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Is Obesity becoming a Health Challenge for India?

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Abstract - In India, overweight and obesity prevalence has doubled over a twenty-year period, 2005 – 2015. The increase in overnutrition at state level is even more striking, with some states experiencing more than 100% increase in the prevalence of overweight and obesity during the above period. Overnutrition is linked to increase in the health burden in the form of rise in non-communicable diseases such as diabetes, cardiovascular diseases, heart strokes, certain type of cancers, etc. This article examines the recent trends in overnutrition and diabetes prevalence in India and analyses the effect of overnutrition on diabetes considering state level data. Diabetes has been rising in India, and our empirical analyses finds that overweight and obesity prevalence positively affects diabetes prevalence. In other words, the nutritional transition in India is leading to epidemiological transition.

Keywords: Diabetes, Nutritional Transition, Overweight and Obesity.

I. INTRODUCTION

Available evidence from India points towards the rapid emergence in overweight and obese population. The overweight plus obese population (having age 18 years or above) increased from 14.2% in 2005 to 19.1% in 2015 to 31.8 % in 2024 (WHO) which amounts to an increase of about 35% and 66 % respectively. Table 1 shows the proportion of total population (age group 15-49 years), which is underweight and overweight or obese for the period of 2005-06 and 2015-16. These estimates are extracted from NFHS data. These values show a sharp rise in the overweight and obese population over the period of ten years. The proportion of overweight and obese population increased from 11.4% to 20.4% while underweight prevalence declined from 35% to 22.5% for total population. Overnutrition among males doubled, and increased by 65% among females. Though the growth in prevalence is higher among males but it may be noted that females have persistently higher overweight and obesity prevalence as compared to males. Table also shows a clear decline in the underweight population. Examining these trends, we find a nutritional pattern in the form of shift away from undernutrition towards overnutrition. This compels us for further analysis, especially at disaggregated level, to better understand this observed nutritional shift and make more conclusive inferences.

Table 1: Underweight and Overweight or Obesity Prevalence for Total Population (15-49 years age group) for the Period of 2005-06 and 2015-16

	Underweight Prevalence		Overweight or Obesity Prevalence	
	2005-06	2015-16	2005-06	2015-16
Population	35%	22.5 %	11.4 %	20.4 %
Male	34.2 %	20.2 %	9.3 %	18.9 %
Female	35.5 %	22.9 %	12.6 %	20.7 %

Source: Compiled by authors using NFHS data.

The distribution of individual level data on BMI (Body Mass Index) is plotted to better understand the transition in overnutrition pattern. The data is extracted from Demographic and Health Surveys (DHS) for years 2005-06 and 2015-16, and compared these distributions. DHS of India, namely, NFHS, is a large-scale, multi-round survey conducted in a representative sample of households throughout India. Figure 1 illustrates these BMI distributions. It shows that the BMI distribution has shifted towards right and the mass of the population with higher BMI values has increased (specifically for BMI ≥ 25 kg/m^2) and the mass of the population with lower BMI values (BMI < 18.5 kg/m^2) has fallen during 2005 and 2015. This shift of BMI distribution indicates a transition away from undernutrition towards overnutrition in India.

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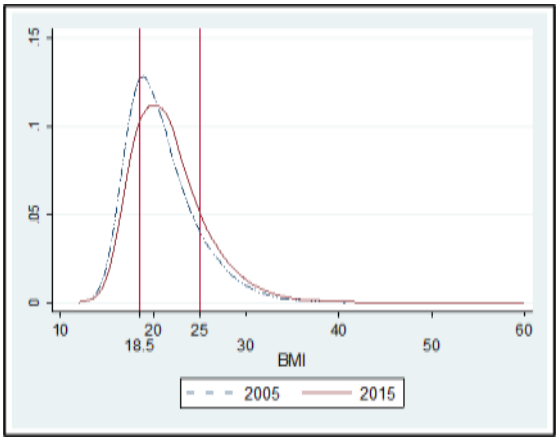

Figure 1: Shift in BMI distribution for Total population in India during 2005 and 2015

Source: Figure constructed by author using NFHS data.

II. OVERNUTRITION: STATE LEVEL ANALYSIS

To clearly observe the transition in nutritional pattern, on a map of India, we colour coded states with specific overweight prevalence using an online map tool. We divided the overweight and obesity prevalence in four exclusive intervals and assigned a specific colour code to each interval, as shown below the maps. Each interval indicates the percentage of population having BMI $\geq$ 25 kg/m^2 and the intervals considered are 0-9.9, 10-19.9, 20-29.9, and 30 or above. Figures 2 and 3 present these maps for years 2005 and 2015 across males and females, respectively. We find a stark rise in overweight and obesity prevalence among several states. From these figures, it can be observed that most states have transited from below 10% or 20% prevalence in 2005 to above 20% or 30% prevalence by 2015 for both male and female population. These results are consistent with the shift in BMI distribution discussed above since every state is found to have experienced a rise in overnutrition. Although every state experienced a rise in overweight and obesity, the increase has been much higher in some states.

For males, Punjab was the only state having above 20% overweight and obesity prevalence (22.2%) in year 2005. By 2015, more than 15 states have above 20% prevalence and states like Goa, Andhra Pradesh and Sikkim have above 30% prevalence. Further, more than half of the states had below 10% prevalence in 2005 but by year 2015 none of the states have below 10% prevalence. This pattern again suggests the shift in nutritional status towards higher overnutrition even at state level. We observe similar trends among female population.

Another interesting observation is in the form of regional patterns. There exists a notable difference in the North, Central and North-Eastern regions (mostly comprising of BIMARU and EAG states) and Southern region, with Southern region having a relatively higher overweight and obesity prevalence. This trend continues in year 2015 as well. This prompts questions on the role played by diet and lifestyles patterns across these regions. The implication of this is that nutritional policies must take into account this heterogeneity and many states in the North, Central and North-Eastern regions do not require policies that aim at reducing calorie consumption.

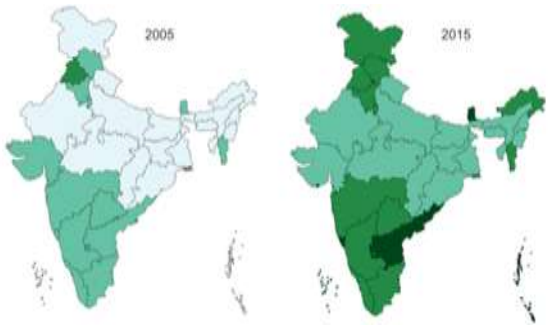

Figure 2: Prevalence of Overweight and Obesity among Males in India during 2005 and 2015

Source: Figure constructed by author using NFHS state level data.

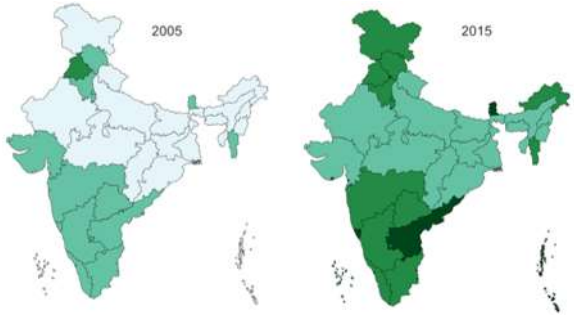

Figure 3: Prevalence of Overweight and Obesity among Females in India during 2005 and 2015

Source: Figure constructed by author using NFHS state level data set.

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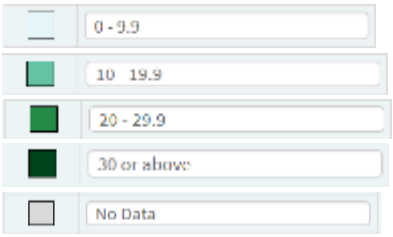

III. REVERSAL OF TREND – THE NUTRITIONAL TRANSITION

For better understanding about the change in nutritional status, we now bring in the underweight and overweight plus obesity prevalence together and conduct a comparative analysis for the changes in underweight prevalence and overweight plus obesity prevalence during the recent decade. Table 2 and 3 present state level estimates for both underweight and overweight plus obesity prevalence across male and female population taken from NFHS data for years 2005-06 and 2015-16. The table presents estimates for the states that have higher overweight and obesity prevalence than underweight prevalence by year 2015-16. In table 2, the first column reports underweight prevalence among males for 2005-06 and this is compared with overweight plus obesity prevalence among males for 2005-06 given in second column. The relationship between the two is indicated by an inequality sign between the two columns for each state. Similarly, the estimates for female population are presented in columns 3 and 4 for year 2005-06. In table 3, columns 1 to 4 can be interpreted in similar way for year 2015-16.

Tables 2 and 3 highlight the striking pattern observed in the form of Reversal of Nutritional Trend in India. About 15 states in India which had a higher underweight prevalence than overweight and obesity prevalence in year 2005-06 have witnessed a stark change in this pattern and by year 2015-16 all these states had a higher overweight prevalence compared to underweight prevalence. This trend is similar across both male and female population. This is indicated by the reversal of sign of inequality across the two years among both males and females. This striking change witnessed in about half of the Indian states during a decade's time is quite intriguing yet alarming. States like Kerala, Punjab, and Delhi continue to have higher overweight and obesity than underweight prevalence since 2005. Therefore, we may conclude that presently more than half of the Indian states, 18 states or 24 states plus union territories, are experiencing greater burden due to overnutrition as compared to undernutrition. Remaining 11 states continue to have a higher underweight prevalence even in year 2015. The percentage increase in overweight and obese population has varied considerably across states with some states experiencing over 100% increase. States like Andhra Pradesh, Delhi, Goa, Kerala, Tamil Nadu and Punjab are among the states having the highest overnutrition in India in year 2015-16. It is found that the nutritional trends have overturned to a considerable extent and a sharp and continuing rise in overweight and obesity and persistent decline in underweight prevalence is witnessed in India. If these trends continue then soon overnutrition would be a dominating burden across India.

Table 2: Nutritional Transition across States during 2005-06 among Male and Female Population

	2005-06					
State	Male			Female		
	(1) BMI < 18.5		(2) BMI ≥ 25	(3) BMI < 18.5		(4) BMI ≥ 25
Andhra Pradesh	30.8	>	13.6	33.5	>	15.6
Arunachal Pradesh	15.2	>	7.1	16.4	>	8.8
Delhi	15.7	<	16.8	14.8	<	26.4
Goa	24.7	>	15.5	27.9	>	20.2
Haryana	30.9	>	10.8	31.4	>	17.4
Himachal Pradesh	29.7	>	10.6	29.9	>	13.5
Jammu & Kashmir	28	>	6.2	24.6	>	16.7
Karnataka	33.9	>	10.9	35.4	>	15.3
Kerala	21.5	>	17.8	18	<	28.1
Manipur	16.3	>	9.2	14.8	>	13.3
Meghalaya	14.1	>	5.9	14.6	>	5.3

Mizoram	9.2	<	11.4	14.4	>	10.6
Nagaland	14.2	>	5.7	17.4	>	6.4
Punjab	20.6	<	22.2	18.9	<	29.9
Sikkim	12.2	>	11.9	11.2	<	15.4
Tamil Nadu	27.1	>	14.5	28.4	>	20.9
Tripura	41.7	>	4.8	36.9	>	7.1
Uttarakhand	28.4	>	7.9	30	>	12.8

Source: Compiled by author using NFHS state level data.

Table 3: Nutritional Transition across States during 2015-16 among Male and Female Population

	2015-16					
State	Male			Female		
	(1) BMI < 18.5		(2) BMI ≥ 25	(3) BMI < 18.5		(4) BMI ≥ 25
Andhra Pradesh	14.8	<	33.5	17.6	<	33.2
Arunachal Pradesh	8.3	<	20.6	8.5	<	18.8
Delhi	17.7	<	24.6	14.8	<	33.5
Goa	10.8	<	32.6	14.7	<	33.5
Haryana	11.3	<	20	15.8	<	21
Himachal Pradesh	18	<	22	16.2	<	28.6
Jammu & Kashmir	11.5	<	20.5	12.1	<	29.1
Karnataka	16.5	<	22.1	20.7	<	23.3
Kerala	8.5	<	28.5	9.7	<	32.4
Manipur	11.1	<	19.8	8.8	<	26
Meghalaya	11.6	>	10	12.1	<	12.2
Mizoram	7.3	<	20.9	8.4	<	21.1
Nagaland	11.4	<	13.9	12.3	<	16.2
Punjab	10.9	<	27.8	11.7	<	31.3
Sikkim	2.4	<	34.8	6.4	<	26.7
Tamil Nadu	12.4	<	28.2	14.6	<	30.9
Tripura	15.7	<	15.9	19	>	16
Uttarakhand	16.1	<	17.7	18.4	<	20.5

Source: Compiled by author using NFHS state level data.

In this analysis, the cut-off used for defining overweight and obesity is 25 kg/m^2 which is based on WHO International Criteria-based BMI classification. WHO in its report on Asia-Pacific region has redefined obesity by measuring obesity using separate classification or cut-offs for Asia-Pacific region acknowledging the differences in body type (physique, body build, etc.) and genetic composition across the population of Asia-Pacific region and population in European countries and United States. The new set of cut-offs has been proposed by WHO called Asian criteria-based BMI classification defines overweight and obesity using cut-off point of 23 kg/m^2 and a cut-off point of 25 kg/m^2 defines obese population.[1]

Although a common BMI standard will facilitate an easy comparison across population in different regions or countries but customised and well-designed region-specific cut-offs based on genetic composition and demography will make the understanding of epidemiology more comprehensive yet accurate. If Asian criteria-based BMI is considered to measure overweight and obesity then its prevalence will be more severe and higher proportion of population will be at risk from obesity associated adverse health impacts. This difference is captured by figure 4. A difference in the overweight and obesity prevalence is witnessed when measured using two separate criteria. It can be easily observed that International criteria understates the overweight and obesity prevalence by a difference of more than 10% in both the years. In year 2005-06, the proportion of population which is overweight or obese is 13.9% as per international criteria though the same figure is 24.4% based on

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Asian Criteria. For year 2015, the figures are 18.1% and 31.2% for each of the respective criteria.

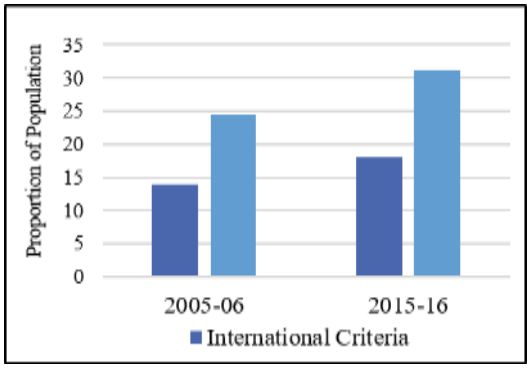

Figure 4: Overweight and Obese population in India based on WHO International Criteria and Asian Criteria

Source: Figure constructed by authors using NFHS individual level data set for 2005-06 and 2015-16.
(Note: WHO International Criteria measures overweight and obesity using BMI ≥ 25 kg/m^2 cut-off and Asian Criteria uses BMI ≥ 23 kg/m^2 cut-off.)

IV. NUTRITIONAL BIAS ACROSS GENDERS

The data also provides insights about the differences in malnutrition across genders. We examine malnutrition amongst males and females in 2015-16 across states in India. Overnutrition and undernutrition trends across some selected states for both males and females for year 2015-16 are presented in table 4. We find both underweight prevalence as well as overweight and obesity prevalence is higher amongst females as compared to males. This implies that a smaller proportion of females lie in the normal weight range. Females have a higher underweight prevalence than males across 24 states and a higher overweight and obesity prevalence across 21 states in year 2015-16. The overnutrition and undernutrition trend brings out an interesting aspect of our socioeconomic scenario. While analyzing the nutritional status across different wealth quintiles at national level (all-India average), we find that underweight is higher among lower (or poorer) wealth quintiles while overweight and obesity is more prevalent among higher (or richer) wealth quintiles (NFHS, 2015-16). Also, females have higher underweight prevalence and higher overweight and obesity prevalence than males across lower and richer wealth quintiles, respectively. This suggests that among households that belong to the lower wealth quintiles allocation of nutrition is biased against females thus females are more likely to be underweight. While higher overweight and obesity for females among higher wealth quintiles could be related to restrictions on women in higher wealth quintiles such as not allowed to work outside, participate in sports and related physical activities, etc. It could also be related to prevalence of domestic help in the households. This suggests that women are at a higher risk of both undernutrition and overnutrition in India.

Table 4: Across Gender Comparison of Nutritional Trends during 2015-16

State	Overweight and Obesity Prevalence (BMI ≥ 25)			Underweight Prevalence (BMI < 18.5)		
	Females		Males	Females		Males
Chhattisgarh	11.9	>	10.2	26.7	>	24.1
Madhya Pradesh	13.6	>	10.9	28.4	=	28.4
Uttarakhand	20.4	>	17.7	18.4	>	16.1
Haryana	21	>	20	15.8	>	11.3
Gujarat	23.7	>	19.7	27.2	>	24.7
Tamil Nadu	30.9	>	28.2	14.6	>	12.4
Punjab	31.3	>	27.8	11.7	>	10.9
Kerala	32.4	>	28.5	9.7	>	8.5

Source: Compiled by author using NFHS state level data.

V. DIABETES – A MAJOR HEALTH CHALLENGE IN INDIA

Given the recently growing problem of diabetes among low- and middle-income countries, the factors causing it are not well understood, especially in India. One of the major factors expected to

contribute to the rise in diabetes is obesity. During past decade, the rise in diabetes prevalence has begun to pose a new challenge to the health policy makers in India. About 20% of the urban population and 8.8% of the total population is diabetic in India (International Diabetes Federation (IDF), 2018). With more than 72 million people being diabetic, India has also been stated as diabetes capital of world (IDF). More than 50% of adult population with diabetes is still undiagnosed in India (IDF). Also, given the recent growth in diabetes, WHO has termed diabetes as a growing challenge for India. Also, obese population with diabetes is at more risk of developing heart diseases and strokes (WHO). Therefore, diabetes is also known as *Silent Killer* as it increases the susceptibility towards other NCDs. Diabetes prevalence has doubled in both rural as well as urban areas during the period of 2005 and 2015 (NFHS). State-wise diabetes prevalence across genders and rural-urban regions highlights a substantial increase in its prevalence in almost every state over ten-year period 2005-2015 (NFHS). Table 5 presents the prevalence of diabetes for total population, having age 18 years or above, for years 2000-2015. Diabetes prevalence increased by 1.4% and exhibited a percentage increase of about 20%.

Table 5: Percentage of Adult Population (30+ years of age) having Diabetes in India during 2005 - 2022

	2005	2015	2022
Diabetes	20.1	23.2	27.9

Source: WHO data set

VI. EFFECT OF OVERNUTRITION ON DIABETES: FIXED EFFECTS ESTIMATES

We now estimate the effect of overweight and obesity prevalence on diabetes prevalence in India using state level data from NFHS for years 2005-06 and 2015-16 across 21 states of India. Data estimates are defined by gender (male and female) and residence (rural and urban). We have considered state level estimates for all desired variables across male and female in rural and urban region in India. We consider diabetes prevalence (per lakh population) as our dependent variable. We estimate a Fixed Effects (FE) model which accounts for any time-invariant state specific unobserved heterogeneity. The estimation results are presented in Table 6. Columns 1 and 2 estimate the effect of overweight and obesity prevalence on diabetes prevalence and columns 3 and 4 estimate the effect of obesity prevalence on diabetes prevalence. We include many control variables that are likely to affect diabetes prevalence. These include per capita net state domestic product at 2004-05 prices (in Rs.), literacy rate (in percentage) and proportion of population that smokes, and percentage of population that consumes alcohol.

Coefficients (in columns 1-4) are positive and highly statistically significant indicating that both overweight and obesity prevalence has an effect on diabetes prevalence in India. The results show that as compared to overweight prevalence, obesity prevalence has a much stronger effect on diabetes prevalence. The marginal effect of an increase in obesity prevalence on diabetes is found to be more than twice (2.3 times) the effect of overweight and obesity prevalence. Average diabetes prevalence increases by about 63 people per lakh population due to a unit rise in overweight and obesity prevalence and by about 143 people per lakh population due to a unit rise in obesity prevalence. The results are found to be highly statistically significant.

Table 6: Results: Effect of Overnutrition on Diabetes

Model	(1)	(2)	(3)	(4)
Overweight and Obesity Prevalence (BMI ≥ 25)	70.51*** (28.11)	63.01*** (25.17)		
Obesity Prevalence (BMI ≥ 30)			157.24*** (66.34)	142.99*** (49.63)
Controls	No	Yes	No	Yes
Time Fixed Effects	Yes	Yes	Yes	Yes
Observations	164	152	164	152
F – Statistic	17.63	9.17	17.54	9.21
Prob > F	0.0000	0.0001	0.0000	0.0001
Within R-square	0.4486	0.5334	0.4327	0.5230

*** significant at 1% significance level. Robust standard errors are clustered at state level are

presented in parentheses. Both models include per capita net state domestic product at 2004-05 prices (in Rs.), literacy rate (in percentage), proportion of population that smokes and consumes alcohol consumption, and time fixed effects as controls. Note: Estimated coefficients for only main covariate is presented here.

VII. CONCLUDING REMARKS

Overnutrition and associated health risks are no longer confined to high-income countries and have now become an emerging problem among the low- and middle-income countries. India is presently facing the dual burden of inadequate nutrition, in the form high prevalence of both undernutrition and overnutrition. At all India level, the gap between underweight prevalence and overweight and obesity prevalence has drastically reduced from 24% to only about 2% during the past decade. It is likely that overweight and obesity prevalence will soon exceed underweight prevalence in India. We find that India is presently experiencing a nutritional transition. The nutritional transition is more evident at state level where among 24 states and union territories, overweight and obesity prevalence dominates the underweight prevalence. Our analysis shows a shift in the burden of inadequate nutrition away from undernutrition towards overnutrition.

This rapid increase in overnutrition has been linked to the increase in both health and economic burden in the form of rise in non-communicable diseases such as diabetes, cardiovascular diseases, heart strokes, certain type of cancers, etc. and associated health care costs. Prevalence of NCDs, especially diabetes, have shown a considerable rise during 2005 and 2025 in India. We examined the link between diabetes and overnutrition using a Fixed Effects model estimation on state level data from NFHS for the years 2005-06 and 2015-16. We find that overweight and obesity prevalence has a statistically significant positive effect on diabetes prevalence in India.

The findings of this paper have significant implications for policy interventions. The economic burden imposed by diabetes is quite large given its substantially high health care costs. Rise in diabetes prevalence imposes health care costs and this cost burden may have severe adverse impacts on private households as more than 70% of the total health expenditure in financed by private households in India in the form of out of pocket health expenditures. The study finds a positive correlation between diabetes prevalence and overweight and obesity prevalence. Therefore, policies that target overweight and obesity prevalence may also reduce diabetes prevalence and there can be huge economic gains.

APPENDIX

1. *International criteria-based BMI:* <18.5 for underweight, 18.5-24.9 for normal weight, 25.0-29.9 for overweight and ≥ 30 for obese individuals. At an aggregate level, overweight prevalence is defined as proportion of population having BMI ≥ 25 kg/m^2. Similarly, obesity prevalence is proportion of population having BMI ≥ 30 kg/m^2.

Asian criteria-based BMI: <18.5 for underweight, 18.5-22.9 for normal-weight, 23.0-24.9 overweight, 25-29.9 obese with moderate risk of co-morbidities and ≥ 30 obese with severe risk of co-morbidities.

2. BIMARU states refer to states having poor economic conditions. These states include Bihar, Madhya Pradesh, Rajasthan and Uttar Pradesh.

Empowered Action Group (EAG) states include eight socioeconomically backward states of India. These states include Bihar, Chhattisgarh, Jharkhand, Madhya Pradesh, Orissa, Rajasthan, Uttaranchal and Uttar Pradesh.

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