ratios exist across background characteristics. This confirms the fact that the overweight problem is more socially segregated.

These results also confirm that in India, as indicated earlier, the problem of underweight is more wide spread across all socio economic categories while the problem of overweight is more socially segregated and is more visible among the richer groups.

Table-5: Results of the Multinomial Logistics for the nutritional status of Indian women aged 15-49 years across selected background variables

Covariates		Underweight	Pre-overweight	Overweight or Obesity
		Odds Ratio (95 % CI)	Odds Ratio (95 % CI)	Odds Ratio (95 % CI)
Place	Urban ®	-	-	-
	Rural	0.97 (0.94-1.00)	0.88* (0.84 -0.92)	0.66* (0.64-0.69)
Age	15-19®	-	-	-
	20-29	0.90*(0.86-0.93)	1.63 (1.50-1.77)	2.09* (1.90-2.29)
	30+	0.80*(0.76-0.84)	2.80 (2.57-3.07)	6.42* (5.83-7.07)
Wealth Index	Poorest®	-	-	-
	Poorer	0.84* (0.80-0.88)	1.44 (1.29-1.61)	1.81* (1.56-2.09)
	Middle	0.65* (0.62-0.69)	1.98 (1.79-2.20)	3.08* (2.69-3.53)
	Richer	0.54* (0.52-0.57)	2.71 (2.44-3.01)	5.76* (5.05-6.58)
	Richest	0.42* (0.40-0.45)	3.78 (3.38-4.22)	11.35* (9.91-13.00)
Education	Illiterate®	-	-	-
	Primary	0.85* (0.82 -0.89)	1.08* (1.01-1.16)	1.15* (1.08-1.22)
	Secondary	0.89* (0.86 -0.93)	1.13* (1.06-1.19)	1.25* (1.18-1.32)
	Higher	0.76* (0.71 -0.82)	1.21* (1.11 -1.31)	1.28* (1.19-1.38)
Marital status	Never®	-	-	-
	Currently	0.73* (0.70-0.76)	1.40* (1.31-1.50)	2.04* (1.90-2.19)
	Formerly	0.76* (0.70-0.82)	1.37* (1.22-1.53)	1.91* (1.71-2.13)
Occupation	Not working ®	-	-	-
	Service	0.84* (0.80-0.89)	1.01 (0.95-1.08)	0.90* (0.86-0.96)
	Manual[#]	1.04* (1.00-1.07)	0.88* (0.80 -0.89)	0.66* (0.62-0.69)

The reference category is the normal women

manual includes agricultural labourers

* Significant at 95% level.

In order to understand the trickle down effect, a similar analysis was carried out for the three selected states, namely Delhi, Punjab and Kerala; and the results are presented in Table-6. The results show that unlike rest of India, the chances of being overweight remain nearly the same for both urban and rural residents in these three states; nevertheless, the result is not statistically significant in these three states. Further, the odds ratios across wealth index and education clearly show that the overweight problems are quite high even among the poorer and uneducated sections. These findings indicate that the problem of obesity is not only prevalent among the wealthier urban residents but also trickled down even to the poorer, uneducated and the rural population. The odds of being pre-

overweight across rural and urban areas in these states also show evidences of the trickledown effect as the rural people exhibited a slightly higher propensity to be pre-overweight. A higher prevalence of pre-overweight is a cause for concern because these women are likely to become overweight soon. However, the variations in the odds of being underweight show similar trends, as observed for India as a whole. The odds of being underweight does not vary sharply across categories except in the case of wealth index indicating that the problems of underweight cuts across all categories.

The rural population is at a slightly higher risk of being underweight, while urban women face a marginally higher threat of becoming overweight. The higher likelihood to be pre-overweight among the rural population clearly shows that the trickledown effect is discernible in these states even though the results did not prove to be statistically significant. Nevertheless, the statistically insignificant results for the nutritional status of women in these three states suggest that there is no significant difference in the nutritional status of women living in rural or urban areas in these states. The likelihood of being undernourished decreases with an increase in the age and literacy level even in these states. On the contrary, older and more educated women are more likely to be vulnerable to overweight. Women aged between 30 to 49 years are seven times more vulnerable to overweight than the women belonging to the youngest age group. The risk of being underweight reduces and chances of being overweight and obese get aggravated with an improvement in the socio-economic status. The relative odds of being underweight and overweight for the richest section amount to 0.28 and 4.51 respectively. Ever married (OR 0.57) and not working women are more likely to be overweight in these states.

Overall, these findings show the presence of trickledown effect of overweight problem among the poorer, rural and uneducated sections of the population, who are reeling under a fairly high proportion of underweight women across categories. Therefore the simultaneous existence of underweight and overweight problems in these states is restricted not only to the wealthier and urban sections but has even trickled down to the rural and poorer sections of the society.

Table - 6: Results of the Multinomial Logistics for the nutritional status of women aged 15-49 years across to selected background variables, in three selected states

Covariates		Underweight	Pre-overweight	Overweight or Obesity
		Odds Ratio (95 % CI)	Odds Ratio (95 % CI)	Odds Ratio (95 % CI)
Place	Urban®	-	-	-
	Rural	1.03 (0.91-1.16)	1.11 (0.97-1.27)	0.99 (0.89 -1.11)
Age	15-19®	-	-	-
	20-29	0.88 (0.74-1.06)	2.01* (1.52-2.66)	2.36* (1.79-3.11)
	30+	0.60* (0.48-0.75)	3.44* (2.54-4.65)	7.37* (5.51-9.87)
Wealth Index	Poorest®	-	-	-
	Poorer	0.74 (0.41-1.34)	0.87 (0.36 -2.05)	1.34 (0.52-3.47)
	Middle	0.53* (0.30-0.94)	0.82 (0.36-1.87)	1.56 (0.63-3.89)
	Richer	0.41* (0.24-0.72)	1.01 (0.45-2.26)	2.36 (0.95-5.82)
	Richest	0.28* (0.16-0.50)	1.49 (0.66 -3.35)	4.51* (1.82-11.16)
Education	Illiterate®	-	-	-
	Primary	0.90 (0.72-1.12)	1.05 (0.82 -1.33)	1.05 (0.86 -1.28)
	Secondary	0.95 (0.80-1.13)	1.20 (1.00 -1.45)	1.26* (1.08 -1.47)
	Higher	0.74* (0.57-0.95)	1.20 (0.93 -1.53)	1.22* (1.00 -1.50)
Marital status	Never®	-	-	-
	Currently	0.57* (0.48-0.68)	1.35* (1.08-1.69)	1.99* (1.61-2.46)
	Formerly	0.74 (0.50-1.08)	1.47 (1.00-2.18)	1.96* (1.40-2.76)
Occupation	Not working®	-	-	-
	Service	1.02 (0.85-1.23)	0.86 (0.71-1.05)	0.83* (0.70 -0.97)
	Manual	1.00 (0.84-1.19)	0.88 (0.72 -1.07)	0.72*(0.61-0.86)

Normal is the reference category

* Significant at 95% level

Conclusion

Nutrition research in India has to a large extent, revolved around the issue of undernutrition while the policies so far have targeted the poor and the rural people with a view to improve their nutritional status. However, this paper highlights the need to focus attention on the problems of overweight as well among adult Indian women. This paper also brings to the fore the simultaneous existence of both underweight and overweight problems across different groups of the Indian society mainly because the former seems to cut across all sections of the society, while the latter is mostly confined, socially, to the urban and richer sections of society. Thus, the double burden of underweight and overweight problems is more visible among the urban and well off people in India. Further, a high proportion of pre-overweight women in relation to India's total population and their distribution also demonstrate not only the potential risks in the future but also the trickle down effect on the population.

The results from Delhi, Punjab and Kerala show that in these states the problem of overweight and obesity is more severe as compared to the underweight problem. Compared to the rest of India, the overweight problem in these three states is not only restricted to the urban and well-off sections but

the prevalence is also high among the poor, uneducated and rural people indicating the trickle down effect. Hence research on nutrition issues in India may have to focus on the paradoxical co-existence of underweight and overweight problems among women and also efforts need to be directed towards designing appropriate policies for tackling this issue.

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