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THE NUTRITION TRANSITION AND THE INTRA-HOUSEHOLD DOUBLE BURDEN OF MALNUTRITION IN INDIA

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Abstract

India is clearly far along in the nutrition transition. This paper shows that there have been rapid increases in the proportion of adult women in India who are overweight and obese: these increases are seen not just in urban but in rural areas as well, and there are regional specificities. Correspondingly, diabetes and hypertension affect a large proportion of adults, even as childhood undernutrition remains a public health problem. These have important consequences for the design of public health systems, especially in rural India. At the same time, the intra-household dual burden of malnutrition is also increasing. Among other factors, households with wealthier and less educated mothers, and children born with a healthy weight, seem less vulnerable to the dual burden of malnutrition. Also significant are household expenditure (suggesting that the phenomenon is associated with affluence) and lifestyle choices, calling for better and nuanced behavior change communication strategies.

JEL Classification: I14, I12

Contents

1. INTRODUCTION

Much of the discourse on malnutrition in India has understandably focused on undernutrition—manifest as poor anthropometric outcomes, especially for children, or inadequate intakes of food. Yet, the country has also seen a significant rise in overnutrition and overweight/obesity in recent years. Interestingly, this latter trend is no longer a predominantly urban phenomenon, but characterizes many rural populations as well. Thus, India seems to be going through a *nutrition transition*, a term that refers to the processes of change in the food environment, physical activity, and lifestyle that result in declining levels of undernutrition and increasing levels of overnutrition over time (Popkin1993).

Nationally representative surveys conducted during 2011-2013 suggest that the prevalence of overweight or obesity—defined as the percentage of adults whose body mass index (BMI) is higher than 25—ranges across states from 6% to 31% among women, while the figures for rural areas are 5% to 28% (Meenakshi 2016). These magnitudes have been increasing rapidly over time. Being overweight or obese poses significant risks for noncommunicable diseases (NCDs) including heart disease and diabetes. According to the Global Burden of Disease study, in India, the number of disability-adjusted life years (DALYs)—an aggregate measure of cause-specific disease burden that accounts for both disability and premature mortality—lost to diabetes increased by nearly 40% between 2000 and 2012. Over the same period, the number of DALYs lost to heart disease increased by 20%, even as the overall number of DALYs lost due to disease *decreased* by nearly 9% (WHO 2016).

These increases in overweight and obesity and its health consequences are occurring even as the magnitude of undernutrition among children in India, despite progress, remains high and is a continuing public health concern. In 2011–2013, the prevalence of underweight among preschool children ranged from 21% to 46% across states; the corresponding range in rural areas was 23% to 49% (Meenakshi 2016). Undernutrition among young children is often irreversible, has consequences into adulthood, and may lead to the inter-generational transmission of malnutrition.

While this double burden of malnutrition—the coexistence of under- and over-nutrition—may simply be a reflection of marked and increasing inequalities in economic and social access to resources and thus refer to distinct subpopulations, studies suggest that as economies develop, undernutrition among children and overnutrition among adults often coexist *within the same household* (Garrett and Ruel 2005; Doak et al. 2002). For example, in many African and Asian countries, nearly 10% of households have a stunted child and overweight mother pair; figures for Latin American countries are higher (Garrett and Ruel 2005). This phenomenon, referred to as the *intra-household dual burden of malnutrition*, merits further study since it is clearly not an indication of socioeconomic inequalities in the aggregate, nor of inadequate access to food at the household level (since adults are overnourished) but rather reflects inequalities *within* the household in the distribution of food and other health resources. In India, there are very few studies that have examined this phenomenon.

This provides the context for this study, which has two primary objectives. First, after a brief review of literature presented in section 2, the paper quantifies the changes in the prevalence of overweight and obesity (using lower thresholds for BMI that are perhaps more appropriate for Asian populations), and of diabetes and hypertension among adults (section 3). The focus is on the richer states[1] because overweight and obesity is more pronounced in these states, and also (though not exclusively) on women, as they are more susceptible than men to being overweight or obese (see for example Ramachandran 2014; Subramanian et al. 2009; Chhabra and Chhabra 2007; Kulkarni et al., 2017). The second objective is to examine the extent and correlates of the intra-household double burden of malnutrition (section 4), using unit record data from the second wave of the India Human Development Survey (IHDS 2). Section 5 concludes.

2. THE LITERATURE ON OVERWEIGHT AND OBESITY IN INDIA

There is extensive literature characterizing overweight and obesity in developed countries. However, the literature on developing countries in general, and on India in particular, is relatively limited outside of studies that document its increasing prevalence. The focus here is on the literature on India that examines the socioeconomic factors associated with overweight and obesity.

The primary (and perhaps obvious) explanation for increasing BMI is the imbalance between energy or food intakes on the one hand and energy expenditures through physical activity on the other. But there is no evidence to suggest that average energy intake in India has increased. In fact, energy intakes as derived from consumer expenditures surveys have shown a secular decline over time. While these estimates are known to suffer from significant measurement errors (from inadequate capturing of processed foods and meals purchased outside the home) that have likely only increased over time, the reduction in average intakes is also documented by other surveys. For instance, 24-hour dietary recall surveys—considered the gold standard in dietary assessment—conducted by the National Nutrition Monitoring Bureau (NNMB) for rural areas also document a similar decline (see Ramachandran 2014). However, a reduction in average intakes is consistent with a rightward shift of the upper tail of the distribution of energy intakes. Further, there has also been a change in the composition of diets, with decreased reliance on cereals, but an increased reliance on fats and sugars (more details in Meenakshi 2016).

It has been argued that some of this reduction in intakes is explained by the declining needs for energy associated with (a) improvements in infectious diseases and (b) a reduction in physical activity levels, although the empirical evidence on this is limited (see Deaton and Drèze 2009; Eli and Li, 2015). While it is clear that there has been an expansion in the use of labor-saving devices in urban areas, it is not evident that an expansion of a similar magnitude has also occurred in rural areas. To what extent the mechanization of agriculture has led to the substitution of women's labor is also not clear. But Ramachandran (2014) suggests that it is the rapid decline in physical activity levels accompanied by a modest decline in energy intakes that is responsible for the rapid increases in overnutrition. Similarly, Siddiqui and Donato (2016) argue that some states have a more obesogenic[2] environment, with infrastructure encouraging more sedentary behavior and a rapid expansion in the availability of fast foods or cultural factors that stimulate overeating among some populations.

[1] Richer states are defined as the 9 states with the lowest head count ratios of poverty in 2011–12. The states are Karnataka, West Bengal, Maharashtra, Tamil Nadu, Haryana, Andhra Pradesh, Punjab, Himachal Pradesh, and Kerala.

[2] The term "obesogenic environment" refers to "an environment that promotes gaining weight and one that is not conducive to weight loss" within the home or workplace (Swinburn et al. 1999). In other words, the obesogenic environment refers to an environment that contributes to obesity.

The literature also suggests that socioeconomic status (as reflected in wealth or income levels as well as educational attainment) is a strong predictor of overweight and obesity (in a direction opposite to that found in developed countries; in the latter case obesity is associated with poverty). Griffiths and Bentley (2001) found that households with high-income or more education, and women pursuing sedentary occupations, or watching television more than once a week, were all factors associated with women being overweight or obese; and that socioeconomic status was the most important predictor of women's nutrition status, not rural or urban residence. Subramanian et al. (2009) also report a strong and positive association between socioeconomic status and BMI for women. More recently, Kulkarni et al. (2017) also find that overweight and obesity is largely concentrated among high-income groups and that the relationship between socioeconomic status and the risk of being overweight or obese is stronger in urban than in rural areas. A distinguishing feature of this paper is the explicit inclusion of relative prices of food (to capture diet choices): they find that these play an important role in determining the probability of being underweight as well as overweight or obese. Furthermore, Ackerson et al. (2008) find that after accounting for individual factors, neighborhood wealth was independently and positively related with BMI and the risk of being overweight among women. Gaiha et al. (2011) find that increasing age and growing affluence are key factors in explaining the prevalence of NCDs in India.

Similarly, there appears to be a positive association between education and overweight among women, as noted for example by Griffiths and Bentley (2001) and Kulkarni et al. (2014). While this finding may seem contradictory to the role of education in enabling good health found in developed countries, it is likely that the positive association is a reflection of the low levels of education in India in general, and the correlation between income and educational attainment. For example, Siddiqui and Donato (2016) find a nonlinear relationship between education and overnutrition, where increasing education translates into a reduction in the likelihood of overweight and obesity after a threshold; they suggest that this is indicative of weight-control behaviors among highly educated women.

In addition to these household- and individual-level variables, Schmidhuber and Shetty (2005) and Popkin et al. (2012) suggest that the macro-environment also matters, with falling relative prices of food, freer trade, and globalization all leading to a rapid nutrition transition.

Another strand of literature highlights the community-specific and regional variation in the prevalence of overweight and obesity in India. For instance, after controlling for socioeconomic status, Muslim women and Sikhs appear to have greater likelihood of overweight and obesity as compared to Hindus (Siddiqui and Donato 2016; Griffiths and Bentley 2001). Although they do not directly test for differences in dietary patterns across these groups, they argue that differences in cultural practices related to food may lead to these observed differences.

Regional variations are also highlighted by Siddiqui and Donato (2016), Kulkarni et al. (2014), and Ackerson et al. (2008), with some states in the north and far south seeing higher prevalences (as also seen below in section 3). Even within these regions, Sengupta et al. (2014) find that in Delhi, Punjab, and Kerala, the problem of overnutrition has trickled down to poorer, rural, and less educated sections of the population.

Finally, one factor that is perhaps particular to economies that have traditionally dealt with hunger and undernourishment is the role played by inadequate nutrition in utero or in infancy. The literature suggests that this stimulates a set of anatomical, hormonal, and physiological changes that enhance survival in a "resource poor" environment. However, in a postnatal environment with plentiful resources, these developmental adaptations may increase susceptibility to obesity and chronic diseases (Popkin 1994; Popkin et al. 2012).

3. THE MAGNITUDE OF OVERWEIGHT, OBESITY, AND NONCOMMUNICABLE DISEASES

The recently conducted fourth round of the District Level Household Survey, 2012–13 (DLHS4) highlights the high prevalence of overnutrition in India. Although designed to be representative at the district level (districts are subunits of states), the survey was implemented only in selected states,[3] which are, by and large, among the richer states in the country and account for about 38% of the rural and 54% of the urban population (according to the 2011 census). This section focuses only on these states as a rise in overnutrition is more likely to be apparent in the more well-off states. To track changes over time, unit record data from the second and third National Family Health Surveys (NFHS2 and NFHS3), for the years 1998-99 and 2005-06 are also used.

Globally, a BMI benchmark of 25 is used to determine whether individuals are overweight, and of 30 to determine obesity. For India, there is reason, however, to use lower benchmarks, as Asians appear to be at risk of NCDs at lower levels of BMI than other populations as they have a higher percentage of body fat than (for example) European populations of the same age, sex, and BMI (see Yajnik 2002; Zhou 2002). The WHO has identified 23 kg/m^2 and 27.5 kg/m^2 as additional trigger points for potential public health action along the continuum of BMI (WHO 2004).

Figures 1 and 2 use unit record data from the DLHS4, NFHS2, and NFHS3 surveys to compute the percentage of adult women whose BMI exceeds 23 and 27.5, respectively.[4] States are arranged in decreasing order of proportion of population below poverty line using poverty estimates of 2011–12. For almost all (the richer) states more than 20% of women have a BMI greater than 23. Kerala shows the highest prevalence, which increased from 36% in 1998–99 to 48% in 2012–13. Despite regional differences in the level of overweight and obesity, it is apparent that all these states have seen a rise in the proportion of obese women with BMI exceeding 27.5 (Figure 2).

The problem of overnutrition has percolated to rural areas as well: by 2012–13 all the states considered here had at least 20% of rural women with BMI more than 23 (Figure 1B). The increases between 2005–06 and 2012–13 were particularly dramatic. If the higher BMI cutoff of 25 is used, in states such as Kerala, the prevalence of overweight or obesity in 2012–13 was 30% (as compared with 48% using the 23 threshold), suggesting that there is a substantial mass in the distribution of BMI between 23 and 25—a pattern seen in nearly all other states.

[3] The remaining states were covered by the Annual Health Survey conducted by the Registrar General of India.

[4] Trends in the magnitudes of overweight and obesity using the conventional cutoffs, and for all states, are discussed in Meenakshi (2016).

That overnutrition is not only an urban phenomenon is borne out by other data as well. Surveys by the National Nutrition Monitoring Bureau (NNMB) have tracked heights and weights over time in rural areas of 10 states. Using this data, Ramachandran (2014) notes that while less than 5% of adults were either overweight or obese in the 1970s and 1980s, by 2004–05, this figure had grown to nearly 11% of women and 8% of men (NNMB 2006), figures that are comparable in magnitude to those reported by the NFHS3 for 2005-06. As noted above, in less than 10 years, these figures nearly doubled in most states.

Figure 1A: Percent of Adult Women Overweight/Obese (using BMI>=23), by State, Overall

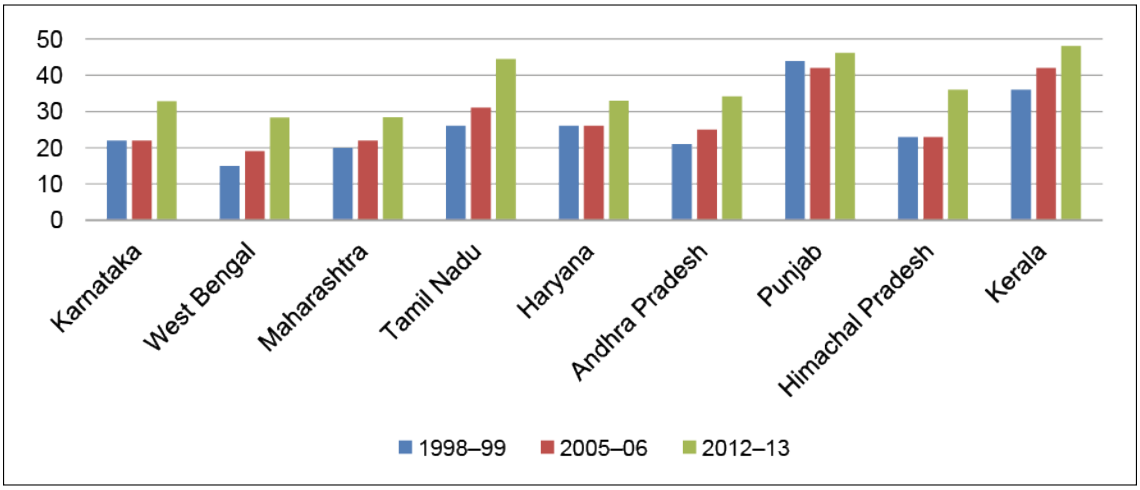
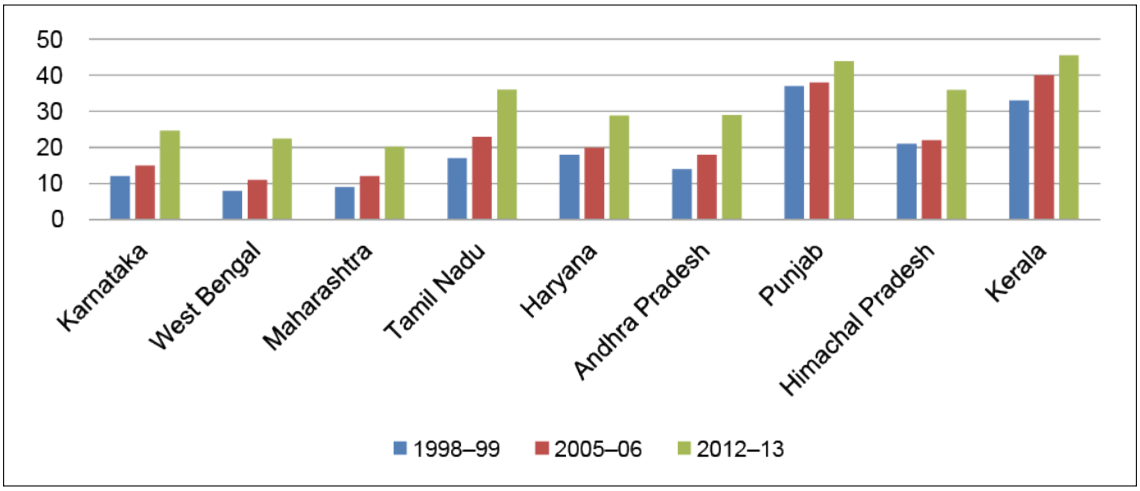


Figure 1B: Percent of Adult Women Overweight/Obese (using BMI>=23), by State, Rural



Note: Data refer to women aged 15 to 49 years.

Source: 1998–99 and 2005–06 data are computed from the unit-record data of the second and third rounds of the National Family Health Survey; 2012–13 data are from the fourth round of the District Level Household and Facility Survey.

Also, there is clear evidence of regional differences in magnitudes of overnutrition even within this subset of richer states, although there is a weak (negative) correlation with poverty levels. Punjab in the north and Kerala in the south have the highest proportions of adult women with BMI greater than 23, in both rural and urban areas. These regional differences have been highlighted in other studies as well, including Ackerson et al. (2008) and Sengupta et al. (2014) as noted in section 2.

Figure 2A: Percent of Adult Women Obese (using BMI>=27.5), by State, Overall

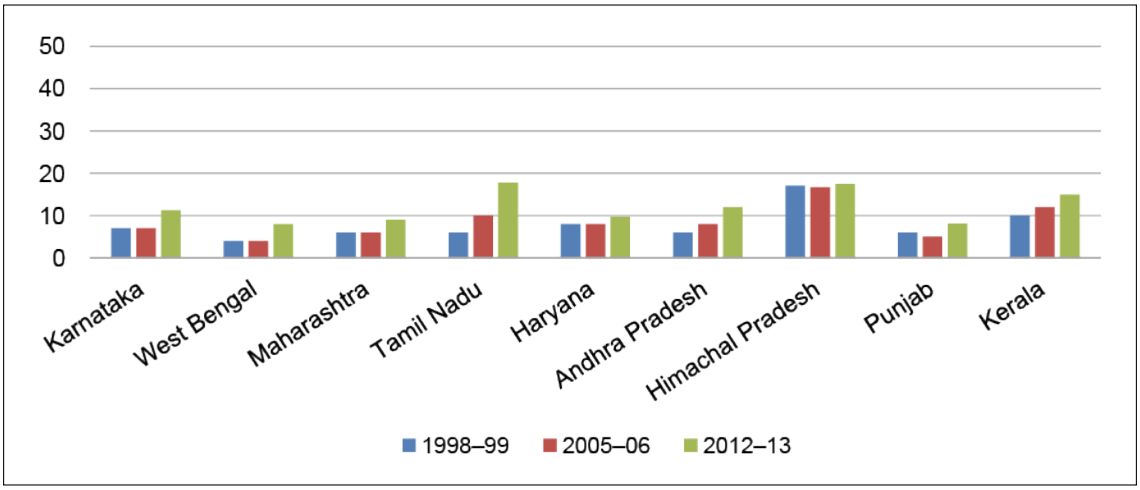
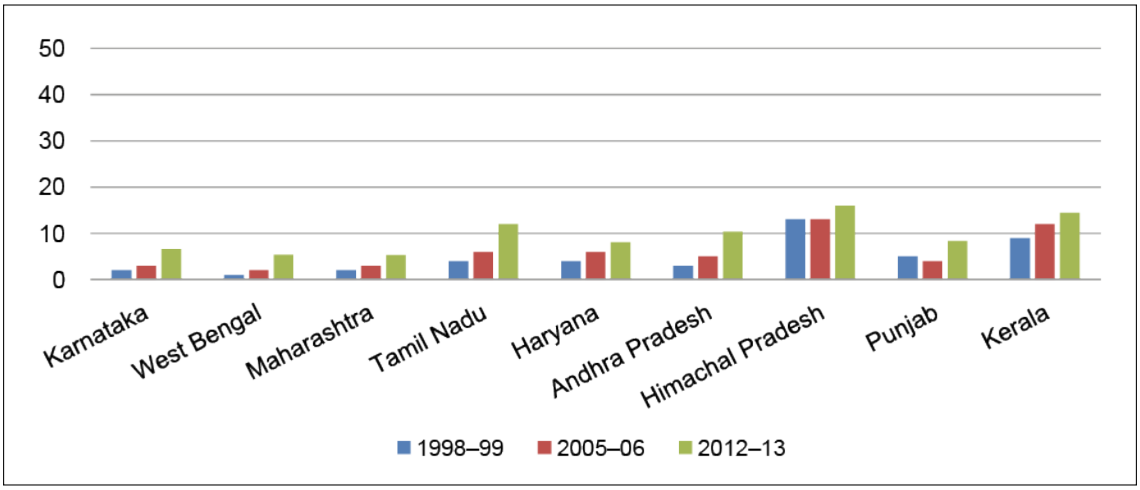


Figure 2B: Percent of Adult Women Obese (using BMI>=27.5), by State, Rural

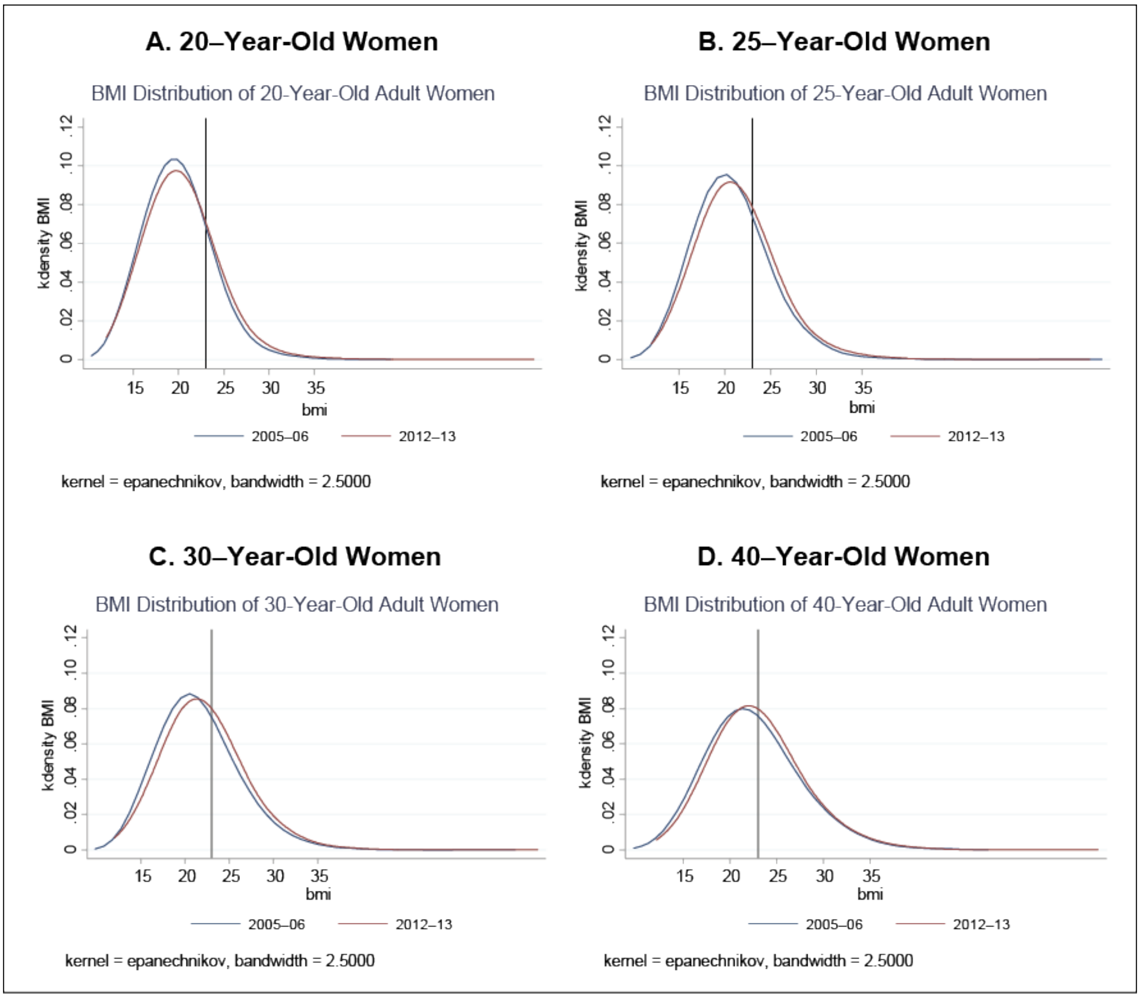


Note: Data refer to women aged 15 to 49 years

Source: 1998–99 and 2005–06 data are computed from the unit-record data of the second and third rounds of the National Family Health Survey; 2012–13 data are from the fourth round of the District Level Household and Facility Survey.

The magnitudes presented here not age-standardized. Over the period 2005–2006 to 2012–2013, there was a shift in the age distribution of adult women toward older age groups. In 2005–2006 about 47% of urban and rural women were above the age of 30 years, but by 2012–2013 these figures had changed to 52% and 50%, respectively. Thus a part of the increase in magnitude of overweight and obesity may simply be a reflection of an aging population, because body metabolism tends to decrease with age, leading to increased weight and BMI. To examine if this is the case, Figure 3 plots the distribution of BMI for women who are 20, 25, 30, and 40 years old over this time period, taking advantage of the relatively large size of sample in both the NFHS3 and DLHS4 surveys. While there was little change in the distribution of BMI of 20-year-old women, all older age groups saw a systematic increase in BMIs.[5] On average, the prevalence of overweight and obesity increased by 3% for 30-year-old women and 2% for 40-year-old women, figures not very different from the 4% increase seen (on average) in the age-unadjusted prevalences of overweight and obesity.

Figure 3: Changes in the Probability Density Function of BMI of Adult Women, 2005–2006 to 2012–2013, by Age Group



Note: Both years refer to women aged 15 to 49 years.

Source: Computed from the unit-record data of third round of the National Family Health Survey (2005–06) and the fourth round of the District Level Household and Facility Survey (2012–13).

The NNMB surveys also provide information on other anthropometric indicators of overnutrition, including the waist–hip ratio (WHR), with a WHR of greater than 0.8 being indicative of abdominal obesity (Willett et al. 1999; Huxley et al. 2008; note however that the WHO 2011 uses a higher cutoff of 0.85). In 2004–05, nearly 64% of

5 In each case, the Kolmogorov-Smirnov test rejects the null hypothesis of the equality of the BMI distributions across the two years 2004–05 and 2012–13, for all the age groups shown in the figure above.

all adult women in the 10 states surveyed had abdominal obesity; this figure was as high as 88% in Kerala (NNMB 2012).

As noted earlier, overweight and obese individuals are predisposed to a wide range of health problems including diabetes and hypertension. The WHO Global Report on Diabetes (2016) notes "In the past three decades, the prevalence (age-standardized) of diabetes has risen substantially….mirroring the global increase in the number of people who are overweight or obese….Over the past decade, diabetes prevalence has grown faster in low- and middle-income countries than in high-income countries" (p. 26). Each year, nearly 7% of deaths in India are related to diabetes. Not surprisingly, given these magnitudes, these health issues not only are prevalent in urban areas, they are becoming common in rural areas as well.

Table 1 presents data from DLHS4 on the prevalence of pre-diabetes or diabetes—as captured by the percentage of adults whose random blood sugar levels exceed 140 mg/dl. Nearly a quarter of adults in rural Kerala either have, or are at risk of developing, Type 2 diabetes (note that this includes individuals who may have been diagnosed with diabetes and were already on medication); this figure is lowest in Andhra Pradesh, with nearly 8% of adults being in this situation. An NNMB survey conducted the year before and using a cutoff of *fasting* blood glucose levels of 126 mg/dl, an indication of Type 2 diabetes, found that approximately 8% of men and 7% of women (including new and old cases) were diabetic. There are no significant differences by gender.

Table 1: Percent of Adults with Random Blood Sugar Levels Greater Than 140 mg/dl, Rural Areas, by State and Gender, 2012–2013

	Random Blood Sugar Level above 140 mg/dl	
	Male	**Female**
Kerala	26	24
Himachal Pradesh	18	16
West Bengal	16	14
Haryana	14	13
Punjab	13	14
Maharashtra	13	11
Tamil Nadu	12	11
Karnataka	9	8
Andhra Pradesh	8	7

Source: State reports of the fourth round of the District Level Household and Facility Survey.

Hypertension is also a significant problem. The proportion of rural women with high blood pressure ranges from 16% to 32%, while for men it ranges from 20% to 41% (Table 2). These figures are higher than the NNMB survey referred to above, which suggested that the proportion of adult rural women with blood pressure greater than 140/90 mmHg ranged from 12% to 27%.

Taken together, the evidence in this section highlights the rapid increase—much of it in the last 10 years—in the magnitude of overweight and obesity at which Asian populations are at greater risk of NCDs, in both urban and rural areas; not surprisingly, these are reflected in a high and increasing prevalence of hypertension and diabetes. Also highlighted are regional specificities—with states in the south and north witnessing the highest magnitudes.

Table 2: Percent of Adults with Blood Pressure Greater Than 140/90 mmHg, Rural Areas, by State and Gender, 2012–2013

	Blood Pressure above 140/90 mmHg	
	Male	**Female**
Punjab	41	29
Himachal Pradesh	39	32
Kerala	37	30
Haryana	27	20
Maharashtra	25	20
Andhra Pradesh	24	18
Tamil Nadu	23	16
Karnataka	21	19
West Bengal	20	18

Source: State reports of the fourth round of the District Level Household and Facility Survey.

4. MAGNITUDE OF THE INTRA-HOUSEHOLD DUAL BURDEN OF UNDERWEIGHT CHILDREN AND OVERWEIGHT MOTHERS (UC-OM)

As noted earlier, the coexistence of overweight women and underweight children within a household suggests that more than resource constraints, it is intra-household equity that matters. In other words, the causal pathways that lead to such an *intra-household* dual burden of malnutrition can be very different from those that characterize the *population-level* dual burden. Hence, the intra-household double burden merits a separate analysis, from that which considers the population level dual burden.

Unit record data from the first (2004–05) and second (2011–12) waves of the India Human Development Surveys (IHDS) may be used to quantify the magnitude of the dual burden of malnutrition. A dual burden household may be defined as one that has an underweight child (a preschool child younger than 60 months with a weight-for-age less than 2 standard deviations of the median of the age-specific reference population) and an overweight mother[6] (with a BMI greater than 23 kg/m^2 following the lower cutoffs for Asian populations), abbreviated as UC-OM.

Table 3 shows that the percentage of households with overweight or obese mothers has increased from 15% in 2004–05 to 20% in 2011–12 in rural areas, while in urban areas it increased from 31% to 41%. Over the same time period, there was a decrease in the proportion of households with underweight children in both urban and rural areas, although one-third of rural households and one-quarter of urban households continue to have underweight children. These figures are consistent with those reported in other surveys.

[6] A similar definition of has been used by Barnett (2011) and Jehn and Brewis (2009). It is also common to define a dual burden household as one that has a stunted (compromised height) child, but since there was significant measurement error in the data on child heights in this survey of children, it is not used.

Table 3: Cross-Tabulation of Households by Child and Mother's Anthropometric Outcomes, by Region of Residence, 2004–05 and 2011–12
(percent of households)

	2004–05			2011–12		
	Normal Weight Child	Under-weight Child	Total	Normal Weight Child	Under-weight Child	Total
			Rural Areas			
Underweight mother	15	16	32	17	14	31
Normal weight mother	34	20	54	33	16	49
Overweight/Obese mother	10	4	15	15	5	20
Total	60	40	100	64	36	100
Number of observations		6,303			5,150	
			Urban Areas			
Underweight mother	12	8	21	10	7	17
Normal weight mother	33	15	48	30	11	42
Overweight/Obese mother	24	6	31	33	8	41
Total	69	31	100	74	26	100
Number of observations		3,160			2,411	

Notes: Data refer to children aged 0 to 5 years and mothers aged 15 to 49 years. A child is defined as normal weight when weight-for-age z-score≥–2; a child is defined as underweight when weight-for-age z-score<–2. Underweight mother is defined as a mother with BMI<18.5 kg/m^2, normal weight mother as 18.5≤BMI<23 kg/m^2, and overweight as BMI≥23 kg/m^2.

Source: 2004–05 and 2011–12 figures are computed from unit record data of the IHDS 1 and 2.

Despite this decrease in households with underweight children, however, the percent of UC-OM households increased from 4% to 5% in rural India and from 6% to 8% in urban India; the higher prevalence in urban India is in part a reflection of the higher levels of urban overweight or obesity. Another way to interpret these figures is to note that one-fifth (urban) to one-quarter (rural) of all households with an overweight mother had an underweight child. suggesting that intra-household inequality in resource allocations may be important.[7]

Might this problem be more severe for the relatively more affluent states which saw greater increases in the proportion of overweight mothers and more modest declines in underweight children? Table 4 suggests that this is indeed the case in nine richer states, with 7% and 10% of rural and urban households having a UC-OM pair in 2011–12 respectively.

The phenomenon of the coexistence of an underweight child and overweight mother has been observed in other low- and middle-income countries including Kenya, Bangladesh, Guatemala, Ghana, and Peru. In Guatemala, 6% of households had UC-OM pairs, while in Bangladesh and Kenya less than 5% did so in early 2000 (Lee et al. 2012; Barquera et al. 2007; Oddo et al. 2012; Jehn and Brewis 2009).

[7] As noted earlier, mothers who were born as underweight babies are more likely to be overweight as adults as compared to those who were born with a normal weight.

Table 4: Cross-Tabulation of Households by Child and Mother's Anthropometric Outcomes, by Region of Residence in Richer States, 2004–05 and 2011–12
(percent of households)

	2004–05			2011–12		
	Normal Weight Child	**Under-weight Child**	**Total**	**Normal Weight Child**	**Under-weight Child**	**Total**
		Rural Areas				
Underweight mother	18	13	31	15	10	26
Normal weight mother	35	18	53	32	14	46
Overweight/Obese mother	12	4	16	22	7	28
Total	64	36	100	69	31	100
Number of observations		2,644			2,085	
Urban Areas						
Underweight mother	13	8	20	8	5	13
Normal weight mother	31	14	45	29	10	39
Overweight/Obese mother	28	7	35	37	10	48
Total	71	29	100	75	25	100
Number of observations		1,443			1,072	

Notes: Data refer to children aged 0 to 5 years and mothers aged 15 to 49 years. A child is defined as normal weight if weight-for-age z-score≥-2; a child is defined as underweight when weight-for-age z-score<–2. Underweight mother is defined as a mother with BMI<18.5 kg/m^2, normal weight mother as 18.5≤BMI<23 kg/m^2, and overweight as BMI≥ 23 kg/m^2. Richer states includes Karnataka, West Bengal, Maharashtra, Tamil Nadu, Haryana, Andhra Pradesh, Punjab, Himachal Pradesh, and Kerala.

Source: 2004–05 and 2011–12 figures are computed from unit record data of the IHDS 1 and 2.

What are the socioeconomic factors that are associated with households with double burden? The literature suggests that prevalence of dual burden is associated with older maternal age, maternal short stature, and increasing family size (Oddo et al. 2012; Lee et al. 2010; Jehn and Brewis 2009). Education of the mother appears to be protective against the intra-household dual burden in Indonesia, but the reverse appears to be the case in Bangladesh (Oddo et al. 2012).

Similarly, household wealth is positively associated with the prevalence of the double burden of malnutrition, suggesting that lack of access to adequate food is not a constraint (Lee et al. 2012). However, some studies do not find any association with wealth at all (see for example Lee et al. 2010). A cross country analysis by Jehn and Brewis (2009) looked at this phenomenon in 19 lower- and middle-income countries and found it to be less prevalent in countries with lower wealth. Similarly, Garrett and Ruel (2005), analysing data from several countries in Africa, Asia, and Latin America, find that the phenomenon increases with GDP per capita up to a point.

Leroy et al. (2014) explore the interaction between education and household wealth in explaining the prevalence of stunted child–overweight mother households in Mexico. They find that household wealth was significantly associated with increases in the prevalence of double burden pairs only among mothers who had not completed primary school. They argue that among more educated mothers, wealth is associated with both increases in child height and an absence of undesirable weight gain among mothers, and hence maternal education could mitigate the negative effect of increasing household income on dual burden households.

Some studies for China, India, and Vietnam find urban residence to be associated with the phenomenon of intra-household dual burden (Doak et al. 2000; Barnett 2011), while Lee et al. (2012) find it to be a rural phenomenon in Guatemala. However, an analysis for several countries by Garrett and Ruel (2005) finds that it is not necessarily associated with urbanization.

Analyses of the intra-household dual burden that focus on India include VanderKloet (2008) and Barnett (2011), who both use the Young Lives dataset for Andhra Pradesh. VanderKloet (2008) looks at households with an overweight mother and adolescents (11–13 years old) and finds that male, prepubertal children, non-immunised children, and those with a small maternal support network were more likely to be in UC-OM households than in households with a non-underweight child and an overweight mother. Barnett (2011) considers the prevalence of households with an overweight mother and a stunted child, and an overweight mother with an underweight child aged 4.5–5.5 years, and finds that households living in urban areas are more likely to have these pairs, while VanderKloet (2008) finds location to have weak association. Note, however, that the Young Lives dataset oversampled poor households and may thus have underestimated the magnitude of the phenomenon.

This paper attempts to contribute to this limited literature by examining correlates of households with an underweight child aged less than 60 months and an overweight mother (UC-OM) using a nationally representative dataset.

5. FACTORS ASSOCIATED WITH THE INTRA-HOUSEHOLD DUAL BURDEN OF MALNUTRITION

Both binary and multinomial logit regression models are used to identify the predictors of dual burden (UC-OM) households. In the binary case, all other households are the reference group, whereas in the multinomial logit, the various socioeconomic and behavioral factors that are associated with households that have UC-OM, an underweight child and non-overweight mother (UC-NOM), and a non-underweight child and overweight mother (NUC-OM) are examined using households with a non-underweight child and non-overweight mother (NUC-NOM) as the reference category. The analysis is conducted both at the all-India level and also for a subset of nine better-off states to see whether the risk factors vary across the two.[8]

Based on the review in the previous sections as well as literature that pertains to other developing countries, the following covariates are included, with some variation in alternative specifications, as noted in the tables.

Child characteristics: In addition to demographic characteristics of the child's age (in months) and its gender, two dichotomous measures of the health of the child are used: first, whether the child had diarrhea during the month preceding the survey; and second, whether the child was fully immunized for a given age. Low birth weight is also a strong predictor of poor nutritional outcomes for children (see for example Wardlaw 2004); this is captured by a subjective assessment by the child's mother of whether the child was average or above average in size when born, in comparison to children who were born with a below-average size at birth (reference category). Although it would have been ideal to have some indicator of child-specific food intakes, this data is not available.

[8] A likelihood ratio test of no differences in coefficients in the richer states as compared to all states was rejected.

Maternal characteristics: Mother's age (and a squared term in age to capture nonlinearities) is included, as the literature suggests weight gain first increases (as metabolism slows with age and results in weight gain) and then decreases with age. There are studies showing a positive association between parity and weight gain due to pregnancy and the onset of obesity in women (Brown et al. 1992; Wolfe et al. 1997); as a proxy we include the number of children in the household.

Maternal education has been linked to child malnutrition (negatively) and also to overnutrition among women. To capture this, mother's education is categorised into four levels: none, primary education (1–5 years in school), upper primary (6–8 years), and higher secondary and above (9 or more years); no education is the reference category. Mother's occupational status is also included in the analysis under the assumption that mothers who are working in blue collar jobs (used as the reference category) would have more active lifestyles than mothers who are not working or mothers in white collar jobs.[9] Mother's height is also included as a continuous variable, as maternal short stature is a marker of malnutrition in early life and has been associated with increased BMI; also undernourished mothers have a higher probability of having malnourished children (Ferreira et al. 2009; Sichieri et al. 2003; Victora et al. 2008). Although education and occupational choice may be related, they may be expected to have independent influences on both adult and child nutritional status, and hence are included separately.

Lifestyle factors as captured by the number hours spent on watching television are also included, with a dummy variable with value 1 if women watch more than 2 hours of television a day, and 0 if they watch for fewer hours.

Household characteristics: Household income is captured by including household expenditure quintiles as covariates. Lastly, place of residence (rural or urban) is also included.

Thus, given a vector of child characteristics C_i, maternal characteristics M_i, and household characteristics H_i for household i, a model of the intra-household double burden of malnutrition may be specified as:

$$ln\frac{P_i^s}{P_i^t} = \beta_0 + \beta_1 C_i + \beta_2 M_i + \beta_3 H_i \text{, for } s \neq t$$

where the probability of household *i* having a pair *s* is denoted by P_i^s.

In a binary logit model *s* = UC-OM and *t* refers to all other households (that do not have a UC-OM pair). In the multinomial logit case, the probabilities refer to *s* = UC-OM, UC-NOM, NUC-OM and *t* = NUC-NOM. In other words, using NUC-NOM as the reference pair, the multinomial logit regressions are estimated for the UC-OM, UC-NOM, and NUC-OM households.

The estimation sample is drawn from the IHDS2 dataset (for 2011–12). Given that there are rural–urban differences in the magnitudes of overweight, obesity, and dual burden households, and that the factors that drive them may vary across rural and urban areas, these models were first estimated separately by region. However, a likelihood ratio test indicated that the null hypothesis of no rural–urban differences in

9 A mother is classified as working in a white collar job if she is a scientist, director, manager, economist, teacher, clerk or related worker, sales worker, merchant, shopkeeper, salesperson, etc. She is classified as working in a blue collar job if her occupation is agriculture and plantation laborer, cultivator, production laborer, bricklayer, construction worker, miner or related worker, or a service worker (maid, cook, or sweeper).

coefficients could not be rejected across all specifications. For this reason, results are presented only for the pooled model below, although as noted above, a dummy variable to represent region of residence is included. All standard errors are clustered at the primary sampling unit.

Table 5 presents the odds ratio of the predictors from the binary logistic model on UC-OM for both richer and all states, and for two specifications. For all states, and across both specifications, only two child-level factors—birth size and age—are significant predictors of UC-OM. A child who was large or average at the time birth has 29% lower odds of being UC-OM as compared to a child who was very small or small in size; similarly, older children are more likely to belong to a UC-OM pair. However, for the subset of richer states, none of the child-level characteristics seem to matter.

Among maternal characteristics, for all states, relative to other households, taller mothers are less likely to have underweight child and to be overweight; this result is in line with other studies that found similar associations (Oddo et al. 2012; Lee et al. 2010). Older mothers and mothers who watch more than 2 hours of television are also more likely to be overweight and have an underweight child compared to other households. The insignificance of the quadratic term in age perhaps reflects the fact that mothers with preschool children are not likely to be old enough for curvature in the relationship with age to matter.

The dual burden is more likely to occur in households where mothers have some formal education relative to households where mothers have no education; this is similar to findings by Oddo et al. (2012) for Bangladesh and Wong et al. (2015) for Malaysia. However, occupation does not seem to exert any independent effect on the probability of a household having a UC-OM pair. Many of these covariates are, however, insignificant when the subset of richer states is considered: only mother's height and the number of children are significant in predicting familial coexistence of underweight child and maternal overweight. This may reflect the well-known positive association of weight gain with each pregnancy and also that higher parity is associated with child undernutrition, and is in line with what Lee et al. (2010) found.

Finally, households in wealthier quintiles relative to households in the lowest quintile appear to be more vulnerable to the double burden of malnutrition. For example, households in the fifth quintile have a 139% higher chance of having UC-OM pairs as compared to households in the lowest quintile in richer states, while the corresponding figure for all states is 49%, and is consistent with other studies (for example, Lee et al. 2012; Doak et al. 2005). As expected, urban residents have higher likelihood of having UC-OM pairs relative to rural residents.

To examine if the covariates associated with being a UC-OM household vary if, instead of a comparison group of all other households, a multinomial approach is used in which the factors associated with belonging to UC-OM, UC-NOM, and NUC-OM households are examined simultaneously, with the reference category of NUC-NOM household. Relative risk ratios from the MNL using the first specification are presented in Table 6,[10] while Table 7 does the same for the more parsimonious specification. As before, variants that contain observations for all states, and a subset of the richer states, are presented separately.

[10] The models were tested for the validity of the independence of irrelevant alternatives (IIA) assumptions using the Hausman test, which failed to reject the null hypothesis of independence irrelevant alternatives, suggesting that the MNL specification is appropriate.

Table 5: Odds Ratios for Covariates from a Logit Regression of the Probability of a UC-OM Household, Alternative Specifications

Dependent Variable: Probability that a Household has a UC-OM Pair	Richer States		All States	
	Specification 1	Specification 2	Specification 1	Specification 2
Age (in months)	1.000	1.000	1.009**	1.009**
	(0.005)	(0.005)	(0.004)	(0.004)
Gender (girl)	0.937	0.936	0.999	0.996
	(0.141)	(0.141)	(0.115)	(0.115)
Diarrhea last month	0.640		1.078	
	(0.201)		(0.185)	
Fully immunized	0.980		1.091	
	(0.157)		(0.132)	
Birth size	0.839	0.855	0.713**	0.713**
	(0.169)	(0.170)	(0.101)	(0.101)
Number of children	1.186**	1.187**	1.087	1.077
	(0.101)	(0.100)	(0.066)	(0.065)
Height (in meters)	0.943***	0.943***	0.950***	0.950***
	(0.012)	(0.011)	(0.009)	(0.009)
Age (in years)	1.208	1.207	1.204*	1.208*
	(0.164)	(0.163)	(0.126)	(0.126)
Age square	0.998	0.998	0.998	0.998
	(0.002)	(0.002)	(0.002)	(0.002)
More than 2 hours of TV	1.058	1.055	1.277**	1.276**
	(0.163)	(0.161)	(0.149)	(0.150)
Primary education	1.127	1.116	1.423*	1.456*
	(0.357)	(0.352)	(0.289)	(0.296)
Upper primary	1.181	1.167	1.561**	1.614**
	(0.341)	(0.338)	(0.299)	(0.311)
Higher secondary and above	1.181	1.165	1.403	1.490*
	(0.343)	(0.339)	(0.293)	(0.309)
Not working	1.033		1.137	
	(0.218)		(0.176)	
White collar jobs	0.990		1.446	
	(0.351)		(0.362)	
Expenditure quintile 2	3.211***	3.202***	1.576**	1.586**
	(1.427)	(1.421)	(0.339)	(0.341)
Expenditure quintile 3	2.161*	2.164*	1.206	1.217
	(0.960)	(0.959)	(0.272)	(0.274)
Expenditure quintile 4	2.715**	2.716**	1.466*	1.496*
	(1.207)	(1.206)	(0.331)	(0.336)
Expenditure quintile 5	2.399*	2.406*	1.461	1.490*
	(1.097)	(1.097)	(0.348)	(0.353)
Urban residence	1.614**	1.634***	1.478***	1.532***
	(0.305)	(0.278)	(0.208)	(0.199)
N	2,543	2,543	5,527	5,527

Notes: UC-OM = underweight child and overweight mother. Base categories: boy for gender, didn't have diarrhea for diarrhea last month, not fully immunized for fully immunized, very small/small for birth size, less than 2 hours of TV for hours of TV, no education for mother's education, blue collar job for mother's occupation, expenditure quintile 1 for expenditure quintile, rural for place of residence. A child is defined as underweight when weight-for-age z-score<–2; non-underweight when weight-for-age z-score≥–2. Mother is defined as overweight when BMI>=23 kg/m^2 and non-overweight when BMI<23 kg/m^2. Richer states includes Karnataka, West Bengal, Maharashtra, Tamil Nadu, Haryana, Andhra Pradesh, Punjab, Himachal Pradesh, and Kerala. Standard errors, clustered at the primary sampling unit, in parentheses; * p<0.10, ** p<0.05, *** p<0.01.

Source: Computed using IHDS2 unit record data.

Similar to the case with binary logit analysis, the MNL results for all states suggest that the child's age and birth size significantly affect the probability of being a UC-OM (relative to a NUC-NOM) household. Similarly, shorter and older mothers, and mothers who spend more time watching television, have higher chances of being in a UC-OM household; mothers with some formal education relative to illiterate mothers have higher odds of being UC-OM. The association with income is also the same: households in the highest quintile relative to the lowest quintile and households living in urban areas relative to rural households have higher chances of being UC-OM. These results remain unchanged in the more parsimonious specification as well. The set of significant coefficients (in terms of relative risk) is much smaller when the subset of richer states is examined, with taller mothers, mothers with more children, and households in higher-expenditure quintiles more likely to have a UC-OM than a NUC-NOM pair; this is also consistent with the results from the binary case.

Table 6: Relative Risk Ratio for Covariates from a Multinomial Logit Regression of the Probability that a Household has a UC-OM, UC-NOM, or NUC-OM Pair (Relative to NUC-NOM)

	Richer States					
Variables	**(1) UC-OM**		**(2) UC-NOM**		**(3) NUC-OM**	
	Child Characteristics					
Age (in months)	1.006	(0.005)	1.014***	(0.004)	1.009***	(0.003)
Gender (girl)	0.942	(0.148)	1.029	(0.121)	0.996	(0.101)
Diarrhea last month	0.838	(0.277)	1.760***	(0.318)	1.451**	(0.265)
Fully immunized	0.986	(0.165)	0.890	(0.107)	1.075	(0.121)
Birth size	0.871	(0.184)	0.763*	(0.110)	1.398**	(0.215)
	Maternal Characteristics					
Number of children	1.166*	(0.105)	1.017	(0.075)	0.962	(0.071)
Height (in meters)	0.922***	(0.012)	0.956***	(0.009)	0.969***	(0.008)
Age (in years)	1.234	(0.173)	0.853	(0.088)	1.305**	(0.151)
Age square	0.998	(0.002)	1.002	(0.002)	0.997	(0.002)
More than 2 hours TV	1.105	(0.176)	0.993	(0.115)	1.137	(0.119)
Primary education	1.233	(0.408)	0.949	(0.189)	1.491*	(0.350)
Upper primary	1.179	(0.351)	0.743	(0.136)	1.388	(0.295)
Higher secondary and above	1.264	(0.377)	0.679**	(0.125)	1.703**	(0.355)
Not working	1.048	(0.224)	0.713***	(0.086)	1.392**	(0.183)
White collar jobs	1.202	(0.450)	0.965	(0.270)	1.795***	(0.407)
	Household Characteristics					
Expenditure quintile 2	3.008**	(1.347)	0.914	(0.187)	1.000	(0.249)
Expenditure quintile 3	1.981	(0.887)	0.761	(0.152)	1.093	(0.256)
Expenditure quintile 4	2.491**	(1.109)	0.603**	(0.121)	1.267	(0.287)
Expenditure quintile 5	2.538**	(1.160)	0.702*	(0.149)	1.622**	(0.383)
Urban residence	1.916***	(0.368)	0.958	(0.135)	1.606***	(0.191)
N	2,543		2,543		2,543	

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Table 6 *continued*

Variables	Richer States					
	(4) UC-OM		(5) UC-NOM		(6) NUC-OM	
Child Characteristics						
Age (in months)	1.015***	(0.004)	1.013***	(0.002)	1.010***	(0.002)
Gender (girl)	0.984	(0.117)	0.955	(0.068)	0.988	(0.073)
Diarrhea last month	1.183	(0.211)	1.469***	(0.151)	0.966	(0.120)
Fully immunized	1.085	(0.135)	0.894	(0.066)	1.098	(0.087)
Birth size	0.642***	(0.097)	0.651***	(0.062)	1.059	(0.118)
Maternal Characteristics						
Number of children	1.032	(0.065)	0.953	(0.035)	0.906**	(0.040)
Height (in meters)	0.930***	(0.009)	0.956***	(0.006)	0.977***	(0.006)
Age (in years)	1.266**	(0.133)	0.943	(0.055)	1.382***	(0.101)
Age square	0.997	(0.002)	1.001	(0.001)	0.996***	(0.001)
More than 2 hours TV	1.263*	(0.153)	0.871*	(0.067)	1.101	(0.085)
Primary education	1.551**	(0.325)	1.062	(0.119)	1.460**	(0.221)
Upper primary	1.586**	(0.310)	0.780**	(0.080)	1.616***	(0.210)
Higher secondary and above	1.558**	(0.326)	0.719***	(0.079)	2.051***	(0.271)
Not working	1.152	(0.179)	0.787***	(0.061)	1.464***	(0.143)
White collar jobs	1.512	(0.393)	0.740	(0.143)	1.594***	(0.265)
Household Characteristics						
Expenditure quintile 2	1.411	(0.312)	0.833*	(0.090)	0.954	(0.149)
Expenditure quintile 3	1.155	(0.265)	0.802*	(0.091)	1.400**	(0.208)
Expenditure quintile 4	1.348	(0.311)	0.598***	(0.072)	1.541***	(0.229)
Expenditure quintile 5	1.552*	(0.372)	0.610***	(0.080)	2.063***	(0.311)
Urban residence	1.716***	(0.242)	0.982	(0.085)	1.645***	(0.143)
N	5,527		5,527		5,527	

Notes: UC-OM = underweight child and overweight mother, UC-NOM = underweight child and non-overweight mother, NUC-OM = non-underweight child and overweight mother, NUC-NOM = non-underweight child and non-overweight mothers. Base categories: boy for gender, didn't have diarrhea for diarrhea last month, did not get up-to-date vaccination for up-to-date vaccination, very small/small for birth weight, less than 2 hours of TV for hours of TV, no education for mother's education, blue collar jobs for mother's occupation, expenditure quintile 1 for expenditure quintile, rural for place of residence. A child is defined as underweight when weight-for-age z-score<–2; non-underweight when weight-for-age z-score≥–2. A mother is defined as overweight when BMI>=23 kg/m^2 and non-overweight when BMI<23 kg/m^2. Richer states includes Karnataka, West Bengal, Maharashtra, Tamil Nadu, Haryana, Andhra Pradesh, Punjab, Himachal Pradesh, and Kerala. Standard errors, clustered at the primary sampling unit, in parentheses; * p<0.10, ** p<0.05, *** p<0.01.

Source: Estimated using IHDS2 unit record data.

Turning to the predictors of households with UC-NOM, households with older children are more likely, with larger birth-weight children less likely, and those who had diarrhea recently are more likely to belong to this group relative to NUC-NOM. For example, children who were large/average when they were born have 35 % (all states) lower risk of being UC-NOM relative to NUC-NOM households. Maternal height and mothers' education are associated with lower probability of having UC-NOM pairs relative to NUC-NOM. Sedentary lifestyles (as captured by the number of hours spent watching television) are likely to lead to lower odds of being UC-NOM. Mothers working in blue collar jobs have more chances of being UC-NOM as compared to mothers who are not working; this variable matters even after controlling for household income quintiles. Not unexpectedly, richer households are less likely to have a UC-NOM pair compared to NUC-NOM; however, area of residence does not seem to matter. Unlike the case with UC-OM, there are no major differences in the variables that are significant across all states and the subset of richer states; they are also robust to choice of specification (see Table 7). These results are similar to those of Jehn and Brewis (2009), who find that households in the lowest wealth quintile and with less educated mothers have higher risk of having an underweight child and a non-overweight mother.

Table 7: Relative Risk Ratio for Covariates from a Multinomial Logit Regression of the Probability that a Household has a UC-OM, UC-NOM, or NUC-OM Pair (Relative to NUC-NOM), Alternate Specification

	All States					
Variables	(1) UC-OM		(2) UC-NOM		(3) NUC-OM	
Child Characteristics						
Age (in months)	1.010**	(0.005)	1.014***	(0.003)	1.009***	(0.003)
Gender (girl)	1.009	(0.152)	1.011	(0.107)	1.007	(0.099)
Diarrhea last month	0.763	(0.243)	1.485**	(0.251)	1.351*	(0.232)
Birth size	0.803	(0.165)	0.738**	(0.098)	1.375**	(0.198)
Maternal Characteristics						
Height (in meters)	0.927***	(0.012)	0.963***	(0.008)	0.970***	(0.008)
Age (in years)	1.218	(0.155)	0.926	(0.081)	1.281**	(0.128)
Age square	0.998	(0.002)	1.001	(0.002)	0.997*	(0.002)
Primary education	1.200	(0.354)	0.987	(0.175)	1.653**	(0.351)
Upper primary	1.136	(0.307)	0.838	(0.135)	1.526**	(0.286)
Higher secondary and above	1.175	(0.314)	0.721**	(0.114)	1.959***	(0.355)
Not working	1.175	(0.240)	0.741***	(0.081)	1.438***	(0.174)
White collar jobs	1.197	(0.418)	0.843	(0.225)	1.630**	(0.344)
Household Characteristics						
Expenditure quintile 2	2.849***	(1.131)	0.976	(0.176)	1.169	(0.258)
Expenditure quintile 3	1.841	(0.727)	0.853	(0.150)	1.264	(0.257)
Expenditure quintile 4	2.404**	(0.934)	0.721*	(0.128)	1.497**	(0.297)
Expenditure quintile 5	2.323**	(0.924)	0.715*	(0.138)	1.904***	(0.387)
Urban residence	1.811***	(0.333)	1.032	(0.135)	1.604***	(0.182)
N	2,877		2,877		2,877	

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Table 7 *continued*

Variables	All States (4) UC-OM		(5) UC-NOM		(6) NUC-OM	
Child Characteristics						
Age (in months)	1.017***	(0.004)	1.012***	(0.002)	1.010***	(0.002)
Gender (girl)	1.072	(0.119)	0.976	(0.060)	1.013	(0.071)
Diarrhea last month	1.096	(0.183)	1.467***	(0.130)	0.949	(0.109)
Birth size	0.653***	(0.090)	0.714***	(0.059)	1.119	(0.114)
Maternal Characteristics						
Height (in meters)	0.930***	(0.008)	0.958***	(0.005)	0.973***	(0.006)
Age (in years)	1.167	(0.118)	0.892**	(0.042)	1.312***	(0.086)
Age square	0.999	(0.002)	1.002**	(0.001)	0.997***	(0.001)
Primary education	1.368*	(0.251)	1.009	(0.094)	1.513***	(0.204)
Upper primary	1.520**	(0.253)	0.794***	(0.066)	1.806***	(0.204)
Higher secondary and above	1.475**	(0.265)	0.675***	(0.063)	2.380***	(0.267)
Not working	1.296*	(0.182)	0.791***	(0.053)	1.521***	(0.135)
White collar jobs	1.428	(0.352)	0.675**	(0.121)	1.423**	(0.221)
Household Characteristics						
Expenditure quintile 2	1.426*	(0.268)	0.842*	(0.076)	1.019	(0.138)
Expenditure quintile 3	1.265	(0.245)	0.854*	(0.081)	1.470***	(0.188)
Expenditure quintile 4	1.463*	(0.292)	0.672***	(0.069)	1.713***	(0.220)
Expenditure quintile 5	1.616**	(0.330)	0.608***	(0.071)	2.312***	(0.299)
Urban residence	1.675***	(0.219)	0.983	(0.079)	1.689***	(0.138)
N	6,875		6,875		6,875	

Notes: UC-OM = underweight child and overweight mother, UC-NOM = underweight child and non-overweight mother, NUC-OM = non-underweight child and overweight mother, NUC-NOM = non underweight child and non-overweight mother. Base categories: boy for gender, didn't have diarrhea for diarrhea last month, very small/small for birth size, no education for mother's education, blue collar job for mother's occupation, expenditure quintile 1 for expenditure quintile, rural for place of residence. A child is defined as underweight when weight-for-age z-score<–2; non-underweight when weight-for-age z-score ≥–2. A mother is defined as overweight when BMI>=23 kg/m^2 and non-overweight when BMI<23 kg/m^2. Richer states includes Karnataka, West Bengal, Maharashtra, Tamil Nadu, Haryana, Andhra Pradesh, Punjab, Himachal Pradesh, and Kerala. Standard errors, clustered at the primary sampling unit, in parentheses; * p<0.10, ** p<0.05, *** p<0.01.

Source: Estimated using IHDS2 unit record data.

Finally, examining factors associated with NUC-OM households, the results in Tables 6 and 7 suggest that, relative to NUC-NOM households, taller mothers have lower chances and older mothers have higher chances of being NUC-OM. Occupation is also a significant predictor, with chances of being a NUC-OM increasing if mothers are employed in jobs that involve less physical labor or are not working (relative to mothers working in more physically strenuous jobs).

Furthermore, households with educated mothers relative to mothers with no education, or households in higher income quintiles relative to the lowest income quintile, have higher risk of having a NUC-OM pair than being NUC-NOM. However, for richer states, this is seen only in the highest quintile. As expected, results across both the richer and all states predict that urban relative to rural households have higher chances of having a NUC-OM pair. As shown in Table 7, the results are unaffected when an alternate specification is considered.

To summarize, a child's birth size and age, the mother's health (as captured by her height) and age, her education, whether she has a sedentary lifestyle, and household expenditure are significant in explaining the probability that a household has an underweight child and overweight mother. All these are in the expected direction and are consistent with the evidence found for other developing countries including Indonesia and Bangladesh. While urban residence matters, it appears to affect only the level and not the magnitudes of the marginal effects of the covariates. These results are robust to both the choice of specification and the method of estimation (as there are no substantial differences in the set of factors that are significant across both the binary and MNL specifications). However, when a subset of the richer states is examined separately, only the mother's health, the number of children she has, and household expenditure are significant—once again, results that are robust to both choice of specification and method of estimation. Thus there appear to be strong regional differences in the principal drivers of the probability of having a dual burden household. Also, lack of access to household-level resources does not appear to explain the phenomenon, suggesting that intra-household allocation of food and other resources may be inequitable, although the lack of data on food intakes precludes a definitive statement.

6. CONCLUSIONS

India is clearly far along in the nutrition transition. This paper has estimated, using unit record data, the proportion of adult women whose BMI is greater than 23 and 27.5, cutoffs at which populations in South Asia are at greater risk of noncommunicable diseases (NCDs), and has demonstrated that these numbers are substantial and increasing rapidly. Not surprisingly, the magnitudes of at least two of the NCDs—diabetes and hypertension—are large and have important implications for the public health system in terms of its ability to diagnose and manage these conditions. Given regional variations, there is need for different intensities of intervention—with a focus on diagnosis and management in high-burden states, and prevention in regions where the magnitudes of overweight and obesity are lower. This is likely to be a particular challenge in rural areas as well, where there is need for sensitization and strengthening of health infrastructure (both physical, including for basic blood tests, and human capital) that are critical to monitoring and managing diabetes and hypertension.

To what extent macro policy levers, especially those affect relative prices of food can be used to effect better health outcomes needs further investigation. Some states do subsidize the provision of edible oil and sugar through the public distribution system, potentially leading to greater consumption. Also, some have argued that the Indian National Food Security Act, with its focus on highly subsidized cereals, may act as a disincentive to make better diet choices in favor of fruits, vegetables, and dairy products—as higher-quality diets are also more expensive. However, the limited evidence (see Meenakshi 2016) suggests that quantities consumed of fats, oils, and sugars are highly inelastic with respect to price, perhaps limiting the effectiveness of price instruments, and that income effects may dominate in consumption trends. Others (Popkin et al. 2012) on the other hand, have argued that the fall in the relative price of oil has contributed to its increased consumption; there is clearly, need for more research in this area.

While the magnitude of undernutrition, especially among children, is declining in nearly all states, the phenomenon of the intra-household dual burden is increasing. The analysis suggests that among other factors, healthier mothers, mothers with fewer years of education, and households where children are born with a healthy weight are less likely to have a dual burden of malnutrition, underscoring the importance of current policy initiatives designed to ensure safe and healthy pregnancy outcomes. The significance of the household expenditure variable suggests that unlike the case in many developed countries (but similar to the experience of other countries undergoing the transition), this is associated with affluence; equally clearly, lifestyle choices also matter. Although this analysis could not directly address to what extent such households are characterized by inequalities in food intakes, it is reasonable to infer that a reallocation may help address the problem of the intra-household dual burden. Behavior change communication strategies that address both healthy lifestyle and diet choices for adults and appropriate feeding practices for children need greater emphasis. However, even here, there are regional differences in both trends and factors contributing to them, suggesting that a region-specific set of interventions will need to be implemented.

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