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BMI (WHO International versus Asian Criteria) in Early Pregnancy and Pregnancy Outcomes: A Single Centre Prospective Study

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ABSTRACT

Objective: Maternal BMI is a good indicator of maternal nutritional status. Being overweight, obese or underweight carry adverse effects on the mother as well as the fetus. Our objective was to classify pregnant women in early pregnancy according to WHO International and Asian BMI cut-offs and compare their pregnancy outcomes.

Methods: It was a prospective observational study over a period of one year. Women who had antenatal visit within 14 weeks of gestation and delivered in our hospital were included. A total of 209 women were available for analysis.

Results: Mean age of the cohort was 28.1±3.9 years. As per Asian BMI cut-offs, 34.9%, 17.2%, 47.8% women had BMI in normal, overweight, and obese range respectively. However, on WHO BMI cut-offs, 52.2%, 37.3% and 10.5% of women had normal, overweight, and obese range respectively. Hypertensive disorders of pregnancy and gestational diabetes was the commonest antenatal complication. Caesarean delivery had significant association with overweight and obese women. Asian BMI cut-offs had significant predictability for antenatal complications. Sensitivity, specificity, and positive predictive value of Asian BMI were 69%, 68.2% and 94.9% when compared with 50.8%, 77.3% and 92% of WHO BMI.

Conclusion: Asian BMI has high sensitivity in predicting adverse pregnancy outcomes.

Key words: Pregnancy, outcome, Asian, WHO, BMI

Introduction

In recent years, WHO has recognized obesity as a global health burden. The contributory factors include changes in the socioeconomic conditions, lifestyle and food habits. Women predominantly are more affected than men.[1] Obesity poses a serious challenge, as obese pregnant women have increased risk of maternal and perinatal complications.

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The maternal complications include hypertensive disorders of pregnancy, gestational diabetes, operative vaginal delivery, cesarean delivery, postpartum hemorrhage and increased infection rates. Birth defects, macrosomia, increased admissions to neonatal intensive care unit are the neonatal complications in obese women.[2,3]

The National Family Health Surveys (NFHS) in India indicated an increase in obese women from 15% in NFHS-3 to 20.6% in NHFS-4 (2015-16) to 24% in the NHFS-5 (2019-21).[4] Obesity can reliably be measured by body mass index (BMI). BMI is a simple index of weight for height and is irrespective of age and sex of the population. The weight is measured in kilograms and is divided by square of height in meters (kg/m^2). The American College of Obstetrics and Gynecology (ACOG) recommends recording of BMI at the initial prenatal visit and counsel women as per their BMI status regarding the maternal and fetal risks.[5]

Asian Indians have increased abdominal obesity, increased intra-abdominal fat deposition and ectopic site fat deposition. This puts them at high risk of adverse outcomes even at lower BMI. The Asian BMI classification has a lower cutoff for overweight and obese categories when compared to the WHO International classification.[6]

We did this study to find out early pregnancy (<14 weeks) BMI in women attending antenatal clinics and classifying them according to WHO International BMI & Asian BMI classification. The maternal and neonatal outcomes were compared between the two BMI groups.

Material and methods

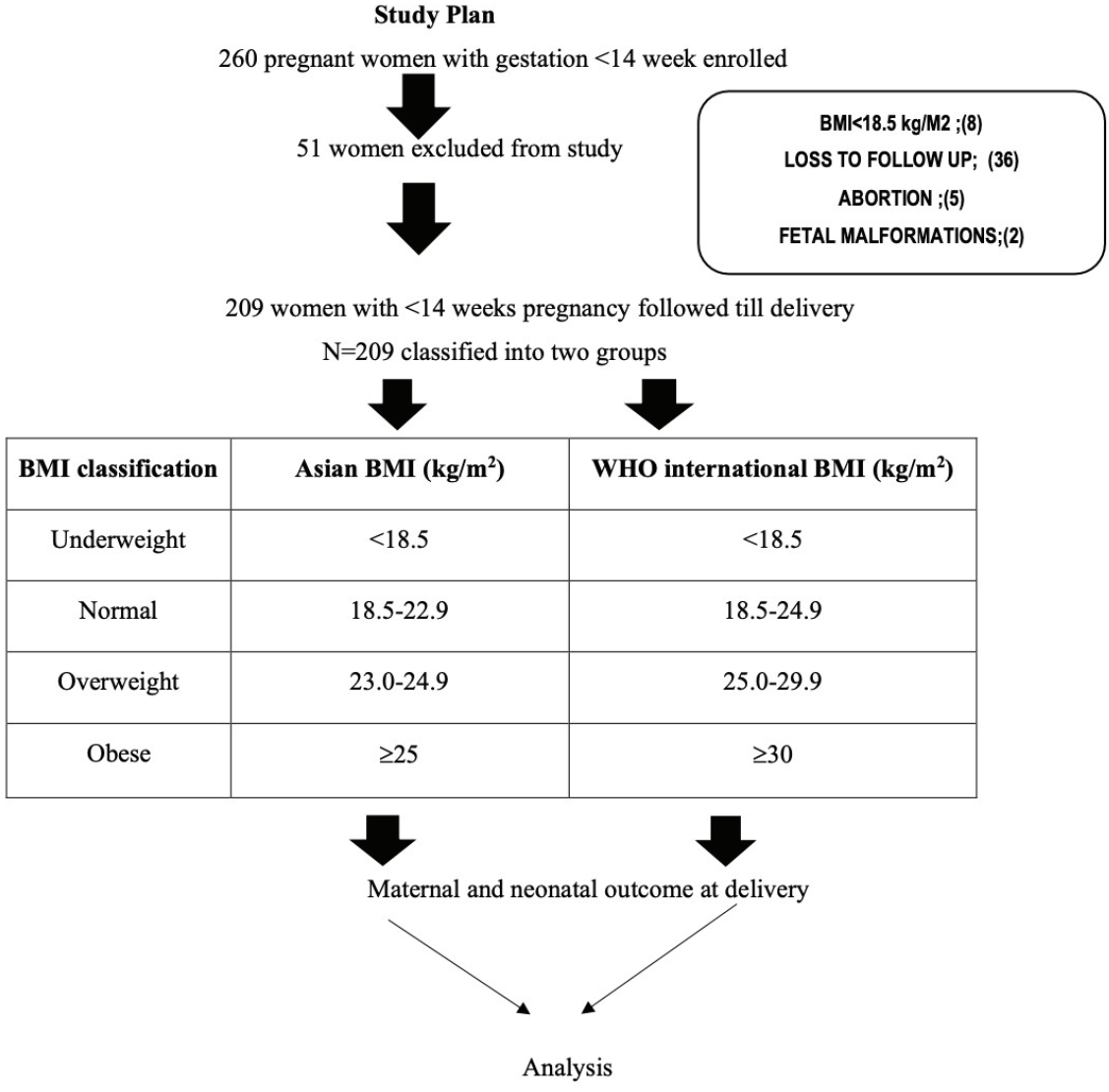
This was a prospective observational study done over a period of one year in a tertiary care teaching hospital in North India. The study was approved by the Institutional Ethics Committee [ECR/262/Inst/UP/2013/RR-19]. Pregnant women presenting to antenatal clinic below 14 weeks gestation were included. The gestational age was calculated from the last menstrual period and was confirmed by ultrasound. All gave informed consent. Women with BMI <18.5 kg/m^2, multiple pregnancy and with coexistent medical disorders were excluded. All were subjected to detailed history and clinical examination. Height was measured without shoes by a wall-mounted measuring tape with an accuracy of 0.5 cm. Weight was measured on a standard scale with an accuracy of 100gm. BMI was calculated using Quetelet's index [Weight (kg)/Height (m^2)] .Thereafter, women were classified according to WHO International BMI and Asian BMI cutoffs(fig.1) All were subjected to routine antenatal investigations including blood sugar (2 hour post 75 g glucose load) as per DIPSI guidelines. Dietary counseling and recommended weight gain advice were given as per their BMI. Further antenatal care was performed as per protocol. Antenatal progress was noted at each visit. Fetal growth was assessed by maternal weight gain, obstetric examination, and ultrasonography. All were followed till delivery. The primary outcomes were the development of pregnancy complications like gestational diabetes, hypertensive disorder of pregnancy (HDP), preterm labor, prelabor rupture of membrane (PROM), FGR (fetal growth restriction), APH (antepartum hemorrhage), intrahepatic cholestasis of pregnancy. The secondary outcomes observed were the mode of delivery, postpartum hemorrhage (PPH), subinvolution of uterus and surgical site infection (SSI). The neonatal outcomes noted were gestational age at delivery, APGAR score, birth weight ,any admission to NICU (neonatal intensive care) and neonatal death.

Statistical analysis

The statistical analysis was done using SPSS (Statistical Package for Social Sciences) Version 21.0 (IBM Inc., USA). The values are represented in number, percentage (%) and mean±SD. Chi-square and ANOVA tests were used to compare the data. A 'p' value < 0.05 was considered significant. Predictive efficacy of WHO International and Asian BMI cutoffs was assessed in terms of sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV)and accuracy.

Results

A total of 260 antenatal women with gestational age less than 14 weeks were enrolled for the study. However, only 209 were available for the final analysis. (fig.1) The mean age of the cohort was 28.1±3.9 years. Majority of the women were multigravida, had education up to intermediate level and were residing in urban areas. Of all,39.2% were in lower middle



BMI classification	Asian BMI (kg/m^2)	WHO international BMI (kg/m^2)
Underweight	<18.5	<18.5
Normal	18.5-22.9	18.5-24.9
Overweight	23.0-24.9	25.0-29.9
Obese	≥25	≥30

Figure 1

socioeconomic status class and only 8.6% belonged to upper socioeconomic status class.

When women were classified as per WHO International BMI cutoff, 109/209 (52.2%) were normal; 78/209 (37.3%) overweight and 22/209 (10.5%) obese. However, 73/209 (34.9%) were normal, 36/209 (17.2%) overweight, and 100/209 (47.8%) were obese when women were classified using the Asian BMI cutoffs. Of the 109/209 women, classified as normal as per WHO International cutoffs, 36 women were reclassified as overweight, and 78 women turned obese from overweight when subjected to Asian BMI cutoffs. Table 1 shows the high-risk pool cohort after applying the Asian BMI cutoffs.

Table-1: BMI (WHO versus Asian criteria): The high-risk pool cohort after Asian BMI cutoffs

WHO BMI Criteria	Asian BMI Criteria			Total
	Normal	Overweight	Obese	
Normal	73	36	0	109
Overweight			78	78
Obese			22	22
	73	36	100	209

BMI: Body Mass Index, figures in bold indicates number of subjects added to high risk pool

Of all, 187(89.4%) women developed pregnancy complications. Hypertensive disorder of pregnancy (34.4%) was the commonest complication observed, followed by gestational diabetes (31.6%) and anemia in 29.2% women. The other complications observed

were intrahepatic cholestasis of pregnancy (19.6%), fetal growth restriction (19.1%), prelabor rupture of membranes /preterm labor (11.5%), and antepartum hemorrhage (1.9%). Considering overweight and obese as high-risk women for developing antenatal complications, the sensitivity, specificity, PPV, NPV of BMI cutoffs by WHO and Asian criteria were calculated. The Asian BMI cutoffs (OR 4.7; [95%CI 1.8-12.3]) had higher odds of diagnosing antenatal complications when compared to WHO BMI cutoffs (OR 3.5; [95%CI: 1.2-9.9]). Table 2, Table 3.

Table-2: Predictive efficacy of Asian BMI cutoff for prediction of antenatal complications

*High risk	Antenatal complications		Total
	Present	Absent	
Yes	129	7	136
No	58	15	73
Total	187	22	209

High risk*: includes overweight and obese women as per Asian BMI cutoffs; sensitivity: 69%; specificity: 68.2%; PPV: 94.9%; NPV: 20.5%; Accuracy: 68.9%; Odds Ratio: 4.7 [95% CI 1.8-12.3]

Table-3: Predictive efficacy of WHO BMI cutoff for prediction of antenatal complications

*High risk	Antenatal complications		Total
	Present	Absent	
Yes	95	5	100
No	92	17	109
Total	187	22	209

High risk*: includes overweight and obese women as per WHO BMI cutoffs; sensitivity: 50.8%; specificity: 77.3%; PPV: 92%; NPV: 15.6%; Accuracy: 53.6%; Odds Ratio: 3.5 [95% CI 1.2-9.9]

In the cohort, 185/209 (88.5%) women had delivery at term whereas 24/209 (11.5%) had preterm delivery. 48.8% (102/209) women went into spontaneous labor while 51.2% (107/209) required induction of labor. The indications for labor induction were preeclampsia (27.8%), intrahepatic cholestasis of pregnancy (18.6%), fetal growth restriction (14.9%), gestational diabetes (10.2%) and prelabor rupture of membranes (9.3%). Table 4 shows the mode of delivery in groups when classified by WHO International and Asian BMI cutoffs. A significant association between higher BMI and cesarean delivery was observed. Of all who delivered vaginally,8.9% required assisted vaginal delivery.

Table 4: Association of BMI cutoffs (WHO and Asian) with Mode of delivery

BMI Criteria (number)	Mode of delivery		P value
	Vaginal (n=90)	Cesarean section (n=119)	
WHO			
Normal (109) Overweight (78) Obese (22)	56 31 03	53 47 19	0.004
Asian			
Normal (73) Overweight (36) Obese (100)	41 15 34	32 21 66	0.01

Postpartum hemorrhage, subinvolution of uterus were higher in the obese group but was not significant statistically. Amongst all,32/209(15.3%) women developed surgical site infection. Obese women, both by WHO International and Asian cutoffs had significant association with surgical site infection ($p<0.001$ and $p=0.03$ respectively).

Of all, 147/209 (70.3%) neonates had birth weight ≥ 2500 g while 62/209 (29.6%) had low birth weight. Both WHO International and Asian BMI cutoffs did not show any significant association with APGAR score at 5 minutes of birth. Large for gestational age (LGA) infant and neonatal jaundice was observed more in neonates of obese women. There were no neonatal deaths.

Discussion

Overweight and obesity poses a major global public health challenge. There is an alarming increase in the proportion of overweight /obese Indian women. It has increased from 12.6% in 2006 to 20.7% in 2016.[7] The recent NFHS (2019-21) shows that about 33.2% of urban, and 19.2% of rural women are overweight or obese. Overall, 24% of Indian women belong to overweight or obese population.[4] The reasons attributed are globalization, consumption of energy dense, nutrient poor food, sedentary lifestyle, sedentary occupation, reduced physical activity as the major drivers of the global obesity epidemic.[7] The mean age of women in our cohort was 28.1+-3.9 years. Majority of cases (52.6%) were in 26–30 year age group. However, proportion of those aged >30 years were higher in the obese group. It was observed that overweight and obese women were significantly older, had higher education and were multigravida.

Older maternal age, urban residence is said to be associated with increased odds of obesity among pregnant women.[7]

In our cohort, 47.8% women were obese as per Asian BMI cutoffs which is approximately five times higher than the WHO BMI cutoffs. WHO cutoffs are mainly based on western standards. Asian Indians have increased abdominal obesity, subcutaneous fat and excess intrabdominal fat deposition which puts them at high risk of adverse outcomes even at lower BMI cutoffs. Beena et al. in their study observed that prevalence of overweight and obesity increased when Asian Indian BMI cutoffs were applied and hence concluded that Asian BMI seems to be a better alternative to WHO BMI.[8]

Amongst the antenatal complications, HDP, gestational diabetes and anemia were the commonest complications. Overall, HDP was observed in 34.4% women. In our cohort, 84.7% of high-risk women developed HDP as compared to 70% of high-risk women when Asian and WHO BMI cutoffs were used respectively. Further, 31.6% women developed gestational diabetes. Of them, 80% belonged to high-risk group in comparison to 66.6% when Asian versus WHO BMI cutoffs were used. The Asian BMI criteria had higher sensitivity and accuracy in diagnosing antenatal complications. In India, anemia during pregnancy is a significant public health problem, with 45.7% of pregnant women in urban areas and 54.3% women in rural areas having anemia.[4] The integrated three-pronged approach includes increasing iron intake and hemoglobin status in all family members through dietary diversification and use of iron fortified iodized salt, operationalizing hemoglobin estimation in all pregnant women for early detection of anemia, providing iron folic acid (IFA) medication at an appropriate dosage to pregnant women and monitoring for improvement following IFA therapy. This can help achieve the SDG target for anemia reduction in reproductive age group women.[9]

In our cohort, the proportion of women requiring induction of labor was higher in overweight and obese as compared to normal BMI women in Asian (53% vs 49.3%) and WHO (55.1% and 49.5%) cutoffs. Studies have shown an increased need of induction of labor in obese women. In study by Sharadha et al, labor induction was significantly high in the obese group (52.4%) when compared with 22.6% in normal group women.[10] Furthermore, obese women are at increased risk of failed induction.[11] In our study delivery by cesarean section occurred more frequently in obese women. Similar observations regarding high cesarean delivery rates in obese group has been reported by different studies.[8,10,11,12] Suboptimal uterine contractility or increased fat deposition in pelvic soft tissues has been speculated as the reason for increased cesarean rates in obese group women.[11]

Observational studies have shown an increased risk of postpartum complications like thromboembolism, infection and hemorrhage in the obese mother.[13] However, in our overweight and obese women, postpartum hemorrhage (PPH) was high, though not significant. PPH in obese women has been attributed to increased bleeding from a larger area of placental attachment because of macrosomia, large volume of distribution in these women and thereby decreased bioavailability of uterotonic agents.[11] Obese women in our cohort had significantly more surgical site infection than the normal and overweight ones. Studies have found wound infections to be more common in the obese women. The association of wound infection with obesity remain significant even when the procedure is elective and prophylactic antibiotics are administered.[14]

Large for gestational age babies were higher in overweight and obese women. Studies have shown that obese women have increased chances of delivering large for date babies.[15] The contributory factors likely are increased insulin resistance and higher plasma triglyceride levels in the fetus. The placental lipases cleave the triglycerides thereby transferring the free fatty acid to the fetus. The combination of fetal hyperinsulinemia and increased fatty acid delivery to the fetus can account for the increased birth weight in overweight and obese women.[16,17]

In the last few decades prevalence of women being overweight or obese is increasing thereby leading to antenatal complications like HDP, gestational diabetes, failed induction, and high cesarean rates. Effective interventions to reduce the prevalence of overweight and obesity in pregnant women could have significant beneficial effects on the pregnancy outcomes. For better pregnancy outcomes, the optimal care should begin in the periconceptional period.

Conclusion

There is an urgent need of public health efforts to promote weight management among women of reproductive age before conception or during pregnancy. Maternal overweight and obesity are important contributors to pregnancy complications and adverse outcomes. The use of Asian BMI cutoffs led to a larger proportion of obese and overweight women. The Asian cutoffs had higher sensitivity and accuracy of diagnosing antenatal complications.

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Conflicts of interest:

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