

Obesity and Reproductive Health Outcomes among Women in India

Jitendra Gouda* and Chander Shekhar**

Abstract

Historically most populations suffering from obesity resided in high-income, industrialized countries. In recent times, dramatic increases in the prevalence of overweight or obesity are seen in low-income countries. In India more than 30 million of people are either overweight or obese. It is higher among women than men. Considering the increasing incidence of obesity among women, this study analyzes the reproductive health outcomes among overweight or obese women. The National Family Health Survey (NFHS), 2005-06 is used for the analysis of prevalence of overweight or obesity and its association with reproductive health outcomes among women. Bivariate, Trivariate and Multivariate analyses in terms of binary logistic regression were used. More than fifteen per cent of women were found to be overweight or obese in India. Women aged 35+ (9 per cent), from affluent families (25 per cent), with higher education (29 per cent), without work (8 per cent) and with media exposure (9 per cent) were more overweight/obese. Such women were more likely to report stillbirths (OR: 1.306; $P < 0.001$), caesarean delivery (OR: 2.391; $P < 0.001$), larger than average (OR: 1.150; $P < 0.001$) and overweight child (OR: 1.382; $P < 0.001$) at birth. In addition, higher BMI level is found to be positively correlated with secondary infertility among women in India. Prevalence of overweight/obesity among women has increased alarmingly over the period. Overweight/obese women experienced more adverse reproductive health outcomes than women of normal BMI.

Key words: Obesity, Reproductive health, Women, India.

I. Introduction

Overweight and obesity have reached epidemic proportions globally with more than one billion overweight, and at least 300 million of them clinically obese (WHO, 2003). The number is increasing alarmingly and expected to reach 2.3 billion overweight people aged 15 years, and over 700 million obese people worldwide in 2015 (WHO, 2012). It is a major contributor to the global burden of chronic disease, disability and premature death. Historically, most populations suffering from obesity resided in high-income, industrialized countries (Caballero, 2007). In recent times, the most dramatic increases in the prevalence of overweight or obesity are seen in low-income countries (Prentice, 2006; WHO, 2011). In these countries, overweight and obesity often coexist with under-nutrition (Mendez et al., 2005). Overweight and obesity virtually affect all ages and socio-economic groups. The recently concluded National Health and Nutrition Examination Survey, 2009-10 suggests that more than one-third of adults and almost 17 per cent youth were obese in 2009-2010 in USA. Almost 41 million women and more than 37 million men aged 20 and over were obese. In the age group of 2-19 years, more than 5 million girls and approximately 7 million boys were obese (Ogden et al., 2012). The situation in low-income countries is also worrisome, with a large proportion of both men and women either overweight or obese. India registers more than 30 million of overweight or obese population in the country; noticeably higher

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among women (15 per cent) than men (10 per cent) (IIPS & Macro International, 2007). Unlike the developed countries where overweight or obesity is generally concentrated among low-middle groups, elevated adiposity level in developing countries is more associated among richer sections of the society, predominantly in urban area (Griffiths & Bentley, 2001; Prentice, 2006; Ziraba et al., 2009; Gaur et al., 2013). The most apparent factors that can lead to overweight or obesity are excessive intake of energy-dense food, lack of physical activity and sedentary life style (Prentice, 2006; Sinha & Kapoor, 2010).

II. Obesity and reproductive outcomes

Overweight or obesity and its association with chronic morbidities has been profoundly established in many studies worldwide (Misra et al., 2009; Chan & Woo, 2010; WHO, 2012). Yet, the exploration of linkage between higher BMI and reproductive health outcomes among women has not been sufficient. However, few studies largely from western countries found an adverse relationship between overweight or obesity and reproductive health outcomes among women. In a nutshell, a study conducted in Australia evidently reported that women with high gestational weight gain (GWG) are more likely to have short and long term negative health outcomes for maternal and child health, and it highlights the need for its prevention. Excess GWG increases the likelihood of antenatal hypertensive disorders, gestational diabetes, atypical delivery outcomes and failure to breastfeed. Besides, it is associated with increased neonatal mortality, and neonatal, infant and later life adiposity. Further, it results in increased and persistent postpartum overweight, higher weight in subsequent pregnancies and increased risk of overweight and obesity in later adult life, with each being known for risk of development of cardiovascular disease and type II diabetes (Willcox et al., 2012). Similarly, another study from United States found that obesity is associated with early puberty, aberrant menstrual patterns, decreased contraceptive efficacy, ovulatory disorders and increased miscarriage rate (Lash & Armstrong, 2009). In 2008 in New Zealand, 49 per cent of women who had stillbirths and 45 per cent of mothers of neonatal deaths were in overweight or obese condition (PMMRC, 2010). In India, studies to examine the impact of overweight or obesity on reproductive health stated that, overweight or obese women experienced more stillbirths or premature pregnancy termination than normal women (Agrawal & Mishra, 2004; Sudha et al., 2009). Yet, the study had limitations in exploring many other adverse reproductive outcomes which are evident to be associated among obese women from western countries.

Rationale of this study

Physiology of men and women are different. Reproduction is an important aspect of human life and essential for its existence. Thus, birth of a healthy child is believed as fundamental for his/her survival. It is not uncommon that mother's health remains important for determining the health of a child at birth. Birth of an under-nourished or low birth weight child to an anemic mother is well established (Muthayya, 2009). However, pregnancy outcomes of an overweight or obese mother are not or partly understood at different dimensions. Complications during pregnancy, at delivery or childbirth and problems related to motherhood of an overweight or obese mother are least explored. Existing studies conducted on these issues are largely from western or industrialized countries which have least implications in the low-income countries like India.

With this backdrop, the present study is an attempt to shed light on the level and trend of overweight and obesity in India and their impact on three stages of a woman's reproductive life, i.e., during her gestation, on pregnancy outcomes and motherhood among ever-married women. Based on this perspective, the specific objectives are: (a) to measure the prevalence of overweight/obesity among women by selected socio-economic and demographic covariates; (b) to understand the adverse health impact during gestation and on its final outcomes among overweight/obese women; and (c) to examine the effect of being overweight or obesity on secondary infertility among women.

III. Methods

Data source

The latest round of National Family Health Survey (NFHS), 2005-06 data was used for the analysis of prevalence of overweight or obesity and its association with gestational problems, pregnancy outcomes and infertility among overweight/obese women. NFHS is the Indian version of Demographic Health Survey (DHS) program, which collects, analyzes and disseminates accurate and representative data on population, health, HIV and nutrition through more than 300 surveys in over 90 countries. The information is processed and presented in reports and data formats that describe the situation of the relevant country. It incorporates many steps including scientific sampling procedure to ensure that the data properly reflect the situation of the relevant country and that data are comparable across countries (IIPS & Macro International, 2007).

The information based on 49,394 ever married women with at least one child in the last five years preceding the survey aged 15-49 years incorporated in the NFHS, 2005-06 was used to analyze the prevalence of overweight/obesity and its association during gestation and on its final outcomes in India. Further, individual data on 118,733 women included in NFHS third round in India were used to estimate secondary infertility among women due to overweight/obese condition. The unit of analysis was woman in the study.

Variables

The variables used in this study can be divided into two categories, i.e. outcome and predictor variables.

Outcome Variables

The impact of overweight/obesity was assessed at three stages of women's reproductive life: during pregnancy, at child birth and motherhood. Vaginal bleeding and leg/body/face swelling were the variables considered for pregnancy. Incidence of stillbirth, caesarean delivery, very large or larger than average child and overweight child (>3.5 kg) were the variables to represent final pregnancy outcomes at birth. Secondary infertility was considered to represent the motherhood. To construct the secondary infertility, information on women aged 15-49 years who remained married for the last five years with at least one child, non-amenorrhic, no childbirth since last five years, menstrual cycle not resumed since last six months and the woman herself says that she can't get pregnant were considered.

Predictor variables

Overweight/Obesity: In NFHS each ever-married women aged 15-49 years were weighed using a solar-powered scale with an accuracy of ± 100 g. Their height was measured using an adjustable wooden measuring board, specifically designed to provide accurate measurements (to the nearest 0.1 cm.) in a developing-country field situation. The weight and height data can be used to calculate the body mass index (BMI).

As per the guidelines given by WHO, a BMI of less than 18.5 kg/m^2 is defined as underweight, indicating chronic energy deficiency. BMI in the range of 18.5 and 24.9 kg/m^2 is defined as normal; 25.0 and 29.9 kg/m^2 as overweight and more than 30.0 kg/m^2 as obese (WHO, 2004; Pan & Yeh, 2008). Based on these cut-offs, this study uses a two-category variable specifying the nutritional status of women, merging underweight and normal weight indicating as 'not obese' and women with BMI above 25.0 kg/m^2 as overweight or obese. Women who were pregnant at the time of the survey or women who had given birth during the two months preceding the survey were excluded.

Beside this, the survey collected information on a number of demographic and socio-economic factors which could potentially affect the nutritional status of women. The variables which were included as predictors in the study were place of residence, age, caste, religion, educational attainment, wealth index, work status and media exposure of the respondents.

IV. Statistical Analysis

Descriptive statistics and bivariate analysis were carried out to estimate the level and trend of overweight/obesity in India. Bivariate and tri-variate analysis were used to understand the socio-economic and demographic differentials in the prevalence of overweight or obesity. Multivariate analysis in terms of binary logistic regression was used to estimate the adjusted effect of selected socio-economic and demographic covariates on the prevalence of overweight or obesity and its consequences during gestation, on pregnancy outcomes and secondary infertility. Binary logistic is used due to the nature of the outcome variables. The outcome variables have two categories, namely, yes and no (coded as 0 and 1 respectively). The results are presented in the form of odds ratio (OR) with 95% of confidence interval. The odds ratio (OR) explains the probability that an overweight or obese woman will have the adverse reproductive co-morbidities relative to the probability that a woman with normal BMI will develop the same. In all the analysis, weights are used to restore the representativeness of the sample. The model can be put into a more compact form as follows:

$$\ln\left(\frac{p_i}{1-p_i}\right) = \beta_0 + \beta_{1x_1} + \dots + \beta_{Mx_{m,i}}$$

Where β_0, \dots, β_M are regression coefficients indicating the relative effect of a particular explanatory variable on the outcome. These coefficients change as per the context in the analysis in the study.

Results

The prevalence of overweight/obesity among women increased over the years in India. In particular, in NFHS-2, the prevalence of overweight/obesity was 12 per cent which has increased to 15 per cent in NFHS-3 (Figure 1). The level of BMI among women is presented in Table 1. The maximum and minimum levels of BMI among women stand at 59.62 and 12.04 respectively. Although the mean value of BMI falls in the normal range, the standard deviation and coefficient of variance shows that there is a greater variability in the BMI score, showing uneven concentration of women in the normal BMI range.

Figure 1: Prevalence of overweight/obesity among women in India, 1998-06

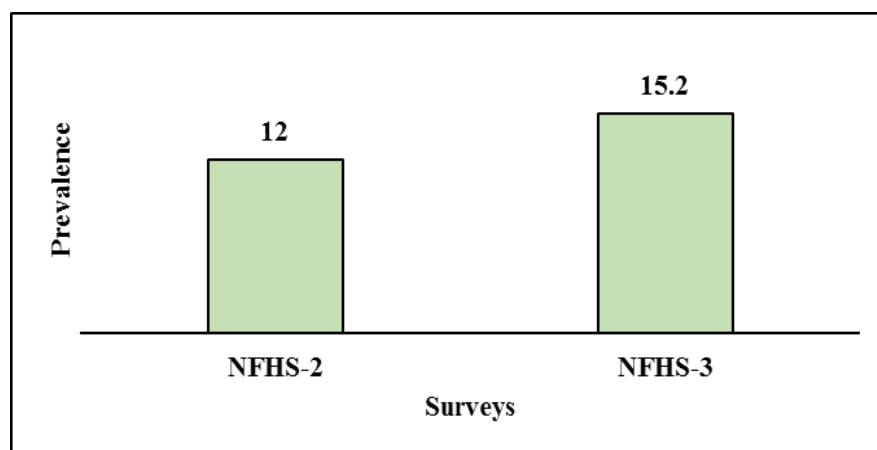
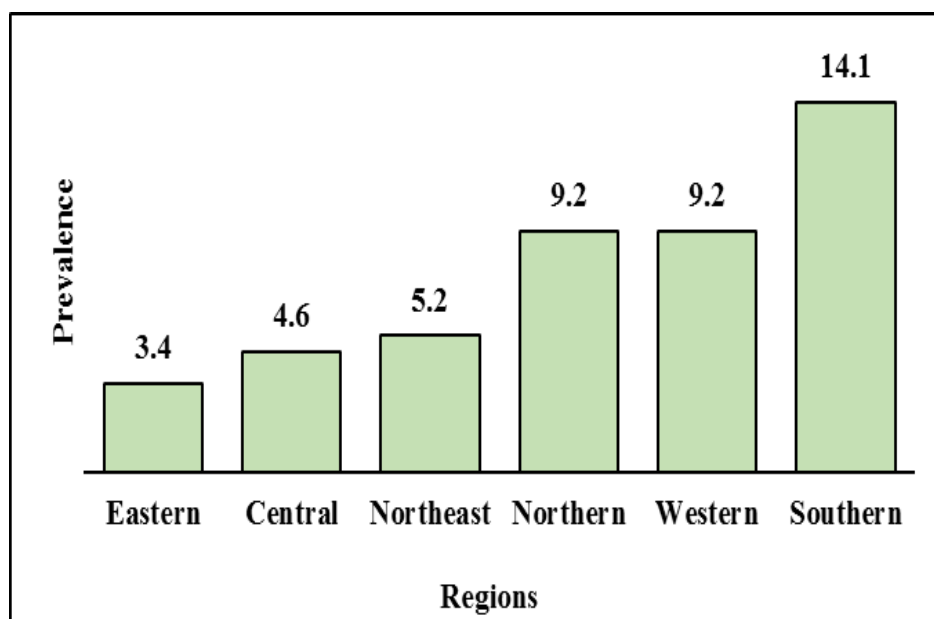


Table 1: Level of BMI among ever married women in India, 2005-06

Description	Level
Minimum	12.04
Maximum	59.62
Mean	20.37
Standard deviation	3.46
Coefficient of Variance	11.96
Sample Size	49394

It is observed that southern region recorded the highest proportion of overweight or obese women (14.1 per cent), followed with Western and Northern regions (9.2 per cent each). Eastern region recorded the lowest proportion of overweight/obese women (3.4 per cent) (Figure 2). Women in urban area were more overweight or obese than rural women. This pattern was observed across the selected covariates. Nevertheless, women aged 35+ (9.4 per cent), upper (Others) caste (11.6 per cent), with higher education (28.8 per cent), richer (25.1 per cent), without work (8 per cent) and with media exposure (9.4 per cent) found to be more overweight or obese (Table 2).

Figure 2: Prevalence of overweight/obesity among women from different regions in India, 2005-06



The adjusted effects of selected socio-economic and demographic characteristics on the prevalence of overweight or obesity among women is presented in Table 3. Women aged 35+ (OR: 4.617; CI: 3.148-6.772; $P < 0.001$) were more likely to be overweight or obese than the women aged 15-24 years. Women from upper (Others) caste groups were 16 per cent more likely to be overweight or obese than the women from lower castes. Women with higher education were thrice more likely to be overweight or obese than women with no education. Women from affluent households were as high as 15 times more likely to be overweight or obese as women from poor families. Media exposure and prevalence of overweight or obesity was positively correlated. In addition, women of higher parities were more likely to be overweight or obese as compared with women of first parity (Table 3).

Table 2: Prevalence of overweight/obesity by different covariates in India, 2005-06.

Covariates	Rural	Urban	Total	Samples
Age (years)				
15-24	1.4	4.5	1.9	18, 545
25-34	3.9	16.4	7.2	26, 017
35+	5.0	26.9	9.5	4, 832
Caste				
Scheduled Castes	2.7	10.1	4.4	8, 822
Scheduled Tribes	1.0	6.3	1.5	8, 195
Other Backward Classes	3.7	16.4	6.6	16, 268
Others	6.2	21.5	11.5	13, 955
Religion				
Hindu	3.3	16.7	6.4	34, 077
Muslim	4.7	15.6	8.0	8, 023
Christian	6.3	20.2	10.9	4, 964
Others	10.0	22.0	13.2	2, 330
Education				
No education	1.9	7.8	2.6	20, 054
Primary	3.4	10.8	5.0	7, 245
Secondary	7.1	18.5	11.3	18, 426
Higher	16.9	34.6	28.8	3, 668
Wealth Index				
Poorest	0.9	2.9	1.0	8, 862
Poorer	1.9	6.1	2.3	9, 225
Middle	3.7	7.2	4.4	10, 305
Richer	8.9	11.8	10.0	10, 817
Richest	17.9	28.2	25.1	10, 185
Work status				
No	4.4	17.0	8.0	34, 868
Yes	2.7	15.2	4.5	14, 430
Media Exposure				
No exposure	1.5	6.6	1.9	12, 192
Have exposure	5.3	18.0	9.4	37, 175
Parity				
First parity	4.3	16.7	8.0	15, 840
Second parity	4.7	19.9	9.1	13, 861
Third and more	3.0	13.6	4.9	19, 693

Table 3: Adjusted effects of selected covariates on the prevalence of overweight/obesity in India, 2005-06

Characteristics	India	
	Odds Ratio	95% CI
Age (years)		
15-24 [®]		
25-34	2.196***	1.546-3.120
35+	4.617***	3.148-6.772
Caste		
Scheduled Castes [®]		
Scheduled Tribes	0.501***	0.378-0.662
Other Backward Classes	1.155**	1.003-1.331
Others	1.163**	1.007-1.343
Religion		
Hinduism [®]		
Buddhism	--	--
Islam	1.393***	1.225-1.584
Christianity	1.356**	1.038-1.771
Others	1.446***	1.209-1.731
Education		
No Education [®]		
Primary	1.243**	1.042-1.482
Secondary	1.528***	1.324-1.765
Higher	2.526***	2.100-3.037
Wealth Index		
Poorest [®]		
Poorer	1.983***	1.480-2.656
Middle	3.342***	2.547-4.385
Richer	6.608***	5.056-8.636
Richest	15.644***	11.924-20.526
Work status		
No [®]		
Yes	0.885**	0.786-0.997
Media Exposure		
No exposure [®]		
Had exposure	1.563***	1.296-1.887
Parity		
First [®]		
Second	1.266***	1.136-1.411
Third and more	1.245***	1.095-1.416
Constant		0.003
Pseudo R2		0.1837

[®]-Reference group, ** p<0.05, *** p<0.001..

Table 4: Prevalence of adverse reproductive health outcomes among women in India, 2005-06

Characteristics	During pregnancy						Final pregnancy outcomes					
	Vaginal bleeding		Leg, face and body swelling		Stillbirth		Cesarean Delivery		Very large or larger than child		Overweight child	
	Normal BMI	Overweight/Obese	Normal BMI	Overweight/Obese	Normal BMI	Overweight/Obese	Normal BMI	Overweight/Obese	Normal BMI	Overweight/Obese	Normal BMI	Overweight/Obese
Economic condition												
Poor	3.8	3.3	24.1	28.7	16.9	19.4	2.3	8.0	21.9	25.2	8.2	18.7
Non-poor	4.8	6.7	24.9	34.9	18.5	23.4	11.7	30.1	24.8	27.7	7.7	10.1
Religion												
Hindu	4.1	6.4	23.4	33.6	17.4	25.2	7.1	29.2	23.5	27.9	7.6	10.4
Islam	4.3	4.1	29.4	35.4	20.2	19.7	4.9	21.0	23.0	26.6	9.0	13.9
Christianity	4.8	9.1	30.6	38.8	15.9	11.0	13.4	37.3	24.3	30.8	10.7	9.7
Others	4.3	6.4	25.4	37.3	12.5	11.7	10.0	25.3	18.2	21.5	7.5	2.3
Years of schooling												
Below 10 years	4.9	6.1	24.1	33.0	17.8	22.7	9.6	25.8	25.3	28.8	6.9	10.5
10 and more years	6.3	7.6	28.7	37.9	18.0	23.9	24.1	42.4	24.0	26.3	8.0	9.3
Occupation												
Housewife	4.4	6.3	24.5	34.1	17.8	22.0	8.6	28.3	23.5	27.6	7.4	10.6
Working outside home	4.1	6.5	24.5	35.1	17.6	27.0	4.4	25.6	23.0	26.5	9.0	10.3
Age at first birth												
Below 19 years	3.9	5.0	23.9	29.2	16.7	22.9	3.8	15.3	23.1	28.1	8.4	13.3
20 and more years	4.9	7.0	25.4	36.7	19.4	23.1	11.9	33.8	23.7	27.0	7.4	9.7
Parity												
First parity	4.9	7.0	27.9	38.8	14.9	20.6	12.7	38.3	24.1	29.2	7.0	10.0
2-3 parity	4.5	6.6	22.5	33.9	17.9	25.1	6.5	27.4	24.0	27.2	7.7	10.2
3 and above	3.6	4.4	24.7	27.5	19.6	23.2	1.3	6.0	21.3	24.0	12.3	16.0
Media exposure												
No exposure	3.6	5.2	24.0	36.4	16.9	19.5	2.0	8.9	20.7	28.9	9.3	19.3
Had exposure	4.6	6.5	24.8	34.1	18.1	23.4	9.5	29.6	24.7	27.2	7.6	10.2

Overweight/obese women across economic status, religion, year of schooling, occupation, age at first birth, parity and media exposure had higher proportion of selected adverse reproductive health outcomes both during the gestation and at final outcomes. Nevertheless, overweight/obese women from affluent families with 10 and more years of schooling, working outside and with media exposure reported more vaginal bleeding, leg, face and body swelling during gestation and had more stillbirths and caesarean deliveries as the final birth outcomes. Overweight/obese women of first parity experienced more vaginal bleeding and leg, face and body swelling than women of 3 and above parities (Table 4).

It is evident in Figure 3 that as the BMI level shifts towards obese condition, women experienced more vaginal bleeding and leg, body and face swelling during their gestational period. In particular, only four per cent of women with normal BMI as compared with more than seven per cent of obese women experienced excessive vaginal bleeding during pregnancy. Further, one fourth of normal BMI women reported leg, body and face swelling during pregnancy which increased to more than 35 per cent among obese women.

Figure 3: Adverse health impact during gestation among women in India, 2005-06

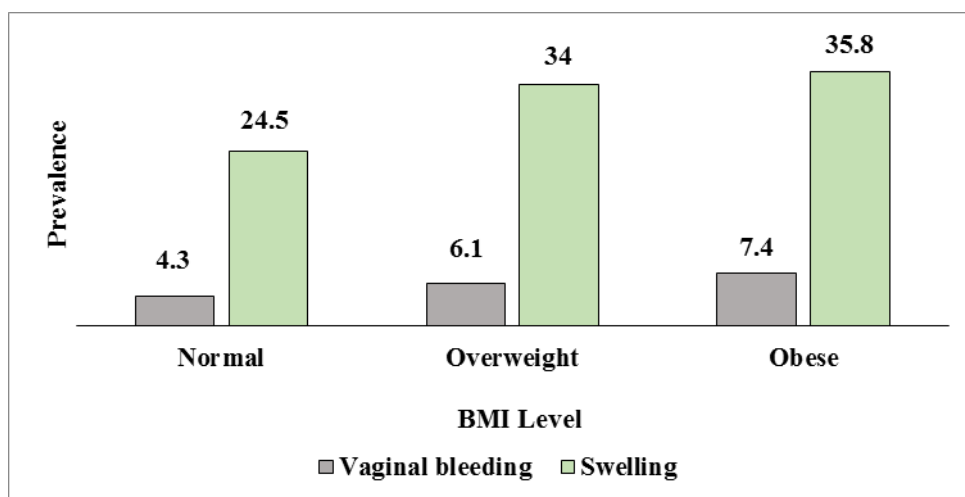
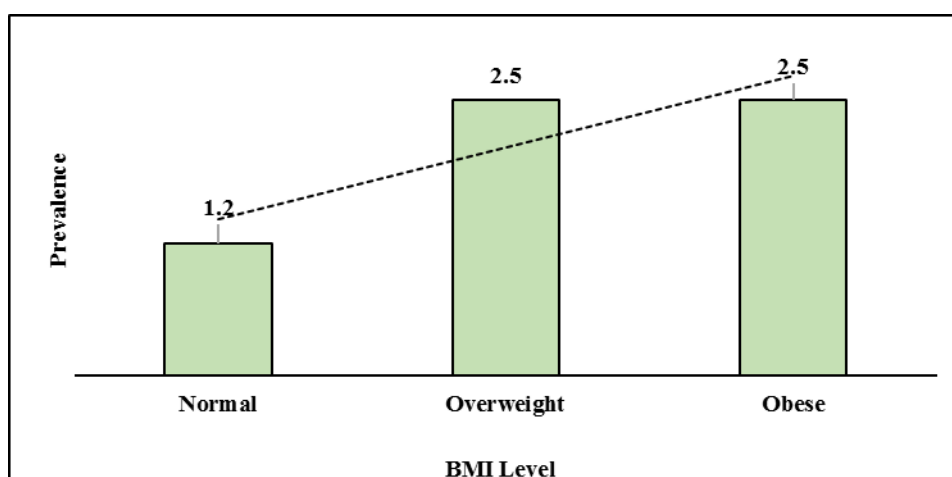


Figure 4: Prevalence of secondary infertility among women in India, 2005-06



It is evident from Figure 4 that as the BMI level shifted towards overweight or obese condition, prevalence of secondary infertility among women increased. To be specific, the prevalence of secondary infertility among normal BMI women stood at 1.2 which increased twofold (2.5 per cent) among overweight or obese women.

Table 5: Adjusted effects of socio-economic and demographic characteristics on the prevalence of adverse pregnancy outcomes in India, 2005-06

Characteristics	Bleeding	Swelling	Stillbirth	Cesarean delivery	Very large Child	Overweight child
Health condition						
Normal BMI [®]						
Overweight/Obese	1.171*	1.540***	1.306***	2.391***	1.150***	1.382***
Economic condition						
Poor [®]						
Non-poor	1.208**	1.089**	1.175***	2.671***	1.150***	1.247*
Religion						
Hindu [®]						
Islam	1.185	1.290***	0.959	0.943	0.920	1.04
Christianity	1.005	1.314***	0.799**	1.315**	0.998	1.372**
Others	2.131***	0.952	0.578***	0.991	0.577***	0.672*
Years of schooling						
Less than 10 years [®]						
10 and more years	1.156*	1.189***	0.963	1.615***	0.880***	1.146
Occupation						
Housewife [®]						
Working outside home	0.96	1.143***	1.094*	0.905*	1.001	1.137
Age at first birth						
Below 19 years [®]						
20 and more years	1.108	1.071*	1.331***	1.814***	0.985	0.878
Parity						
First parity [®]						
2-3 parity	0.976	0.747***	1.371***	0.656***	1.039	1.068
3 and above parity	0.807	0.768***	1.610***	0.192***	0.925	1.623***
Media exposure						
No exposure [®]						
Had exposure	1.124	0.926	1.015	1.912***	1.138**	0.94
Constant	0.038	0.345	0.134	0.029	0.282	0.064
Pseudo R2	0.01	0.12	0.01	0.12	0.003	0.01

®-Reference group; * p<0.1; ** p<0.05; *** p<0.001

The result of multivariate analysis shows that overweight/obese women were more likely to have all the selected adverse reproductive outcomes than the referent normal BMI women. Yet, the likelihood to have cesarean delivery was highest among all the selected adverse health outcomes for overweight/obese women. Women from affluent household were more likely to experience all the selected adverse reproductive health outcomes than women from poor families. Women from other religious groups were twice ($P<0.001$) more likely to have vaginal bleeding during gestation. Women of higher parities were less likely to experience leg, body and face swelling during pregnancy and cesarean delivery than women of first parity. Years of schooling and experiencing adverse reproductive health outcomes were positively correlated. Women with 10 and more years of schooling were more likely to experience leg, face and body swelling (OR: 1.189; $P<0.001$) and cesarean delivery (OR: 1.615; $P<0.001$) than women with less than 10 years of schooling (Table 5).

Women aged 25-34 and 35 and more years were 0.124 and 0.020 times less likely to be secondary infertile than young women aged 15-24 years. A positive correlation between educational attainment and prevalence of secondary infertility among women was observed in this study. Women studying up to secondary and higher levels were 1.708 and 2.945 times more likely to be secondary infertile respectively than women with no education (Table 6).

Table 6: Adjusted effects of socio-economic and demographic covariates on the prevalence of secondary infertility among women in India, 2005-06

Characteristics	Secondary Infertility	
	Odds ratio	95% CI
BMI Level		
Normal [®]		
Overweight/obese	0.850*	0.710-1.016
Place of residence		
Urban [®]		
Rural	1.099	0.934-1.293
Age group (yers)		
15-24 [®]		
25-34	0.124***	0.074-0.206
35 and above	0.020***	0.012-0.032
Caste		
Scheduled Castes [®]		
Scheduled Tribes	0.950	0.714-1.264
Other Backward Classes	0.968	0.793-1.182
Others	0.950	0.766-1.180
Religion		
Hindu [®]		
Islam	1.111	0.873-1.414
Christianity	0.636**	0.438-0.926
Others	0.952	0.698-1.300
Education		
No education [®]		
Primary	0.991	0.817-1.203
Secondary	1.708***	1.393-2.094
Higher	2.945***	2.002-4.333
Economic status		
Poor [®]		
Non-poor	0.814**	0.674-0.982
Work Status		
Housewife [®]		
Working outside home	0.970	0.834-1.128
Media Exposure		
No exposure [®]		
Had exposure	0.897	0.744-1.081
Constant		1255.485
Pseudo R2		0.1524

® Reference category; * p<0.1; ** p<0.05; *** p<0.001

V. Discussion

This study has found that overweight/obesity was increasing alarmingly over the years in India, noticeably among the women. Urban women were more overweight or obese than their rural counterparts. This pattern was observed across the selected covariates. Further, women aged 35 and above with higher education, media exposure and from affluent households were more overweight or obese. This corroborates the findings of many other studies that women at higher ages, with higher parities and media exposure are more overweight/obese than their respective counterpart women (Kain et al., 2003; Agrawal & Mishra, 2004; Mendez, Monterio et al., 2005; Kim et al., 2007). In India, the elevated adiposity level is noticeably higher among richer and educated sections of the society. This is contrary to a number of studies conducted in developed or industrialized countries, where overweight or obesity generally concentrate among the low-middle

income groups (Prentice, 2006; Ziraba et al., 2009). In recent time, few studies from developing countries substantiated that overweight/obesity is more among the affluent or better off sections of the society (Prentice, 2006). Studies argued that physical activity declines along with metabolic rate in the middle years of women. On the other hand, the energy requirement decreases, therefore, even regular or routine eating may lead to weight gain (Sinha & Kapoor, 2010). In addition, the rising economy, urbanization and increasing standard of living of people can assure a sedentary life to women in India. The physical activity at work has also reduced to a great extent due to mechanization and improved motorized transport which have resulted in positive energy balance in most of the Asian countries (Gopalan, 1996; Vijayalakshmi et al., 2002; Popkin, 2006; Parizkova et al., 2007). The transition in nutrition intake from traditional to the modern, i.e., more energy dense or junk food has helped women to gain more weight in recent decades (Popkin & Ng, 2007).

Another contribution of the study is that as the BMI level shifts towards overweight or obese condition, women experienced more adverse reproductive health outcomes. In a nutshell, overweight or obese women reported more stillbirths or termination of pregnancy, cesarean delivery and had larger than average and overweight child at birth. Overweight or obese women from urban area with higher education, media exposure and from affluent households reported higher incidence of all selected adverse reproductive health outcomes. This substantiates the result of other studies that overweight/obese women experience more adverse final pregnancy outcomes than the normal BMI women (Agrawal & Mishra, 2004; Lash & Armstrong, 2009; PMMRC, 2010; Willcox et al., 2012). Although the reasons are quite obvious and established in a number of studies worldwide, naming a few with special relevance to the low-middle income countries would be worthwhile. Among all, the foremost cultural practice and social value of giving rich diets to mothers during and after delivery may help a woman to gain more gestational weight, predominantly among the well-off group (Sinha & Kapoor, 2010). Studies also cite the medical or other physiological factors leading to overweight/obese women to have more adverse health problems. The incidence of gestational diabetes mellitus (GDM) in pregnancy among overweight/obese women is higher than that of normal BMI women. This is a major cause of stillbirths or very large babies and other complications (Chu et al., 2007; Sathyapalan et al., 2010; Institute of Obstetricians and Gynecologists, 2011). Overweight/obese women are more likely to have high blood pressure 10 times more than the normal BMI women. This condition could prevent the placenta from getting proper amount of blood needed and decreased oxygen flow to the baby. In medical terms it is called 'Preeclampsia'. In this condition a woman has to go through the assisted or caesarean delivery (Leddy et al., 2008; Dennedy & Dunne, 2010). Studies have also noted that overweight/obese women are more likely to have hypertension, higher obstetric pain and difficulty in initiating breastfeeding (Weiss et al., 2010; Institute of Obstetricians and Gynecologists, 2011). However, analyses of all these health issues are out of the purview of this study.

Infertility is a major health problem and is increasing rapidly in South Asian countries (Jejeebhoy, 1998; Unisa, 2010). Secondary infertility in terms of its level, trend and treatment seeking behavior has been explored in a number of studies but the causes are not mentioned in much detail (Healy et al., 1994; Jejeebhoy, 1998). This study is the first of its kind to establish a positive correlation between overweight/obesity and secondary infertility. As the BMI level shifted towards obese condition, women were more likely to be secondary infertile. This finding substantiates the result of other studies conducted in western or industrialized countries (Kesmodel, 2012). While examining the causes, they showed that in obese women with excessive adipose tissue, abnormal hypothalamic and pituitary hormone secretions are common and lead to an ovulation (lack of ovulation). Further, overweight/obesity is strongly related to polycystic ovarian syndrome (PCOS) in women. Overweight/obese women are particularly susceptible to diabetes and insulin resistance. Even with fertility drugs or IVF treatments, pregnancy rates are adversely affected by obesity. Many studies have demonstrated that in obese women, especially those with PCOS, as little as a 5-10% weight loss often is associated with resumption of ovulation and higher pregnancy rates with all fertility treatments (Laurence, 2010).

Limitations of the study

There are few issues that need to be kept in mind while considering the findings of this study. First, the survey considered only the weight and height to measure overweight and obesity among women in India. There are many other sophisticated means to determine the overweight and obesity condition of a woman. Waist circumference (WC) is one among those tools which can give a better measurement especially in Asian region (WHO, 2004). This information is not available in the dataset used. Second, the information about the height and weight of women was collected at the time of survey, whereas the information on health complications during pregnancy, at childbirth and reproduction were collected retrospectively. Though associating the information collected at two different times may run into certain level of inappropriateness, the existing literature from western countries strongly corroborated the findings of this study. Thus, in the absence of any longitudinal survey to relate obesity with reproductive health, the findings of this study can be accepted with little carefulness. Third, the survey collected limited information on lifestyle, physical activity and diet. Although the demographic, socio-economic and lifestyle factors incorporated in this study may capture much of the variation, more detailed information on these subjects in future studies can help understand the causes of overweight and obesity better.

Conclusion

India is a low-middle income country where the health problems related to under-nutrition are still major concerns. At this juncture, the increasing incidence of overweight/obesity may exhibit double burden of nutritional-health problems. It has to grapple the problem of under-nutrition or anemia on the one hand, and overweight/obesity on the other (Mendez et al., 2005; Kennedy et al., 2006). The existing health policy in India is more intent to control under-nutrition and anemia prevalent among women and children; thereby it overlooks the problem of overweight or obesity which is growing alarmingly among the urbanities, educated and affluent. Thus, the growing demand which may appear before the government or the urban health planners is to address this rising epidemic with equal importance with the other erstwhile issues. A timely prevention may hopefully reduce the burden of chronic co-morbidities which are found to be associated with overweight/obesity on the health system in India.

References

- Agrawal, P., & Mishra, V. (2004). Covariates of overweight and obesity among women in North India. Population and Health Series Honolulu. *East-West Center Working Papers*, Available at: <http://scholarspace.manoa.hawaii.edu/handle/10125/3748> Accessed on 12 June 2015.
- Caballero, B. (2007). The global epidemic of obesity: An overview. *Epidemiologic Reviews*, 29, pp. 1-5. doi: 10.1093/epirev/mxm012
- Chan, R. S. M., & Woo, J. (2010). Prevention of Overweight and Obesity: How Effective is the Current Public Health Approach. *International Journal of Environmental Research and Public Health*, 7(3), 765-783. doi: 10.3390/ijerph7030765
- Chu, S. Y., Kim, S. Y., Lau, J., Schmid, C. H., Dietz, P. M., Callaghan, W. M., & Curtis, K. M. (2007). Maternal obesity and risk of stillbirth: a meta-analysis. *American Journal of Obstetrics and Gynecology*, 197(3), 223-228.
- Dennedy, M. C., & Dunne, F. (2010). The maternal and fetal impacts of obesity and gestational diabetes on pregnancy outcome. *Best Practice & Research Clinical Endocrinology & Metabolism*, 24(4), pp. 573-589.
- Gaur, K., Keshri, K., & Joe, W. (2013). Does living in slums or non-slums influence women's nutritional status? Evidence from Indian mega-cities. *Social Science & Medicine*, 77, pp. 137-146.
- Gopalan, C. (1996). Current food and nutrition situation in south Asian and south-east Asian countries. *Biomedical and Environmental Sciences: BES*, 9(2-3), 102-116.
- Griffiths, P. L., & Bentley, M. E. (2001). The nutrition transition is underway in India. *The Journal of Nutrition*, 131(10), 2692-2700.
- Healy, D. L., Trounson, A. O., & Andersen, A. N. (1994). Female infertility: causes and treatment. *The Lancet*, 343(8912), 1539-1544.

- IIPS and Macro International (2007). *National Family Health Survey (NFHS-3) Report, India: Volume I*. Mumbai.
- IIPS and Macro International (2007). *National Family Health Survey (NFHS-3) Report, India: Volume II*. Mumbai.
- Institute of Obstetricians and Gynecologists (2011). Royal College of Physicians of Ireland and Clinical Strategy and Programs Directorate, Health Service Executive. Obesity and Pregnancy. *Clinical Practice Guideline 2*. Available at: http://www.rcpi.ie/content/docs/000001/648_5_media.pdf Accessed on 11 June 2015.
- Jejeebhoy, S. J. (1998). Infertility in India - levels, patterns and consequences: Priorities for social science research. *Journal of Family Welfare*, 44(2), 15-24.
- Kain, J., Vio, F., & Albala, C. (2003). Obesity trends and determinant factors in Latin America. *Cadernos de Saúde Pública*, 19, S77-S86.
- Kennedy, G., Nantel, G., & Shetty, P. (2006). Assessment of the double burden of malnutrition in six case study countries. *FAO Food and Nutrition Paper (FAO)*.
- Kesmodel, U. S. (2012). Fertility and obesity. In *Maternal obesity and pregnancy*, Springer Berlin Heidelberg. pp. 9-30
- Kim, S. A., Yount, K. M., Ramakrishnan, U., & Martorell, R. (2007). The relationship between parity and overweight varies with household wealth and national development. *International Journal of Epidemiology*, 36(1), 93-101.
- Lash, M. M., & Armstrong, A. (2009). Impact of obesity on women's health. *Fertility and Sterility*, 91(5), 1712-1716.
- Laurence, A., Jacobs M. D. (2010). Obesity and infertility: A connection. *Fertility centers of Illinois*. Available at: http://www.ivfchicago.com/pdf/OBESITY_article.pdf Accessed on 8 August 2015.
- Leddy, M. A., Power, M. L., & Schulkin, J. (2008). The impact of maternal obesity on maternal and fetal health. *Reviews in Obstetrics and Gynecology*, 1(4), 170.
- Mendez, M. A., Monteiro, C. A., & Popkin, B. M. (2005). Overweight exceeds underweight among women in most developing countries. *The American Journal of Clinical Nutrition*, 81(3), 714-721.
- Misra, A., Chowbey, P., Makkar, B. M., Vikram, N. K., Wasir, J. S., Chadha, D., ... & Munjal, Y. P. (2009). Consensus statement for diagnosis of obesity, abdominal obesity and the metabolic syndrome for Asian Indians and recommendations for physical activity, medical and surgical management, *Journal of the Association of Physicians of India*, 57, 163-70.
- Muthayya, S. (2009). Maternal nutrition & low birth weight-what is really important. *Indian Journal of Medical Research*, 130(5), 600-608.
- Ogden, C. L., Carroll, M. D., Kit, B. K., & Flegal, K. M. (2012). Prevalence of obesity in the United States, 2009-2010. *NCHS Data Brief*, 82, 1-8.
- Pan, W. H., & Yeh, W. T. (2008). How to define obesity? Evidence-based multiple action points for public awareness, screening, and treatment extension of Asian-Pacific recommendations. *Asia Pacific Journal of Clinical Nutrition*, 17(3), 370.
- Parizkova, J., Chin, M. K., Chia, M., & Yang, J. (2007). An international perspective on obesity, health and physical activity: current trends and challenges in China and Asia. *Journal of Exercise Science and Fitness*, 5(1), 7-23.
- PMMRC (2010). Perinatal and Maternal Mortality in New Zealand 2008: Fourth Report to the Minister of Health July 2009 to June 2010. Wellington: Ministry of Health. Available at: <http://www.hqsc.govt.nz/assets/PMMRC/Publications/Fourth-PMMRC-report-2009-10.pdf> Accessed on 25 July 2015.
- Popkin, B. M. (2006). Global nutrition dynamics: the world is shifting rapidly toward a diet linked with non-communicable diseases. *American Journal of Clinical Nutrition*, 84(2), 289-298.
- Popkin, B., & Ng, S. W. (2007). The Nutrition Transition in High and Low-Income Countries: What are the Policy Lessons? *Agricultural Economics*, 37(S1), 199-211.
- Prentice, A. M. (2006). The emerging epidemic of obesity in developing countries. *International Journal of Epidemiology*, 35(1), 93-99.
- Sathyapalan, T., Mellor, D., & Atkin, S. L. (2010). Obesity and gestational diabetes. In *Seminars in Fetal and Neonatal Medicine*. WB Saunders, 15(2), 89-93.
- Sinha, R., & Kapoor, A. K. (2010). Cultural Practices and Nutritional Status among Premenopausal Women of Urban Setup in India. *The Open Anthropology Journal*, 3, 168-171.
- Sudha, G., Reddy, K. S. N., & Reddy, K. K. (2009). Association between Body mass index and infertility: A cross sectional study. *Asia-Pacific Journal of Social Sciences*, 1(1), 73-81.
- Unisa, S. (2010). Infertility and treatment seeking in India. Findings from District level household survey. *Social Aspects of Accessible Infertility Care in Developing Countries*, pp. 59-65.

- Vijayalakshmi, K., Reddy, G. A., Krishna, T. P., & Krishnaswamy, K. (2002). Obesity in adolescents of different socio-economic groups: prevalence in Andhra Pradesh, India. *Asia-Pacific Journal of Clinical Nutrition*, 11(supplement), S740–S743.
- Weiss, J. L., Malone, F. D., Emig, D., Ball, R. H., Nyberg, D. A., Comstock, C. H., ... & FASTER Research Consortium. (2004). Obesity, obstetric complications and cesarean delivery rate: A population-based screening study. *American Journal of Obstetrics and Gynecology*, 190(4), 1091-1097.
- Willcox, J. C., Campbell, K. J., van der Pligt, P., Hoban, E., Pidd, D., & Wilkinson, S. (2012). Excess gestational weight gain: an exploration of midwives' views and practice. *BMC Pregnancy and Childbirth*, 12(1), 102.
- World Health Organization (2003). Obesity and Overweight fact sheet. *Global strategy on diet, physical activity and health*. Available at http://www.who.int/dietphysicalactivity/media/en/gsfs_obesity.pdf. Accessed on 7 August 2015.
- World Health Organization expert consultation (2004). Appropriate body-mass index for Asian populations and its implications for policy and intervention strategies. *The Lancet*, 363, 157–163.
- World Health Organization (2011). Non-communicable Diseases in the South-East Asia Region. *Situation and Response Report*. Available at: http://www.searo.who.int/nepal/mediacentre/2011_non_communicable_diseases_in_the_south_east_asia_region.pdf?ua=1 Accessed on 10 August 2015.
- World Health Organization (2012). Obesity and overweight factsheet. *WHO Media Centre*, Washington D.C. Available at: <http://www.who.int/mediacentre/factsheets/fs311/en>. Accessed on 10 August 2015.
- Ziraba, A. K., Fotso, J. C., & Ochako, R. (2009). Overweight and obesity in urban Africa: A problem of the rich or the poor? *BMC Public Health*, 9.