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A study to compare Asian and WHO body mass index cutoffs to predict adverse maternal outcome in pregnancy.

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Abstract

The prevalence of overweight and obesity in India is increasing faster than the world average. Obesity in pregnancy is associated with adverse maternal outcome like gestational diabetes, hypertensive disorders of pregnancy, higher birth weight, preterm delivery, large for gestational age, and caesarean section. WHO inter national criteria of BMI cut-off is frequently used to predict adverse maternal outcome. This study was done to compare Asian and WHO International body mass index cutoffs to predict adverse maternal outcome in pregnancy.

Method: 360 women with live singleton pregnancy above 28 weeks were included. BMI was calculated for all. Maternal outcomes (GDM, Preeclampsia, APH, Preterm labor, PROM, need of labor induction, LSCS, PPH & Sepsis) in relation to WHO and Asian criteria for BMI cut off were compared.

Results: Mean age of the women was 25.80 ± 4.20 years. As per Asian BMI cut-off, 35.8% (129/360) were overweight and 46.4% (167/360) were obese whereas 43.6% (157/36) were overweight and only 2.8% were obese as per WHO BMI cut-off. The sensitivity and negative predictive value of Asian BMI criteria in detecting APH, GDM, preeclampsia and PPH was more than sensitivity and negative predictive value of WHO BMI criteria.

Conclusion: As Asian cutoffs of BMI have better predict ability for adverse maternal and perinatal outcome, it should be implemented widely at the first ANC visit to identify the high-risk women.

Keywords: Pregnancy, Asian BMI cut-off, WHO BMI cut-off, maternal outcome

Introduction

The global prevalence of obesity has significantly increased in the past decades and the World Health Organization (WHO) has described the phenomenon as a "global epidemic" posing a serious threat to public health.[1] The prevalence of overweight and obesity in India is increasing faster than the world average.

According to National Family Health Survey (NFHS-5), India there is an increase in the percentage of overweight and obese married women from 20.6% in NFHS-4 (2015-2016) to 24% in NFHS-5 (2019-2021).[2]

Greater adiposity in pregnancy is associated with increased risk of gestational diabetes, hypertensive disorders of pregnancy, higher birth weight, preterm delivery, large for gestational age, and caesarean section. [3-6] Overweight and Obesity are defined as abnormal or excessive fat accumulation that presents a risk to health.[7] The Body Mass Index (BMI) or Quetelet Index is the most frequently used measure of Overweight and Obesity and Waist circumference (WC) is used to measure abdominal adiposity.[6]

According to WHO International cut off BMI ≥30kg/m^2 is considered as obese and BMI between 25-29.9 kg/m^2 as overweight.[8] Asian Indians are at high risk at lower BMI group, hence guidelines for Obesity and Overweight based on Body Mass Index (BMI) for Asian Indians were revised based on consensus developed through discus sions by a Prevention and Management of Obesity and Metabolic Syndrome. According to this, BMI ≥25 kg/m^2 is categorized as Obese and BMI between 23 – 24.9 kg/m^2 as Overweight.[8]

Majority of the studies to predict maternal outcome with increasing BMI are done using WHO international cut-off and very few studies are done using Asian Indian BMI cut off·[8] Hence, this study was done to observe maternal outcome with revised Asian Indian BMI cut-offs. We also compared the results with WHO Inter national BMI cut-offs to determine best predictor of maternal outcome amongst the both.

Material and Methods

This was a hospital based comparative study done in the Department of Ob-Gy, SMS Medical College, Jaipur. Women with live singleton pregnancy above 28 weeks and willing to participate were included in the study after taking written informed consent. Women with pre-existing medical disorders and with BMI <18 Kg/m^2 were excluded. Sample size was calculated at 95% confidence level assuming 60% sensitivity of WHO BMI to predict gestational hypertension and 30% prevalence of obesity among pregnant women using WHO criteria. At absolute allowable error of 10%, 307 pregnant women were required as sample size which was further enhanced to 360 pregnant women as final sample size considering 15 % drop out. A detail history and examination were done for all. Weight and height were measured at first visit in first trimester. All women were monitored during ANC and labor as per protocol and maternal outcomes were mea sured as occurrence of GDM, Preeclampsia, APH, Preterm labor, PROM, need of labor induction, LSCS, PPH & Sepsis. Maternal outcomes in relation to WHO and Asian criteria for BMI were compared. Data was entered in MS Excel sheet and statistically analysed.

Results

Table 1 shows socio-demographic profile of the women. 45.8% women were below 25 years and mean age of the women was 25.80 ± 4.20 years. Majority of the women in present study were Hindu (67.5%), illiterate (66.9%), belonged to rural area (68.8%) and lower socio-economic status (64.4%). In present study 43.1% were primi gravida. Table 2 shows distribution of women according to WHO and Asian BMI criteria. According to WHO BMI cut-off, 53. 6% (193/ 360) women had normal BMI, 43.6% (157/ 36) were overweight and only 2.8% were obese while according to Asian BMI cut-off, 17.8% (64/360) women had normal BMI, 35.8% (129/360) were overweight and 46.4% (167/360) were obese. On comparing two groups it was observed that by Asian BMI cut-off, 46.4% women were obese and by WHO BMI cut-off only 2.8% women were obese. There was

significant increase in women in obese group by Asian BMI cut off. By WHO BMI cut-off 193 women (53.6%) had normal BMI while Asian BMI cut-off shows 64 women (17.8%) had normal BMI, So, 129 women (35.8%) women became high risk by Asian BMI cut-off. Table 3 shows antepartum maternal outcomes with WHO and Asian BMI criteria. Out of 360 women included in the study 98 (27.2%) women had gestational age <37 weeks. 29.9% overweight women and 20% obese women as per WHO criteria had gestational age <37 weeks while 29.5% overweight women and 50.9% obese women as per Asian criteria had gestational age <37 weeks. As BMI increases the incidence of gestational age <37 weeks also increased, though results were statistically not significant [p = 0.5 (WHO), 0.1(Asian)]. Out of 360 women, 59 women (16.4%) developed GDM. Out of them 55.9% women were overweight and 6.8% women were obese when WHO BMI criteria was used and 30.5% women were overweight and 62.7% women were obese when Asian BMI criteria was used. GDM was significantly more in overweight and obese women. 37 women (10.3%) developed pre-eclampsia, out of them 40.5% women had normal BMI, 59.5% women were overweight when WHO criteria was applied and 32.4% women were overweight and 59.5% women were obese when Asian criteria was applied. 34 women (9.4%) presented with APH. Out of them 32.4% had normal BMI and 67.6% women were overweight when WHO criteria was used and 2.9% women had normal BMI, 29.4% women were overweight and 67.6% women were obese when Asian criteria was applied.

Table 4 shows intrapartum and postpartum maternal outcome with WHO and Asian criteria of BMI. 126 women (35%) required induction of labor. By applying WHO BMI criteria, 34.9% women with normal BMI, 61.9% overweight women and 3.2% obese women required induction of labor. There is about two- fold increase in labor induction among the overweight and obese group (34.9% vs. 65.1%). By applying Asian BMI criteria, 9.5% women with normal BMI, 25.4% overweight women and 65.1% obese women required induction of labor. There is about ten- fold increase in labor induction among the overweight and obese group (9.5% vs. 90.5%). 84 women (23.3%) had caesarean delivery. Out of them 44% had normal BMI, 53.6% were overweight and 2.4% were obese when WHO criteria was used and 7.1% had normal BMI, 36.9% were overweight and 60% were obese when Asian criteria was applied. 46 women (12.8%) had PPH. Out of them, 39.1% women had normal BMI, 52.2% were overweight and 8.7% women were obese when WHO cut- off for BMI was applied and 6.5% women had normal BMI, 32.6% women were overweight and 60.9% women were obese when Asian BMI was applied. In this study 23 women (6.4%) developed P. sepsis. When WHO BMI criteria was applied, 34.8% women had normal BMI, 60.9% women were overweight and 4.3% women were obese which is statistically not significant (p value= 0.17). When Asian BMI criteria was applied, 8.7 % women had normal BMI, 26.1% women were overweight and 65.2% women were obese women which is statistically not significant (p value = 0.1). In present study the sensitivity and NPV of Asian BMI criteria in detecting APH, GDM, preeclampsia and PPH was more than sensitivity and NPV of WHO BMI criteria, respectively. (Table 5)

Discussion

In present study 165 (45.8%) out of 360 were in the age group of 18-25 years which was comparable with result observed by Anjana Verma et al. [9] Mean age of the women (25.80 ± 4.2 years) in our study was lower than mean age observed by Indarti J et al[10] (31.23 ± 5.34

years), Aubry, EM et al[11] (31.06 ± 5.08 years) and Eley V et al[12] (30.6 ± 5.4 years). Majority of the women (68.8%) in our study belonged to rural areas while in a study done by Wojtyla C et al[13], 41.2% women belonged to rural areas and in a study done by Van Der Linden et al[14] only 3.2% women resided in rural areas. In present study 66.9% women were illiterate which is in contrast with the study done by Van Der Linden EL et al[14], in which only 11.1% women were illiterate. In the study done by Misra VK et al[15] and Anjana Verma et al[9] all women included in the study were literate. In this study 64.4% women belonged to lower and 3.3% belonged to upper socio-economic status which is in contrast with observation made by Wojtyla C et al[13], where 18.9% women belonged to upper and 17.7 % women belonged to lower socio-economic status. In a study done by Athukorala C et al [16], 23.5% women belonged to low socio-economic group and 33.7% belonged to upper socio-economic group. Majority of the women (43.1%) in our study were primigravida while majority of the women in the study done by Van Der Linden EL et al[14] were gravida 2 or gravida 3.

In present study according to WHO BMI cut-off, 53.6% (193/360) women were normal, 43.6% (157/36) were overweight and only 2.8% were obese while according to Asian BMI criteria, 17.8% (64/360) were normal, 35.8% (129/360) overweight and 46.4% (167/360) were obese. On comparing two groups it was observed that by Asian BMI cut-off, 46.4% women were obese and by WHO BMI cut-off only 2.8% women were obese. There was significant increase in women in obese group by Asian BMI cut off. By WHO BMI cut-off 193 women (53.6%) had normal BMI while Asian BMI cut-off shows 64 women (17.8%) had normal BMI, So, 129 women (35.8%) women became high risk by Asian BMI cut-off. Therefore, on applying WHO cut-off in defining the high-risk group, there is twofold chance of missing out the risk population. Our results were in line with results of Aziz N et al[17]. They observed that the prevalence of obesity increased from 11.81% when the WHO criteria was used to 43.11% with the new guidelines. The re-classification reduced the prevalence of pregnant women with normal BMI from 50.29% to 31.82% and led to 18.47% of pregnant women being reclassified as overweight. Thus, nearly one in five pregnant women were added to the pool of mothers “potentially at risk” for adverse events. In a study done by Sharadha et al[18] prevalence of obesity increased from 8.5% when the WHO criteria was used to 29.7% when Asian classi fication was used. Out of 152 women considered normal as per WHO cut-off, 42 were reclassified as overweight and 51 women turned obese from overweight.

In present study, percentage of preterm increased with increase in BMI (17.2% in normal, 29.5% in overweight & 50.9% in obese). Our results were in line with results of Anjana Verma et al[9] (3.6% in normal, 4.2% in overweight & 6.2% in obese). In study done by Hendler I et al[19] a significant occurrence of the preterm birth among the obese pregnant women was found. In the present study, no significant correlation of the preterm deliveries was observed in any BMI group (p=0.5 & 0.1). GDM was significantly more in overweight and obese women (p Value = 0.009). Results of present study was in accordance with studies done by Anjana Verma et al [9], Sahu MT et al[20], Bhattacharya S et al[21] and Mamula et al[22] observed that women who were overweight, obese, or morbidly obese had significantly increased risks for gestational diabetes (p Value <0.001). Sharadha et al[18] in their study showed that GDM was significantly more in overweight and obese women (p value = 0.002). It was observed that women who were overweight or obese had increased risks for Pree

clampsia, which was consistent with the studies done by Anjana Verma et al[9], Sahu MT et al[20], Bhattacharya S et al[21] and Mamula et al[22]. Chibber R et al [23] observed that systemic hyper inflammation plays an important role in the pathogenesis of preeclampsia. Adipose tissue of women with obesity generates more actively several inflammatory mediators (C- reactive protein, interleukin-6) resulting in excessive inflam matory response. This state of hyper inflammation could result in an increased risk of preeclampsia in women with overweight and obesity. According to Dasgupta et al [24] maternal obesity is associated with hyperinsulinemia and hyperlipidemia, which enhances oxidative stress with decreased prostacyclin and more peroxide production, resulting in vasoconstriction and platelet aggregation, which increases the risk of hypertensive disorders of preg nancy. Overweight and obese women had significantly more risk of APH. Meenakshi et al [25] in their study showed that APH is due to abruption was slightly more in overweight and obese women but it was not significant. In a study done by Dasgupta et al [24] increase in risk of antepartum haemorrhage was noticed in morbidly obese women, chiefly due to placental abruption. In present study need for induction of labor was significantly more in overweight and obese women which is consistent with the observation made by Athu korala C et al[16], Bhattacharya S et al[21], Sharadha et al[18] and Maier JT et al[26] where overweight and obese women were more likely to be induced than normal weight women. In this study it was observed that overweight or obese women had caesarean delivery more frequently than women with normal BMI.

Our observations were in line with observations made by A. Pettersen-Dahl et al [27], Anjana Verma et al [9] , Sharadha et al [18], and Vinaya gam V et al [28]. They observed a significant association between increasing maternal BMI and delivery by caesarean section. Out of 46 women who had PPH, 60.9% women were overweight and obese as per WHO cut-off and 93.5% women were overweight and obese as per Asian cut-off. In present study with increase in BMI there was an increased risk of PPH. Our results were consistent with results of studies done in the past. Scott-Pillai et al [29] in their study observed an elevated risk of PPH in overweight and obese women. Bhattacharya S et al [21] stated that delivery showed a linear increase with increasing BMI. The increase in PPH seen with increasing BMI is attributed to large placental area, macrosomia, large volume of distribution, decreased bioavailability of uterotonic agents, increased incidence of induced labor and caesarean section in these women according to Studd J et al [30]. According to Dimuthu Vinaya gam et al [31], there is malfunction in uterine contractility secondary to increased cholesterol and leptin.

In present study the sensitivity and NPV of Asian BMI criteria in detecting APH, GDM, preeclampsia and PPH was more than sensitivity and NPV of WHO BMI criteria, respectively. The results of present study was in line with Sharadha et al. [18]

Conclusion

Overweight and obesity are associated with increased risk of gestational diabetes mellitus, hypertensive disorder of pregnancy, pre-eclampsia, caesarean section and failed induction. Asian cutoffs of BMI have better predict ability for adverse maternal and perinatal outcome.

As Asian Indians are at high risk at lower BMI due to increased abdominal obesity, increased subcutaneous and intraabdominal fat deposition and increased ectopic site fat deposition, Asian cutoffs of BMI should be implemented widely at the first visit to identify the high-

risk women. Early identification and management of these high-risk group will reduce the incidence of maternal and perinatal adverse outcome.

Ethical approval

"Informed consent was obtained from all individual participants included in the study."

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Table 1: Socio-demographic profile of the women

Variables	Number	Percentage
Age		
<25	165	45.8
≥25	195	54.2
Mean Age	25.80 ± 4.2	
Religion		
Hindu	243	67.5
Muslim	111	30.8
Christian	6	1.7
Residence		
Rural	248	68.8
Urban	112	31.2
Socio-economic Status		
Upper	12	3.3
Middle	116	32.2
Lower	232	64.5
Literacy Status		
Literate	119	33.1
Illiterate	241	66.9
Gravida		
G1	155	43.1
G2	128	35.6
G≥3	77	21.3

Table 2: Distribution of cases according to WHO and Asian BMI cut-off

WHO BMI Criteria	Asian BMI Criteria			
	Normal	Overweight	Obese	Total No (%)
Normal	64	129	-	193 (53.6)
Overweight	-	-	157	157 (43.6)
Obese	-	-	10	10 (2.8)
Total No (%)	64 (17.8)	129 (35.8)	167 (46.4)	360 (100)

Table 3: Antenatal Maternal outcomes with WHO and Asian criteria of BMI

Variables	WHO Criteria			P value	Asian Criteria			P value
	WNL (n =193)	Overweight (n= 157)	Obese (n =10)		WNL (n=64)	Overweight (n = 129)	Obese (n = 167)	
	No (%)	No (%)	No (%)		No (%)	No (%)	No (%)	
GA (Weeks)								
<37 (n = 98)	49 (25.4)	47 (29.9)	2 (20.0)	0.5	11 (17.2)	38 (29.5)	49 (50.9)	0.1
≥37 (n = 262)	144 (74.6)	110 (70.1)	8 (80.0)		53 (82.8)	91 (70.5)	118 (49.1)	
GDM								
Yes (n=59)	22 (37.8)	33 (55.9)	4 (6.8)	0.007	4 (6.8)	18 (30.5)	37 (62.7)	0.009
No (n = 301)	171 (56.8)	124 (41.2)	6 (2.0)		60 (19.9)	111 (36.9)	130 (42.2)	
Pre-eclampsia								
Yes (n = 37)	15 (40.5)	22 (59.5)	0 0	0.08	3 (8.1)	12 (32.4)	22 (59.5)	0.1
No (n = 323	178 (55.1)	135 (41.8)	10 (3.1)		61 (18.9)	117 (36.2)	145 (44.9)	
APH								
Yes (n = 34)	11 (32.4)	23 (67.6)	0 0	0.01	1 (2.9)	10 (29.4)	23 (67.6)	0.01

No (n = 326)	182 (55.8)	134 (41.1)	10 (3.1)		63 (19.3)	119 (36.5)	144 (44.6)	

Table 4: Intrapartum and Postpartum maternal outcomes with WHO and Asian BMI criteria

Variables	WHO Criteria			P value	Asian Criteria			P value
	WNL (n =193)	Overweight (n= 157)	Obese (n =10)		WNL (n=64)	Overweight (n = 129)	Obese (n = 167)	
	No (%)	No (%)	No (%)		No (%)	No (%)	No (%)	
Induction of Labour								
Yes (n = 126)	44 (34.9)	78 (61.9)	4 (3.2)	<0.001	12 (9.5)	32 (25.4)	82 (65.1)	<0.001
No (n = 234)	149 (63.7)	79 (33.8)	6 (2.6)		52 (22.2)	97 (41.5)	85 (36.3)	
Mode of Delivery								
Vaginal (n = 276)	156 (56.5)	112 (40.6)	8 (2.9)	0.1	58 (21.0)	98 (35.5)	120 (43.5)	0.01
LSCS (n = 84)	37 (44.0)	45 (53.6)	2 (2.4)		6 (7.1)	31 (36.9)	47 (60.0)	
PPH								
Yes (n = 46)	18 (39.1)	24 (52.2)	4 (8.7)	0.008	3 (6.5)	15 (32.6)	28 (60.9)	0.04
No (n = 314)	175 (55.7)	133 (42.4)	6 (1.9)		61 (19.4)	114 (36.3)	139 (44.3)	
P. Sepsis								
Yes (n = 23)	8 (34.8)	14 (60.9)	1 (4.3)	0.17	2 (8.7)	6 (26.1)	15 (65.2)	0.1
No (n = 337)	185 (54.9)	143 (42.4)	9 (2.7)		62 (18.4)	123 (36.5)	152 (45.1)	

Table 5: Performance of BMI for predicting various maternal outcome

Variables	**Sensitivity (%)**	**Specificity (%)**	**PPV (%)**	**NPV (%)**	**Diagnostic Accuracy (%)**
GDM					
BMI (Asian)	93.2	19.9	18.6	93.8	31.9
BMI (WHO)	62.7	56.8	22.2	88.6	57.8
Pre-eclampsia					
BMI (Asian)	91.9	18.9	11.5	95.3	26.4
BMI (WHO)	59.5	55.1	13.2	92.2	55.6
APH					
BMI (Asian)	97.1	19.3	11.1	98.4	26.7
BMI (WHO)	67.6	55.8	13.8	94.3	56.9
PPH					
BMI (Asian)	93.5	19.4	14.5	95.3	28.9
BMI (WHO)	60.9	55.7	16.8	90.7	56.4