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Original article

Comparison of underweight, overweight and obesity prevalence among Indian women in different national health surveys

Smita Asthana [a], Dishank Rawat [b], Satyanarayana Labani [a, *]

[a] ICMR-NICPR, Division of Epidemiology and Biostatistics, National Institute of Cancer Prevention and Research, Indian Council of Medical Research, I-7, Sector-39, Noida. UP 201301, India
[b] Vardhaman Mahavir Medical College and Safdarjung Hospital, New Delhi

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ABSTRACT

Background: Earlier studies are mostly based on the first three National Family Health Surveys (NFHSs) for estimating and comparing prevalence of underweight, overweight and obesity among Indian women and lack the information on latest survey.
Objectives: The objective of this work was to study and compare the prevalence of underweight, overweight and obesity among Indian women using the updated data from different NFHSs.
Materials and methods: Data collected under three surveys – NFHS-2, NFHS-3 and NFHS-4 – from different states of India were arranged according to geographical regions. Data on age, marital status, area of urban or rural, education, religion and wealth index were also collected. Body mass index (BMI) less than 18.5 kg/m^2 was labelled as 'underweight', 25–30 kg/m^2 'overweight' and greater than or equal to 30 kg/m^2 'obese'.
Results: Overall prevalence of underweight in Indian women reduced to 22.9%, while overweight (15.5%) and obese (5.1%) increased over different survey years. There was a decline in prevalence of underweight (−17.1%) and increase in prevalence of overweight (7.3%) and obese (2.3%) among illiterate. The urban areas showed comparatively higher burden of obesity (9.1%) than the rural areas (3.1%), but there was not much change (4.8–6%) over years. Prevalence of underweight remained higher in rural areas (26.7%) although there was apparent decline (13.8%). The states/union territories (UTs) belonging to Central (25.3%–28.3%) and Eastern regions (21.3%–31.5%) of India showed higher prevalence of underweight.
Conclusion: Indian women are recovering from throes of underweight, but a rising trend in overweight and obesity is a great concern.

1. Introduction

As the developed regions of the world come to terms with the overweight/obesity epidemic,[1] many developing and underdeveloped regions are facing what has often been referred to as the double burden of malnutrition.[2,3] Along with preexisting burden of underweight/undernutrition, these resource-stricken regions now also have to contend with steeply rising prevalence of overweight and obesity.[4–6] Both the states of unhealthy weight impose a substantial burden on such regions.[2,7] In 2014, 39% (~1.9 billion) of the global adult population was reported to be overweight, and 13% (~600 million), to be obesity. In the period between 1980 and 2014, worldwide obesity has more than doubled.[8] Trends over the past 4 decades in 200 countries have predicted global prevalence of obesity to reach 18% in men and 21% in women by 2025, from 11% in men and 15% in women in 2014.[4]

In India, gender disparities exist for both ends of the unhealthy weight. In urban areas, more than 23% of women are either obese or overweight versus 20% among men.[9] Analysis of earlier data suggests that the overall trends may be moving from underweight to overweight or obesity.[5,13] Owing to better lifestyle and improved economy, the burden of underweight or undernutrition on community is decreasing. Underweight and overweight or obesity states not only result in increased levels of individual morbidity and mortality[14] but also worsen neonatal and maternal outcomes.[15]

The National Family Health Survey (NFHS) is a large-scale, multiround survey conducted in a representative sample of

* Corresponding author. Division of Epidemiology and Biostatistics, Indian Council of Medical Research- NICPR, I-7, Sector-39, Noida. UP, India.
E-mail address: satyanarayanalabani@yahoo.com (S. Labani).

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Table 1
Percentage of women with underweight, overweight and obesity by state/union territory in India.

State/region of India	NFHS-4			NFHS-3			NFHS-2		
	Underweight	Overweight	Obesity	Underweight	Overweight	Obesity	Underweight	Overweight	Obesity
India	22.9 (−12.7)	15.5 (5.7)	5.1 (2.3)	35.6 (15.3)	9.8 (−0.8)	2.8 (0.6)	20.3	10.6	2.2
North									
Chandigarh	13.3 (−)	26.5 (−)	14.9 (−)	NA (−)	NA (−)	NA (−)	NA	NA	NA
Delhi	14.8 (0)	23.4 (4.8)	10.1 (2.3)	14.8 (−8.9)	18.6 (−15.2)	7.8 (−1.4)	23.7	33.8	9.2
Haryana	15.8 (−15.5)	16.1 (3.1)	4.9 (0.5)	31.3 (10)	13 (−3.6)	4.4 (0.5)	21.3	16.6	3.9
Himachal Pradesh	16.2 (−13.7)	21.7 (10.3)	7 (4.9)	29.9 (9.1)	11.4 (−1.7)	2.1 (−0.2)	20.8	13.1	2.3
Jammu and Kashmir	12.1 (−12.5)	21.6 (8.2)	7.5 (4.2)	24.6 (3.6)	13.4 (−0.4)	3.3 (0.3)	21	13.8	3
Punjab	11.7 (−7.2)	22.2 (1.4)	9.2 (0.1)	18.9 (−4.1)	20.8 (−9.4)	9.1 (0)	23	30.2	9.1
Rajasthan	27 (−9.7)	10.8 (3.7)	3.3 (1.5)	36.7 (16.8)	7.1 (0)	1.8 (0.2)	19.9	7.1	1.6
Uttarakhand	18.4 (−11.6)	15.6 (5.5)	4.9 (2.2)	30 (−)	10.1 (−)	2.7 (−)	NA	NA	NA
Central									
Chhattisgarh	26.7 (−16.7)	9.5 (5.2)	2.4 (1.1)	43.4 (−)	4.3 (−)	1.3 (−)	NA	NA	NA
Madhya Pradesh	28.4 (−13.3)	10.5 (4.3)	3.1 (1.7)	41.7 (21.9)	6.2 (0.1)	1.4 (0.2)	19.8	6.1	1.2
Uttar Pradesh	25.3 (−10.7)	12.6 (5.1)	3.9 (2.2)	36 (16)	7.5 (0)	1.7 (0.2)	20	7.5	1.5
East									
Bihar	30.5 (−14.6)	9.5 (5.5)	2.2 (1.6)	45.1 (25.7)	4 (0.3)	0.6 (0.1)	19.4	3.7	0.5
Jharkhand	31.6 (−11.4)	8.2 (3.7)	2.1 (1.2)	43 (−)	4.5 (−)	0.9 (−)	NA	NA	NA
Odisha	26.5 (−14.9)	13 (7.5)	3.5 (2.4)	41.4 (22.2)	5.5 (1.1)	1.1 (0.5)	19.2	4.4	0.6
West Bengal	21.3 (−17.8)	16.1 (6.7)	3.8 (1.8)	39.1 (19.4)	9.4 (0.8)	2 (0.7)	19.7	8.6	1.3
Northeast									
Arunachal Pradesh	8.5 (−7.9)	15.9 (8.2)	2.9 (1.8)	16.4 (−4.6)	7.7 (2.6)	1.1 (0.5)	21	5.1	0.6
Assam	25.7 (−10.8)	11.1 (4.2)	2.1 (1.2)	36.5 (16.4)	6.9 (2.7)	0.9 (0.2)	20.1	4.2	0.7
Manipur	8.8 (−6)	20.8 (9.4)	5.2 (3.3)	14.8 (−6.3)	11.4 (0.6)	1.9 (0.7)	21.1	10.8	1.2
Meghalaya	12.1 (−2.5)	10.4 (5.9)	1.7 (0.9)	14.6 (−5.7)	4.5 (−1.3)	0.8 (−0.4)	20.3	5.8	1.2
Mizoram	8.4 (−6)	17.4 (8)	3.7 (2.5)	14.4 (−6)	9.4 (4.1)	1.2 (0.7)	20.4	5.3	0.5
Nagaland	12.3 (−5.1)	13.5 (7.8)	2.7 (2)	17.4 (−3.5)	5.7 (−2.5)	0.7 (0)	20.9	8.2	0.7
Sikkim	6.4 (−4.8)	21.3 (8.9)	5.4 (2.4)	11.2 (−10.8)	12.4 (−3.3)	3 (0.5)	22	15.7	2.5
Tripura	19 (−17.9)	13.7 (7.3)	2.4 (1.7)	36.9 (−)	6.4 (−)	0.7 (−)	NA	NA	NA
West									
Dadra and Nagar Haveli	28.7 (−)	14.2 (−)	5 (−)	NA (−)	NA (−)	NA (−)	NA	NA	NA
Daman and Diu	12.9 (−)	23.6 (−)	8.1 (−)	NA (−)	NA (−)	NA (−)	NA	NA	NA
Goa	14.7 (−13.2)	23.6 (8.2)	9.9 (5.1)	27.9 (6.3)	15.4 (−5.8)	4.8 (0.5)	21.6	21.2	4.3
Gujarat	27.2 (−9.1)	16.7 (4.6)	7.1 (2.5)	36.3 (15.6)	12.1 (−3.7)	4.6 (0.2)	20.7	15.8	4.4
Maharashtra	23.5 (−12.7)	17.3 (6.4)	6.1 (2.5)	36.2 (16)	10.9 (−0.8)	3.6 (0.7)	20.2	11.7	2.9
South									
Andaman and Nicobar Islands	13.1 (−)	24 (−)	7.8 (−)	NA (−)	NA (−)	NA (−)	NA	NA	NA
Andhra Pradesh	17.6 (−15.9)	22.9 (11.4)	10.3 (6.2)	33.5 (13.2)	11.5 (−0.5)	4.1 (1.9)	20.3	12	2.2
Karnataka	20.8 (−14.7)	16.7 (5.1)	6.5 (2.8)	35.5 (15.1)	11.6 (−2)	3.7 (0.8)	20.4	13.6	2.9
Kerala	9.7 (−8.3)	26 (2.9)	6.4 (1.4)	18 (−4)	23.1 (2.5)	5 (1.2)	22	20.6	3.8
Lakshadweep	13.5 (−)	26 (−)	14.6 (−)	NA (−)	NA (−)	NA (−)	NA	NA	NA
Puducherry	11.3 (−)	26.5 (−)	10.2 (−)	NA (−)	NA (−)	NA (−)	NA	NA	NA
Tamil Nadu	14.6 (−13.8)	22.6 (6.8)	8.3 (3.2)	28.4 (7.4)	15.8 (1.1)	5.1 (2.4)	21	14.7	2.7
Telangana	22.9 (−)	20 (−)	8.6 (−)	NA	NA (−)	NA (−)	NA	NA	NA

Underweight: BMI < 18.5 kg/m^2.; overweight: 25 kg/m^2 < BMI < 30 kg/m^2.; obese: BMI ≥ 30 kg/m^2
NA: data not available; (−): percentage change not calculated.
The value in parenthesis indicate the change in percentage prevalence between two consecutive NFHS reports.
Data source: NFHS-2/NFHS-3/NFHS-4 reports.

Table 2
Percentage of women with underweight, overweight and obesity by background characteristics in India.

Background characteristic	NFHS-4			NFHS-3			NFHS-2		
	Underweight	Overweight	Obesity	Underweight	Overweight	Obesity	Underweight	Overweight	Obesity
Age (years)									
<30	25.3–41.9	3.4–11.3	0.8–2.9	38.1–46.8	2.1–6.8	0.2–1.4	38.8–41.8	1.7–7.3	0.1–1.2
30–49	13.7–15.7	20.7–24.4	7.0–9.3	26.4–31.0	13.5–17.4	3.9–6.4	31.1–35.0	11.7–16.8	2.4–3.9
Marital status									
Never married	37.4	5.2	1.4	44.9	3.8	0.7	35.6	10.6	2.2
Ever married	18.0–20.1	18.8–19.2	5.3–7.3	33.0–33.9	10.7–11.5	3.2–3.7	39.3	10.3	2.1
Residence									
Urban	15.5	22.2	9.1	25	17.4	6.1	22.6	23.5	5.8
Rural	26.8	12	3.1	40.6	6.2	1.3	4.6	5.9	0.9
Education									
Illiterate	24.6	13.2	3.7	41.7	5.9	1.4	42.6	5.1	0.9
Literate	17.9–26.2	14.3–18.0	4.5–6.2	21.8–37.2	8.6–18.4	2.1–5.4	17.8–32.6	12.9–26.0	2.7–6.4
Religion									
Hindu	23.6	15	4.8	36.4	9.3	2.6	36.9	9.6	2
Others	11.7–26.5	9.5–26.8	2.9–11.8	17.8–41.1	3.0–21.5	0.9–10.1	15.8–49.4	7.0–33.7	0.4–9.8
Wealth index									
Low	29.5–35.8	5.0–9.5	0.8–1.8	46.3–51.5	1.6–3.4	0.2–0.5	48.1	2.6	0.3
Medium	23.1	14.9	3.8	38.3	6.5	0.9	35.6	8.6	1.5
High	11.6–17.1	20.8–25.2	7.4–11.0	18.2–28.9	12.5–22.0	2.9–8.4	17.3	27.2	6.8

Underweight: BMI < 18.5 kg/m^2.; overweight: 25 kg/m^2 < BMI < 30 kg/m^2.; obese: BMI ≥ 30 kg/m^2.
Data source: NFHS-2/NFHS-3/NFHS-4 reports.

households throughout India. Earlier surveys had been conducted in 1992–1993, 1998–1999 and 2005–2006. Earlier studies using NFHS data were limited to NFHS-1/NFHS-2/NFHS-3.[9,11–13,16–18] However, our study attempts to study the prevalence of underweight, overweight and obesity among Indian women (aged 15–49 years) in three NFHSs including the latest one conducted in 2015–2016 (NFHS-2, NFHS-3 and NFHS-4).

2. Material and methods

The study uses secondary data of cross-sectional studies extracted from NFHS data sets and reports. The NFHS is a large scale, multiround survey conducted in a representative sample of households throughout India. The survey provides state and national information on the issues related to health and family welfare in India. Four such surveys have been conducted till date: NFHS-1 in 1992–1993, NFHS-2 in 1998–1999, NFHS-3 in 2005–2006 and NFHS-4 in 2015–2016. The number of women surveyed under NFHS-2, NFHS-3 and NFHS-4 was 89,199; 1,24,385 and 6,99,686, respectively. The report of NFHS-1 was not used in our analysis because comparable data were unavailable.

2.1. Population and sampling

A multistage sampling design was used by the NFHS. The questionnaires were modelled on standard Demographic and Health Surveys (DHS) questionnaires. Indian women aged 15–49 years served as the study population.

2.2. Data extraction

The relevant prevalence data along with country-wide prevalence for women aged 15–49 years belonging to 36 states/union territories (UTs) were extracted from NFHS-2/NFHS-3/NFHS-4 reports. The extracted data were then categorized under different groups on the basis of geographical region (rural/urban), age, marital status, education, religion, wealth index, etc. These group categories were then compared to ascertain the results. There were 29 comparable states/UTs between NFHS-3 and NFHS-4 and 27 comparable states/UTs between NFHS-2 and NFHS-3.

2.3. Data analysis

Data preparation and analysis was carried out using Microsoft Excel, SPSS, version 24, and R package, version 3.3.2. Figures were created using Minitab 17. Women with body mass index (BMI) < 18.5 kg/m^2 were labelled as 'underweight', between 25 and 30 kg/m^2, 'overweight' and BMI ≥ 30, 'obese'. Data on age of women were divided into two categories, younger (<30) and older (30–49), for the purpose of presentation. States/UTs were divided into 6 geographical regions: Northern, Central, Eastern, Northeastern, Western and Southern (Table 2).

Change in prevalence of underweight, overweight and obesity between successive surveys was calculated as percentages and compared nationally and region wise. In addition, regions with underweight, overweight and obesity prevalence greater than 20%[17] were identified and labelled as 'double burden' states.

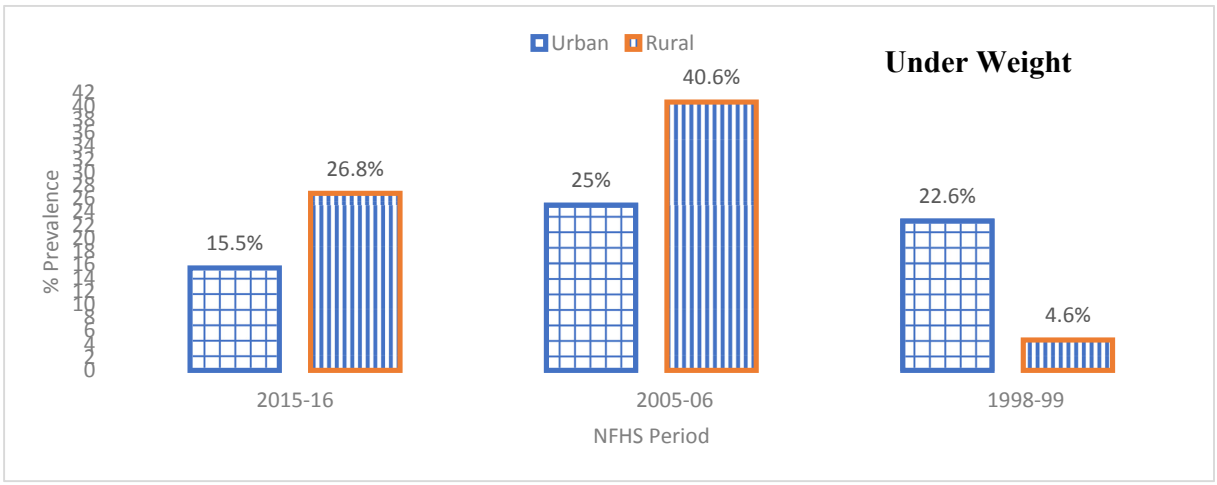
3. Results

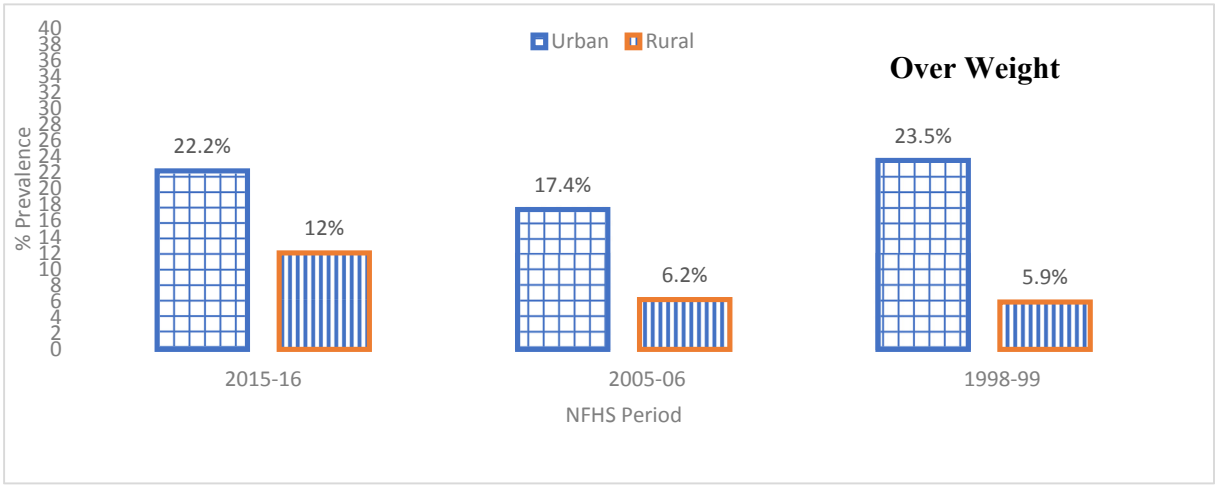
Table 1 shows the percentage of women with underweight, overweight and obese by state/UT in India as noted from NFHS reports. There was decrease in prevalence of underweight in both the age groups; <30 and 30–49 years from NFHS-2 to NFHS-3 and

Table 3
National and region-wise prevalence (%) of underweight, overweight and obesity among Indian women (aged 15–49 years).

State/region of India	Prevalence of underweight among Indian women (min–max)				Prevalence of overweight among Indian women (min–max)				Prevalence of obesity among Indian women (min–max)				
	NFHS-4	NFHS-3	NFHS-2	Change between NFHS-3 & NFHS-2	Change between NFHS-4 & NFHS-3	NFHS-4	NFHS-3	NFHS-2	Change between NFHS-3 & NFHS-2	Change between NFHS-4 & NFHS-3	NFHS-4	NFHS-3	NFHS-2	Change between NFHS-3 & NFHS-2	Change between NFHS-4 & NFHS-3
India	22.9	35.5	35.8	−0.3	−12.6	15.5	9.8	10.6	−0.8	5.7	5.1	2.8	2.2	0.6	2.3
Northern region	(11.7–27)	(14.8–36.7)	(12–36.1)	(+0.2–+5.5)	(−15.6 to −2)	(10.8–26.5)	(7.1–20.8)	(7.1–33.8)	(−15.2–0)	(0.7–15.1)	(3.3–14.9)	(1.8–9.1)	(1.6–9.2)	(−1.4–0.6)	(−1.6–7.4)
Central region	(25.3–28.3)	(36–43.4)	(35.8–38.2)	(+0.2–+3.5)	(−16.7 to −10.7)	(9.5–12.6)	(4.3–7.5)	(6.1–7.5)	(−1.8 to −1.3)	(4.3–5.2)	(2.4–3.9)	(1.3–1.7)	(1.2–1.5)	(−0.1–0.1)	(1.1–2.2)
Eastern region	(21.3–31.5)	(39.1–45)	(39.3–48)	(−6.6–+5.7)	(−17.8 to −11.4)	(8.2–16.1)	(4.0–9.4)	(3.7–8.6)	(−3.1–0.3)	(3.7–7.5)	(2.1–3.8)	(0.6–2.0)	(0.5–1.3)	(−0.2–0.1)	(1.2–2.4)
Northeastern region	(6.4–25.7)	(11.2–36.9)	(10.7–27.1)	(−11.2– +9.4)	(−18 to −2.5)	(10.4–21.3)	(4.5–12.4)	(4.2–15.7)	(−3.3–4.1)	(4.2–9.4)	(1.7–5.4)	(0.7–3.0)	(0.5–2.5)	(−0.4–0.7)	(0.9–3.3)
Western region	(12.9–28.5)	(27.9–36.3)	(27.1–39.7)	(−3.5–+0.8)	(−13.2 to −9.1)	(14.2–23.6)	(10.9–15.4)	(11.7–21.2)	(−5.8 to −0.8)	(−1.2–12.7)	(5.0–9.9)	(3.6–4.8)	(2.9–4.4)	(0.2–0.7)	(0.2–6.3)
Southern region	(9.7–23.1)	(18–35.4)	(18.7–38.8)	(−3.9 to −0.6)	(−15.9 to −8.3)	(16.7–26.5)	(11.5–23.1)	(13.6–20.6)	(−2–2.5)	(−6.4–12.5)	(6.4–14.6)	(3.7–5.1)	(2.2–3.8)	(0.8–2.4)	(1.3–6.6)

+ and − indicate increase and decrease in the prevalence, respectively.
Northern region: Chandigarh, NCT Delhi, Haryana, Himachal Pradesh, Jammu and Kashmir, Punjab, Rajasthan, Uttarakhand; Central region: Chhattisgarh, Madhya Pradesh, Uttar Pradesh; Eastern region: Bihar, Jharkhand, Odisha, West Bengal; Northeastern region: Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim, Tripura; Western region: Dadra and Nagar Haveli, Daman and Diu, Goa, Gujarat, Maharashtra; Southern region: Andaman and Nicobar Islands, Andhra Pradesh, Karnataka, Kerala, Lakshadweep, Puducherry, Tamil Nadu, Telangana.
Underweight: BMI < 18.5 kg/m^2.; overweight: 25 kg/m^2 < BMI < 30 kg/m^2.; obesity BMI ≥ 30 kg/m^2; min: minimum; max: .
Data source: NFHS-2/NFHS-3/NFHS-4 reports.





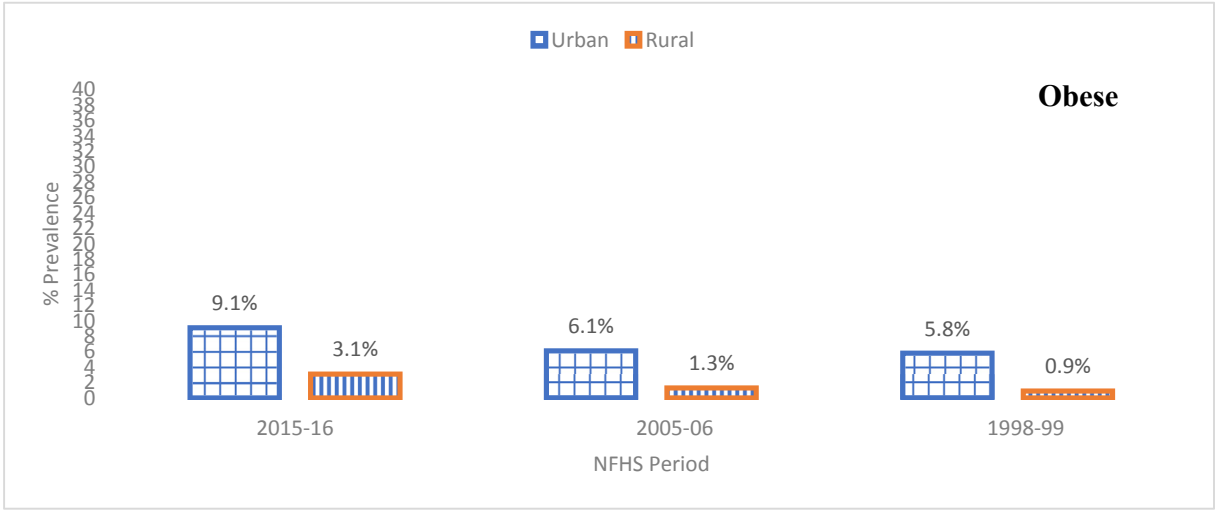
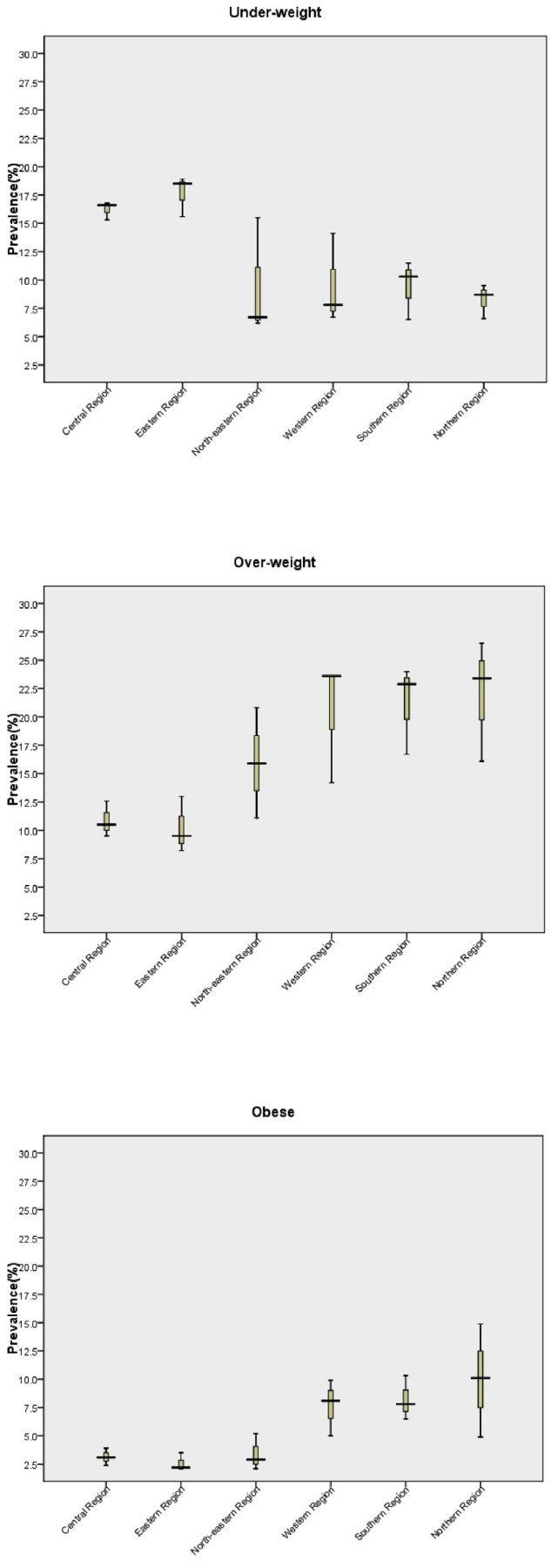


Fig. 1. National prevalence changes of underweight, overweight and obesity among Indian women (aged 15–49 years) from 1998–1999 to 2015–2016. Years 2015–2016, 2005–2006 and 1998–1999 indicate prevalence of underweight, overweight and obese for both rural and urban areas. (Data Source: NFHS-2/NFHS-3/NFHS-4) Underweight (BMI < 18.5 kg/m^2); overweight (25 kg/m^2 < BMI < 30 kg/m^2); obese (BMI ≥30 kg/m^2). BMI, body mass index; NFHS, National Family Health Survey.

from NFHS-3 to NFHS-4. Obesity (5.3–7.3%) and overweight (18.8–19.2%) both showed high prevalence in NFHS-4 as compared with NFHS-3 and NFHS-2 for ever married women. For never married women, increase in prevalence of obesity and overweight was not evident. National rural prevalence of overweight and obesity was 12% and 3.1%, respectively, while the national urban prevalence was 22.2% and 9.1%, respectively. Between NFHS-3 and NFHS-4, a sharp rise of 15.4% and 9.4% has been noted for urban and rural areas, respectively. Between NFHS-2 and NFHS-3, a fall of 7.6% and 0.3% in prevalence of overweight women had been reported for



urban and rural areas, respectively. Among illiterates, there has been a decline in prevalence of underweight (−17.1%) and increase in prevalence of overweight (7.3) and obese (2.3%). Prevalence of underweight was high in low wealth index (29.5–35.8%) as compared with high wealth index category (11.6–17.1%). Prevalence of overweight and obesity showed reverse trends and was higher in high wealth index. Obesity prevalence ranged from 7.4% to 11.0% among high wealth index and 0.8%–1.8% among low wealth index. Similarly, overweight was also high among the high wealth index population (20.8–25.2%) as compared with the low wealth index population (5.0–9.5%). This type of pattern was found in NFHS-3/NFHS-2 reports also but more marked in NFHS-2 report (Table 2).

In 2015–2016 (NFHS-4), 22.9% of Indian women were reported to be underweight, 15.5% overweight and 5.1% obese. The states/UTs belonging to Central (25.3%–28.3%) and Eastern regions (21.3%–31.5%) showed higher prevalence of underweight, while states/UTs from Northern (3.3%–14.9%), Southern (6.4%–14.6%) and Western (5.0%–9.9%) regions showed higher prevalence of obesity. There was a sharp fall (−12.6%) in the prevalence of underweight, 5.7% increase in the prevalence of overweight and 2.3% increase in the prevalence of obesity. Comparison between earlier reports (NFHS-2 versus NFHS-3) had revealed a negligible fall (−0.3%) in the prevalence of underweight, a modest fall (0.8%) in the prevalence of overweight and an increase in the prevalence of obesity (0.6%). These declines in the prevalence of underweight and increase in the prevalence of overweight and obesity were evident from all regions of the country (NFHS-3 vs NFHS-4). Maximum change was found in the states of northern region (7.4%), followed by 6.6% in Southern region and 6.3% in the Western region (Table 3).

Fig. 1 shows national prevalence of underweight, overweight and obesity among rural and urban areas. The urban prevalence of overweight and obesity has exceeded urban prevalence of underweight. The total and rural prevalence(s) seemed to be closely following the change, with a crossover imminent in the near future.

States in Central and Eastern regions suffered from higher prevalence of underweight, as compared with the national prevalence. The prevalence of underweight in northern states was otherwise low. States in Northern, Southern and Western regions reported higher prevalence of overweight and obesity than the national prevalence (Fig. 2).

4. Discussion

Underweight, overweight and obesity have long remained significant public health concerns in India. Overall prevalence of underweight in Indian women exceeded the overall prevalence of overweight and obesity. However, the gap is closing fast, with overweight and obesity set to exceed underweight as the more prevalent problem countrywide. Changes have shown a decline in underweight and increase in overweight and obesity, which is more prominent in NFHS-4 than in NFHS-3. This type of change of decrease in underweight and increase in overweight and obesity is evident through all regions and all sociodemographic factors of young age and old age, rural and urban, illiterate and literate and

Fig. 2. Boxplots of region-wise total prevalence (%) of underweight, overweight and obesity among Indian women (aged 15–49 years). Regions: Central (Chhattisgarh, Madhya Pradesh, Uttar Pradesh); Eastern (Bihar, Jharkhand, Odisha, West Bengal); Northeast (Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim, Tripura); Northern (Chandigarh, NCT Delhi, Haryana, Himachal Pradesh, Jammu and Kashmir, Punjab, Rajasthan, Uttarakhand); Southern (Andaman and Nicobar Islands, Andhra Pradesh, Karnataka, Kerala, Lakshadweep, Puducherry, Tamil Nadu, Telangana); Western (Dadra and Nagar Haveli, Daman and Diu, Goa, Gujarat, Maharashtra). (Data-Source: NFHS-4). Underweight (BMI < 18.5 kg/m^2); overweight (25 kg/m^2 < BMI < 30 kg/m^2); obese (BMI ≥30 kg/m^2).

among different socioeconomic strata. This type of shift cannot merely be explained on the basis of population explosion. Lifestyle changes such as improvement of economic standards, food habits, sedentary life, consumption of junk food, etc. could be the possible explanations.

All the comparable 29 states/UTs showed falling prevalence of underweight, ranging from a 2% fall in Delhi to an 18% fall in Tripura. A total of 17 of 29 states showed a fall of more than 10%; even Jharkhand, with the highest current prevalence at 31.5%, saw a decline of 11.4% from 42.9%. Bihar, which had reported the highest prevalence earlier (45%), showed an almost 15% fall. Bihar also showed the highest urban prevalence at 22.2%. Highest rural prevalence of underweight was noted in Dadra and Nagar Haveli (38.9%). Sikkim reported the lowest prevalence both in rural areas (5.8%) and overall (6.4%). Lowest urban prevalence was reported in Mizoram (7.5%). Only Rajasthan and Gujarat reported relatively high prevalence (~27%) despite sizeable decline in prevalence (−9.7% and −9.1%, respectively) (Table 1).

None of the comparable 26 states in NFHS-4 showed a fall in the prevalence of overweight. The rise in the prevalence of overweight in states ranged from 1.4% (Punjab) to 17.6% (Andhra Pradesh). Chandigarh exhibited the highest total prevalence of 41.5%, closely followed by Lakshadweep at 41.4%. Andhra Pradesh reported the highest urban prevalence (45.6%). The lowest prevalence overall (10.3%) and in rural areas (5.9%) was reported in Jharkhand. Urban prevalence was the lowest in Meghalaya. Prevalence of both underweight and overweight was higher in the states of Gujarat (27.2% and 23.7%, respectively) and Maharashtra (23.5% and 23.7%, respectively), as compared with the national prevalence(s). Overall, 4 states (Gujarat, Maharashtra, Karnataka and Telangana) reported the prevalence of both underweight and overweight as greater than 20%.

Overweight has become a more prevalent problem than underweight in the urban areas of the country. Several earlier international[1,2,5,6] and regional/national studies[3,19–21] had reported a shifting burden towards overweight in developing regions/countries. There has been a significant decline in the prevalence of underweight in women. This could be viewed as a reassuring development when compared against the earlier trends which had indicated a negligible fall.[21] The overall prevalence is still quite high, but the reported change of an almost uniform decline across all states/regions looks promising. Central and Eastern regions however reported higher prevalence of underweight. This is likely due to higher poverty burden of Central and Eastern States.[22,23]

Prevalence of overweight among Indian women, however, has shown a sharp rise. While states with preexisting higher burden of overweight, such as Punjab, showed smaller spikes, most other states exhibited more alarming trends. The median prevalence of overweight was higher than the national prevalence in Southern, Northern and Western Regions, probably because they house comparatively prosperous states and have seen more development in the recent years than the Central, Eastern and Northeastern states.[22,23] It is also quite concerning that even the rural centres are beginning to show a shift towards higher prevalence of overweight. Earlier studies had indicated a similar trend, albeit the magnitude of the problem was far lower.[13,16,18,24,25] The urban/rural divide of overweight prevalence is likely to dissolve as rural areas see more infrastructural and socioeconomic development. Even in urban settings, there may be a large subset of underweight population masked by sheer density of population.[26] A total of four states (Gujarat, Maharashtra, Karnataka and Telangana) exhibited double burden of malnutrition among women using traditional cut-off values for BMI. An earlier study using NFHS-3 data examined coexistence of underweight and overweight individuals among Indian states and reported 4 (Gujarat, Tamil Nadu, Jammu and Kashmir and Haryana) as double burden states.[17] Persistence of Gujarat as a double burden state warrants a closer look. There is a significant association of urban residence, higher socioeconomic and educational status with overweight/obesity by earlier studies.[3,9,10,16,18,19,24,25] Rapid urbanization and constant one-way migration towards urban centres[27] along with improving socioeconomic and educational status,[28] are likely to ensure that the problem of overweight will continue to grow. When considering the steady rise in prevalence of overweight and obesity, the current strategies to improve nutritional status begins to appear less effective and somewhat questionable. The steady improvement in socioeconomic and educational status of Indian households has perhaps not been accompanied by similar improvements in health awareness, specifically with regards to weight.[29] Thus, while focussing on improving just the educational and economic status of women is likely to reduce underweight prevalence, it still does not lead them towards a healthier weight. Often, they are rendered at a higher risk of obesity.[23] Novel measures must be devised to ensure that these pools feed in towards normal weight instead of switching between each other.[30]

5. Conclusion

Comparing data reported from NFHS-3/NFHS-2 with the data extracted form NFHS-4, the fall in prevalence of underweight among women appears to be a promising sign. However, it is marred with the increasingly grave situation of rising overweight and obesity. Northern, Southern and Western regions showed comparatively higher prevalence of overweight and obesity among women. Prevalence of overweight and obesity in urban centres is almost double the prevalence in rural centres; however, prevalence of overweight and obesity in rural centres is also on the rise. Unless appropriate measures are taken, the effort to reduce prevalence of underweight will get offset by a steep rise in the prevalence of overweight and obesity. The strides made to relieve female populace of India from underweight should not have to end with an inadvertent towards another health problem.

Conflicts of interest

None.

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None.

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Appendix A. Supplementary data

Supplementary data related to this article can be found at https://doi.org/10.1016/j.cmrp.2019.06.001.

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