Article

Portliness Amidst Poverty: Evidence from India

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Abstract

We analyse patterns and correlates of excess weight of adults in India. We find that urban women are particularly at risk of being overweight or obese and that income or wealth, relative inequality, and lifestyle choices are strongly correlated with body mass index. Using panel data for women, we find that there is strong persistence in being overweight or obese—there are significant transitions into this category but very little movement out of this category over time. Estimates of health impacts indicate that overweight or obese weight status is positively associated with the incidence of diabetes and blood pressure.

Keywords

Excess weight, body mass index, gender, India, blood pressure, diabetes

JEL: I12, I15, O12

I. Introduction

The health economics literature in developing countries has traditionally focused on the causes and impacts of undernutrition, malnutrition and the burden of infectious diseases (see, e.g., Pathak & Singh, 2011). Issues of unhealthy weight, obesity and consequent effects on non-communicable diseases have traditionally been viewed as *First World problems* that affect the population of developed countries. The reality is, however, starkly different. The proportion of overweight

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or obese individuals is increasing rapidly in all countries regardless of development status. Over the period 1975–2014, the number of obese individuals in the world has increased from 105 million to 641 million; 3.2 per cent of the men were obese in 1975 compared to 10.8 per cent in 2014, and the proportion of obese women has increased from 6.4 per cent in 1975 to 14.9 per cent in 2014 (Lancet, 2016). There are more obese people than underweight in the world today, and obesity is increasingly viewed as a global pandemic. Lancet (2014) reports that worldwide, in 2010, overweight and obesity were estimated to cause three to four million deaths, 4 per cent of years of life lost and 4 per cent reduction in disability-adjusted life-years. In terms of sheer numbers, the right-hand panel of Figure 1 shows that more overweight or obese people live in China than anywhere else in the world.

With indications that the problem of excess weight is only going to worsen in the future thus contributing to the global burden of health, policymakers in developing countries face an obesity-led increase in projected public health expenditures. An analysis of the patterns, determinants, causes and implications of this issue is therefore both essential and timely. This is particularly true in a country like India where the high rates of economic growth in the last two decades

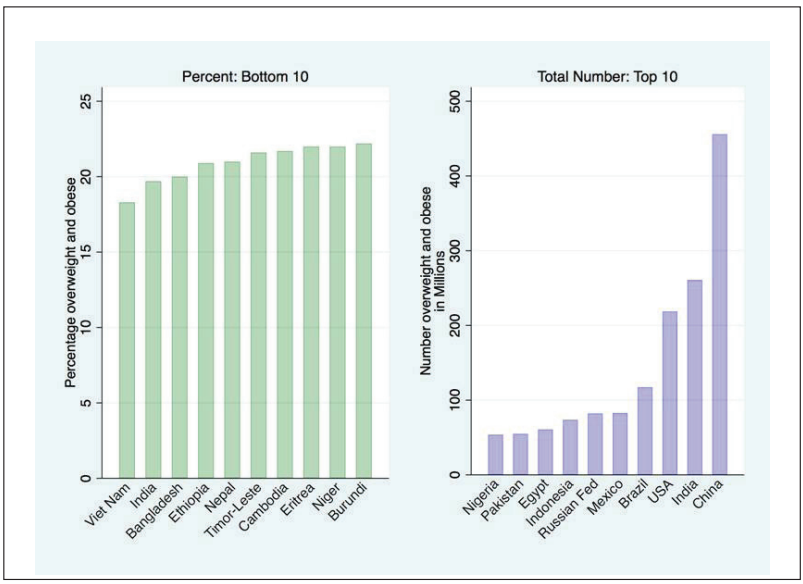


Figure 1. Ranking of Countries by Per Cent and Number Overweight or Obese in 2016

Source: World Health Organization's Global Health Data Observatory Repository at http://apps.who.int/gho/data/node.main.A900A?lang=en

Notes: Per cent overweight or obese is a rate that is applicable to all those who are five years and older, number overweight or obese is for all age-groups. Authors' computations using the WHO Global Health Data Observatory Repository.

and the resultant increases in income and wealth have been associated with an increase in the proportion of the population that is overweight or obese. The right-hand panel of Figure 1 shows that as of 2016, India had the second highest number of overweight or obese individuals among all countries. In terms of proportions, 20 per cent of adults and 11 per cent of adolescents belonged in this category (Lancet, 2014).[1] The health implications of this increase in the proportion of the adult population that is overweight or obese are substantial. For example, the prevalence of diabetes in India is already greater than the global average with 9.5 per cent of adults recorded as being diabetic as of 2015 (compared to the global average of 9%). This widespread prevalence has the potential to lead to other health problems as diabetes is linked to ailments such as stroke and cardiovascular disease. Additionally, excess weight can result in chronic health risks like hypertension and heart disease. The impact of these diseases on household budgets is likely to be substantial.

While many individual-, household- and community-level factors could be correlated with the prevalence of excess weight, we focus on the role of income and lifestyle choices in this article. Over the past two decades, income levels in India have grown considerably, allowing more disposable income to be spent on luxury goods, including unhealthy foods and suboptimal lifestyle choices. Further, the lives of Indians have increasingly become sedentary—spending considerable time in front of the television and using domestic help to assist with household chores. These factors combine to result in lower rates of metabolism and increased weight. Our results are therefore consistent with Upadhyay (2012), who argues that economic growth, an expanding middle-class population, growing urbanisation and an increasingly sedentary lifestyle, all contribute to the ever-increasing importance of non-communicable diseases as the major health challenge in India. Our contribution to the literature is to demonstrate the channel through which this works, namely income and less active lifestyles. Further, our results indicate that excess weight is significantly positively associated with diabetes and blood pressure.

Unlike the large literature on the trends and implications of undernutrition, the literature on excess weight in developing countries is limited. Gaiha, Jha, and Kulkarni (2010) use the first round of the IHDS data from 2005 to document the impact of economic affluence and accompanying dietary changes on the incidence of non-communicable diseases that include diabetes, heart disease and cancer in India. Romling and Qaim (2011) study the problem of being overweight or obese in Indonesia and recognise that developing countries increasingly face the twin problems of malnutrition and rising numbers of people with unhealthy weight levels. Differentiating between direct and indirect influences, this study also documents that food consumption and levels of physical activity are direct inputs, whereas education, income and marital status influence obesity more indirectly.[2]

Using data from the World Health Organization (WHO), Case and Menendez (2009) report that in most Western European countries, obesity is more prevalent among women than men.[3] This is consistent with the findings of Martorell, Khan, Hughes, and Grummer-Strawn (2000) and Subramanian, Perkins, Ozaltin, and

Davey-Smith (2011). Bhurosy and Jeewon (2014) argue that the trend in body mass index (BMI) for women in developing countries may outstrip that for women in developed countries.[4] Khandelwal and Reddy (2013) reports that overweight-obesity rates are rising in India and determinants include diets heavy in oils, fats and sugar, lack of physical activity and poor nursing practices.

Our analysis of overweight and obesity in India shows that income is an important predictor of excess weight, as are proxies for levels of physical activity such as hours spent watching television and the availability of domestic help. We find that this is a health problem that is especially relevant to urban women in India. Moreover, in contrast to other studies, our ability to follow a set of individuals across a seven-year time span allows a more rigorous treatment of time-invariant unobservables in our methods and data. We believe this provides for an analysis which is more cognizant of confounding factors.

II. Data

Our analysis is conducted using data from two waves of the Indian Human Development Survey (IHDS) collected in 2005 and 2012. This is a nationally representative multi-topic survey of 41,554 households in 1,503 villages and 971 urban neighbourhoods across India collected by the National Council of Applied Economic Research and the University of Maryland. A total of 83 per cent of the households from the first round (conducted in 2004–2005—henceforth referred to as the IHDS1 data set) were resurveyed in the second round (conducted in 2011–2012—henceforth referred to as the IHDS2 data set). The response rate was more than 90 per cent for both waves. The survey collected information about health, education, employment, economic status, marriage, fertility, gender relations and social capital. While both rounds of the survey collected data on height and weight of women, the data for men was collected systematically only in 2012. Therefore, we are able to construct a panel and compare changes in weight status over time only for women. Cross-sectional gender differences are examined using the more contemporary IHDS2 data set.

Descriptive statistics for the IHDS2 cross-sectional sample is presented in Table A1 in the Appendix, and the corresponding estimates for the panel sample are presented in Table A2 in the Appendix. In Table A1, columns 1 and 2 present the descriptive statistics for the full sample. Columns 3–10 present the corresponding descriptive statistics for males and females residing in rural (columns 3–6) and urban areas (columns 7–10), respectively. A total of 62 per cent of the sample is female, and 16 per cent, 43 per cent and 7 per cent have primary, middle and secondary school education, respectively. In both rural and urban samples, men are more educated than women: 27 per cent and 10 per cent of rural and urban males report having no schooling compared to 50 per cent and 23 per cent of rural and urban females. On the other end of the spectrum, 6 per cent and 19 per cent of rural and urban males report having at least secondary schooling compared to 2 per cent and 12 per cent of rural and urban females. Over 80 per cent of the sample are Hindus.

Infrastructure facilities are better in urban areas compared to rural areas: while more than 70 per cent of urban males and females report living in households with piped water, only 32 per cent of rural males and females do so. Not surprisingly, car and motorcycle ownership rates are also higher in the urban sample as is the likelihood of having domestic help. The average hours per day spent by males in the household watching television is lower than the corresponding average for females, and this is true both in the rural and the urban samples. Finally, the standard deviation of PSU/cluster per capita expenditure (a measure of local level inequality) is higher in the urban sample, indicating that the urban sample is more heterogeneous along this dimension.

The panel sample in Table A2 consists of women aged 18–70 years in IHDS1 who are tracked in IHDS2. Sample means are reported in three separate groups: full sample, rural and urban. The proportion of those with no education in rural settings is greater than that in urban settings, whereas the opposite is true when we consider secondary school or higher. Household infrastructure is better in urban areas. In general, one's lifestyle appears to be more sedentary in urban areas: hours spent watching TV is greater and the existence of household help is more common in these settings.

Figure A1 in the Appendix presents the state-wise percentage of males and females aged 18–70 years who are overweight or obese (IHDS2 sample). The left panel presents the percentages for the rural sample and the right panel the corresponding percentages for the urban sample. There is considerable variation in the proportion of the population that are overweight or obese by state, but the patterns generally corroborate the national averages presented in Table 1. Estimates show that rural Delhi has the highest proportion of overweight or obese people whereas Punjab has that honour in the urban data. In every state, the percentage of the population that is overweight or obese is greater among urban residents than among rural residents. Barring a few exceptions, the proportion of women who are overweight or obese exceeds the corresponding proportion of men although there is some variation in these estimates. For example, the proportion of urban females that are overweight or obese ranges from 20 per cent in Assam to 52 per cent in Punjab; the proportion of urban males that are overweight or obese ranges from 17 per cent in Madhya Pradesh to 40 per cent in Karnataka and Punjab. There appears to be a positive correlation between income and unhealthy BMI levels. The estimates in Panel A indicate that the proportion of the population overweight or obese is greater in the richer states of India (Kerala, Punjab, Haryana and Delhi), and this is true in both rural and urban areas. Further, states with sources of nutrients that are relatively calorie-rich non-diversified and concentrated such as Punjab, which is mainly wheat-producing and consuming, and Kerala, which is mainly rice-producing and consuming, rank high in terms of both rural and urban overweight or obese statistics. The wheat–rice consumption markers would also be relevant to rural Delhi, urban Karnataka and rural Tamil Nadu. This suggests possible correlation between state-specific food consumption patterns and the incidence of overweight or obesity.

Table 1. Proportion in Different Weight Categories

	Males and Female IHDS2			Females Overtime		
Category	**Male (1)**	**Female (2)**	**Difference (3 = 1 2)**	**2005 (IHDS1) (4)**	**2012 (IHDS2) (5)**	**Difference (6 = 4 5)**
Panel A:						
Average BMI	21.76	22.14	−0.38***	21.38	22.62	−1.24***
Average BMI rural sample	21.12	21.29	−0.16***	20.73	21.71	−0.98***
Average BMI urban sample	23.07	23.71	−0.65***	22.79	24.39	−1.60***
Panel B:						
WHO Cut-offs						
Proportions: Full Sample						
Underweight or lower	0.21	0.21	−0.00	0.24	0.18	0.05***
Normal weight	0.61	0.56	0.05***	0.61	0.55	0.06***
Overweight or higher	0.19	0.23	−0.04***	0.15	0.27	−0.11***
Proportions: Rural Sample						
Underweight or lower	0.24	0.26	−0.01***	0.27	0.23	0.05***
Normal weight	0.62	0.58	0.04***	0.62	0.58	0.04***
Overweight or higher	0.14	0.16	−0.03***	0.10	0.19	−0.11***
Proportions: Urban Sample						
Underweight or lower	0.13	0.13	0.01	0.15	0.09	0.06***
Normal weight	0.57	0.52	0.05***	0.59	0.50	0.09***
Overweight or higher	0.29	0.35	−0.06***	0.26	0.41	−0.15***
Proportion Overweight or Obese. Urban Sample						
Expenditure quartile 1	0.19	0.24	−0.05***	0.14	0.29	−0.15***
Expenditure quartile 2	0.26	0.31	−0.05***	0.21	0.36	−0.15***

(Table 1 Continued)

(Table 1 Continued)

	Males and Female IHDS2			Females Overtime		
Category	Male (1)	Female (2)	Difference (3 = 1 2)	2005 (IHDS1) (4)	2012 (IHDS2) (5)	Difference (6 = 4 5)
Expenditure quartile 3	0.29	0.38	−0.08***	0.29	9.44	−0.15***
Expenditure quartile 4	0.39	0.45	−0.06***	0.38	0.52	−0.14***
No school	0.21	0.30	−0.10***	0.19	0.32	−0.12***
Primary school	0.27	0.36	−0.09***	0.25	0.38	−0.13***
Middle school	0.28	0.36	−0.08***	0.29	0.45	−0.16***
Secondary school or higher	0.39	0.41	−0.01	0.38	0.55	−0.17***
Panel C: Alternative Cut-offs						
Proportions: Full Sample						
Underweight or lower	0.21	0.21	−0.00	0.24	0.18	0.05***
Normal weight	0.46	0.43	0.03***	0.48	0.40	0.08***
Overweight or higher	0.34	0.36	−0.03***	0.28	0.42	−0.13***
Proportions: Rural Sample						
Underweight or lower	0.24	0.26	−0.01***	0.27	0.23	0.05***
Normal weight	0.49	0.46	0.03***	0.51	0.44	0.07***
Overweight or higher	0.27	0.28	−0.02***	0.21	0.33	−0.12***
Proportions: Urban Sample						
Underweight or lower	0.13	0.13	0.01	0.15	0.09	0.06***
Normal weight	0.38	0.36	0.02***	0.42	0.33	0.09***
Overweight or higher	0.48	0.51	−0.03***	0.43	0.58	−0.15***

Source: Authors' computations using the IHDS data.

Notes: See Section II and Note 5 for definitions of the WHO and alternative cut-offs. Sample in columns 1 and 2 restricted to 18–70-year-olds at the time of the survey. IHDS2 data only. Sample in columns 4 and 5 restricted to adult women (18–70 years old) in IHDS1. Significance: *** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$.

Table 2. Determinants of BMI and Overweight. Cross-sectional Analysis

	BMI				Overweight or Obese							
					WHO				Alternative			
	Rural		Urban		Rural		Urban		Rural		Urban	
	Male	Female	Male	Fema	Male	Fema..	Male	Female	Male	Female	Male	Female
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Household Income												
Expenditure quartile 2	0.245**	0.138	0.112	0.316	0.003	0.016*	0.021	0.013	0.018	0.002	0.028	0.024
	(0.090)	(0.086)	(0.173)	(0.191)	(0.008)	(0.008)	(0.019)	(0.017)	(0.012)	(0.011)	(0.027)	(0.018)
Expenditure quartile 3	0.400***	0.467***	0.350*	0.552**	0.015	0.031***	0.015	0.036	0.039	0.035***	0.044**	0.037*
	(0.139)	(0.092)	(0.191)	(0.234)	(0.017)	(0.008)	(0.016)	(0.024)	(0.024)	(0.012)	(0.020)	(0.021)
Expenditure quartile 4	0.709***	0.719***	0.766***	0.825**	0.036***	0.063***	0.056***	0.048	0.070***	0.054***	0.089***	0.058*
	(0.123)	(0.119)	(0.184)	(0.330)	(0.011)	(0.007)	(0.017)	(0.036)	(0.017)	(0.014)	(0.017)	(0.031)
Relative Inequality												
PSU inequality	0.039	0.082	0.053*	0.068**	0.006	−0.001	0.007*	0.006**	0.006	0.013	0.007***	0.003
	(0.088)	(0.105)	(0.028)	(0.024)	(0.009)	(0.005)	(0.004)	(0.002)	(0.009)	(0.008)	(0.002)	(0.002)
Household Infrastructure												
Household has flush toilet	0.604***	0.250	0.466***	0.110	0.035*	0.022	0.026*	−0.002	0.056***	0.033	0.054***	0.014
	(0.168)	(0.171)	(0.087)	(0.158)	(0.019)	(0.019)	(0.014)	(0.015)	(0.019)	(0.027)	(0.013)	(0.016)
Household has piped water	0.327**	0.151	0.177	0.110	0.024*	0.013*	−0.000	0.004	0.047**	0.014	0.019	0.004
	(0.116)	(0.132)	(0.148)	(0.132)	(0.013)	(0.007)	(0.015)	(0.014)	(0.019)	(0.017)	(0.014)	(0.014)
Household owns car	1.115***	0.854***	0.209	0.503***	0.142**	0.080***	0.027	0.050***	0.161***	0.088***	0.014	0.037**
	(0.272)	(0.220)	(0.184)	(0.081)	(0.054)	(0.028)	(0.025)	(0.012)	(0.051)	(0.025)	(0.028)	(0.013)
Household owns motor cycle	0.897***	0.442***	0.839***	0.595***	0.066***	0.025**	0.069***	0.056***	0.086***	0.037***	0.089***	0.066***
	(0.132)	(0.120)	(0.108)	(0.074)	(0.012)	(0.012)	(0.013)	(0.008)	(0.012)	(0.011)	(0.011)	(0.012)

(Table 2 Continued)

(Table 2 Continued)

	BMI				Overweight or Obese							
					WHO				Alternative			
	Rural		Urban		Rural		Urban		Rural		Urban	
	Male	Female	Male	Fema	Male	Fema..	Male	Female	Male	Fema..	Male	Female
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Lifestyle												
Hours watching TV women	0.163***	0.134***	0.117**	0.153***	0.017***	0.009***	0.013**	0.012***	0.016**	0.019***	0.015***	0.012***
(per day)	(0.057)	(0.032)	(0.043)	(0.041)	(0.004)	(0.003)	(0.005)	(0.004)	(0.007)	(0.003)	(0.005)	(0.004)
Hours watching TV men	−0.095**	−0.102	−0.066	−0.099	−0.013**	−0.008*	−0.012**	−0.007	−0.018**	−0.014**	−0.012**	−0.011**
(per day)	(0.040)	(0.061)	(0.044)	(0.059)	(0.004)	(0.004)	(0.005)	(0.005)	(0.007)	(0.006)	(0.006)	(0.005)
Domestic help	−0.199	0.452**	0.715***	0.733***	0.016	0.035	0.110***	0.067***	−0.034	0.056**	0.062**	0.065***
	(0.178)	(0.201)	(0.160)	(0.162)	(0.038)	(0.029)	(0.029)	(0.013)	(0.028)	(0.020)	(0.025)	(0.016)
Constant	14.553***	12.560***	15.682***	12.908***	−0.274***	−0.434***	−0.257***	−0.496***	−0.439***	−0.586***	−0.345**	−0.500***
	(0.582)	(0.483)	(1.310)	(1.092)	(0.070)	(0.073)	(0.086)	(0.074)	(0.078)	(0.088)	(0.142)	(0.072)
Other individual and household controls	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Ramsey RESET test‡	9.72***	23.06***	1.56	18.70***	37.06***	48.62***	6.09***	29.52***	20.11***	28.71***	4.07***	15.61***
Sample size	14,812	23,330	8,935	15,685	14,812	23,330	8,935	15,685	14,812	23,330	8,935	15,685

Source: Authors' computations using the IHDS2 data.

Notes: OLS regression results presented. Dependent variable in columns 5–8 = 1 if BMI ≥ 25. Dependent variable in columns 9–12 = 1 if BMI ≥ 23. Sample restricted to 18–70-year-olds at the time of the survey. IHDS2 data only. Regressions include controls for age, education, marital status, household size, age at first birth, hours per day and days per year worked, part-time and full-time work, household religion, household membership in various groups including *mahila mandals*, trade unions, self-help groups, credit or savings groups and political parties and state dummies. These are not reported in the table. Standard errors clustered at the state level are in parenthesis. ‡Ramsey RESET test (F-test) using fitted values of dependent variable. Significance: *** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$.

III. Patterns of Overweight and Obesity

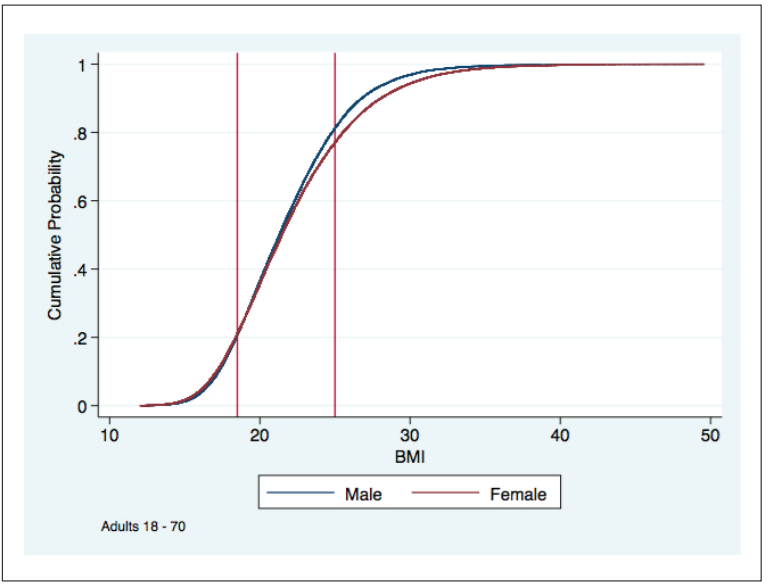
Adult Males and Females: Cross-sectional Analysis

An individual can be categorised into different weight categories based on their BMI, where BMI is defined as the ratio of weight in kilograms to height in meters, squared. The WHO categorises individuals as being underweight (if BMI is less than 18.5), normal weight (if BMI is 18.5 but less than 25), overweight (if BMI is 25 but less than 30), obese (if BMI is 30 but less than 40) or morbidly obese (if BMI is 40 or higher). WHO (2004), however, argues that these general cut-offs might not be appropriate for the Asian population: in particular, Asian populations have different associations between BMI, the percentage of body fat and health risks, as compared to the European population. WHO (2004) suggests different cut-offs so that individuals are underweight if BMI is less than 18.5, normal weight if BMI is 18.5 but less than 23, overweight if BMI is 23 but less than 27.5, obese if BMI is 27.5 but less than 32.5, and morbidly obese if BMI is 32.5 or higher.

We start by analysing patterns for adult males and females (aged 18–70 at the time of the survey) using IHDS2. Proportions in different weight categories in these data are presented in columns 1–3 of Table 1. Average BMI is (statistically) significantly lower for males than for females, and this is true both for the full sample and also separately for the rural and urban residents. Further, the gender difference in BMI is higher for the urban sample compared to the rural sample. Approximately 23 per cent of adult women and 19 per cent of adult men are overweight or obese. While the proportion of those that are underweight or lower is of the same approximate magnitude as these numbers (21% of men and women are categorised as underweight or severely underweight), it is clear that the representation in the upper tail of the BMI distribution in contemporary India is not trivial. The gender-differentiated cumulative density functions (CDF) of BMI presented in Panel A of Figure 2 corroborate these findings. The CDF of BMI for women lies below and to the right of the corresponding CDF for men. This implies that unhealthy weight levels are more pronounced for adult women.

A disaggregation of the rates of overweight and obesity by rural/urban residence reveals that not surprisingly, the proportion of the population that is overweight or obese is higher in urban areas as compared to rural areas. In urban India, up to 35 per cent of adult women and 29 per cent of adult men are either overweight or obese. These proportions are significantly higher than in rural areas where about 16 per cent of women and 14 per cent of men fall in this category. Panel B of Figure 2, which presents the CDFs of BMI separately for males and females by rural/urban residence shows that the distribution of BMI for both urban men and women stochastically dominates the corresponding distribution for rural men and women. Further, as in the case of Panel A in this figure, a larger proportion of women than men fall in the excess weight category regardless of where they live. Columns 1–3 of Table 1 further report that a greater proportion of men are of normal weight, both in urban and rural areas. Women are significantly more likely

Panel A. Full Sample



Panel B. By Rural/Urban Residence

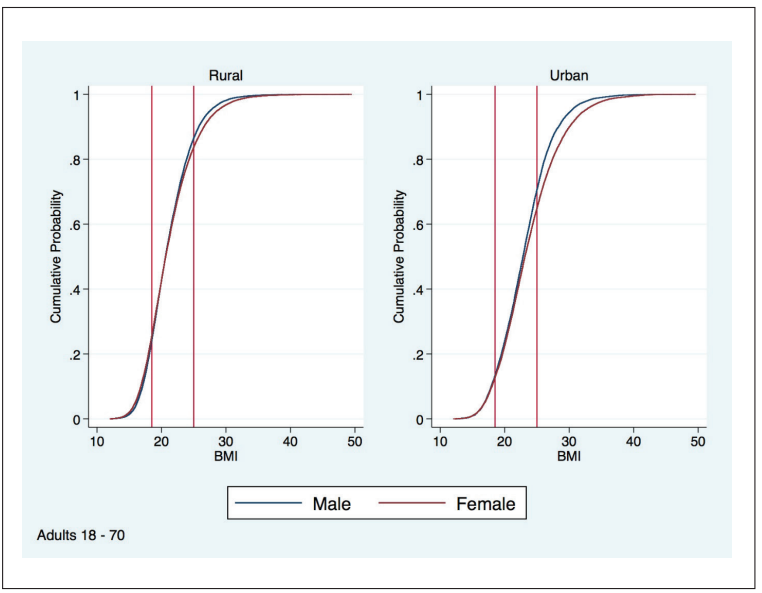


Figure 2. Overall Patterns: Males and Females Aged 18–70 Years. Cumulative Density Functions

Source: The authors.

Note: Authors' calculations are based on individuals aged 18–70 years in IHDS2.

to be underweight and lower in rural areas, though in the urban areas there is no discernible gender difference in the proportion of individuals who are underweight.

Columns 1–3 of Table 1 also present the patterns of overweight and obesity by expenditure quartiles. These are presented only for the urban sample given that excess weight is more of an urban problem. We see a positive association between spending and excess weight. In particular, increase in income of the household is monotonically associated with increases in the likelihood of the individual being overweight or obese. While 24 per cent of women in households that are in the first quartile of the expenditure distribution are overweight or obese, this proportion rises to 45 per cent for women in households that are in the highest quartile of the expenditure distribution. The corresponding proportions for men are 19 per cent and 39 per cent. At every quartile, women are significantly more likely to be overweight or obese than men.

Panel C of Table 1 reports results using alternate cut-offs that are discussed earlier. This alternative categorisation leads to larger proportions of those in the highest weight category (and smaller proportions in the normal weight category). This suggests that using the standard cut-offs leads to significant underestimation of the proportion of the population that is overweight or obese. For example, in urban India, the proportion of women categorised as overweight or obese using the alternate definition is 16 percentage points higher than under the WHO categorisation.

Adult Females over Time: Panel Analysis

Proportions in different weight categories in the panel sample are presented in columns 4–6 of Table 1. The average BMI for these women has increased from 21.38 to 22.62 over the seven-year period between IHDS1 and IHDS2, and the increase is statistically significant (see top panel). Disaggregating the overall sample into rural and urban components, while the average BMI has increased for both samples, the increase is somewhat greater in the urban sample (7%) compared to the rural sample (5%).

Columns 4–6 of Table 1 report proportions in various weight categories by WHO cut-offs. It is clear that in the full panel sample, the proportion of both underweight or lower and normal weight has declined over time. In particular, while 61 per cent of women were in the normal weight category in IHDS1, this proportion had declined to 55 per cent by IHDS2. The decline in the underweight or lower category over time is of a similar magnitude moving from 24 per cent in the first round to 18 per cent in the second. The category that has shown a substantial increase over this period is overweight and the obese. While 15 per cent of adult women were overweight or obese in IHDS1, this proportion had almost doubled to 27 per cent by IHDS2. Examining trends separately in rural and urban samples reveals that the proportion of women in the overweight or higher category is larger in urban areas where 26 per cent of adult women were in this category in IHDS1, with an increase in this proportion to 41 per cent seven years later. The concomitant increase in rural areas is from 10 per cent to 19 per cent

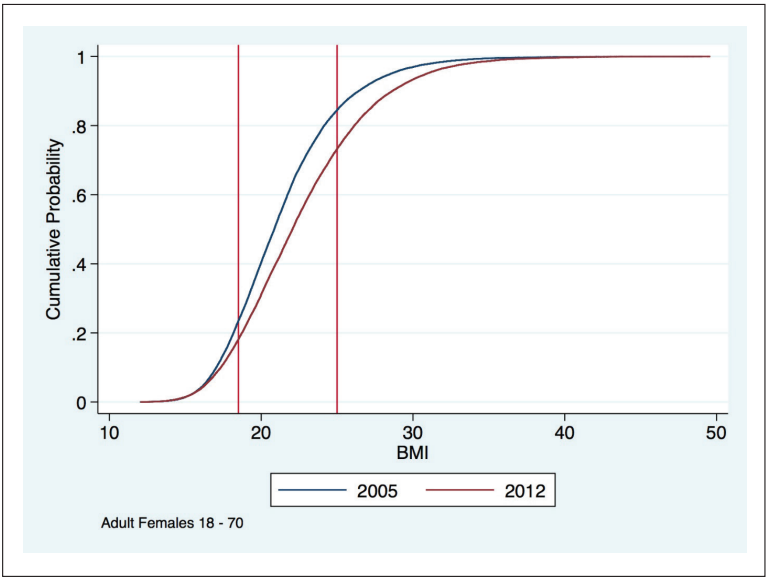
which, although still substantial, is of smaller magnitude. The time-differentiated CDFs for BMI in Panel A of Figure 3 echo these findings. Further, it is evident that the proportions obtained by focusing on those that fall above the cut-off for being overweight or obese in both rural and urban areas in Panel B of Figure 3 closely match the corresponding averages presented in columns 4–6 of Table 1. In particular, Panel B reports that whereas about 25 per cent of urban women were overweight or obese in IHDS1, this proportion had risen to close to 40 per cent by IHDS2. That is, about two in every five adult women in urban India in 2012 were too heavy for their height. This is a staggering proportion for a low–middle income country.

Table 1 also reports proportions calculated using the alternative cut-offs described earlier. Not surprisingly, the observed proportions of overweight or obese are considerably higher if we use these alternative thresholds. In particular, estimates for the full sample indicate that the proportion of adult women in the highest weight category has increased from 28 per cent in IHDS1 to 42 per cent in IHDS2.

The panel data facilitates an examination of transition patterns from IHDS1 to IHDS2. The transition across weight categories over the two survey rounds is presented in Figure 4. Panel A shows estimates from a transition matrix that tracks changes in a woman's weight over the seven-year time span. In rural areas, the proportion that is overweight or obese in 2012 given that they were of normal weight in IHDS1 is 19 per cent. Alternatively, 69 per cent of those who were overweight or obese in IHDS1 remained in the same category in IHDS2. In urban areas, the extent of movement to the overweight or obese category is larger. Of those who were of normal weight in IHDS1, 35 per cent have transitioned to the excess weight category by IHDS2. A total of 73 per cent of those who were overweight or obese in IHDS1 have remained so in IHDS2. These estimates thus underline that movement into the excess weight category is rapid and once achieved, is lasting. This is true in both rural and urban areas. Additionally, for those who were already in the highest weight category in IHDS1, there is considerable persistence especially in urban settings.

For a continuous version of these transitions, we focus on the LOWESS plots in Panel B of Figure 4. One may consider these graphs as linear versions of the transition matrices presented in Panel A. It is clear that there is a strong positive and systematic relationship between BMI in IHDS1 and IHDS2. This relationship is stronger for the urban sample. The proportions underlying these relationships reveal that 40 per cent of urban women who were normal weight in IHDS1 are overweight or obese in IHDS2, and about 12 per cent of women who were underweight in IHDS1 are in the highest weight group seven years later. Figure 4 also shows that the association for BMI for rural women becomes flatter as compared to the association for urban women at higher thresholds of BMI. This suggests that there is some levelling off of the positive relationship between weights at two points in time for the same adult woman in rural areas. In urban areas, however, there is little comparable decline in slope that is evident, indicating that BMI in IHDS1 remains a strong predictor of BMI for these women in IHDS2.

Panel A. Full Panel Sample



Panel B. By Rural/Urban Residence

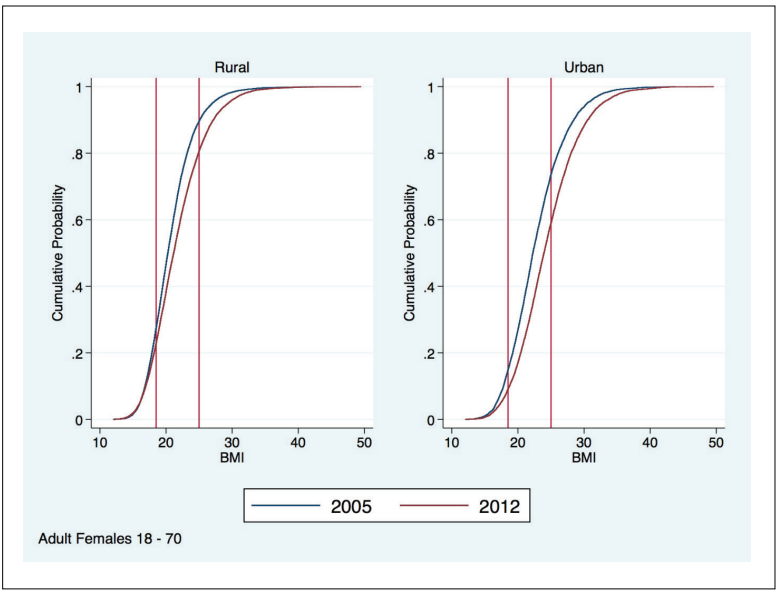


Figure 3. Patterns over Time: Females Aged 18–70 Years in the Panel Sample: Cumulative Density Functions

Source: The authors.

Note: Authors' calculations based on women 18–70 years in IHDS1 who are tracked in IHDS2.

Panel A. Transition by Weight Category

Panel B. LOWESS Plots

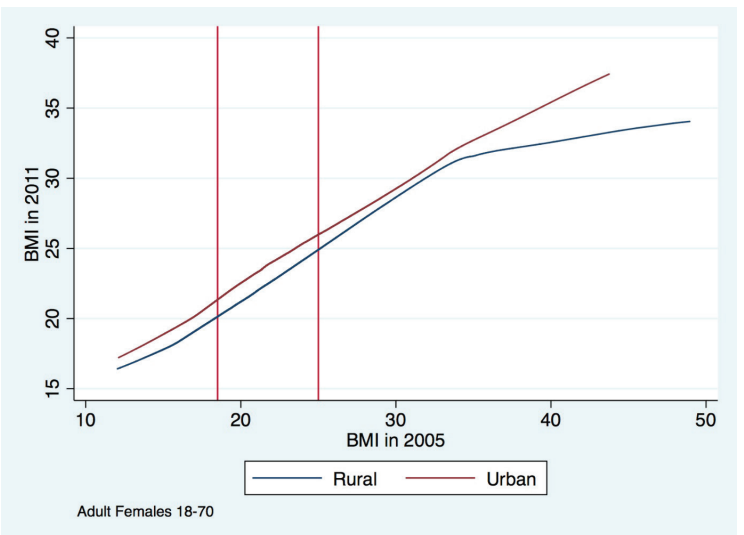


Figure 4. Transition across Weight Categories: Females Aged 18–70 Years in the Panel Sample, Rural/Urban Residence

Source: The authors.

Note: Authors' calculations based on women 18–70 years in IHDS1 who are tracked in IHDS2.

IV. Multivariate Regression Approach

Cross-sectional Analysis: Adult Males and Females, 2012

We gain a more rigorous understanding of the factors that are correlated with adult and adolescent weight by running regressions of the following form:

$$W_{ih} = \beta_0 + \beta_1 X_{ih} + \varepsilon_{ih} \quad (1)$$

where W_{ih} is the weight status of individual i in household h. We consider a number of different outcome variables including BMI and the likelihood of being overweight or obese (using the two different cut-offs for categorisation of overweight or obese following WHO and alternative thresholds). The set of explanatory variables (X_{ih}) includes individual, household and community characteristics. Individual characteristics consist of age, gender, educational attainment, marital status and employment status, including sector of employment and age at first birth for women. Household characteristics consist of income of the household (captured by per capita household expenditure), religion and caste of the household head, household size, household assets, household's access to infrastructure and lifestyle variables (average hours spent by men and women watching television, presence of domestic help, share of expenditure on processed food and the share of expenditure on eating out). Community characteristics include cluster level inequality to capture the notion of social desirability which is relevant in India—in poorer and in more unequal societies, weight is traditionally viewed as a signal of prosperity. All regressions include state fixed effects and are weighted using sampling weights provided in the data. Standard errors are clustered at the state level.

Regression results using the IHDS2 cross-sectional data are presented in Table 2. Regressions are run separately for four different samples (rural males, rural females, urban males and urban females) and for three different outcome variables. In columns 1–4, the dependent variable is the BMI of individual i in household h. Columns 5–8 have as dependent variable an indicator that takes the value of 1 if the individual is overweight or obese (BMI is greater than 25) and 0 otherwise, and columns 9–12 replicate the analysis of columns 5–8 using the alternative (lower) cut-off for being overweight or obese (BMI is greater than 23). Given our focus on the effect of household income/wealth and lifestyle choices, Table 2 reports results for these variables from the estimations.[5]

We start with a discussion of the results for BMI in columns 1–4 of Table 2. It is clear that an increase in income of the household is associated with an increase in BMI. In particular, in all four samples, average BMI is monotonically increasing with increase in household income, with higher expenditure quartiles consistently associated with higher BMI. Household infrastructure (access to flush toilet and piped water) is associated with an increase in BMI for males, and this is stronger for rural residents where these facilities may be less abundant. Household ownership of a car or motorcycle is also associated with an increase in BMI for both rural and urban residents, irrespective of gender. An increase in local inequality (captured by PSU level inequality) increases BMI for urban males and females, though the magnitude of the coefficient is larger for females.

Household lifestyle variables are strongly correlated with BMI. An increase in average hours per day spent by women watching television has a large and statistically significant positive effect on the BMI of both men and women. Hours spent watching television by women increases BMI across the four samples. However, a rise in the average hours per day spent by men watching television is not associated with an increase in BMI, the exception being rural males where the effect is negative. If time spent watching television is correlated between men and women, this could potentially explain why hours spent by women increases BMI for both men and women in rural and urban samples. Alternatively, hours spent by men alone (over and above the hours spent by women) may proxy for labor–leisure tradeoffs where more time spent watching television results in fewer hours at work. With the exception of rural males, the presence of domestic help is associated with a large increase in BMI, and the effect is particularly strong in urban households.

Columns 5–8 of Table 2 report results that are similar to those presented in columns 1–4. The association between household expenditure and the likelihood of being overweight or obese is weaker than in the case of BMI but still evident for the highest expenditure quartile across all groups except urban women. Household infrastructure as measured by access to flush toilets and piped water has an effect on the likelihood of being overweight or obese mainly in rural areas. Ownership of car and motorcycle continues to have a positive impact for both rural and urban households. For both males and females in the urban sample, an increase in local inequality is associated with an increase in the likelihood of being overweight or obese. Lifestyle variables continue to be significant. An increase in average hours per day spent by women watching television is associated with a large and statistically significant increase in the likelihood of being overweight or obese, irrespective of sector of residence. On the other hand, an increase in the average hours per day spent by men watching television is negatively associated with the likelihood of being overweight or obese; for urban women, this relationship is not statistically significant. The presence of domestic help has a positive effect on the likelihood of excess weight but only in urban areas.

Columns 9–12 of Table 2 replicate the results for the likelihood of being overweight or obese using the alternative cut-offs. It is clear that many of the results are similar to those presented in columns 5–8. In general, using the higher WHO cut-offs introduces a conservative bias in our results (using the alternative cut-offs only strengthens our results).[6]

Panel Analysis: Adult Females over Time

We take advantage of the panel nature of the IHDS surveys to control for unobservables that may be simultaneously correlated with the error term and the variables of interest. However, as noted earlier, the first round of the IHDS survey did not systematically collect information on weight and height of males. Therefore, we are unable to examine trends in rates of overweight and obesity for males across both rounds and restrict our analysis of these measures to women.

The patterns for the panel sample are also examined using multivariate regressions. Specifically, we run regressions of the following form:

$$W_{ih,t} = \beta_0 W_{ih,t-1} + \beta_2 X_{ih,t} + \varepsilon_{ih,t} \quad (2)$$

Where $W_{ih,t}$ is the weight status in period t while $W_{ih,t-1}$ is the weight status of that individual in period $t - 1$. The other explanatory variables in Equation (2) are the same as those in Equation (1).

Table 3. Determinants of BMI by Rural/Urban Residence. Adult Women over Time

			Overweight or Obese			
	BMI		WHO		Alternative	
	Rural	Urban	Rural	Urban	Rural	Urban
	(1)	(2)	(3)	(4)	(5)	(6)
BMI in 2005	0.627***	0.586***	0.047***	0.047***	0.055***	0.045***
	(0.029)	(0.080)	(0.002)	(0.005)	(0.003)	(0.005)
Household Income						
Expenditure quartile Q2	−0.000	0.290*	0.006	−0.005	−0.009	0.017
	(0.132)	(0.163)	(0.013)	(0.018)	(0.020)	(0.023)
Expenditure quartile Q3	0.253*	0.260	0.010	0.004	0.017	0.007
	(0.125)	(0.203)	(0.011)	(0.031)	(0.018)	(0.029)
Expenditure quartile Q4	0.256*	0.495	0.012	0.001	0.024	0.036
	(0.127)	(0.319)	(0.014)	(0.043)	(0.024)	(0.033)
Relative Inequality						
PSU inequality	0.008	0.053***	0.001	0.002	0.003	0.002
	(0.050)	(0.015)	(0.007)	(0.002)	(0.005)	(0.001)
Household Infrastructure						
Household has a flush toilet	0.100	−0.091	0.036	−0.019	0.009	−0.007
	(0.258)	(0.103)	(0.025)	(0.016)	(0.024)	(0.018)
Household has piped water	0.078	−0.032	0.007	−0.005	0.008	−0.007
	(0.150)	(0.128)	(0.011)	(0.013)	(0.018)	(0.012)

(Table 3 Continued)

(Table 3 Continued)

			Overweight or Obese			
	BMI		WHO		Alternative	
	Rural	Urban	Rural	Urban	Rural	Urban
	(1)	(2)	(3)	(4)	(5)	(6)
Household owns a car	0.504*	0.297*	0.029	0.050**	0.046	0.043**
	(0.288)	(0.148)	(0.034)	(0.022)	(0.027)	(0.019)
Household owns a motor cycle	0.407***	0.393***	0.031**	0.049***	0.038**	0.056**
	(0.126)	(0.086)	(0.013)	(0.011)	(0.014)	(0.022)
Lifestyle						
Hours watching TV women	0.139**	0.186***	0.010*	0.013***	0.020***	0.017***
(per day)	(0.051)	(0.056)	(0.005)	(0.005)	(0.006)	(0.005)
Hours watching TV men	−0.125*	−0.148**	−0.011**	−0.008	−0.014	−0.012**
(per day)	(0.071)	(0.066)	(0.004)	(0.007)	(0.009)	(0.006)
Domestic help	−0.102	0.397*	0.005	0.034	−0.015	0.043**
	(0.306)	(0.224)	(0.039)	(0.021)	(0.036)	(0.020)
Constant	3.231*	5.571***	−1.156***	−1.236***	−1.445***	−1.025***
	(1.575)	(1.727)	(0.138)	(0.164)	(0.220)	(0.140)
Includes other individual and household controls	YES	YES	YES	YES	YES	YES
Ramsey RESET test‡	34.49***	1.70	139.71***	45.91***	112.37***	82.04***
Sample size	11,208	7,081	11,208	7,081	11,208	7,081

Source: The authors (computations done using the IHDS data).

Notes: OLS regression results presented. Dependent variable in columns 5–8 = 1 if BMI ≥ 25. Dependent variable in columns 9–12 = 1 if BMI ≥ 23. Sample restricted to adult women (18–70 years old) in IHDS1 who are tracked in IHDS2. Regressions include controls for age, education, marital status, household size, age at first birth, hours per day and days per year worked, part-time and full-time work, household religion, household membership in various groups including *mahila mandals*, trade unions, self-help groups, credit or savings groups and political parties and state dummies. These are not reported in the table. Standard errors clustered at the state level are in parenthesis. ‡Ramsey RESET test (*F*-test) using fitted values of dependent variable. Significance: *** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$.

The regression results for the determinants of BMI in rural and urban areas in the panel sample of adult women are presented in columns 1 and 2 of Table 3. Although many of these results are similar to ones documented in the cross-sectional analysis, the panel sample has the advantage that we are able to condition on the woman's BMI status in IHDS1. It is clear that lagged BMI is a strong positive predictor of current BMI for adult women, with the rural estimate slightly larger than the urban estimate. BMI is systematically higher for those residing in richer households as measured by quartiles of the expenditure distribution. Further, owning assets such as a car or a motorcycle has significant positive impacts on BMI. Our measure of local (relative) inequality indicates that in urban areas, specifically, higher levels of inequality are associated with increased BMI. This is again consistent with a demonstration or conspicuous consumption effect where higher weight is used to signal greater household prosperity.

An increase in the number of hours per day spent watching TV by women is significantly correlated with increased BMI. This is again indicative of sedentary lifestyle choices contributing to increases in weight. The number of hours of TV watched by men is also significant but has a dampening effect on the BMI of adult women in both rural and urban areas. An explanation for this may be as discussed earlier. Hours spent watching TV for women has a positive impact on their BMI as before. Presence of household help is significantly predictive of increased BMI but only in urban areas.

Columns 3 and 4 of Table 3 report results when the dependent variable is replaced by an indicator variable for overweight or obese weight status. Columns 5 and 6 present the corresponding results when the categorisation of overweight or obese is defined using the alternative cut-offs. The results, using either definition, tell the same story as those in columns 1 and 2. Lagged BMI is strongly predictive of current overweight or obese status across all columns in Table 3. Ownership of car and motorcycles is again strongly positive in columns 3 and 4. The number of hours of TV watched by women continues to have a significant positive impact while men's hours seem to matter less. The availability of domestic help has an impact only in the urban sample that uses the alternate weight cut-offs.

V. Health Outcomes for Adult Women

One of the main motivations underlying our interest in the topic of excess weight is its impact on health. There is evidence that non-communicable diseases (NCD) such as hypertension, diabetes and cardio-vascular diseases are increasing in India and have exacted a substantial toll on mortality and disability (Pathak & Singh, 2011; Upadhyay, 2012). Medical evidence indicates that important risk factors for these diseases include overweight or obese status (Chopra, Misra, Gulati, & Gupta, 2013; Hassanzadeh, Mohammadbeigi, Eshrati, & Moemenbellah-Fard, 2012).

We examine the effect of being overweight or obese on a set of health outcomes in this section of the article. Both rounds of the IHDS survey collect information on

the incidence of non-communicable diseases including high blood pressure, heart disease and diabetes. Summary statistics presented in Table 4 show that in the full sample about 56 per cent of adult women suffer from high blood pressure. The proportion that suffers from heart disease and diabetes is 1.1 per cent and 2.6 per cent, respectively. Disaggregation by location reveals that the incidence of these diseases is relatively low in rural areas as compared to urban areas. In particular, 7.8 per cent of adult women report experiencing high blood pressure in urban locales, the corresponding proportion in rural settings is 4.4 per cent. The rates of heart disease and diabetes in rural areas are significantly lower as well. More specifically, while about 1.5 per cent report suffering from heart disease and 4.2 per cent report diabetes in urban settings, these proportions are 1 per cent and 1.4 per cent in rural locations, respectively. The patterns for men are similar: 5.7 per cent of urban men report high blood pressure, 1.8 per cent report heart disease and 5.3 per cent report diabetes. The corresponding percentages are 2.7 per cent, 1 per cent and 1.9 per cent in the rural areas. For the full sample and also separately for the urban and rural samples, the proportion of women reporting high blood pressure exceeds the corresponding proportion of men (differences are highly statistically significant in column 3 of Table 4). There is no gender difference with respect to rates of reporting heart disease. However, column 3 of Table 4 shows that for all three samples, the proportion of men reporting diabetes is significantly higher than the proportion of women who report this NCD.

Panels A–C of Figure A2 shows the state-wise proportion of individuals with high blood pressure, heart disease and diabetes, respectively. In general, the incidence of these NCDs is higher in urban settings than in rural ones and positively associated with the proportion overweight or obese at the state level. For example, high blood pressure and diabetes are relatively high in rural Delhi which ranks at the top of the distribution when it comes to excess weight in rural settings. Further, the incidence of heart disease is the highest in urban Jammu and Kashmir which is ranked second highest in the proportion that is overweight or obese in urban areas. Beyond this, no clear differential pattern by gender and area of residence is evident in the incidence of these NCDs across states.

Table 4. Incidence of Non-communicable Diseases: Males and Females, IHDS2

Category	Male (1)	Female (2)	Difference (3 = 1 – 2)
Panel A			
Proportion reporting high blood pressure	0.037	0.056	−0.019***
Proportion reporting high blood pressure rural sample	0.027	0.044	−0.017***
Proportion reporting high blood pressure urban sample	0.057	0.078	−0.021***

(Table 4 Continued)

(Table 4 Continued)

Category	Male (1)	Female (2)	Difference (3 = 1 – 2)
Panel B			
Proportion reporting heart disease	0.013	0.011	0.001
Proportion reporting heart disease rural sample	0.010	0.009	0.000
Proportion reporting heart disease urban sample	0.018	0.015	0.003
Panel C			
Proportion reporting diabetes	0.030	0.026	0.006***
Proportion reporting diabetes rural sample	0.019	0.014	0.005***
Proportion reporting diabetes urban sample	0.053	0.042	0.011***

Source: The authors (computations done using the IHDS2 data).

Notes: In columns 1–3, sample restricted to males and females aged 18–70 years in IHDS2. Significance: *** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$.

We use a multivariate regression framework to examine the effects of excess weight on health in a systematic manner. We focus only on the panel sample of women. This allows us to condition on the past weight status of individuals which is important. The regression takes the following form:

$$H_{ih,t} = \gamma_0 + \gamma_1 W_{ih,t-1} + \gamma_2 Z_{ih,t} + \upsilon_{ih,t} \quad (3)$$

where $H_{ih,t}$ is the self-reported health outcome of individual i in household h at time t (IHDS2), and $W_{ih,t-1}$ is the individual's weight status in time (IHDS1). $Z_{ih,t}$ includes a set of individual, household and community controls (as in the previous regressions) that are also likely to affect health. While $W_{ih,t-1}$ in Equation (3) may not be completely exogenous to health outcomes in time t, we believe that the issue is of small order for two reasons. First, these are not contemporaneous variables. For the same woman, approximately six to seven years separate the points in time at which the weight category is measured and when the health outcome is evaluated. Second, we bootstrap the standard errors across all health regression models in order to ensure that these are adjusted for model misspecification (Papke & Wooldridge, 2008). Table 5 reports the results.

It is evident from Table 5 that being overweight or obese in IHDS1 has a positive and significant impact on the current incidence of blood pressure and diabetes, regardless of location. The magnitude of the coefficients indicates that effects in rural areas are larger than those in urban settings controlling for all other covariates in these models. In particular, being categorised as overweight or obese in IHDS1 raises the current probability of reporting high blood pressure by about

Table 5. Health Outcomes by Rural/Urban Residence: Adult Women over Time

	BP		Heart Disease		Diabetes	
	Rural	Urban	Rural	Urban	Rural	Urban
	(1)	(2)	(3)	(4)	(5)	(6)
Overweight or obese in 2005	0.071***	0.047***	0.006	0.003	0.046***	0.038***
	(0.014)	(0.008)	(0.005)	(0.004)	(0.009)	(0.007)
Household Income						
Expenditure quartile Q2	0.000	0.013	−0.002	0.005	−0.005	0.003
	(0.007)	(0.009)	(0.004)	(0.004)	(0.004)	(0.007)
Expenditure quartile Q3	0.006	0.012	−0.001	0.014***	−0.002	−0.000
	(0.009)	(0.009)	(0.004)	(0.005)	(0.005)	(0.008)
Expenditure quartile Q4	0.015	0.023*	0.004	0.013**	0.003	0.010
	(0.011)	(0.012)	(0.004)	(0.005)	(0.006)	(0.009)
Relative Inequality						
PSU inequality	−0.000	0.001	0.001	−0.001*	0.003	0.003
	(0.004)	(0.002)	(0.002)	(0.000)	(0.003)	(0.002)
Household Infrastructure						
Household has a flush toilet	0.010	−0.003	0.000	0.002	0.004	−0.006
	(0.016)	(0.009)	(0.006)	(0.004)	(0.010)	(0.006)
Household has piped water	0.004	−0.011	−0.008**	−0.003	−0.006*	0.002
	(0.007)	(0.008)	(0.003)	(0.003)	(0.003)	(0.006)
Household owns a car	−0.014	−0.007	0.001	0.003	−0.002	−0.009
	(0.017)	(0.014)	(0.008)	(0.006)	(0.013)	(0.010)
Household owns a motor cycle	0.007	−0.010	−0.002	−0.005	0.010**	0.004
	(0.008)	(0.008)	(0.004)	(0.004)	(0.004)	(0.006)
Lifestyle						
Hours watching TV women	0.002	0.004	0.001	−0.000	0.001	−0.001

(Table 5 Continued)

(Table 5 Continued)

	BP		Heart Disease		Diabetes	
	Rural	**Urban**	**Rural**	**Urban**	**Rural**	**Urban**
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
(per day)	(0.003)	(0.003)	(0.001)	(0.001)	(0.002)	(0.002)
Hours watching TV men	0.002	−0.005*	0.001	−0.001	−0.002	0.002
(per day)	(0.004)	(0.003)	(0.002)	(0.001)	(0.002)	(0.003)
Domestic help	−0.014	0.022	−0.013***	0.008	0.023	−0.008
	(0.017)	(0.016)	(0.003)	(0.007)	(0.017)	(0.010)
Constant	−0.006	0.368***	−0.014	0.122***	−0.012	0.147**
	(0.077)	(0.102)	(0.035)	(0.046)	(0.044)	(0.071)
Other individual and household controls	YES	YES	YES	YES	YES	YES
Sample size	11,208	7,081	11,208	7,081	11,208	7,081

Source: The authors (computations done using the IHDS data).

Notes: Sample restricted to adult women (18–70 years old) in IHDS1. OLS regression results presented. Dependent variable in columns 1–2 = 1 if individual reports high blood pressure, dependent variable in columns 3–4 = 1 if individual reports heart disease, and dependent variable in columns 5–6 = 1 if individual reports diabetes. Regressions include controls for age, education, marital status, household size, age at first birth, hours per day and days per year worked, part-time and full-time work, household religion, household membership in various groups including *mahila mandals*, trade unions, self-help groups, credit or savings groups and political parties and state dummies. These are not reported in the table. Bootstrapped standard errors are in parenthesis. Significance: *** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$.

7 per cent in rural areas and 5 per cent in urban areas. The corresponding proportionate increases for diabetes are 5 per cent and 4 per cent in rural and urban areas, respectively. Surprisingly, past categorisation in this highest weight status does not appear to increase the incidence of heart disease. It is possible that heart disease is driven relatively equally by genetic factors as well as nutritional and lifestyle factors, especially at ages of 65 years or younger (Marenberg, Risch, Berkman, Floderus, & deFaire, 1994).

The wealth of the household as measured by categorisation into higher expenditure quartiles and household infrastructure have only weak impacts. The availability of domestic help reduces heart disease in rural areas. It appears that conditional on the individual's overweight or obese status in IHDS1, the remaining variables have low power in explaining current health outcomes.

In order to explore why expenditure quartiles have relatively weak impacts, we interact overweight status in IHDS1 with the highest wealth category (fourth expenditure quartile) in IHDS2 and include this interaction term along with all

other controls from before. These results are presented in Table A3 in Appendix A. It is clear that including the interaction does not change our original results in Table 5. In particular, lagged overweight or obese status remains a significant determinant of blood pressure and diabetes in both rural and urban areas, even though the magnitude of the coefficients change slightly. Further, five of the six interaction terms are measured with error indicating that there are few differential patterns along this channel.

VI. Conclusion and Implications for Policy

As erstwhile low-income countries grow richer, they are beginning to exhibit First World problems of excess weight and the resulting phenomenon of acceleration in the incidence of NCDs such as diabetes, heart disease and blood pressure. This study shows that these trends are relevant to India. We document the extent of high weight levels across the country and chart out gradients along different dimensions. It is clear that along with a substantial proportion of its population suffering from malnutrition, India has the dubious distinction of having a sizeable share of its people exhibiting unhealthily high weight levels. Our results reveal that important correlates of excess weight include income, sedentary lifestyles and cultural factors that include viewing weight as a signal of prosperity. Lack of physical activity and easier access to unhealthy foods fuelled by an increase in discretionary spending may also be explanatory factors.

The topic of weight is of critical importance for many reasons including the fact that the health implications of an overweight population are severe. Excess weight is significantly associated with diseases such as diabetes, blood pressure and the incidence of heart attacks. Controlling for time-invariant unobservables in a panel framework, our analysis indicates that being overweight or obese in the past is significantly associated with reporting high blood pressure and diabetes currently by adult women, regardless of rural or urban setting. Further, given changes in activity levels and metabolic functions, implications for the elderly, an age group that we do not study explicitly in this article, are likely to be even more severe. Hence, the importance of drawing attention to this topic in the context of India where resources are constrained and health infrastructure is limited cannot be over-emphasised.

Studies including Khandelwal and Reddy (2013) notes that in terms of policy implications, small steps have been taken in the spheres of regulating fast food and beverages, restricting advertisements on TV which primarily target children and increasing transparency on the nutritional content of foods through labelling guidelines. However, these have largely been ineffectual for a variety of reasons including lack of dedicated resources and focused actions. Romling and Qaim (2011) encourages additional nutritional awareness and explicitly state that given the unique circumstances that women face in developing countries, they should be the focus of most policy interventions. Gaiha et al. (2010) note the defining role of food prices in mediating consumption patterns, focusing in particular on price-induced substitution between goods that significantly change the intake of

calories, proteins and fats. A policy implication of that study is the use of price subsidies to influence consumption patterns, although the study recognises that with cross- and own-price effects, it is hard to pin down how subsidies may affect food intake patterns.

Building on the aforementioned, the role of Government in shaping the dialogue and pursuing priorities in this area is crucial. Key policy actors face the responsibility of disseminating information on the dangers of excess weight and enacting policies to curtail the situation. The 'fat tax' that the government of Kerala imposed in 2016 seems appropriate given the pervasiveness of the problem. More specifically, this is a 14.5 per cent tax surcharge on foods such as pizzas, burgers, doughnuts, pasta and tacos sold by 'branded' restaurants that include fast-food outlets like McDonalds, Pizza Hut, Dominos, Subway and others. However, critics have argued that in of itself, such initiatives may prove to be insufficient as they are partial (does not deal with other risk factors such as salt and trans-fats) and discriminatory ('Western' foods are not the only contributors to obesity). Strategies to encourage more active lifestyles may be more valuable. Initiatives in this vein include concessions for gym memberships, adequate time in school for children to engage in physical exercise, group programmes tailored to urban women to encourage increased activity and establishment of green spaces and exercise facilities when new buildings and complexes are commissioned. A multi-pronged effort of this nature may be more successful in stemming the tide of excess weight that is rising in India.

Appendix

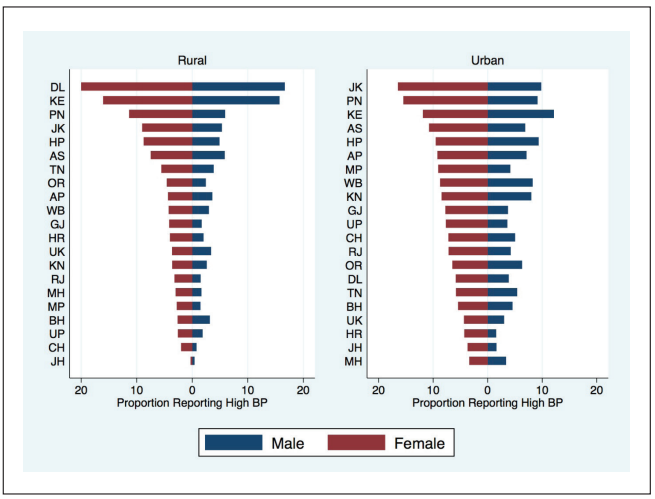
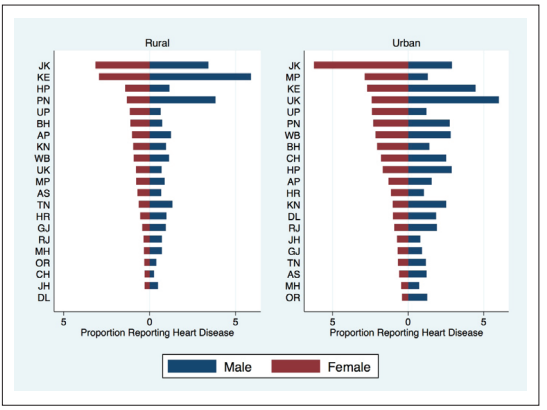


Figure A1. State-specific Disaggregation of Proportion Overweight or Obese by Gender and Rural/Urban Residence: IHDS2

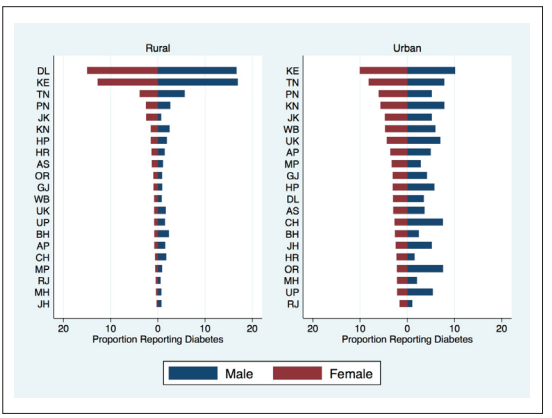
Source: The authors.

Notes: Overweight or obese defined using the WHO categorisation (BMI ≥ 25). Sample restricted to individuals 18–70 years old in IHDS2.

Panel A. Proportion Reporting High Blood Pressure



Panel B. Proportion Reporting Heart Disease



Panel C. Proportion Reporting Diabetes

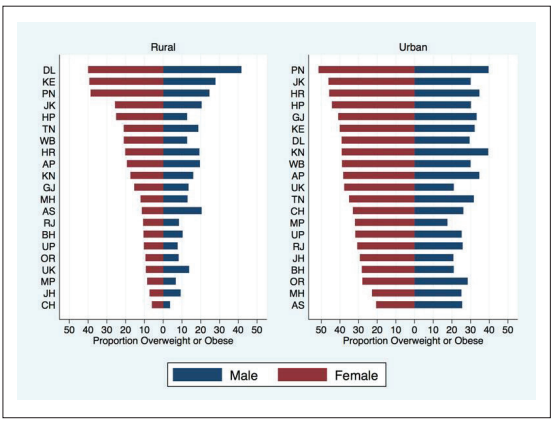


Figure A2. State-specific Disaggregation of Reporting Non-communicable Diseases by Gender and Rural/Urban Residence: IHDS2

Source: The authors.

Table A1. Descriptive Statistics: Cross-sectional Sample

	All		Rural				Urban			
			Male		Female		Male		Female	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Individual Level Characteristics										
Age/10	3.93	1.38	4.15	1.47	3.79	1.32	4.03	1.45	3.87	1.30
Female	0.62	0.49								
Married	0.77	0.42	0.80	0.40	0.76	0.43	0.73	0.44	0.77	0.42
No school	0.34	0.47	0.27	0.45	0.50	0.50	0.10	0.30	0.23	0.42
Primary school	0.16	0.37	0.19	0.39	0.16	0.37	0.13	0.34	0.14	0.35
Middle school	0.43	0.49	0.47	0.50	0.32	0.47	0.58	0.49	0.51	0.50
Secondary school or higher	0.07	0.26	0.06	0.24	0.02	0.15	0.19	0.39	0.12	0.32
Age at first birth 16–20	0.17	0.38			0.29	0.45			0.25	0.43
Age at first birth 21–25	0.19	0.39			0.29	0.45			0.33	0.47
Age at first birth 26–30	0.07	0.26			0.11	0.31			0.13	0.34
Age at first birth 31–35	0.03	0.16			0.04	0.20			0.04	0.19
Household Level Characteristics										
Urban residence	0.32	0.47								
Household size	5.70	2.69	5.65	2.64	5.82	2.78	5.45	2.50	5.68	2.63
Hindu	0.83	0.38	0.85	0.36	0.84	0.36	0.80	0.40	0.78	0.41
Muslim	0.11	0.32	0.09	0.29	0.10	0.30	0.14	0.35	0.16	0.36
Christian	0.02	0.15	0.02	0.13	0.02	0.13	0.03	0.18	0.03	0.18
Household has flush toilet	0.08	0.27	0.03	0.18	0.03	0.18	0.17	0.37	0.18	0.39
Household has piped water	0.45	0.50	0.32	0.47	0.32	0.47	0.72	0.45	0.71	0.45
Household owns car	0.04	0.19	0.02	0.15	0.02	0.15	0.07	0.26	0.07	0.26
Household owns motor cycle	0.30	0.46	0.23	0.42	0.22	0.41	0.49	0.50	0.46	0.50
Hours watching TV per day: men	1.73	1.16	1.67	1.16	1.64	1.13	1.88	1.17	1.86	1.21
Hours watching TV per day: women	2.36	1.48	2.14	1.44	2.15	1.43	2.72	1.42	2.70	1.51

(Table A1 Continued)

(Table A1 Continued)

	All		Rural				Urban			
			Male		Female		Male		Female	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Domestic help	0.03	0.18	0.02	0.14	0.02	0.14	0.06	0.24	0.07	0.25
Expenditure quartile Q1	0.23	0.42	0.23	0.42	0.24	0.43	0.20	0.40	0.21	0.41
Expenditure quartile Q2	0.25	0.43	0.24	0.43	0.25	0.43	0.24	0.43	0.25	0.43
Expenditure quartile Q3	0.26	0.44	0.26	0.44	0.25	0.43	0.27	0.44	0.27	0.44
Expenditure quartile Q4	0.27	0.44	0.27	0.45	0.26	0.44	0.29	0.45	0.27	0.44
Share of Expenditure on										
Processed food	0.11	0.10	0.11	0.10	0.11	0.10	0.11	0.09	0.11	0.09
Eating out	0.04	0.10	0.03	0.09	0.03	0.10	0.06	0.11	0.06	0.12
PSU/ Cluster Level Characteristics										
PSU inequality	0.70	1.08	0.60	0.67	0.60	0.66	0.91	1.72	0.90	1.57

Source: The authors.

Note: Sample restricted to 18–70-year-olds at the time of the survey. IHDS2 data only.

Table A2. Descriptive Statistics: Panel Sample (Adult Women 18–70 Years)

	All		Rural		Urban	
	Mean	SD	Mean	SD	Mean	SD
	(1)	(2)	(3)	(4)	(5)	(6)
Individual Level Characteristics						
Age/10	3.71	0.84	3.68	0.84	3.78	0.83
Married	0.90	0.31	0.89	0.31	0.91	0.29
No school	0.49	0.50	0.58	0.49	0.26	0.44
Primary school	0.17	0.37	0.17	0.37	0.16	0.37
Middle school	0.31	0.46	0.24	0.43	0.48	0.50
Secondary school or higher	0.04	0.19	0.01	0.11	0.09	0.29
Age at first birth 16–20	0.49	0.50	0.51	0.50	0.46	0.50
Age at first birth 21–25	0.33	0.47	0.31	0.46	0.36	0.48
Age at first birth 26–30	0.08	0.27	0.07	0.26	0.09	0.29
Age at first birth 31–35	0.02	0.12	0.02	0.13	0.01	0.11

(Table A2 Continued)

(Table A2 Continued)

	All		Rural		Urban	
	Mean	SD	Mean	SD	Mean	SD
	(1)	(2)	(3)	(4)	(5)	(6)
Household Level Characteristics						
Urban residence	0.29	0.45				
Household size	5.55	2.47	5.65	2.53	5.30	2.29
Hindu	0.83	0.37	0.85	0.36	0.79	0.40
Muslim	0.11	0.31	0.10	0.30	0.14	0.35
Christian	0.02	0.15	0.02	0.14	0.03	0.17
Household has flush toilet	0.13	0.34	0.07	0.26	0.29	0.45
Household has piped water	0.42	0.49	0.30	0.46	0.71	0.45
Household owns car	0.03	0.16	0.01	0.12	0.06	0.23
Household owns motor cycle	0.23	0.42	0.16	0.37	0.39	0.49
Hours watching TV per day: women	1.98	1.53	1.70	1.46	2.53	1.53
Hours watching TV per day: men	1.40	1.17	1.26	1.14	1.68	1.19
Domestic help	0.04	0.19	0.02	0.14	0.07	0.26
Expenditure quartile Q1	0.23	0.42	0.24	0.43	0.21	0.41
Expenditure quartile Q2	0.25	0.43	0.25	0.43	0.25	0.43
Expenditure quartile Q3	0.26	0.44	0.25	0.44	0.27	0.44
Expenditure quartile Q4	0.26	0.44	0.25	0.43	0.27	0.44
Share of Expenditure on						
Processed food	0.11	0.10	0.11	0.10	0.11	0.09
Eating out	0.04	0.11	0.04	0.10	0.06	0.11
PSU/Cluster Level Characteristics						
PSU inequality	0.90	1.22	0.76	0.90	1.25	1.71

Source: The authors.

Note: Sample restricted to adult women 18–70 years old as of IHDS1.

Table A3. Health Outcomes by Rural/Urban Residence with Interaction Terms: Adult Women over Time

	BP		Heart Disease		Diabetes	
	Rural	Urban	Rural	Urban	Rural	Urban
	(1)	(2)	(3)	(4)	(5)	(6)
Overweight or obese in 2005	0.053***	0.048***	0.001	0.004	0.030***	0.044***

(Table A3 Continued)

(Table A3 Continued)

	BP		Heart Disease		Diabetes	
	Rural	Urban	Rural	Urban	Rural	Urban
	(1)	(2)	(3)	(4)	(5)	(6)
	(0.016)	(0.010)	(0.006)	(0.005)	(0.011)	(0.009)
Household Income						
Expenditure quartile Q4	0.011	0.024*	0.002	0.013**	−0.001	0.015*
	(0.011)	(0.012)	(0.004)	(0.005)	(0.006)	(0.009)
Interaction Term						
Overweight or obese in 2005×	0.040	0.368***	−0.016	−0.002	0.035	−0.018
Expenditure quartile Q4	(0.025)	(0.101)	(0.010)	(0.045)	(0.045)	(0.015)
Constant	−0.013	−0.004	0.011	0.122***	−0.018	0.150**
	(0.078)	(0.018)	(0.035)	(0.007)	(0.021)	(0.071)
Other individual and household controls	YES	YES	YES	YES	YES	YES
Sample size	11,208	7,081	11,208	7,081	11,208	7,081

Source: The authors.

Notes: Sample restricted to adult women (18–70 years old) in IHDS1. The OLS regression results presented. Dependent variable in columns 1–2 = 1 if individual reports high blood pressure, dependent variable in columns 3–4 = 1 if individual reports heart disease and dependent variable in columns 5–6 = 1 if individual reports diabetes. Regressions include controls for age, education, marital status, wealth quartiles, household size, age at first birth, hours per day and days per year worked, part-time and full-time work, household religion, household membership in various groups including *mahila mandals*, trade unions, self-help groups, credit or savings groups and political parties, and state dummies. These are not reported in the table. Bootstrapped standard errors are in parenthesis. Significance: *** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$.

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Notes

1. The left-hand panel of Figure 1 shows that the rate for Indian adults is actually one of the lowest in the world, with Vietnam the only country that has lower rates than India. However, India's population is large enough to translate this relatively small proportion to sizable numbers of people.
2. Using the same data sets as the current article, Dang, Maitra, and Menon (2017) show that labour market inactivity is positively associated with BMI.
3. WHO Global InfoBase: obesity and overweight, available online at http://www.who.int/topics/obesity/en/
4. The existing literature argues that maternal education is important, obesity rates are higher among girls whose parents themselves are overweight/obese Maddah and Nikooyeh (2010) and high-energy intake and short stature in poor communities can drive rates of obesity among women aged 20–60 (Alves, Falcao, Pinto, & Correia, 2011).
5. Our models include the full list of variables noted in Tables A1 and A2 in Appendix A. The complete set of results is available on request.
6. Table 2 also reports *F*-values from Ramsey's RESET statistic which is a frequently used diagnostic for whether the model is specified correctly. Note, however, that this test is valid only if the error term follows the normal distribution (Ramsey, 1969), which is unlikely to be the case here particularly when we consider indicator variables for overweight or obese as in columns 5–12. In keeping with this, the test rejects the null hypothesis that the model is correctly specified in most columns of Table 2.

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