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ORIGINAL ARTICLE

Comparison of Feto-maternal Outcomes Among Various BMI Groups As Per Asia Pacific Standards: An Observational Retrospective Comparative Study in a Private Tertiary Care Center in Delhi

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Abstract

Objective To compare the feto-maternal outcomes among various BMI groups as per Asia Pacific Standards.

Method This is a retrospective non-interventional observational study on 1396 antenatal women with singleton pregnancy. Their BMI based on pre-pregnancy weight was calculated and the women were divided into various groups as per Asia Pacific standards for BMI classification. Details of associated morbidities and delivery outcomes were noted in a pre-structured proforma and a comparison was made among the various groups using Chi square test. A p value of < 0.05 was taken as significant.

Results Among the 1396 women under study, 10.6% were underweight, 36% had normal weight, 21% were overweight while 32% were obese or very obese. There was a significant association of low BMI with preterm labor (p value 0.03) and fetal growth restriction (p value < 0.01). Overweight and obese women were found to be more prone to hypertensive disorders of pregnancy (p value- 0.002), gestational diabetes (p value- 0.003) and overweight women were more prone to cholestasis of pregnancy (p value 0.03). The women with higher BMI had a significantly higher requirement of induction of labor (p value-0.0002). There was significant increased number of babies more than 90th percentile in overweight and obese women (p value 0.003). However, there was no change in Neonatal ICU admissions (p value 0.85) or neonatal mortality.

Conclusion Asia Pacific references should be used for studies related to all studies on BMI and pregnancy. All women having BMI outside the normal BMI spectrum are at increased risk of antenatal and postnatal complications. Early identification of such women will enable careful evaluation and counseling to improve the reproductive outcome and feto-maternal health.

Keywords Body mass index · Obesity · Pregnancy

Introduction

India has a diverse demography with populations belonging to different cultures, religions, socioeconomic classes and have varied nutritional status. Rural India has a preponderance of undernourished women whereas urban India is facing a challenge of obesity.

According to the data of National Family Health survey (NFHS 5, 2019–2020) there has been a marked increase in percentage of women with BMI more than 25 kg/m^2. The prevalence of overweight/ obesity had increased by 10–12% over 5 years in many of the states, reaching to almost 40% in some of the urban areas. [1] This makes more than half of the women at risk of developing feto-maternal complications because of abnormal BMI.

There is scanty data to compare the feto-maternal outcomes in various BMI groups in the Indian Asian population and none according to the Asia Pacific standards. The exact associations of low BMI with obstetric morbidities are not very clear. As per some studies there have been increased incidence of preterm delivery, low birth weight and increased perinatal loss in such women while some have actually noted protective effect

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in certain outcomes like macrosomia. [2] Children born to low BMI women are more likely to be stunted and underweight compared to normal BMI women. In contrast, high BMI is associated with comorbidities like preeclampsia, eclampsia, pre- and post-term delivery, induction of labor, macrosomia, cesarean section, and postpartum hemorrhage. [3]

Aim

To study the feto-maternal effects on women with different BMI (Asia Pacific standards) in the women delivering in a private tertiary hospital in New Delhi.

Materials and Methods

This was a one year retrospective study of women who delivered in a private tertiary care center in New Delhi from January 2019 to December 2019. The case records which had documentation of pre-pregnancy BMI, complete antenatal follow-up and delivery details were recruited for the study.

Subject selection: All women with singleton pregnancy, delivering beyond 28 weeks with complete hospital records and documented pre-pregnancy BMIs were recruited.

Exclusion Criteria

- Multiple gestation
- In Vitro Fertilized pregnancy
- Major structural anomalies
- Pre-pregnancy medical illnesses like hypertension, diabetes, chronic renal disease and others.

The period of gestation at the time of delivery, mode of delivery, presence of antenatal medical complications like preeclampsia, gestational diabetes, preterm labor (< 37 weeks), fetal growth restriction, delivery details, fetal weight, fetal apgar scores, neonatal admissions in nursery and neonatal deaths were noted and recorded in a predesigned patient performa. Women with hypertensive disorders of pregnancy included women with gestational hypertension and preeclampsia. Similarly Gestational diabetes was diagnosed in women on the basis of deranged Oral glucose tolerance test (OGTT screening test) as per IADPSG criteria. Unlike most studies which use the WHO classification, here the Asia Pacific Standards were used for classification. (Table 1).

Statistical Analysis

All data were entered in Microsoft excel and analysis was done by SPSS version 20 (SPSS Inc, Chicago, USA). The descriptive statistics was done where necessary and Chi square test was done to identify association between qualitative variables and BMI. P value < 0.05 was considered as statistically significant.

Results

After applying the inclusion and exclusion criteria a total of 1396 women were enrolled in the study between January 2019 and December 2019. Most of the women were in the 20–35 years age group (97.4%). Around 2% of the women were aged less than 19 years, 7% were more than 36 years of age and the rest 91%were in the 20–25 years of age category. The distribution of the women in different BMI groups is shown in Table 2

Demographic and Morbidity Profile

Except for one, all of the underweight women (10.6%) were primiparous and less than 21 years of age. In contrast most of the obese women were multiparous and between 21 and 35 years of age (19% of the women under study). Maternal outcomes for different BMI categories are given in Table 3.

There is a significant association of low BMI with preterm labor ($p = 0.03$) and fetal growth restriction ($p = < 0.01$). Overweight and obesity group were associated with Hypertensive disorders of pregnancy ($p = 0.002$), gestational

Table 2 Distribution of women in different BMI groups

BMI(kg/m^2)	Total No. in the group	%of Total women under study
Underweight (< 18.5)	148	10.60%
Normal (18.51–22.9)	504	36.10%
Overweight (23- 24.9)	294	21.06%
Obese (25–29.9)	365	26.15%
Very Obese (> 30)	85	6.09%
Total	1396	100%

Table 1 The different BMI classifications [4–6]

Classification	Underweight	Normal	Overweight	Obese
WHO	< 18.5 kg/m^2	18.5–24.9 kg/m^2	25–29.9 kg/m^2	> 30 kg/m^2
IOM	< 19.8 kg/m^2	19.8–26.0 kg/m^2	26.1–29.0 kg/m^2	> 29.0 kg/m^2
APS	< 18.5 kg/m^2	18.51- 22.9 kg/m^2	23- 24.9 kg/m^2	25–29.9

Table 3 Maternal outcomes by BMI category

Maternal outcome	Underweight (148)	Normal Wt (504)	Overweight (294)	Obese + V. Obese (450)	X^2 (Test statistic)	*P* value
IOL	28 (18.91%)	129 (25.6%)	93 (31.6%)	158 (35.11%)	19.17	0.0002
CS	17 (11.49%)	94 (18.65%)	66 (22.45%)	143 (31.78%)	36.16	0.00001
GDM	11 (7.43%)	72 (14.28%)	56 (19.04%)	94 (20.89%)	18.09	0.0004
GHT/PE	13 (8.7%)	52 (10.3%)	33 (11.22%)	78 (17.33%)	13.99	0.002
IHCP	14 (9.46%)	44 (8.73%)	43 (14.62%)	40 (8.89%)	8.46	0.037
FGR	20 (13.51%)	12 (2.38%)	15 (5.1%)	20 (4.4%)	31.23	0.00001
Preterm labor	16 (10.81%)	29 (5.75%)	12 (4.08%)	23 (5.1%)	8.87	0.03

IOL: Induction of labor, *CS*: Cesarean section, *GDM*: Gestational diabetes, *GHT/PE*: Gestational hypertension/ Preeclampsia, *IHCP*: Intrahepatic cholestasis of pregnancy, *FGR*: fetal growth restriction

diabetes (GDM) (p value- 0.003) and overweight women were associated with cholestasis of pregnancy ($p = 0.03$). The prevalence of GDM was seen to be high in the normal population as well as the overweight and obese populations, with prevalence ranging between 14 and 21%. This highlights that universal screening of all pregnant women with any BMI is the need of the hour.

Need for induction and modes of delivery too have a strong correlation with BMI. Underweight women needed induction in only 11% cases, compared to 31–35% in overweight and obese/Very obese women. This was significant with $p < 0.01$. Cesareans were also considerable lower in underweight women (11.5%) compared to 22% and 32% in overweight and obese/very obese women ($p < 0.01$).

There was no significant difference in incidence of abruptio, shoulder dystocia, postpartum hemorrhage and third degree perineal tears in the different groups.

Fetal and neonatal outcomes are shown in Table 4. Nursery stay was similar. All the groups had one third to one fourth of babies with weight less than a tenth centile and a normal neonatal outcome in most. This might be because more Indian women have constitutionally small babies, which are not specifically growth restricted. Moreover, a number of factors play a role in deciding the birth weight like birth order/ sex of the baby and nutrition status of the mother. There was no significant difference in the stillbirth rates.

Overweight and obese women had almost 7–10% babies with babyweight > 90th percentile (p value < 0.01), which was significantly higher compared to normal and underweight women.

Discussion

Main findings

Out of 1396 women in the study, 64% had BMI outside the normal range. These women were found to be exposed to multiple antenatal complications. Many of the women were

Table 4 Fetal weight and nursery stay in different BMI categories

Fetal outcome	Underweight (148)	Normal Wt (504)	Overweight (294)	Obese + V. Obese (450)	X^2 (Test statistic)	*P* value
> 90th Percentile B.Wt	0	40 (7.93%)	23 (7.82%)	47 (10.44%)	13.57	0.003
< 10th Percentile B.Wt	53 (35.81%)	155 (30.75%)	79 (26.87%)	127 (28.22%)	2.46	0.48
NICU stay	20 (13.51%)	65 (12.89%)	33 (11.22%)	53 (11.78%)	0.797	0.85

NICHD standards for Asian women were taken as reference. [7]

less than 21 years of age and therefore more prone to complications of low BMI. In underweight women the number of growth restricted babies was almost six times more than those in normal BMI and almost three times more than the numbers in obese women. In low BMI group of women, the growth restricted babies usually remain stunted as they grow up, and the future implications are high. While undernutrition was the primary cause of fetal growth restriction in underweight women, obese women had growth restriction more commonly in association with preeclampsia, gestational diabetes, obesity-related placental dysfunction and other medical disorders.

In underweight women, the number of women going into preterm labors was 10%, and this was double the incidence of preterm labor in in the other BMI groups. The high preterm deliveries can also explain the lower inductions in underweight women for postdatism. The growth restricted and preterm babies, however, enabled a higher vaginal deliveries and lower cesarean and instrumental deliveries. No association was found with stillbirths or neonatal death. It is possible that the degree of morbidities vary with the weight gain. An appropriate weight gain in pregnancy may actually reduce many morbidities.

On analyzing the baby weights, almost 30% of the total babies were found to have a weight of less than 10th percentile. Most of these babies were SGA babies without any underlying pathologies. In contrast only 8% of the babies were more than 90th percentile. This highlights that the Indians usually have smaller babies compared to the westerns. Any further insult like undernutrition, obesity, preeclampsia and other medical disorders further compounds the risks of small babies.

With increasing BMI, there were increasing cases of GDM, Gestational hypertension and Preeclampsia. (Table 4). Obese women had higher incidence of GDM and hypertensive disorders of pregnancy resulting in more cases of big babies, cephalopelvic disproportion and post-dated pregnancies. The higher incidence of medical disorders and post-dated pregnancies increased the number of inductions and further cesarean deliveries in the higher BMI groups. Apart from these effects, studies have also found a higher association with congenital anomalies, hemorrhage, neonatal hypoglycemia or hyperbilirubinemia and increased requirement of neonatal ICU stay in women with higher BMIs. It is very important to have a long-term follow-up of such babies as they may later develop metabolic issues, obesity, attention deficit disorders, psychiatric problems and asthma as well [8–11].

To correctly identify undernourished and overnourished women, different standards have been suggested for classification of pre-pregnancy BMIs (Table 1). Indians have a high amount of body fat and central obesity which has been associated with higher risks of diabetes and metabolic syndrome. Indian guidelines propose use of APS classification to correctly identify more women at risk [4].

Now a comparison of the WHO and APS classifications are important to understand how using the correct classification influences the monitoring and interventions. There were 175 women in the study who were with BMI between 22.9 and 24.9 kg/m^2. This range is overweight by APS classification and normal by WHO classification. This meant that 59.5% of the overweight women or 12.5% of the total women in this study would have been incorrectly labeled as normal if WHO standards had been used and therefore would have been exposed to more complications. These additional women identified by the APS classification will benefit earlier diagnosis and interventions during the antenatal period to improve their outcomes.

The prevalence of underweight women was 10% in the study, which was the same as the Delhi NHFS-5 data (2019–2020). The prevalence of women with BMI > 25 was 32.3% in the study, which was slightly less than the Delhi average of 41.3%. [1]

Obesity, earlier a disease of affluent nations, has now become a common problem of underdeveloped and developing nations as well. There has been a shift from the undernourished to obese end of malnutrition, which is related to availability of cheaper processed and fast foods and sedentary lifestyles.

According to Kribria et al., the prevalence and odds of underweight have been found to be more in young, nulliparous, backward castes, less educated, less wealthy, and rural women. It was even higher in certain belts of Central India. [12–14] The difference seen between the states could be because of better socioeconomic conditions and better education in the urban areas where the reach of social welfare schemes were better.

A systematic review and meta-analysis by Zhangbin et al. showed that pre-pregnancy underweight increased the incidence of low birth weight and SGA. Patel et al. found that the risk ratio of having stillbirths was 1.5, neonatal deaths was 1.7 and LBW babies was 1.5. It was highest when anemia and underweight co-existed. In contrast few studies have showed that only anemia was associated with underweight women. [8, 13, 14]

There are several explanations to the adverse maternal outcomes associated with overweight and obese women. The effects of oxidative stress, proinflammatory status alterations in placental function, and insulin insensitivity disturb the environment of the growing fetus. However, it is yet to be seen if the effects are mitigated by limiting the weight gain in pregnancy, as suggested by certain studies. [15, 16]

Time and again studies have shown that the intrauterine environment can affect the pregnancy and neonatal outcomes. These effects can be understood by the concept of epigenetics. Epigenetics is the study of heritable changes

which influence gene function without modifying the DNA sequence. They are tissue specific and are usually in the form of DNA methylation and histone modifications. They decide the expression of either of the maternal or paternal allele of the gene. It has been seen that while the genes are stable, the epigenetic markers are highly sensitive to a variety of environmental stimuli and so are prone to change in the entire fetal development time. [17, 18]

Studies have shown that maternal obesity leads to more fetal DNA methylations and other epigentic changes which contributes to higher chances of obesity and Type 2 Diabetes. Maternal undernutrition is also responsible for epigenetic changes. These changes are associated with dysfunctional pancreatic B cell and adipose tissue functions. Insulin secretion is reduced, insulin resistance is increased and there is more adipose tissue deposition, predisposing the children to have more metabolic disorders like Type 2 DM. [17–19]

Implications

Two thirds of the women under study had abnormal BMI and thus were susceptible to development of antenatal complications. It is possible to reduce them by an aggressive lifestyle management, starting from her preconceptional period and continuing throughout her pregnancy. The underweight women were mostly malnourished and had less morbidities compared to women with higher BMIs. They are more amenable to correction and may be better of the two extremes of malnutrition. Peripheral outreach programs to correct anemia, remove adolescent malnutrition, provide nutritional counseling, promote literacy, delay age of marriage and child bearing are essential. Clinicians need to emphasize on regular exercises, controlled weight gain and correct nutrition from the preconceptional period.

Strengths and limitations

The study has been done over a period of one year, on 1396 patients thus negating the effects of seasonal variations. While most studies have been done as per WHO BMI classification, this is one of the few studies on the Asia Pacific standards and show an increased number of women affected with deranged BMI. The retrospective nature of the study itself poses multiple limitations.

Conclusion

In the study only 36% women had normal BMI. Given the difference in BMI cutoffs by the WHO and the APS, it is proposed that the BMI cutoffs for overweight in the demography studies in India should be brought down from 25 to 23.9 kg/m^2 for correct identification of all women at risk. An additional 12.5% of overweight women can be screened out by the APS classification. Practitioners should focus on adolescent nutrition, pre-pregnancy lifestyle and nutritional changes. Future studies should focus on a cohort study with focus on gestational weight gain, to see if the correct weight gain mitigates the multiple problems that were associated with abnormal BMIs. More studies are also required for a detailed understanding of neonatal complications.

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Declarations

Conflict of interests None.

Ethical statement This study has been approved by the Institutional Ethical Committee.

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