WORKING PAPER 200/2020

DOUBLE BURDEN OF MALNUTRITION IN INDIA: DECADAL CHANGES AMONG ADULT MEN AND WOMEN

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August 2020

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Price : Rs. 35

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Abstract

The recent COVID-19 pandemic brings to the fore a high fatality rate amongst those with comorbidities of diabetes and hypertension that is often associated with obesity, while it also exposes the vulnerabilities among the less nourished population due to the infection and economic lockdown. An increasing number of developing countries like India have both undernourished people and overnourished individuals posing a huge public health challenge. In these contexts, the study here analyses the decadal changes in double burden of malnutrition among adult men and women in India based on NFHS-3 and NFHS-4 data. Undernutrition is assessed by the thinness and overnutrition by overweight and obesity using Asian cut-off values for BMI.

By 2015-16 the gender gaps in malnutrition have closed in, than it was in 2005-06 perhaps due to an increase in sample size for men. Undernutrition rates have declined in the past decade but are close to 20 percent or more in the population segments of 20-29 years, rural areas, among the poorest and poor asset quintiles, those with less than 5 years of schooling and in the central and eastern regions of India. The worrisome feature is that the increases in overnutrition rates have replaced the decline in undernutrition rates more than the increases in normal nutrition rates resulting in its widespread increase across all parts of country with 50 percent or more among the richest asset quintile, 15 or more years of schooling and more urbanized states of India. The silver lining is that overnutrition rates have declined marginally among those with 18 or more years of schooling in 2015-16. To address the double burden of malnutrition, the way forward would be to harness the large diversity in India's food systems with the assistance of local governments and communities and nudging the individuals to a healthy diet and physical exercises using India's varied fare of traditional and modern options-this could also be in sync with the ongoing call for localness and self-reliance.

Key words*:* Malnutrition, Double Burden, BMI, Health Insurance, Hygiene
JEL Codes: I11, I18, I20, J18, O18

Acknowledgement

This paper is dedicated to the memory of Prof. A. Vaidyanathan. He suggested the use of NNMB data on anthropometric anthropemtric measurements to assess the changes in undernutrtion with the first author, way back in 2007. This enabled in analysing the role of nutritional outomes as a measure of developmental changes in India by the first author and resulted in several journal articles and book chapters. This has also spawned further research from several master's dissertations, a couple of PhD theses and numerous student assignments based on anthropometric data for assessing the pathways that affect malnutrition in the Indian population. The analysis here is a tribute to the association and the immense benefit that the first author has derived from her interactions with Prof. Vaidyanathan.

The second author would like to thank Amrita Chatterjee and Gopinath for useful suggestions as panel members of her master's dissertation. Some components of the analysis based on women's double burden of malnutrition presented here were part of her MA thesis submitted in 2019 at MSE.

Results and discussions from this study was presented at International e-Conference on The Challenges and Rehabilitation Avenues in the Context of Covid-19, organized by Department of Economics (at DDE), Madurai Kamaraj University, 12th-14th, August, 2020 titled 'Health Priorities for an Inclusive Post-COVID Economy'. The authors would like to thank the participants for some useful comments.

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INTRODUCTION

Insufficient or excess nutrient intakes including calories, which is not in balance with an individual's age, body structure and physical activity is referred as malnutrition[1]. For about three decades many of the low and middle income countries (LMIC) are reporting a modest decline in undernutrition among the less wealthy population while overweight and obesity (or overnutrition) rates are rising rapidly among the wealthier sections (Popkin *et. al.,* 2020). Many of the LMICs are populous and even with moderate rate of undernutrition and somewhat low rate of overnutrition the numbers for both are substantially high and hence double burden of malnutrition. It is then not incidental that this double burden of malnutrition overlaps with the co-existence of infectious and non-communicable diseases, and thus making it a public health challenge (Prentice, 2018). Allocation of scarce resources to address a wide range of health problems makes it a big challenge for LMICs. The ongoing COVID-19 pandemic has further exacerbated this challenge as the undernourished are more susceptible to any infection while the obese with co-morbidities like diabetes and hypertension, once infected, have a higher risk of fatality. The lock downs imposed by the pandemic has affected all types of economic activities including food systems and a large disruption in supply chains (Aiyar and Pingali, 2020; FAO *et. al.,* 2020). Thus, the double burden of malnutrition and the ongoing health and economic crisis feed into each other which further affect the health and nutritional status of the people in the LMICs.

Underdeveloped countries are prone to deficiencies in nutrient intake attributed to food insecurity and poverty. Structural transformation results in the low income nations to transition into middle income nations but more often with higher economic inequality than before. Consequently, those at the lower end of the economic strata report prevalence of undernutrition while the changes towards more sedentary

[1] https://www.who.int/features/qa/malnutrition/en/

lifestyles with improved availability and increased affordability of more energy dense and sweetened food items for others, results in higher overweight and obesity (or overnutrition) rates (Black *et. al.,* 2013). The structural transformation has been found to be accompanied by nutrition transition that reduces the overall undernutrition rates while increasing the overnutrition rates (Popkin, 1993; and Kadiyala, *et. al.,* 2019). More notably, as structural transformation happens urbanization rate also picks up and many rural areas also show more diversification into agricultural activities (Sharma, 2015; Chand *et. al.,* 2017). All these are shown to be associated with the nutrition transition on the one hand and persistence of undernutrition in the underdeveloped and lagging regions of the country (Meshram *et. al.,* 2015; Aiyar *et. al.,* 2019) Overnutrition was initially observed in high income countries which then spread to the middle income countries and has now rapidly expanded to the lower income nations (Black *et. al*., 2013 and Di Cesare *et. al.,* 2016).

India is no exception to this economic and nutrition transition and also contributes significantly to the double burden of malnutrition, the onset of which started almost twenty years back (Griffiths and Bentley, 2001; Di Cesare, *et. al*., 2016; and Kulkarni *et. al.,* 2017). Dutta *et. al. (*2019) document the risk to undernutrition and overnutrition rates among adult men and women in India. More importantly, some developing countries like India have documented that the double burden of malnutrition exists even within a household. Children below the age of five years are found to be stunted or underweight and hence undernourished while their mothers and older men and women in the same household are over-nourished (Dang and Meenakshi, 2017; Kulkarni, 2018). Lastly, based on two different indicators of malnutrition, Ramachandran (2018) points to a double burden for a same individual at the same time- a stunted and overweight child or an anemic and overweight woman- or the same individual over the lifecycle-stunted child grown up to be an overweight adult.

Ideally, if one could observe the same individuals for over three decades then understanding their individual pathways to nutrition transition (from an undernourished young child to an overweight or obese adult) or maintaining a status quo would be beneficial for personal and public health intervention[2]. The only panel data set (2005/06 and 2011/12) in the Indian context is the India Human Development Survey (IHDS) data which shows the persistence of overnutrition as well as some transition among adult Indian women (Maitra and Menon, 2019). In the absence of a longitudinal data covering a long duration of time one could possibly compare undernutrition and over nutrition rates and mean BMI for similar age cohorts of men and women by pooling the two waves of the National Family Health Surveys (NFHS). For women (15-49 years) and children (0-59 months) three waves of NFHS in 1998-99, 2005-06 and 2015-16 can be used to observe the changes across cohorts and regions (Luhar *et. al.,* 2018). For children, an additional wave of NFHS in 1992-93 can also be used (Dev *et. al.*, 2013). The IHDS data is a short panel and the BMI values are available only for women in both the years while male BMI values are available only in the later year (Desai et. al 2009 and Desai and Vanneman, 2017). The anthropometric data collected periodically since 1970s by the National Institute of Nutrition (NIN[3]) is available only for select states and is largely a rural sample. However, it is helpful in tracking mean and standard deviation of adult weights and heights separately but does not report BMI values unless one could access the unit record data (Meshram *et. al.*, 2015).

This study attempts to fill this gap in assessing the double burden of malnutrition for India among adult men and women, comparing the changes between 2005-06 and 2015-16 in association with socio-economic and demographic features of the population and sub-regions of the country. Rest of the study is organized as follows

[2] The Young Lives data tracks children in four countries including India but only for the state of Andhra Pradesh. This has enabled studies that assess growth faltering and catching up that

[3] https://www.nin.res.in/downloads.html

Next section is a summary of the way in which malnourishment is assessed. The following section provides the main analysis of the study assessing the decadal changes in double burden of malnutrition for men and women separately along with a discussion of the findings from recent studies. In this section, a global comparison is first presented followed by the analysis for India based on National Family Health Survey data for 2005-06 and 2015-16 focusing on age-groups, rural-urban gaps, asset-group categories, years of schooling, Indian states and non-communicable diseases. The penultimate section is a brief discussion on regional distribution of access to health care and insurance among men and women and presence of water and soap among households connecting it with aspects of risk and resilience to ongoing health issues arising from the COVID-19 pandemic. The final section concludes the study highlighting some economic and policy aspects.

ASSESSMENT OF MALNOURISHMENT

An Overview

In order to assess the rate of malnourishment, the age-standardized z-score (for under-five children) or an index (for adults) based on heights and/or weights are commonly used. While it is easy to record and with low measurement error (except perhaps for heights among infants), the time taken to record and cost involved to measure height and weight is also less. It is a non-invasive method which can also be observed by the respondent or her family member, the trust in the recorded values tends to be high. Consequently, the socio-cultural barriers or individual preferences for measuring the same are also known to be minimal. It is measured at the individual level and quite often the indices or the scores have a scientifically prescribed threshold value for deficiencies and excesses. This means that absolute deprivations as well as relative deprivation while comparing members within a household or between sex or social or demographic group can be assessed. It is a fairly simple measure of malnutrition that can be readily comprehended by a lay person, so communicating about malnutrition, for an effective individual

level behavioral change and for national or sub-national policy intervention becomes easy. However, these measures are suggestive of morbidity that may be associated with malnutrition and provides only an indication about the general health of the individuals in a nation.

Among LMICs, the focus is usually on aspects of undernourishment where anthropometric indicators involving under-five children is the main or an important component (von Grebmer *et. al.,* 2019; and Global Nutrition Report, 2020). The commonly used measures are shortfalls from age specific standardized values for: height for age (or stunting rate), weight for age (or underweight rate) and height for weight (or wasting rate). The standardized values are provided by the World Health Organization (WHO) while the country-wide surveys on children are conducted at regular intervals of time with the support of the national governments, non-governmental organization and nodal institutions overseeing their administering and disseminating the collected information. The prominent nationwide database India is the National Family Health Survey while the District Level Household and Facility Survey (DLHS), Annual Health Surveys (AHS) and most recently the Comprehensive National Nutrition Survey (CNNS) are available for intermittently in more recent years. These additional databases help us to verify the estimates from alternative data sources (Jose, 2019).

Malnourishment among children at the other end of the spectrum (or overnutrition) has begun to emerge more recently.as a public health issue in countries like India within the last five to six years. As mentioned earlier the NFHS collects data on anthropometry for children below five years and is available for four years covering two decades while the data for older children from 5 to 14 years is not available. In the recent CNNS survey conducted between 2016 and 2018, such data was collected for the first time also for children (aged 0-5 years and 5-9 years) and

adolescents (10-19 years)[4]. This data also recorded additional anthropometric measures related to arm circumference that now enables a more detailed study of the early onset of undernutrition and overnutrition rates and pre-morbid conditions for non-communicable diseases (MoHFW, *et. al.,* 2019 and Yadaver, 2019).

Among adults, the common measure used to assess malnutrition is the Body Mass Index (BMI) defined as the ratio of weight (in kilograms) to squared height (in meters) and thus expressed as kg/m^2. The body weight would vary in the short term due to metabolic activities affected by quantity and quality of dietary intakes, physical activity and morbidity condition while body height has unchanged value from the age of 20 years to about 50 years after which stooping can slowly set in. For an adult, a BMI value below 18.5 kg/m^2 is now commonly referred as thinness while earlier it was referred as chronically energy deficient (CED); a value greater than or equal to 25 kg/m^2 is overweight, a value greater than or equal to 30 kg/m^2 is obesity (Shetty and James, 1994; Di Cesare *et. al.,* 2016; and Popkin *et. al.*, 2020). Thus, a simple indicator which can be easily and periodically recorded at an individual level so that it can also be tracked for temporal changes becomes a useful but a broad measure of well-being when the value lies within 18.5-25 kg/m^2. The percentage of population with BMI values outside this range is the malnourishment rate. Double burden of malnutrition is observed if the rates or absolute numbers below 18.5 kg/m^2 and above 25 kg/m^2 are high for the adult population in the age of 20 to 50 years in a region. This would call for different strategies to address the deprivation depicted by low BMI values below 18.5 kg/m^2 and inadequate dietary diversity and physical activity depicted by large BMI values above 25 kg/m^2. NFHS has data for women in 1998-99, 2005-06 and 2015-16 and for men in the last two waves. Dutta *et. al.* (2019) estimate the risk to undernutrition and

[4]Childhood overweight is based on children aged 0–59 months who are more than two standard deviations (moderate and severe) above the median weight-for-height of the WHO Child Growth Standards. Adolescent overweight (obesity) relates to children and adolescents aged 5–19 years who are more than one (two) standard deviation above the median BMI for age of the WHO growth reference for school-aged children and adolescents.

overnutrition based on dietary habits, regional differences and economic status using NFHS-4 data. More recently IHDS provides country wide panel data for adult women's heights and weights in 2004-05 and 2011-12 and only for males in 2011-12. These two data sets provide unit level data while the NIN data is available at age-specific averages for heights and weights separately but not for BMI.

The above mentioned anthropometric measures are considered as nutrient outcome measures as they are an outcome of dietary intake that is net of physical activity and morbidity status. Dietary intakes with shortfall in required dietary allowance (RDA) of specific macronutrients like calories, proteins and fat and micronutrients like iron, calcium, zinc including vitamins like B6, B12, A, C and D are used to assess multiple dimensions of nutrition insecurity. In comparison to this, overnutrition is assessed by excess consumption of fats and sugars than permitted by RDA along with inadequate consumption of quality proteins and different fruits and vegetables. Such type of data is collected based on 24 hours recall of dietary intakes for individual members of a household. The measured intake of different food items are converted to their nutritive values based on dietary guidelines for India and then using RDA values are assessed for undernourishment rates (NIN, 2011; Viswanathan, 2014; and Shankar *et. al.*, 2017). Dietary diversity is also assessed through food frequency of different food items consumed by a child or young mother keeping the week as a reference period. NFHS collects this information for some food items and they are often analyzed in association with anthropometric indicators to assess undernutrition or overnutrition (Naline and Viswanathan, 2017; Agnihotri, 2019).

Observing food intakes for each individual member of the household requires concerted effort and cooperation of the interviewer and interviewee[5].The household level consumption survey of different

[5] The approach followed here is to give measuring cups of different sizes to assess the consumption of different food items by one or two members of the family like a representative woman or an

quantities of a wide range of food items has been available in India periodically since the early 1970s to 2011-12 based on the National Sample Surveys (NSS). A large number of food items reported as quantities consumed per household is converted to their nutritive values suggested by the Indian Council of Medical Research. Conventionally, household level nutritive intakes are reported as per consumer unit intake instead of per capita intake (Chand and Jumrani, 2013; Meenakshi and Viswanathan, 2013, Sharma, 2015; Minocha *et. al.*, 2018; Rawal *et. al.*, 2019; Siddiqui *et. al.,* 2019).

As countrywide surveys also take time to administer and collate so another broad measure is based on supply of different food items at the national level as reported periodically by the Food and Agricultural Organization (FAO). This is a dietary energy based approach using scientifically determined thresholds, an average estimate of prevalence of undernourishment rate is estimated (Naiken, 2014).

Clinical examinations for iron, Vitamin A and D deficiencies are also carried out periodically among populations that show persistence of such deficiencies. These are available through NFHS, NNMB and CNNS databases.

India is one of those developing countries that have endeavoured to collect socio-economic information including some basic anthropometric data from its early years of independence. This has enabled in assessing the changes in well-being during the process of structural transformation, nutrition transition and epidemiological transition. This study is a descriptive analysis of double burden of malnutrition based on the BMI of adult men and women to document the decadal changes in undernutrition assessed by their thinness and overnutrition from overweight and obesity using the Asian cut-offs. This

adolescent girl or a pregnant woman. The diet is recorded for a 24 hour period and repeated for another day of the week (Varalakshmi, 2020).

is assessed across different social and economic segments of the population and also provides discussion about the need to focus on this problem due to the challenges arising out of the COVID-19.

DATA AND METHODOLOGY

To assess the gradation between economic development as measured by per capita GDP and malnutrition at the global level the analysis is based on 157 countries for two different years, 2005 and 2014, that are almost a decade apart. The per capita GDP is in constant 2017 International Dollars using purchasing power parity rates (PPP) and is from the International Comparison Program of the World Bank. The per capita Gross Domestic Product (GDP) ranges from USD800 to USD1, 00,000 and hence covering a wide segment of the developed, developing and less developed countries. For the malnutrition rates (underweight, overweight and obesity rates) the data is from NCD Risk Factor Collaboration (NCD-RisC) Database (2017) for various countries where such data is available from 1975-2014.

The global level analysis is followed by a detailed analysis for India and uses the National Family Health Survey data for 2005-06 (IIPS and ICF, 2017) and 2015-16 (IIPS and macro International, 2007) and shall be referred henceforth as NFHS-3 and NFHS-4 data respectively. This cross-sectional secondary data is part of the Demographic and Health Surveys conducted in many countries all over the world periodically (usually once in five years) but is not a panel data in nature. It is a nationally representative survey conducted by the Ministry of Health and Family Welfare, Government of India with International Institute of Population Studies as the designated nodal agency for implementation. This data provides information on men and women's individual characteristics e.g., age, education in single years, occupation, nutritional status, aspects of fertility, marriage, family planning, and women's empowerment, HIV/AIDS etc. This also includes Clinical, Anthropometric, and Biochemical (CAB) components that are designed to

provide vital estimates of the prevalence of malnutrition, anaemia, hypertension, HIV, and high blood glucose levels through a series of biomarker tests and measurements. Some of these aspects like blood pressure and random blood glucose were added in the NFHS-4 survey recently while most other details are also available in NFHS-3. The individual data is based on interview of 'eligible' (select) men and women. The 'eligibility' is determined on the basis of age group of 15-54 years for men and 15-49 years for women.

The secondary data is collected based on stratified two-stage sampling using the population frame of 2011 census for NFHS-4 (2015-16) data and 2001 census for NFHS-3 (2005-06). Appropriate sampling weights are provided for arriving at estimates at the district (only for NFHS-4), state and national level. Household characteristics that were collected included amenities in the dwelling units like source of water and its treatment, sanitation, materials used for the floor, roof, and walls of the dwelling unit and ownership of various durable goods. The possession of the durable goods is used for estimating the wealth index that assesses the relative economic status of the household within a given survey. Health and hygiene related features focussed upon in the analysis are access to: type of health care facility, health insurance, presence of running water and use of soap.

NFHS-4 interviewed 112,122 men aged 15-54 years and 699,686 women aged 15-49 years from all 29 states and 7 UTs of India. NFHS-3 interviewed a much smaller number of men (74,369) and women (124,385) in the same age-groups and covered all the states and union territories of India but district level identifiers were not provided for this earlier survey unlike the recent one. This study is restricted to men aged 20-54 years with sample sizes of 61,291 from NFHS-3 and 93,040 from NFHS-4; and the sample size of women aged 20-49 years from NFHS-3 is 100,430 and 574,808 from NFHS-4. The lower age limit is determined by the fact that adult height stabilizes by the age of 20 years while the upper age limit is as provided by the data source. Though one could have

restricted upper age limit of the male samples to 49 years as for women but the sample size reduces further. Given this difference in age composition used in the analysis here, the study does not make any comparison on malnutrition rates between the men and women.

The study uses a descriptive approach based on quantitative data across two time points that are ten years apart in documenting the pattern of double burden of malnutrition in India, separately for adult men and women. A major departure in this analysis lies in the use of BMI thresholds for overweight and obesity based on the Asian cut-off values (WHO Expert Consultation, 2004). The BMI range for overweight is 23 to 27.49 kg/m^2 and the threshold for obesity is 27.5 kg/m^2 and above. The lowered BMI thresholds to identify overweight and obesity compared to the WHO prescribed BMI for overweight 25 kg/m^2 and BMI cut-off of 30 kg/m^2 for obesity is due to the fact that recent studies have shown that Asian population show risk for non-communicable diseases like diabetes, hypertension and cardio-vascular diseases at a lower BMI value (Misra *et. al.*, 2011; Meshram *et. al.*, 2015; Lim *et. al.,* 2017).

For undernutrition, the marker would be the WHO cut-off of 18.5 kg/m^2 and below, also referred as thinness or CED. In a different context, Swaminathan *et. al.* (2018) suggest a downward revision in the energy requirements used for calculating prevalence of undernutrition using dietary intake method. Would this also require a lower BMI cut-off for undernutrition for the Asian population? The study of course warns that such a revision could affect estimates for poverty rates as poverty lines in India are linked to caloric norms and other basic consumption expenditures. Another important criticism of the household food intake based norms is that in many rural areas women in particular, have higher physical activity and limited availability and affordability to diverse diets (Editorial, RAS, 2019).

Thus, in this study by choosing BMI as the variable to assess double burden of malnutrition, we hope that the undernourished and the

overnourished adults can perhaps be discerned in a better manner. This could enable better targeting and identification of the needs of different people for public health and poverty alleviation policies amidst scarce resources. However, unlike Popkin *et. al.*, (2020) the double burden of malnutrition in our study is not as rigorously defined and focuses only on adult malnutrition and includes men and women.

RESULTS AND DISCUSSIONS

Adult Malnutrition and Economic Development: International Comparison

This section pertains to international comparison of underweight and overweight rates of adult women and men in 2005 and 2014 as per the global cutoff rates given by WHO which identifies a person as underweight with BMI less than 18.5 kg/m^2 and a person overweight with BMI greater than or equal to 25 Kg/m^2.

The average of world's underweight rates in 2005 was about 6.7 percent for both men and women and declined to 5.6 percent. Among men, the maximum value for underweight rate of 28.5 percent in 2005 and 24.5 percent in 2014 was for India. Among women the highest rate of 30.5 percent among these countries was for Bangladesh in 2005 with India was not far behind at 28.7 percent. This declined to 26.5 percent for Bangladesh (still the highest) and to 24.9 percent for India in 2014. Thus, among adult men and women, the undernutrition rates are among the highest for India compared to the average world rates and that the relative ranking of India has not changed in the decade between 2005 and 2014.

The overweight rates in the world ranged between 7 to 77 percent for men and between 9 to 80 percent for women in 2005. These ranges increased marginally to 9 percent and 80 percent for men and to 19 percent and 83 percent for women in 2014. For India, among men the overweight rates increased from 12 to 16 percent and for women from

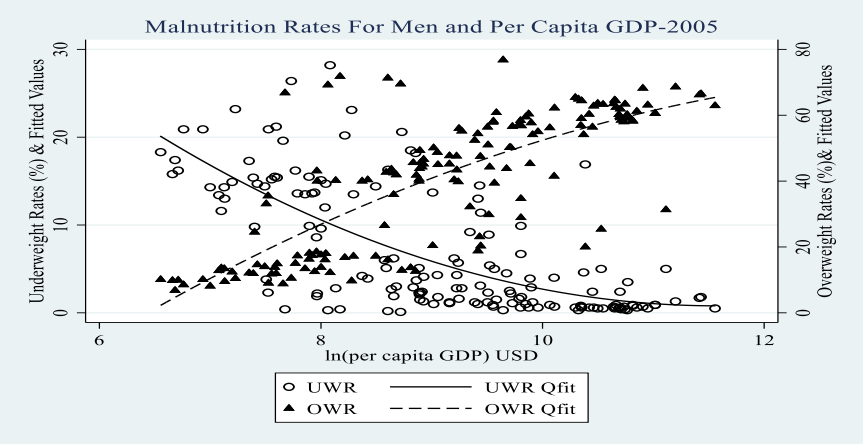
17 to 22 percent during this period. The average overweight rates for men increased from 40 to 45 percent with the standard deviation remaining close to 20 percent while the average rates increased from 44 to 49 percent with a marginal decline in standard deviation from 16 to 15 percent for women. Comparing the underweight and overweight rates, it is clear that there is a double burden of malnutrition among the adult men and women and more so in the Indian population and that women take on the higher burden when compared to men in both these aspects of malnutrition.

The changes in malnutrition rates are compared with respect to their level of economic development using per capita GDP converted to constant 2017 International Dollars using purchasing power parity rates (PPP) (International Comparison Program, World Bank). The underweight is expected to decline with income levels but overweight could either increase monotonically or show an inverted U-shaped relationship with low rates at the low and at high end of the per capita income. As per capita incomes increase changes cheaper access to energy dense food and changes to more sedentary lifestyles increases the BMI to levels beyond the normal range. The decline in overweight rates at high levels of per capita income may be expected due to better health awareness and health care facilities insisting on better care that would reduce the risk of non-communicable diseases. One could also argue that as overweight and obesity are risks to non-communicable diseases then an inverted U-shaped relationship is also expected for non-communicable diseases.

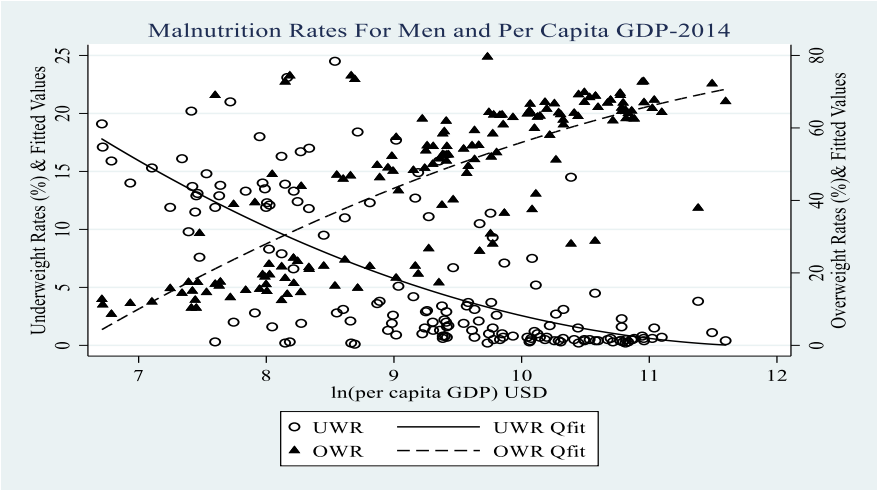
Figures 1(a) and 1(b) show the malnutrition rates for men across per capita GDP for 2005 and 2015 respectively. The underweight rates decline with income levels and overweight rate increase with income levels as expected. Figures 2(a) and 2(b) show the malnutrition rates for women across per capita GDP for 2005 and 2015 respectively. The underweight rates among men are marginally higher at the lower end of the income distribution while it is the reverse for women at the upper

end of the income distribution. The overweight rates appear to have a linear association with per capita GDP for men compared to women for whom it increases at a declining rate and flattens out at fairly high levels of income. These patterns are similar in both 2005 and 2014.

Figure 1: Malnutrition Rates and Per Capita GDP: Men, 2005 and 2014



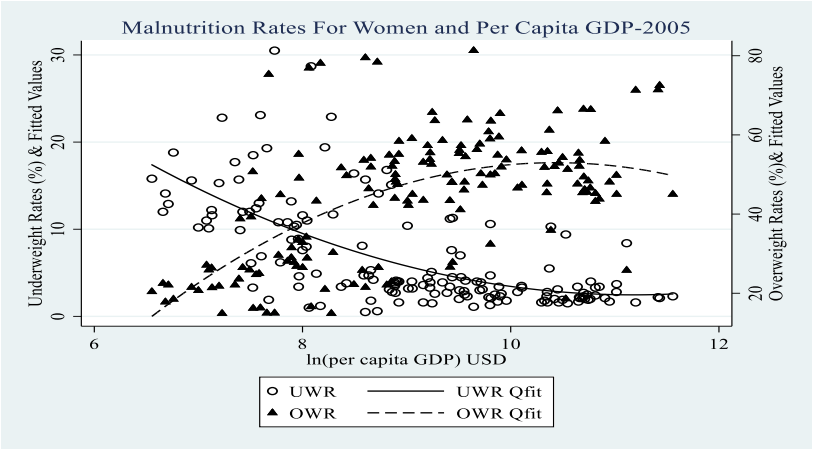
(a) 2005



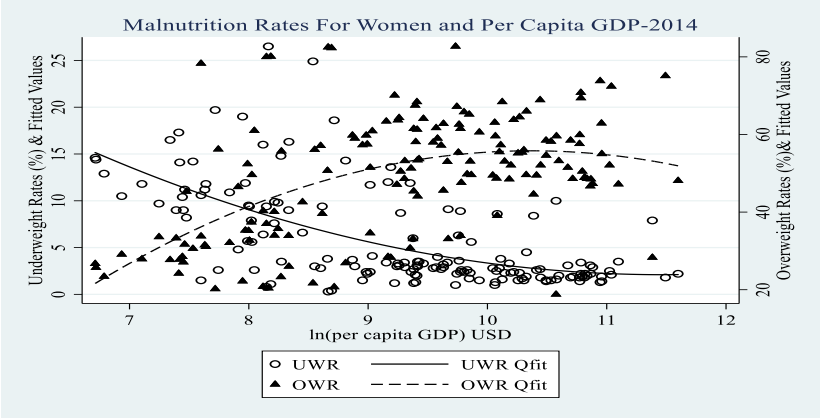
(b) 2014

Source: Author's estimations using World Bank and NCD-RisC

Figure 2: Malnutrition Rates and Per Capita GDP: Women, 2005



(a) 2005



(b) 2014

Source: World Bank and NCD-RisC

A few studies have found empirical evidence for 'obesity Kuznets Curve' (OKC) akin to the Environmental Kuznets Curve (Grossman and Krueger, 1995) arrived at based on the Kuznets curve hypothesis (Kuznets, 1955). Using country-level panel data of 130 countries during the period from 1975 to 2010, Windarti *et. al.* (2019) show that there is

non-linear relationship between country's per capita income and obesity rates for both men and women. The dynamic panel data based analysis of 130 countries from 1970 to 2010, show that the turning point for a decline in obesity rates after its initial rise across real per capita GDP occurs at $7,469 for overweight and $7,434 for obesity among men. The comparatively lower values for females were at $2,530 for overweight and at $ 3,272 for obesity are attributed to hath consciousness among women. Grecu and Rotthoff (2015) based on household level data find evidence for OKC for white females in United States while no such relationship existed for men. This study also provides an estimate of the household income where they observe the turning point for a decline in obesity rates.

As in the context of Environmental Kuznets Curve, estimation of the per capita income where the turning point for the decline of overweight and obesity begins could be useful for policy intervention. It may be worthwhile to study the temporal obesity patterns of those countries to understand what led to the changes. This would help in suggesting policies to other countries so that the decline in obesity rates could be advanced much earlier. In this study we consider two separate years of data to analyze the double burden of malnutrition and its association with per capita incomes. Talukdar *et. al.* (2020) use 147 country data from 1975 to 2014 and find that turning point occurs at very high income levels and obesity rates would continue to increase for several more years. However, not all studies interpret the inverted U-shape in the same manner as OKC. For instance, Popkin at *et. al.* (2020) also provide evidence of an inverted U-relationship between double burden of malnutrition and per capita GDP for 1990 and 2010 to illustrate that the double burden is higher among middle income countries, rather than to estimate at what levels of per capita income the health consciousness becomes apparent and perhaps affordable.

In this current study though we do not carry out a rigorous analysis of the OKC, Tables 1(a) and 1(b) below report the estimated

values of the quadratic relation between each of these malnutrition rates and per capita GDP, separately for men and women and for each of the two years. The adjusted R^2 values across these different models show that the quadratic fit is somewhat better for men even though the scatter plots of the figures show that a linear relationship would also hold good particularly for underweight. There is no reason to expect the underweight rates to increase at very high levels of income; however, one may attempt to estimate the point in the curve after which the undernutrition rate is very low and does not vary across the countries and this has however, not been attempted in this study.

The dispersion of underweight rates is more in the lower end of the per capita GDP and for overweight rates at the upper end of the GDP. Thus, to account for heteroscedasticity which one observes in the scatter plots of these relationships, the estimated models are adjusted for robust standard errors. Even after adjusting for it, the estimated coefficients are all statistically significant for the log of per capita GDP and its square in each of the estimated models. However, based on these estimated coefficients, the turning points of underweight and overweight with respect to the PPP adjusted constant USD prices are at very high levels of per capita GDP thereby indicating that overweight rates will continue to increase over time. The analysis here is different from that of Windarti *et. al.* (2019) and Talukdar *et. al.* (2019) due to methodological differences and other control variables used in the study.

Table 1: Association between the Malnutrition rates and per capita GDP: Men and Women, 2005 and 2014

Year		2005	2005	2014	2014
Variable/Gender		Men	Women	Men	Women
		Undernutrition Rates			
lnpcgdp		-17.72***	-15.60***	-15.07***	-13.23***
sqlnpcgdp		0.77***	0.70***	0.62***	0.58***
Intercept		103.33***	89.66***	90.84***	77.98***
Sample Size		157	157	157	157
Adjusted R^2		0.49	0.42	0.48	0.39
Turning Point	lnpcgdp	11.51	11.14	12.15	11.41
	pcgdp	99358.87	69068.71	189705.06	89784.93
		Overnutrition rates			
lnpcgdp		35.04***	53.83***	38.04***	53.06***
sqlnpcgdp		-1.24**	-2.58***	-1.34**	-2.56***
Intercept		-174.21***	-227.79***	-190.80***	-219.25***
Sample Size		157	157	157	157
Adjusted R^2		0.6	0.37	0.59	0.28
Turning Point	lnpcgdp	14.13	10.43	14.19	10.36
	pcgdp	1368235.15	33933.93	1460120.98	31674.94

Source: Same as Figure 1

The next section analyses the changes in malnutrition rates in India for adult men and women in the past decade and associates it with certain social, economic and demographic features.

Changes in Adult Malnutrition: The Indian context

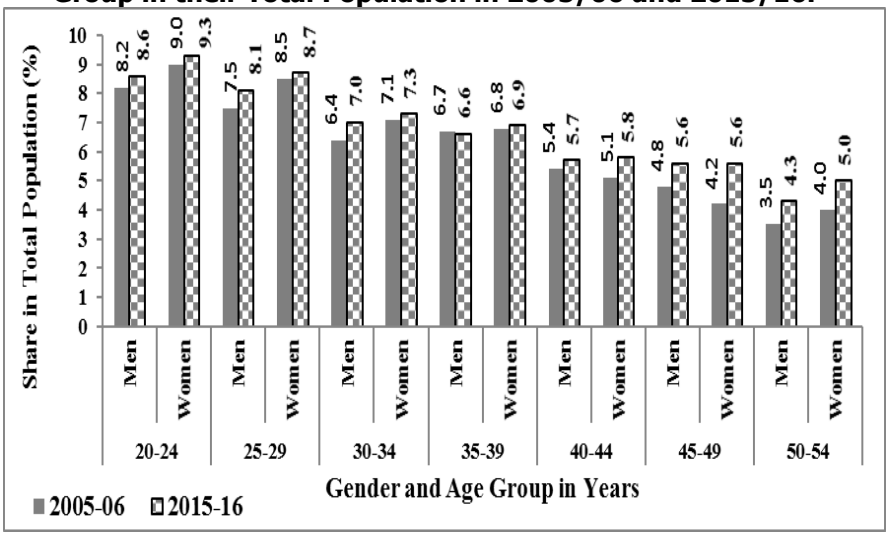
Age-groups

Ramachandran and Kalaivani (2018) use the last three waves for women and the last two waves for men of NFHS surveys to track the changes in undernutrition and overnutrition rates over time. The findings indicate that in the younger age group of 20-39 years the decline in

undernutrition rate results in an increase in normal nutrition rate and also overnutrition rate (BMI>25kg/m^2) for both men and women in the past decade. However, in the age group of 40-50 years the decline is observed for undernutrition (<18.5 kg/m^2) rate and normal nutrition (18.5-24.9 kg/m^2) rate resulting in the increase in overnutrition rate for men. For men, with a decline in undernutrition rate, there is a very small (1 percentage point) increase in normal nutrition rate and larger increase in overnutrition rate. However, comparing changes for men over time has to be understood with caution as the sample size for men has increased from the previous NFHS-3 wave. Furthermore, as the gap between the waves 3 and 4 is 10 years so with economic development the demographic composition would change more in favour of adults which would impact the number of people in different BMI categories for the country as a whole.

The analyses here differ from Ramachandran and Kalaivani (2018) with respect to the Asian cut-offs that are lower than the WHO cut-offs for overnutrition. It considered changes in malnutrition across 10-year age-groups starting from 20 years to 54 years for men and 20-49 years for women. Before that the age composition of the population is assessed as one can expect that a developing country like India would show a change in demographic composition in a gap of 10 years. There has been a marginal increase in the share of these age groups in the overall population (Figure 3). However, it must be emphasized that this change is based on a sample of men and women whose sample sizes vary substantially in 2005/06 with the gap somewhat lower in 2015/16 due to a larger sample size for men than in the previous survey.

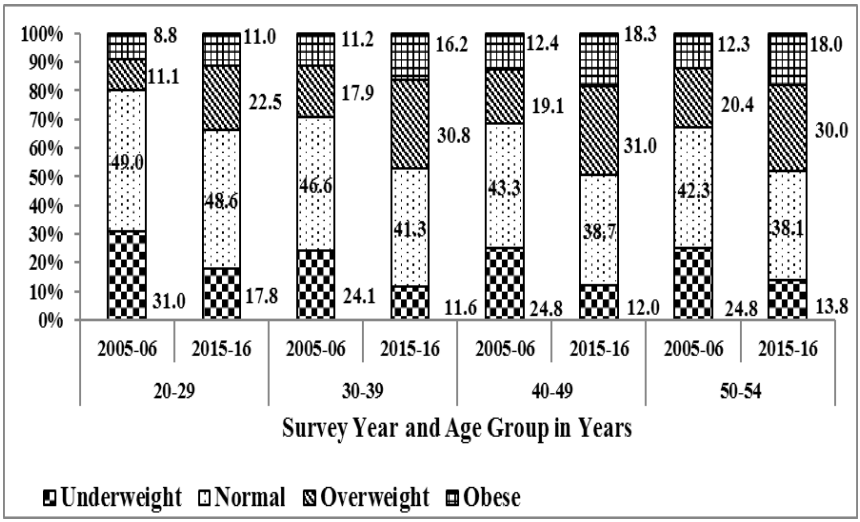
Figure 3: Proportion (percent) of Men and Women across Age-Group in their Total Population in 2005/06 and 2015/16.



Source: NFHS-3 and NFHS-4

Mean BMI increases with age and there is substantial increase in overnutrition rates from the age of 19 to 49 among women while for men the increases with age is more drastic in 2015-16 compared to 2005-06. Using the Asian standards, Figures 4(a) and 4(b) show the changes in proportion of adult men and women across the fur BMI categories. The undernutrition rates decline with age with the youngest age group has a higher rate while the other age-groups have lower and comparable rates. The men one observes that normal weight rate has declined in all the age-groups indicating that the entire increase is towards overweight and obese categories. The percentage point change is noticeable the most for the 20-29 years group. The overweight rates are close to 30 percent in the other age groups while obesity rates are about 18 percent in the 40-50 age group.

Figure 4 (a): Decadal Changes in Malnutrition Rates Across Age Groups for Adult Men

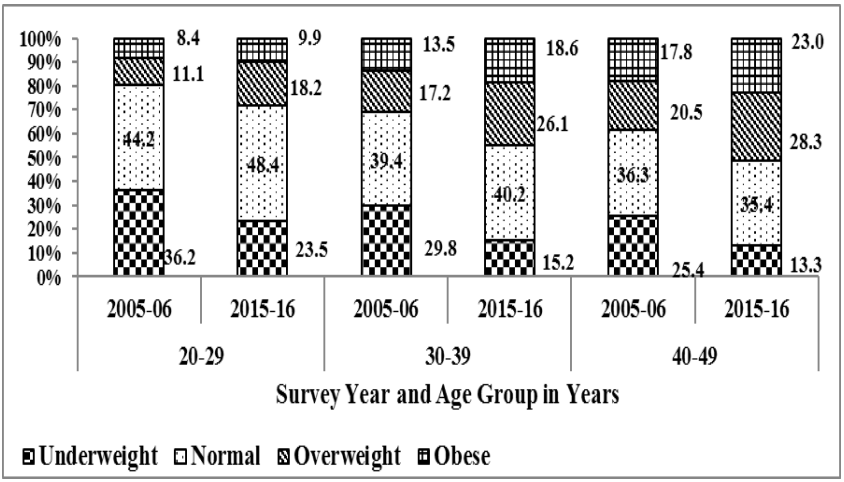


Source: Same as Figure 3

For women one observes that the decline in undernutrition rates does not translate entirely into overweight or obesity rates. Small increases are also observed in the normal nutrition rates except for the decline in 40 to 49 years group. The 20-29 years age group shows a shift largely towards overweight rates but in the other two age groups there is increase in both components of overnutrition.

Thus, by 2015-16 only about 42 percent of women and about 43 percent of men are in the normal nutrition BMI category with a large burden of double malnutrition and more tilted towards overnutrition rate in the older age group. With demographic composition favoring the middle age of 30-50 years for some more decades in India, the burden of malnutrition is heavily in favour of overnourished.

Figure 4 (b): Decadal Changes in Malnutrition Rates Across Age Groups for Adult Women



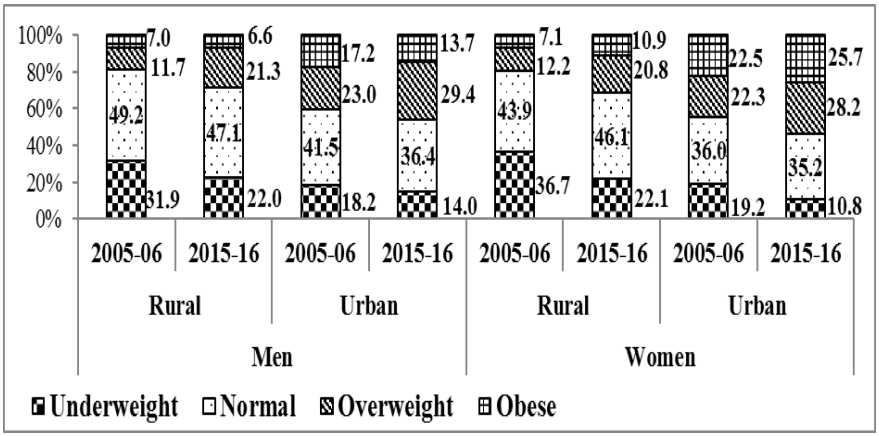
Source: Same as Figure 3

Rural-Urban Patterns

Malnutrition from underweight is largely a rural phenomenon for both men and women and correspondingly overweight and obesity are largely urban phenomenon. Studies show that that the fall in underweight rates or the rise in overweight and obesity rates in rural areas may be due to the influence of urbanization.

In this analysis using the Asian cut-offs, the underweight rates decline for rural men and women between the two decades (Figure 5). This is accompanied by a decline in normal nutrition rates for men unlike for women where it increases marginally. On the other hand, the increases in overweight rates are substantial for both but larger increases in obesity rates for women than for men. For women the overweight and obesity rates in urban areas was close to 45 percent in 2005-06 which increased to a little more than 50 percent by 2015-16 with a decline in rates for undernutrition and a very small decline in normal nutrition.

Figure 5: Changes in Malnutrition Rates for Rural/Urban among Men and Women



Source: Same as Figure 3

Based on the global cut-offs a similar pattern emerges (IIPS, 2007 and 2017). The underweight rates for men and women were close to 40 percent in rural areas for 2005-06 and declines to a little above 25 percent over the decade. The urban rates were also similar form both men and women with a 10 percentage point decline to 15 percent in 2015-16. The overweight rates have increased substantially in rural areas with the rural rates of 14.3 percent among men in 2015-16 is very close to what the urban rates were in 2005-06 (15.9 percent). The rural obesity rates increased from 7.4 percent in 2005-06 to 15.6 percent in 2015-16.

Thus, in terms of rates the rural areas show a similar distribution in 2015-16 in the four categories of BMI. In urban areas the undernutrition and obesity rates are lower for men when compared to women. The urban women are likely to bear a significant risk for non-communicable diseases. On the other hand, India's urbanization rate increased marginally from 32.6 percent in 2005-06 to 34.8 percent in 2015-16 and would have contributed to the increase in overnutrition rates. Aiyar *et. al.* (2019) show that the probability for the prevalence of

overweight incidence increases by around 0.06 percent and that of obesity by around 0.02 percent with every 1 km reduction in the distance between a rural and urban area. Perhaps, the proximity to urban areas is opening up more non-agricultural activity in the rural areas resulting in changes in physical activity and an observed decline in rural poverty which could increase the overnutrition rate. The next section looks at the comparison across economic status.

Economic Status and Double Burden of Malnutrition

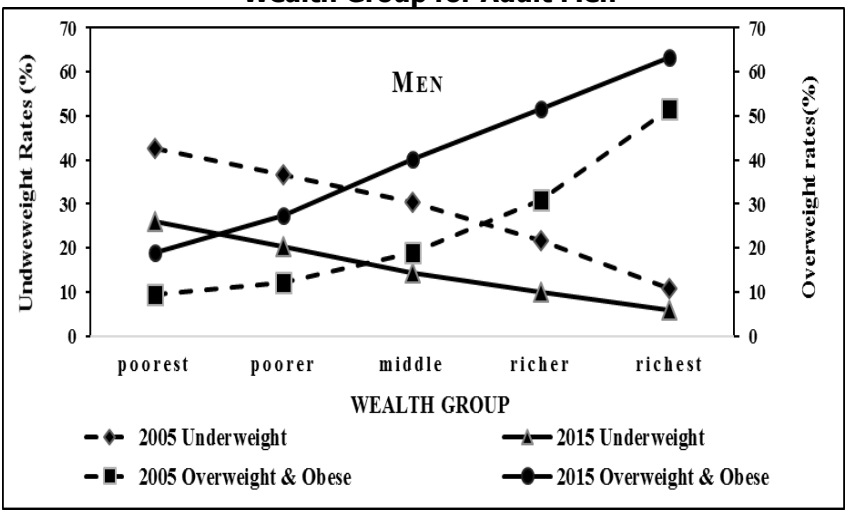
It is well known that NFHS data does not provide household income or consumer expenditure to directly assess poverty or economic status. The possession of durable goods and other amenities are used to create an asset index that provides the relative economic status of households within a given time period (IIPS, 2017). The index score is ranked and households are distributed into five groups with 20 percent of the population in each group. The households in the lowest 20 percent of the asset index score are referred here as 'poorest' households, the next (second) 20 percent are the 'poor', the third 20 percent are 'middle', the fourth 20 percent are the 'rich' and the topmost (highest) 20 percent households are the 'richest' respectively in that year of survey. This asset index score does not help us in understanding if the wealth status of a set of individuals belonging to a region has improved or worsened over a period of time. The categories of economic status for the adult men and women are classified based on their household's economic status.

Figures 6(a) and 6(b) depict the changes for double burden of malnutrition for men and women respectively over the decade across the wealth quintiles in the respective year. The left Y-axis of the figure represents undernutrition rates and the right Y-axis is for overnutrition rates that includes both overweight and obesity rates. The burden of underweight is substantially borne by the poorest, with one-third of men and one-fourth of women being underweight in 2015-16 with a 20 percentage point decline in underweight rates over the decade among

these people. The percentage of overweight men and women is increasing among the poorest households too.

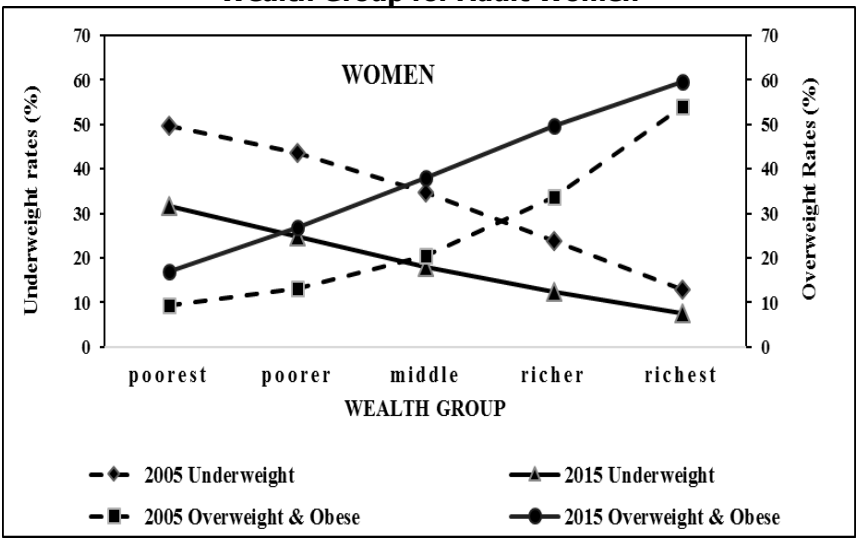
For men the highest increase in the percentage of overweight men is among the men with richer wealth index and least increase is in that of poorest households. The highest proportion of overweight individuals is still from rich households. The highest rate of increase in the percentage of overweight women was observed in middle income households and the lowest increase was among richest households. This means the burden of obesity is shifting from rich households to households with lower wealth in past decade. Among the next category of 'poor', the gap between undernutrition rate and overnutrition rate for men (women) which was about 40 (30) percentage points has closed in to zero. By the middle wealth status, the undernutrition and overnutrition rates have exactly swapped themselves for men while for women the underweight rates which marginally higher than overweight rates have declined substantially but with about 40 percent overnourished rate by the Asian standards. More importantly, in 2005, more than 20 percent of men and women in the "rich" category were undernourished and has reduced to 10 percent in 2015-16 while the overnutrition rate increased from about one-third to one-half in this category.

Figure 6 (a): Decadal changes in malnutrition rates across Wealth Group for Adult Men



Source: Same as Figure 3

Figure 6 (b): Decadal changes in malnutrition rates across Wealth Group for Adult Women



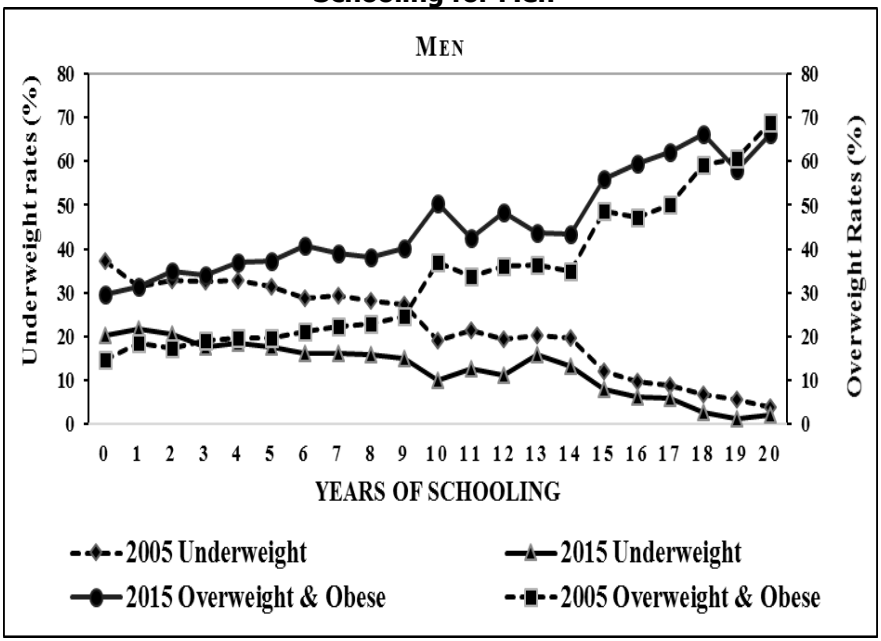
Source: Same as Figure 3

Completed Years of Schooling and Double Burden of Malnutrition

Awareness about good health, hygiene and health seeking behavior is expected to improve with education levels. Completed years of schooling by these adult men and women are used to assess the decadal changes and its association with undernutrition rates and overnutrition rates. The proportion of men and women with no education is the largest and the most dominant category in 2005-06 and 2015-16. For men this share declined from 21 percent to 15 percent and for women from 45.4 percent to 31.9 percent. Those how have completed 10 years of school is currently 12.1 percent and 9.7 percent, while for 12 years of schooling it is 10.9 percent and 7.8 percent for men and women respectively. These changes do not appear drastic as we have not considered the younger cohorts in the 15 to 20 years age group where the schooling rates would change more drastically.

Figures 7(a) and 7(b) show that undernutrition rates were higher than overnutrition rates in 2005 up to 9 years of education for men and up to 5 years of education for women. So these are the cross-over years however by 2015-16, undernutrition rates are lower than overnutrition rates for all the years of education highlighting the divergence between the two and its wide spread. For men, after 15 years of education the overnutrition rate increases to more than 55 percent (Figure 7a). Though a large majority of them could be overweight as per the Asian cut-offs but this is just indicating the alarm for a large impact on the heath of these people. Men with higher levels of education are also more likely to be earning higher incomes with jobs that are sedentary.

Figure 7(a): Double Burden Of Malnutrition Across Years Of Schooling for Men

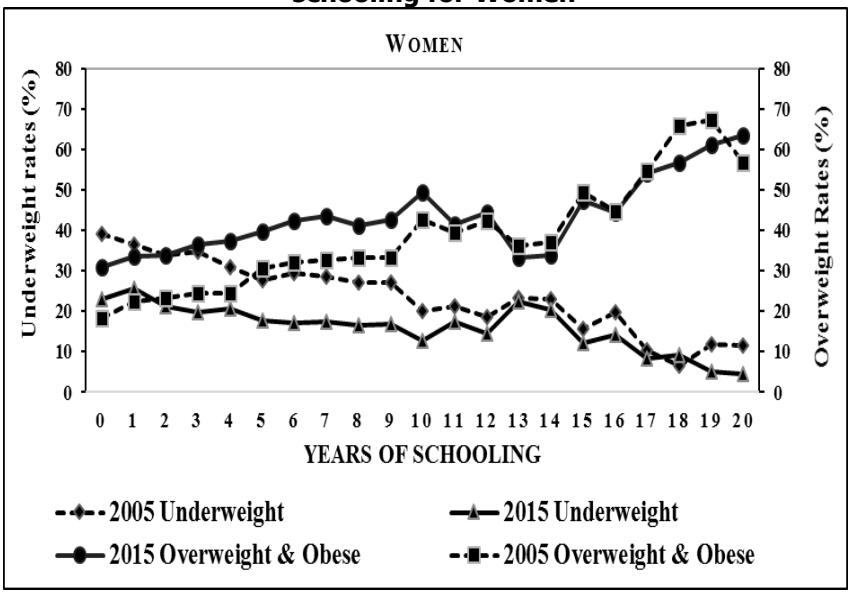


Source: Same as Figure 3

Figure 7(b) shows that almost up to 13 years of education, the percentage of underweight women is between 20-30 percent in 2005-06. The percentage of underweight women with less than 10 years of education has declined by a higher rate from 2005 to 2016 as compared to women with more than 10 years of education. As for overweight, the highest percentage of women are for women who have completed 20 years of education and beyond completion of 14 years of education the overweight rates sharply exceed underweight rates. At the same time, about 30 percent of women who have completed 9 or less years of education are overweight in 2015-16. More than 35 percent of women who were reported to complete 10^{th} and 12^{th} year of their education are overweight since 2005-06. More than 60 percent of women were overnourished in 2005-06 with more than 17 years of education and

good news is that there is an improvement by the 2015-16 in terms of the decline in overnutrition rates among them.

Figure 7(b): Double burden of malnutrition across years of schooling for Women



Source: Same as Figure 3

Though the percentage of men and women with education as 17 years and above is about 4 percent for men and 3 percent for women but this is the group that seems to be showing a very marginal decline. However, we do not see a large decline in overnutrition rates with education to the extent of an inverted U-shape but clearly there is more hope that this could happen soon with more awareness and education. Devaux *et. al. (*2011) find evidence that in the richer of the OECD countries the risk to obesity is lower among the highly educated and this is observed more among women.

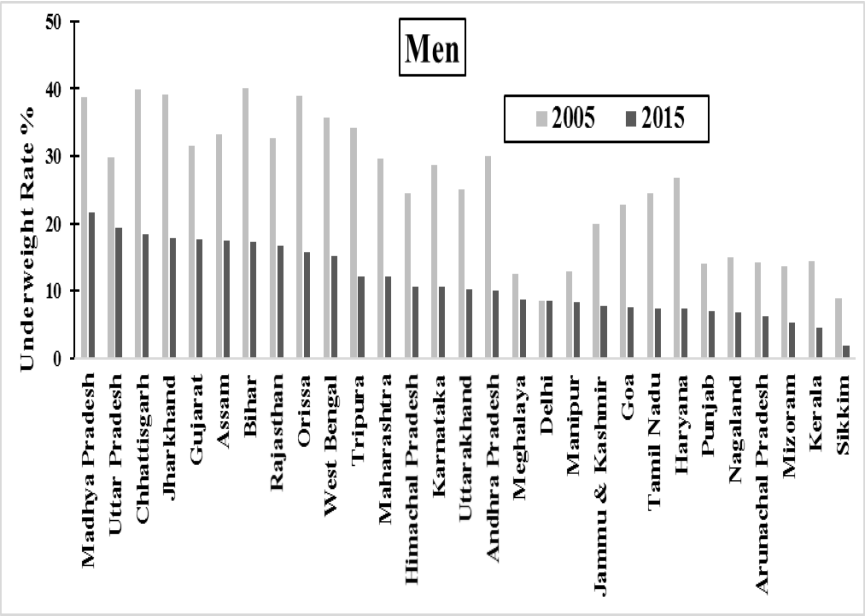
State Level Changes in Malnutrition Rates

Health is a state subject in the Indian constitution so many health policies and investment in health infrastructure would largely depend on the state

governments. On the other hand, there are large differences across states in terms of the economic development, average years of schooling, the nature of structural transformation they have undergone and hence the level of urbanization. All these factors would be associated with the extent of double burden in the states. Further, for any schemes of the central government, the states become the main administrative unit for its implementation. This section tries to examine the nature of double burden across states of India and the pattern of decadal changes in them.

Both men and women report drastic shift in malnutrition rates from 2005 to 2015. Keeping in mind the different age groups for men and women, the changes in malnutrition rates among men and women are discussed separately across states too. Figures 8(a) and 8(b) show that the undernutrition rates for men have decreased while the overnutrition rates have increased for all the states significantly. Figure 8(a) shows that undernutrition rates among men in Orissa, Bihar and Tripura have declined the most in the 10 years span. Sikkim and Kerala are the states with undernutrition rates as low as 2 percent and 4 percent respectively among men in 2015.

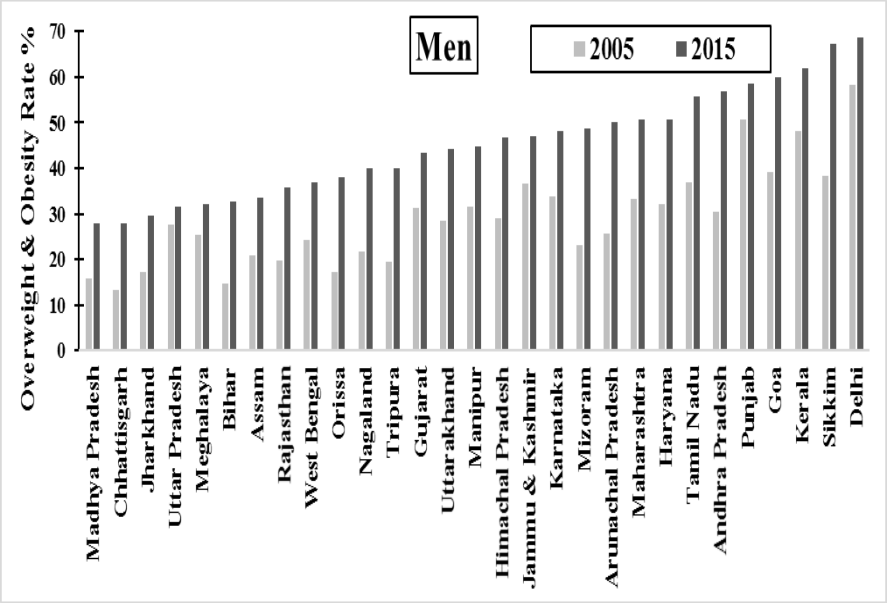
Figure 8(a): Underweight Rates in 2005 and 2015 for Men across States of India



Source: Same as Figure 3

Figure 8 (b) shows that overnutrition rates for men have more than doubled for states like Bihar, Orissa, Tripura, Mizoram and Arunachal Pradesh. Men from Delhi, Punjab, Kerala and Sikkim continue to have the highest overnutrition rates (more than 60 percent) in India. Although the overnutrition rates remained the lowest for men in Madhya Pradesh, Jharkhand, Bihar and Chhattisgarh, the rates almost doubled for them in 10 years. They are also among the states with the highest undernutrition rates among men, which marks the double burden of malnutrition in these states. With close to 20 percent of men suffering from undernutrition and close to 30 percent of men suffering from overnutrition, these states need to be prepared for double duty actions.

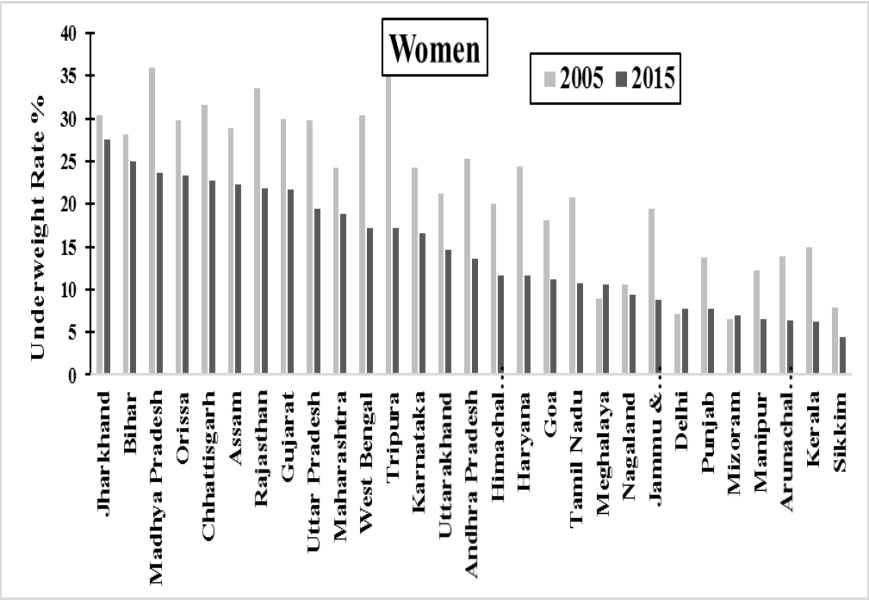
Figure 8(b): Overweight and Obesity Rates in 2015 and 2006 for Men across States of India



Source: Same as Figure 3

Figures 9(a) and 9(b) show that over the period of 10 years, undernutrition rates are decreasing while overnutrition rates are increasing for women in almost all states of India. Although, Meghalaya, Delhi and Mizoram have less than 10 percent of undernutrition rates, they have experienced a slight increase (less than 1 percent). Figure 9(a) shows that women in Tripura, West Bengal, Haryana and Madhya Pradesh have shown 12 percent to 18 percent decline in undernutrition rates. in the rates from 2005 to 2015. All the states are suffering from higher overnutrition rates among women than before except for Meghalaya where the rates declined by 3 percent.

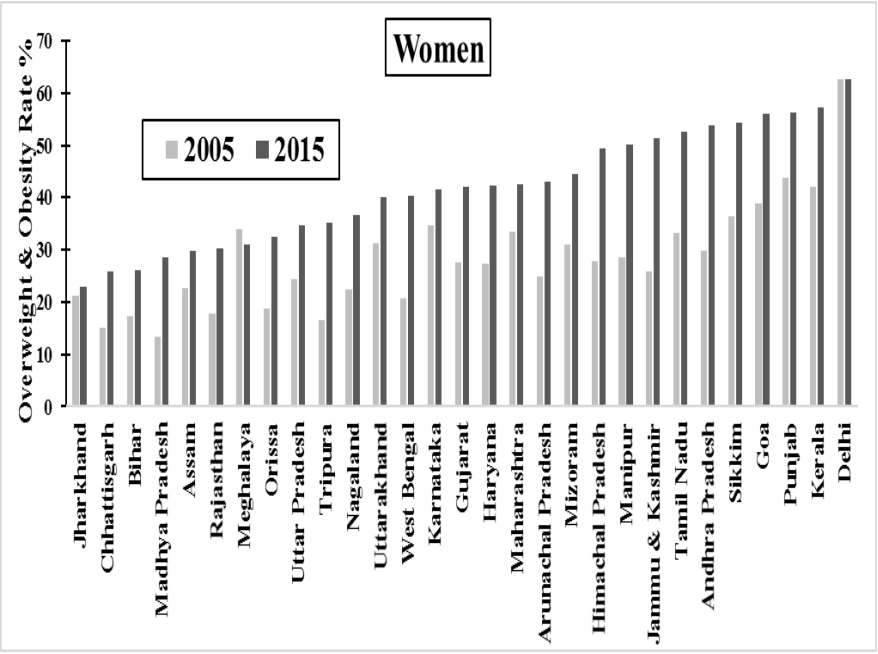
Figure 9(a): Underweight Rates in 2005 and 2015 for Women across States of India



Source: Same as Figure 3

Figure 9(b) shows that Himachal Pradesh, Manipur, Andhra Pradesh and Jammu and Kashmir have shown more than 20 percent rise in overnutrition rates. It can be observed from figures 9(a) and 9(b) that states like Madhya Pradesh, Chhattisgarh, Bihar and Jharkhand are facing more than 20 percent of each of the malnutrition rates among women in 2015-16. This provides us with the evidence for the existing double burden of malnutrition among women in these states.

Figure 9(b): Overweight and Obesity Rates in 2005 and 2015 for Women across States of India



Source: Same as Figure 3

The geographical contiguity of underweight and overweight that was reported in Ackerson *et. al. (*2008) in 1998-99 persists in 2015-16 but with higher rates of overnutrition rates in the northern, westerns and southern states modest increases even among the central and eastern states. The undernutrition rates have declined modestly in the states of central and eastern India.

The Transition Triad: Economic, Nutrition and Epidemiologic

Economic reforms of 1991 are considered to have brought in transition towards market economy from a somewhat socialist and planned economy and also integrating India with global markets (Basu and Maertens, 2010). The economic growth picked up and so did an increase in incomes with higher affordability, availability and access to diverse

processed and packaged foods. Many of these food items are known to have high salt, sugar and fat content considered to be harmful for human health. Even prior to the economic reforms, the process of structural transformation had begun, wherein the share of agriculture in the value added was declining. This would mean an increasing share of non-agriculture sectors with a very moderate increase in industrial sector to begin with which flattened out in recent times to a stagnant level and a very steep and steady rise in services sector share(Amirapu and Subramanian, 2015; and Eichengreen and Gupta, 2011).

This structural transformation however, is considered "stunted" as the pattern of transformation in value added did not entail concomitant changes in the share of those employed in these sectors (Binswanger-Mkhize, 2015). Agriculture and allied activities continue to employ majority of labour force due to a very slow transformation from limited labour absorption in the other two sectors. The higher share of employed in agriculture and lower share in value added meant that more deprivation is associated with those in agriculture thereby affecting their nutrition security and hence are among the undernourished. The changes in economic activity resulted in more urbanization along with sedentary lifestyle and greater usage of modern modes of transportation. This has led to limited physical activity and coupled with access to unhealthy diets resulting in overnutrition (Popkin *et. al.*, 2020). This transformation into overnutrition for a large number of people and at a lower income level has happened referred as nutrition transition and now spreading to rural areas that are proximate to urban towns (Aiyer *et. al.*, 2019).

With economic development, the economic activities have become less labour intensive and more so in those economic activities that traditionally employ women. The sex segregation in the Indian labour market is predominant and hence the demand for female labour has declined. Further, women female employment is lower among women with better economic status and hence the female labour supply has declined among a large section of women as the country's economic

growth picked up substantially. The data for assessing malnutrition in India based on anthropometric measures has been collected through nationwide sample survey for women for a much longer time than for men. They report a positive association that is becoming stronger over the years between overnutrition rate and women's non-participation rate in the labour market (Dang *et. al.*, 2019 and IIPS and ICF, 2017). A better economic status, lower dietary diversity and less physical activity seem to be associated with overnutrition (Agnihotri, 2019). On the other hand poor women in Koraput and Wardha whose manual activities during harvest season increases substantially with limited food availability and intake during harvest season lowers their BMI substantially (Rao and Raju, 2019). Thus in the Indian context, women tend to take a larger share of the double burden in malnutrition and hence a higher risk of non-communicable diseases. It is also worthwhile mentioning here that the undernutrition and overnutrition rates in 2015-16 from NFHS-4 are very similar among both men and women but was far lower among men in 2005-06 from NFHS-3. It not clear if the lower rates in 2005-06 could be attributed to the smaller sample size for men in the earlier round and a larger sample size is more representative of the reality and hence male malnutrition rates could also have been similar in the earlier round. Ramachandran (2006) while comparing the double burden of malnutrition based on NNMB data for rural areas of select states between 1975 and 2001 finds that undernutrition (or thinness) rates declines from more than 50 percent to less than 40 percent while overnutrition (overweight) rates was on the rise. The male undernutrition rate which was higher than for women in 1975 declined slowly and surpassed women who bear the double burden more as the proportion of such women is higher by 2000s and the overweight share was also higher among them.

The third of these transitions is the epidemiological transition (ET) from communicable to non-communicable diseases and has been analyzed in great detail for a quarter of a century from 1990 to 2016 (India State-Level Disease Burden Initiative Collaborators, 2017). The study formed four typologies of the states of India using epidemiological

transition level (ETL) which is defined as the ratio of non-communicable to communicable disease. The low ETL states showed a slow decline in communicable disease burden while all the states showed increases in non-communicable disease burden. The low ETL are in the least developed states (with high undernutrition rates as shown in the earlier section) while the middle and high ETL were in states that are the more prosperous ones. The study highlights the double burden of high prevalence of communicable diseases like the diarrhoeal diseases, lower respiratory infections alongside increasing burden of non-communicable diseases like ischaemic heart disease or chronic obstructive pulmonary diseases. The risk factors associated with these diseases arise from maternal and child malnutrition on the one hand and high blood pressure, diabetes and high BMI on the other hand[6].

In this section the association between undernutrition/overnutrition with the two risk factors of high blood pressure (recorded at the time of survey) and diabetes (self-reported) as well as the (self-reported) heart disease is assessed. Compared to most other studies this analysis is carried out based in the Asian cut-offs. Figures 10 (a) and 10(b) for men and women respectively, show the distribution of under/normal/over nutrition across those who have a high blood pressure (or not), self-report Diabetes (or not) and self-report heart disease (or not).

The three panels of figure 10(a) for men show that the normal weight are of lower percentage among high blood pressure (HBP), self-reported diabetes and heart disease. Further, the obese are substantial among the diabetes. As diabetes and heart diseases are self-reported, the "don't know" have a very similar distribution as and "no" highlighting perhaps that as there may not have been a major discomfort arising out

[6] Vaidyanathan (1985) presents an overview of the debate and perhaps alludes to the fact that "Low levels of sustained intake may on this reasoning result in a population of smaller physical stature which may nevertheless show no greater signs of ill health or clinical malnutrition than a better fed population."

of these problems they may not have accessed the physician and hence are somewhat dissimilar to those who have reported it. In the first panel of Figure 10 (b) it is observed that more than half of the women with HBP are overnourished while the normally nourished dominate among those who did not record HBP. In the middle panel, of this figure more than 60 percent of women who have diabetes are overnourished; more than 40 percent of women who did not or didn't know if they have diabetes had normal weight and about 7 percent of diabetic women were underweight. Tandon *et. al.* (2018) highlight large increase in the diabetes in the last quarter of a century (1990-2016) and these are strongly associated with increasing overnutrition rates. Their study once again reiterated that the epidemiological transition was occurring among all states and compared to the world average of 19 diabetic patients for every 100 overweight individual **(**with BMI 25 kg/m^2 or more**),** India had 38 such patients in 2016. In the third panel of this figure and among women who reported a heart disease, 46 percent are overweight and about 15 percent are underweight. 18 percent of women who didn't or did not have heart disease were underweight.

Figure 10(b): Distribution of BMI Categories Among Self-Reported Morbidity Conditions for Women in 2015-16

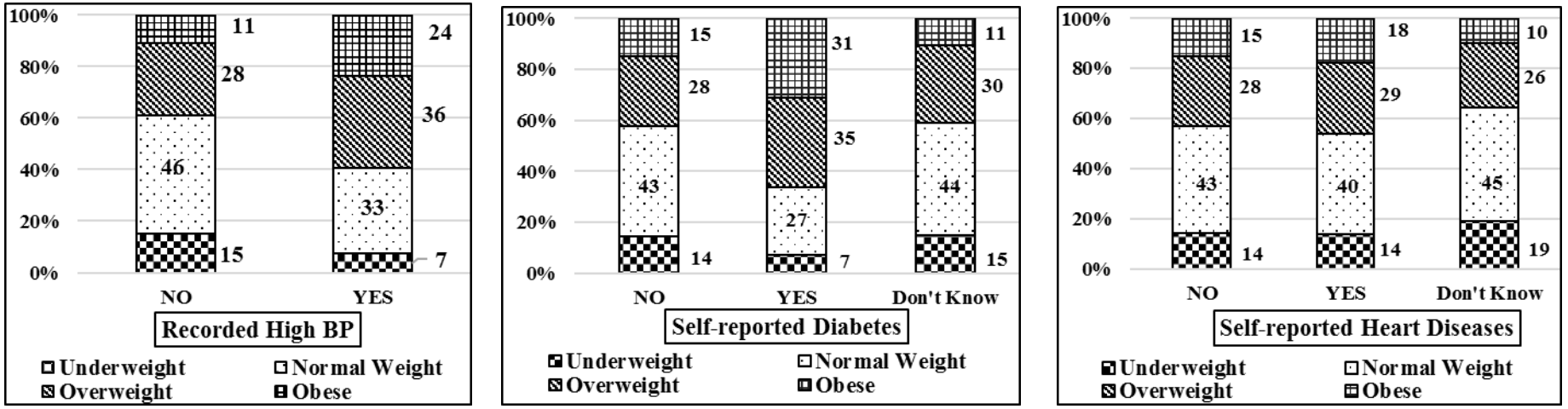
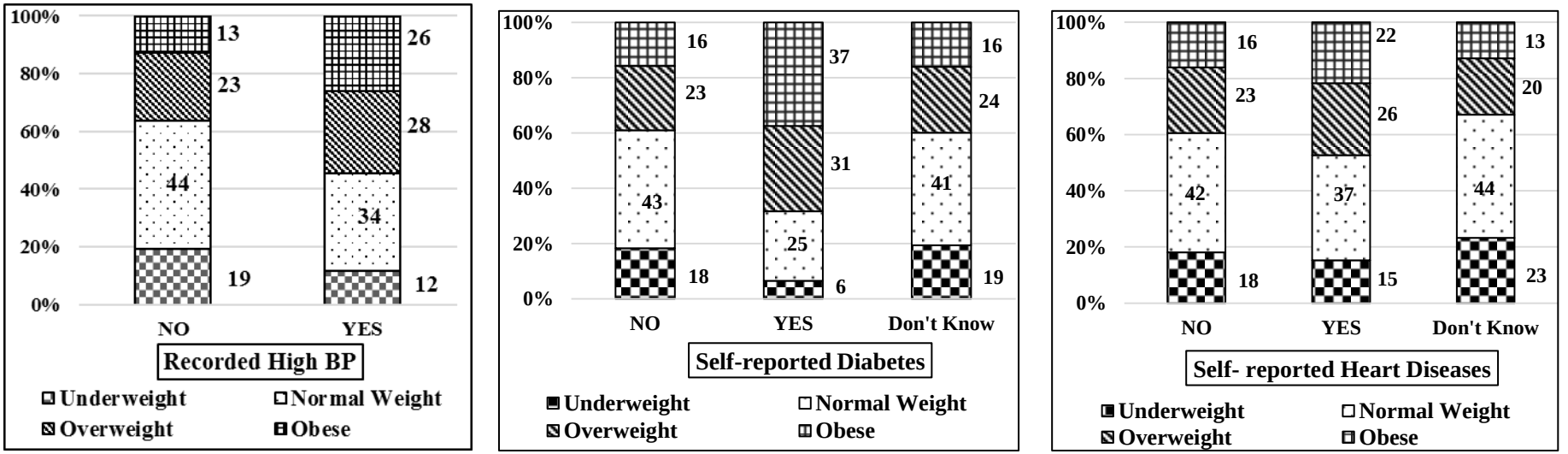


Figure 10(a) Distribution of BMI categories Among Self-Reported Morbidity Conditions for Men in 2015-16

Source: Same as Figure 3



Source: Same as Figure 3

Double Burden and COVID-19 Pandemic

The COVID-19 pandemic is a highly communicable viral disease with reportedly high fatality rate among those with co-morbid conditions like HBP and diabetes (Kannan, 2020) and thus, blurring the disease burden from supposedly mutually exclusive categories of communicable and non-communicable diseases. In this section we look at two components that can be considered to reduce the risk and increase the resilience. The first is availability of adequate water as well as the practice of hand washing with soap on the hand, and on the other hand, access to institutional health care by any member of the household and possibly have personal health insurance either provided by the state or by privately purchased. The aspect of maintaining a simple hygienic practice should be universal and any gaps in that would reflect a very basic deprivation as a precaution towards spread of Coronavirus infection. The health seeking behavior should also be universally observed but given the health systems in our country, one can expect that this may apply less to the deprived segments of the population. Using the NFHS-4 data for 2015-16, this section assesses the distribution of these aspects across five geographical zones of India. Though this information predates the ongoing health crisis but the infrastructure like water pipelines, roads, hospitals have a huge component that is provided by the state. We also expect to see a concentration of better amenities and awareness in metropolitan cities and the more developed states of India. The nature of this pandemic and it being declared a 'natural disaster' had to have the central government to formulate policies to be implemented by the state and local governments. Hence, by looking at the geographical spread as well as gendered differences in access to factors that reduce the risk and improve the resilience will be a further stepping stone to improve the health, hygiene and nutrition of India's population.

The physical, financial and human capital formation to manage and provide these services takes time for skilling and hence we expect that these features may not have changed dramatically in these last 4-5 years. Thus, this analysis is like going back in time to understand a scenario of preparedness towards a pandemic. Table 2 shows that

eastern region had the least usage of soap and water in both rural and urban areas and rural areas of north-eastern and southern states had lower rates of this hygienic practice. In no zone of the country, there was a 100 percent spread of this practice. Table 2 also reports the percentage of households where no member has insurance coverage and then among them what is the type of health care provider predominantly accessed by these households. The non-access to health insurance is high across most regions of the country except in the southern states which also does well in rural areas. In fact, there is hardly any difference between the rural and urban areas in access to health insurance. Except in North-east which fared the best in access to public health care in the absence of access to any health insurance, most urban households access private health care and in the western zone the access to private health care is very high compared to most other states, particularly in rural areas. Thus, overall it appears that a pandemic would put additional burden on such households which are quite often not among the wealthier households.

Table 2: Basic Hygiene and Health Care Features of Households for Geographical Zones of India in 2015-16 (Percentage Share)

Geographic Zones	Share		Use Soap and Water		No Health insurance and Type of Health Care							
					Share		Public		Private		Other	
	U	R	U	R	U	R	U	R	U	R	U	R
North	15.1	12.1	86.3	62.9	82.0	82.3	52.0	56.6	47.5	42.7	0.5	0.7
Central	17.1	24.5	87.4	51.8	82.2	84.5	27.7	25.2	67.7	63.8	4.5	11.0
East	14.0	26.1	64.9	29.2	77.1	72.2	46.3	39.8	51.1	54.4	2.7	5.8
Northeast	2.1	4.3	71.4	45.6	80.8	81.4	65.2	83.6	34.6	16.0	0.2	0.4
West	20.3	11.8	87.5	62.6	80.8	82.4	35.3	43.2	64.5	56.7	0.2	0.1
South	31.4	21.2	70.3	48.4	50.3	37.1	44.3	59.1	55.2	40.4	0.5	0.4
All India	100	100	80.3	49.4	71.1	70.6	41.1	42.7	56.0	49.9	2.9	7.4

Note: North: Chandigarh, Delhi, Haryana, Himachal Pradesh, Jammu and Kashmir, Punjab, Rajasthan and Uttarakhand; Central: Chhattisgarh, Madhya Pradesh and Uttar Pradesh; East: Bihar, Jharkhand, Orissa, West Bengal; North-East: Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim and Tripura; West: Dadra and Nagar Haveli, Daman and Diu, Goa, Gujarat, Maharashtra; South: Andaman and Nicobar Islands, Andhra Pradesh, Karnataka, Kerala, Lakshadweep, Puducherry, Tamil Nadu and Telangana
R: Rural; U: Urban

Source: Author's own calculations from NFHS-4 and All India values are from Tables 11.15 and 2.10 of IIPS (2017) All India reports.

Next we consider the same for men and women on changes in access to insurance across nutrition groups of underweight, normal BMI range, overweight and obese (Table 3). We find that underweight had the least access to insurance among men and women as well as across time. The access has improved by about 20 percentage points compared to the previous decade for men but not so for women. The overnourished men and women in general have marginally higher (about 3-5 percentage points) access to insurance but again men had insured slightly more than women. The change in insurance access was clearly towards the public provider and this is important information to understand that the state based insurance providers are able to penetrate more.

Table 3: Distribution (percent) of Insurance Coverage within Nutrition Categories for Men and Women in 2005-06 and 2015-16, All India

Year	**2005-06 (NFHS-3)**				**2015-16 (NFHS-4)**			
Nutrition Groups	**UN**	**NN**	**OW**	**Ob**	**UN**	**NN**	**OW**	**Ob**
Insurance Type	**Men**							
None	97.4	94.6	89.2	89.9	77.8	77.1	73.6	72.3
Public	1.3	2.4	4.8	4.1	20.6	20.8	22.0	22.3
Private	1.0	2.0	3.8	4.3	0.9	1.1	1.9	2.4
Employer	0.3	0.9	2.1	1.7	0.7	1.0	2.6	3.0
	Women							
None	97.2	95.6	91.1	89.7	81.0	80.0	77.5	75.8
Public	1.2	2.0	4.1	4.3	17.9	18.4	20.0	20.9
Private	1.1	1.7	3.2	4.0	0.9	1.2	1.8	2.2
Employer	0.4	0.7	1.6	2.0	0.2	0.4	0.7	1.0

Note: UN: Undernutrition (BMI<18.5); NN: Normal Nutrition (18.5≤BMI<23); OW: Overweight (23≤BMI<27.5); Ob: Obesity (BMI≥27.5)

Source: Author's own calculations from NFHS-3 and NFHS-4.

Focusing on the more recent year of 2015-16 it is observed that Southern followed by Eastern states have the best access to health insurance (Table 4). For men the non-insurance rates of 24 percent in Andhra Pradesh, 30 percent in Telangana, 55 percent in Tamil Nadu and

53 percent in Odisha showed large penetration rates but expectedly about 5 to 10 percent lower coverage among women.

Table 4: Distribution (percent) of Insurance Type in 2015-16 for Men and Women: Geographic Zones and All India

Zone/ Insurance Type	North	Central	East	Northeast	West	South	All
	Men						
None	88.9	86.6	75.8	82.8	83.5	51.5	75.5
Public	8.5	12.1	21.8	15.5	10.5	44.9	21.3
Private	1.0	0.7	1.2	0.5	2.6	1.8	1.5
Employer	1.7	0.6	1.3	1.2	3.3	1.8	1.7
	Women						
None	90.3	88.6	80.4	87.2	88.6	54.9	78.9
Public	7.9	10.8	18.4	11.7	7.0	42.5	19.1
Private	1.5	0.4	0.9	0.6	3.3	1.9	1.5
Employer	0.4	0.3	0.3	0.4	1.2	0.7	0.5

Source: Author's own calculations from NFHS-4.

CONCLUSIONS

The concern towards double burden of malnutrition in the LMICs was beginning to be noticed since the early 2000s and by mid 2000s more detailed enquiry and research studies had begun to appear (Kennedy *et. al.,* 2006). The problem has reached a great proportion making it part of several the Sustainable Development Goals (SGD) of the United Nations. SDG set targets so that LMICs can address the issues related to malnutrition (goal 2), communicable and non-communicable diseases, equitable health care access (goal 3) and improving gender equality (goal 5). India's double burden of malnutrition gets particularly accentuated due to the large population. India's ranking is highest in undernutrition rate as assessed by thinness among men and women and it has also shown a drastic increase in overnutrition rates in the past quarter of a century. The economic impact of this burden is visible at the individual,

household, community and national level. Poor health either from undernutrition or overnutrition affects productivity and income earning capabilities on the one hand and the loss in income due to illness and morbidities on the other hand. The health expenditure or the loss of an adult family member in prime age affects the household's well-being.

Popkin *et. al.* (2020) stress substantially on the need to address the double burden but the governments in LMICs will need additional human and financial resources to deal with this if it has to come through public policy. Undernutrition in LMICs has attracted aid and donor support for more obvious reasons but to expect that overnutrition among these countries will also attract similar financial resources would be asking for too much. The wealthier sections of the population in these countries can afford the health insurance to cover the non-communicable diseases with better quality care. With a larger emphasis towards privatization of health care particularly for treatment of non-communicable diseases the less wealthy sections of the population have to depend on state insurance schemes. Southern states in India to a large extent have managed to provide insurance schemes as observed from this study but the infectious and communicable diseases are not covered under such schemes and the dependence on public health system is still high. The lack of attention to these diseases during pandemic including immunization for pregnant women, infants and young children can have a setback on the achievements so far in the Indian context. Choudhury and Dubey (2020) report that not only states like Tamil Nadu have higher per capita public health expenditure compared to Bihar, but they also have a higher intra-state equity in its disbursal across the districts. Singh *et. al.* (2020) show that the central and eastern states of India which account for 70 percent of the population and are lagging in several developmental indicators have below all India average number of 0.55 beds per 1000 population in public hospitals. These are the states that show higher undernutrition rates as highlighted in our study and hence under a pandemic would suffer even more due to limited access to health care.

India's double burden of malnutrition has attracted attention in the print media making the common man more aware of it (Bhattacharya, 2017; Swaminathan and Menon, 2020). The overnutrition is largely a life-style issue among the middle and upper income households and could be managed at the household and community level through nudge and awareness, so that there is less pressure on public finances to address this as a public health issue. India's ancient culture and bio-diversity possess some knowledge for a healthy lifestyle to address the double burden. The dietary diversity can be adequately harnessed to address undernutrition as well as overnutrition and yoga, various dance forms and martial arts, and a range of sporting activities provide great scope for physical activities in order to address the challenge of overnutrition from high BMI values.

As Popkin *et. al.* (2020) mention that micronutrient malnutrition is also a component of the double burden but gets lesser attention due to limited data. In the Indian context, most often it is the deficiencies in these that are still more prevalent like iron; vitamins A, C and D; zinc, and calcium (Viswanathan, 2014; Harinaryan, 2018). Inclusion of these deprivations as well has been termed as triple burden of malnutrition by a few recent Indian studies (Ramachandran, 2014 and Meenakshi, 2016). These deficiencies have been shown to make the human body susceptible to infections like COVID-19 as well as recovery from the disease among the more seriously infected (Balasubramanian, 2020; Edabi and Montana-Loza, 2020). Therefore, adding this dimension to the malnutrition is also very important and will be considered in future extensions of our analysis.

FAO *et. al.* (2020) arrived at estimates of average cost per person per day of diets that are adequate in nutrients. Using those cost, Swaminathan (2020) points out that more than half the population in India cannot afford a healthy diet rich and diverse in macro ad micro. In order to ensure a healthier population and with the demographic dividend favoring the youth and the middle aged the economic burden of

healthy diets could be enormous if the well-aware households were to consume it. The state may have to focus more on the same retail market which has made processed food more easily accessible to incentivize to sell healthier and affordable products. This gives an opportunity to be "vocal on right local" (Somanathan, 2020) by increasing emphasis on local food processing industry and better inter-linkages between small scale fruits and vegetable producers and consumers can go a long way in improving dietary quality of the average Indian adult. One hopes that the local governments could pay more attention in making effective policies by involving the local communities to reduce the double burden of malnutrition in India so that it gets closer to the targets set by the SDGs for 2030.

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