

High Pre-Pregnancy Body Mass Index and the Risk of Poor Obstetrics Outcomes among Asian Women Using BMI Criteria for Asians by World Health Organization Western Pacific Region (WPRO): A Large Cohort Study

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Objective: To evaluate the effects of high pre-pregnancy body mass index (BMI) on the risk of poor obstetric outcomes among Asian women using BMI criteria by Regional Office for the Western Pacific Region of WHO (WPRO).

Material and Method: The present study was a retrospective cohort. Subjects of live birth singletons who had full term delivered at four tertiary care centers, teaching university hospitals between January and December 2012 were enrolled. All pregnant women with pre-pregnancy BMI 18.5 kg/m² or over were recruited and categorized into two groups, normal BMI and high BMI. Level of BMI at 18.5-22.9 kg/m² was defined normal BMI, and level at or over than 23 kg/m² was defined as high BMI, respectively. The association between high pre-pregnancy BMI and poor adverse pregnancy outcomes were evaluated.

Results: Two thousand seven hundred and thirty-three pregnant women were recruited. Normal and high pre-pregnancy BMI women were 1,840 and 893, respectively. The average age was 27.81±5.67 and 29.48±13.03 years old respectively. Most of subject were primigravida. Mean BMI of normal group and high BMI group were 20.27±1.42 and 26.66±3.45 kg/m², respectively. In multivariate analysis, high pre-pregnancy BMI pregnant women have significantly higher adjusted risk ratio for gestational diabetes mellitus and preeclampsia, induction of labor, prolong second stage of labor, including, caesarean delivery or obstetrics procedures (RR 1.54, 95% CI 1.30-1.84, RR 1.17, 95% CI 1.12-1.23, RR 1.41, 95% CI 1.04-1.90, RR 1.28, 95% CI 1.11-1.48 and RR 1.17, 95% CI 1.05-1.27, respectively). In addition, the adjusted risk ratio of postpartum hemorrhage and neonatal macrosomia were significantly increased (RR 1.86, 95% CI 1.01-3.43 and RR 1.46, 95% CI 1.28-1.65, respectively).

Conclusion: This evidence strongly suggested that high pre-pregnancy BMI using WPRO criteria increased the risk of pregnancy complications and adverse pregnancy outcomes. This study was one of the largest studies among Asian populations.

Keywords: Body mass index, Pregnancy, Obese

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Obesity is a major public health problem in many countries around the world, including Thailand. According to World Health Organization (WHO) report

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on non-communicable diseases in 2011, Thailand was the second country in South East Asia which had a high percentage of overweight and obese population⁽¹⁾. The increasing rate of overweight Thai women with body mass index (BMI) ≥25 kg/m² climbed up from 22.2% in 2009 to 36.5% in 2010. In addition, obese women with BMI ≥30 kg/m² was 12%. The prevalence of high BMI was increasing globally in all age groups including pregnant women entering pregnancy at

higher pre-pregnancy weight⁽²⁾.

It has been recognized that the current WHO criteria in 2000 to classify overweight and obesity in adult by using BMI have been based on data from Europe or the United State. BMI is calculated as weight (kg) per square of height (m²). A person with BMI between 25.0 and 29.9 kg/m² is considered as overweight and if BMI \geq 30.0 kg/m² is considered as obese. The evidence demonstrated that increasing BMI is one of the most important risk factors for non-communicable diseases (NCDs). It accentuates early development of type 2 diabetes and cardiovascular disease (CVDs) and raises blood pressure, blood glucose and cholesterol levels⁽³⁾. However, these health risks occur in people with lower BMI in Asian populations. Therefore, using BMI cut-off level as recommended by WHO might be inappropriate for Asian populations. The Regional Office for the Western Pacific Region of WHO (WPRO) proposed a specific classification in 2004 for obesity in Asian populations. The definitions of normal, overweight and obesity were defined as BMI in 18.5-22.9, 23-24.9 and \geq 25 kg/m², respectively⁽⁴⁾.

According to WPRO definition, Jitnarin N et al reported results of the National Thai Food Consumption Survey in 2011, the prevalence of obesity was 23.8% while it was only 4.9% when using WHO classification⁽⁵⁾. However, very little information is available about the impact on obstetrical outcomes on Asian women, when using different cut-off points of BMI such as WPRO definition for pre-pregnancy BMI. Therefore, the purpose of this study was to determine the effect of the maternal pre-pregnancy BMI by using WPRO definition for Asian populations on obstetrics and perinatal outcomes from four health centers as university hospitals in different regions of Thailand.

Material and Method

This retrospective cohort study was conducted by selecting women aged 18-40 years with singleton term live birth (\geq 37 weeks of gestation) who attended the antenatal clinic and had their babies delivered at one of four affiliated university hospitals namely Thammasat University, Rajavithi, Phramongkutklao, Srinakharin Khon Kaen hospitals during January and December 2012. The research protocol was reviewed and approved by the ethic committee of each hospital. The medical records of pregnant women were reviewed. Incomplete records were excluded. Also the cases whose pre-pregnancy BMI was lower than 18.5 kg/m². All cases had a minimum

of four antenatal visits. The patients were then classified into two categories as normal BMI and high BMI (overweight and obesity) groups according to the pre-pregnancy BMI by WPRO definition. The normal BMI and high BMI groups were defined as BMI of 18.5-22.9 and \geq 23 kg/m², respectively.

Sociodemographic variables, namely initially visit maternal age, parity, gestational age at initially visit, number of antenatal visit and gestational age at delivery were recorded. Obstetrics and perinatal outcomes included gestational diabetes, preeclampsia, premature rupture of membrane, type of labor (spontaneous or induced), type of delivery (spontaneous vaginal delivery, operative vaginal delivery or cesarean section), prolonged second stage of labor (more than 1 hour for primigravida and 2 hours for multigravida), neonatal weight, macrosomia (birth weight above 90th centile at gestational age of delivery) and postpartum hemorrhage were reviewed and analyzed.

Statistical analysis was conducted using Stata program. The risks of obstetrics complications were presented as adjusted risk ratios with 95% confidence intervals.

Results

A total of 2,733 pregnant women were included in the study. Of these, 1,840 (67.33%) were categorized as normal pre-pregnancy BMI (BMI 18.5-22.9 kg/m²) and 893 (32.67%) as high pre-pregnancy BMI (BMI \geq 23 kg/m²).

The maternal and pregnancy demographics are shown in Table 1. The data demonstrated the maternal demographics between the two groups. Compared to women with normal pre-pregnancy BMI, the mean age and the multiparity proportion of high BMI group were significantly higher. In addition, mean gestational age at first antenatal visit was slightly higher in high BMI group. However, the gestational age at delivery, family history of diabetes mellitus and hypertension were not significantly different between two groups.

The impact of pre-pregnancy BMI on the pregnancy outcomes were summarized in Table 2. After adjusting for the confounding factors, the data showed the women with high BMI group had significantly increased the risks of gestational diabetes (RR 1.54, 95% CI 1.30-1.84, p <0.001), preeclampsia (RR 1.17, 95% CI 1.12-1.23, p <0.001). The average neonatal weight in high BMI group was significantly higher than normal BMI group (3,172.60 \pm 456.55, 3,092 \pm 785.55 grams,

Table 1. Patient characteristics stratified by the pre-pregnancy BMI using WPRO criteria

Characteristic	Pre-pregnancy BMI		p-value
	Normal BMI group (18.5-22.9 kg/m ²) (n = 1,840)	High BMI group (≥23 kg/m ²) (n = 893)	
Age (years)	27.81±5.67	29.48±13.03	<0.001
Parity (%)			0.028
Nulliparous	1,148 (62.39)	518 (58.01)	
Multiparous	692 (37.61)	375 (41.99)	
Gestational age at first ANC (weeks)	15.98±8.13	17.04±8.77	0.001
Average pre-pregnancy BMI (kg/m ²)	20.27±1.42	26.66±3.45	<0.001
Gestational age at delivery (weeks)	38.49±7.14	38.45±1.83	0.880
Family history of diabetes or hypertension	396 (21.52)	183 (20.49)	0.540

respectively, $p = 0.001$). Incidence of labor induction and the rate of instrumental delivery or cesarean section were also higher in high BMI women (RR 1.41, 95% CI 1.04-1.90 and RR 1.16, 95% CI 1.05-1.27, respectively). The risk of prolonged second stage labor and birth weight above 90th centile was significantly increased in high BMI women (RR 1.28, 95% CI 1.11-1.48 and RR 1.46, 95% CI 1.28-1.65, respectively). The risk of antepartum hemorrhage, premature rupture of membranes, and postpartum hemorrhage were similar between two groups.

The obstetrics outcomes in the high BMI group were then subgroup analyzed by dividing the data into overweight (BMI ≥23-24.9 kg/m²) and obesity (BMI ≥25 kg/m²). After adjusting for the confounding factors, the overweight group had no significantly increased risk of gestational diabetes, preeclampsia, labor induction, delivery by instrument or cesarean section, prolonged second stage labor, and postpartum hemorrhage when compared to women with normal pre-pregnancy BMI. Conversely, the obesity group had significantly increased risk of poor obstetric outcomes such as gestational diabetes, preeclampsia, instrumental delivery or cesarean section, prolonged second stage of labor and postpartum hemorrhage as shown in Table 3. There was only a risk for birth weight above 90th centile that the data demonstrated significantly increased in both overweight and obesity groups (RR 2.00, 95% CI 1.45-2.75 and RR 1.97, 95% CI 1.47-2.67, respectively).

Discussion

Currently, obesity is a growing health problem and the leading risk factor for non-communicable

diseases related to multiple chronic medical illness. Compared with women who had normal BMI before pregnancy, previous studies showed that pre-pregnancy obesity had a strong negative impact on pregnancy outcomes including antenatal, intrapartum and neonatal complications. The evidence demonstrated the intense correlation between high BMI and adverse pregnancy outcomes (*i.e.* gestational diabetes mellitus, preeclampsia, induction of labor, delivery by cesarean section, postpartum hemorrhage, wound complications and birth weight above 90th centile) by using BMI cut-off point from WHO definition for overweight and obesity⁽⁶⁻¹⁰⁾.

The prevalence of obesity is lower in Asian region by using WHO cut-off point. However, metabolic diseases such as hypertension, hyperlipidemia, abnormal glucose tolerance tend to occur early at lower BMI. The pattern of metabolic diseases in Asian populations might be different as distinct ethnics. The relationship between BMI and body fat deposit in Asian populations could have an abnormal composition at lower BMI than Caucasians^(11,12).

Anuurad E et al, used WPRO criteria of BMI for Asian populations to evaluate the relationship between BMI and metabolic syndrome in Japanese workers. They showed significant differences between overweight and normal BMI group in levels of HDL-C, triglyceride and blood pressure in their populations⁽¹³⁾. Another Taiwanese study using their own definition from Department of Health in Taiwan to classify BMI as normal (18.5-23.9 kg/m²) and overweight (≥24.0 kg/m²). They evaluated the association between pre-pregnancy BMI and gestational weight gain with

Table 2. Obstetrics and perinatal outcomes in the different pre-pregnancy BMI by WPRO criteria

Outcomes	Adjust RR	95%CI	p-value
Gestational diabetes			
Normal BMI	1.00		
High BMI	1.54	1.30-1.84	<0.001
Preeclampsia			
Normal BMI	1.00		
High BMI	1.17	1.12-1.23	<0.001
Premature rupture of membranes			
Normal BMI	1.00		
High BMI	1.21	0.92-1.61	0.18
Induction of labor			
Normal BMI	1.00		
High BMI	1.41	1.04-1.90	0.03
Instrumental delivery or cesarean section			
Normal BMI	1.00		
High BMI	1.17	1.05-1.27	0.002
Prolonged 2 nd stage of labor			
Normal BMI	1.00		
High BMI	1.28	1.11-1.48	0.001
Birthweight above 90 th centile			
Normal BMI	1.00		
High BMI	1.46	1.28-1.65	<0.001
Postpartum hemorrhage			
Normal BMI	1.00		
High BMI	1.86	1.01-3.43	0.04

pregnancy outcomes in their populations. The data demonstrated the increased risks of gestational diabetes, preeclampsia, and preterm labor in women with high pre-pregnancy BMI (≥ 24.0 kg/m²)⁽¹⁴⁾.

This cohort study demonstrated that the women with high pre-pregnancy BMI using Asian cut-off point (BMI ≥ 23.0 kg/m²) significantly increased risk of gestational diabetes, preeclampsia, induction of labor, delivered by instrument or cesarean section, prolonged second stage labor, postpartum hemorrhage and neonatal macrosomia compared with normal pre-pregnancy BMI women (BMI 18.5-22.9 kg/m²). These findings were similar to earlier report from one of the largest study from United Kingdom that showed increased risk of gestational diabetes, preeclampsia, induction of labor, operative vaginal delivery, delivered by cesarean section, postpartum hemorrhage and neonatal macrosomia but UK data were collected from

Table 3. Comparing obstetrics and perinatal outcomes between women with overweight (BMI ≥ 23 -24.9 kg/m²) and obesity (BMI ≥ 25 kg/m²) by WPRO criteria

Outcome	Adjust RR	95%CI	p-value
Gestational diabetes			
Normal BMI	1.00		
Overweight	1.46	0.88-2.41	0.139
Obesity	2.78	1.90-4.07	<0.001
Preeclampsia			
Normal BMI	1.00		
Overweight	1.16	0.53-2.55	0.710
Obesity	3.70	2.19-6.28	<0.001
Premature rupture of membranes			
Normal BMI	1.00		
Overweight	1.12	0.75-1.68	0.570
Obesity	1.31	0.92-1.87	0.130
Induction of labor			
Normal BMI	1.00		
Overweight	1.13	0.73-1.75	0.580
Obesity	1.39	0.96-2.02	0.080
Instrumental delivery or cesarean section			
Normal BMI	1.00		
Overweight	1.09	0.85-1.40	0.480
Obesity	1.53	1.23-1.92	<0.001
Prolonged 2 nd stage of labor			
Normal BMI	1.00		
Overweight	1.37	0.93-2.02	0.110
Obesity	1.86	1.34-2.61	<0.001
Birth weight above 90 th centile			
Normal BMI	1.00		
Overweight	2.00	1.45-2.75	<0.001
Obesity	1.97	1.47-2.67	<0.001
Postpartum hemorrhage			
Normal BMI	1.00		
Overweight	1.02	0.38-2.75	0.980
Obesity	2.33	1.15-4.74	0.020

women who were defined as high BMI at pre-pregnancy (BMI ≥ 25.0 kg/m²)⁽⁷⁾.

Therefore, using the criteria from WPRO recommendation BMI for Asian populations, the authors compared the pregnancy and perinatal outcomes between the women with normal (18.5-22.9 kg/m²), overweight (BMI 23.0-24.9 kg/m²) and obesity (BMI ≥ 25.0 kg/m²). Our findings showed significant increased risk for poor pregnancy and perinatal

outcomes only in obese women. Nevertheless, the authors found the association between overweight, obesity and macrosomia (birth weight above 90th centile of gestational age at delivery). The data showed increased risk of neonatal macrosomia in overweight and obesity pregnant women about two times compared with normal BMI pregnant women (adjust RR 2.00 and 1.97, $p < 0.001$), respectively.

Macrosomia is one of the risk factor for postpartum hemorrhage and delivered by instrument or cesarean section, therefore we can prevent these complications by prevent high BMI before pregnant⁽¹⁵⁾. Moreover, fetal origin hypothesis was reported from Barker DJP since 1990 that it provided the correlation between rates of infant mortality, later adult metabolic syndrome associated with birth weight especially low birth weight and macrosomia^(16,17). Thus, in our findings, overweight pregnant women may be the starting point for physicians to be concerned about their perinatal outcomes.

Thai Health Promotion Foundation (THPF) has been granting a study of nutrition and health promotion for pregnant women in Thailand. The result of this study showed that maternal nutrition and life style management is a significant factor to make proper pre-pregnancy weight. The new cut-off point of BMI for Asian populations by WPRO criteria is a better weight status indicator for Thai population.

The strength of the present study was its collect data from four health centers from different region that represents the majority population. In addition, it provides information about risk for pregnancy and perinatal outcomes by using WHO's criteria for Asian population that was only small amount of data for pregnant women. To the best of our knowledge, this is the first study to investigate the risks of adverse pregnancy outcomes in women with high pre-pregnancy BMI by using cut-off point of WPRO for Asian populations. The limitation of this study was retrospective and had some limitations because of incomplete data.

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Potential conflicts of interest

None.

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การศึกษาภาวะแทรกซ้อนของการตั้งครรภ์ในกลุ่มมารดาตั้งครรภ์ที่มีดัชนีมวลกายสูงโดยใช้เกณฑ์ดัชนีมวลกายตามองค์การอนามัยโลกกำหนดให้สำหรับประชากรเอเชีย

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วัตถุประสงค์: เพื่อศึกษาผลของดัชนีมวลกายสูงก่อนตั้งครรภ์ โดยใช้เกณฑ์ดัชนีมวลกายตามองค์การอนามัยโลก กำหนดให้สำหรับประชากรเอเชีย ต่อภาวะแทรกซ้อนของการตั้งครรภ์ทั้งในมารดาและทารกแรกคลอด

วัสดุและวิธีการ: ทำการศึกษาย้อนหลังโดยรวบรวมข้อมูลจากแฟ้มประวัติการฝากครรภ์และการคลอดจากหญิงตั้งครรภ์เดี่ยวที่มาคลอดครบกำหนดในโรงพยาบาลมหาวิทยาลัยที่เข้าร่วมจำนวน 4 แห่ง ระหว่างวันที่ 1 มกราคม พ.ศ. 2555 ถึง 31 ธันวาคม พ.ศ. 2555 โดยกลุ่มศึกษาคือหญิงตั้งครรภ์ที่มีดัชนีมวลกายก่อนตั้งครรภ์ตั้งแต่ 18.5 กิโลกรัมต่อตารางเมตรขึ้นไป โดยแบ่งเป็นกลุ่มที่มีดัชนีมวลกายก่อนตั้งครรภ์ปกติ คือ 18.5-22.9 กิโลกรัมต่อตารางเมตรกับกลุ่มที่มีดัชนีมวลกายสูงคือ ตั้งแต่ 23 กิโลกรัมต่อตารางเมตรวิเคราะห์ผลกระทบต่อภาวะแทรกซ้อนของการตั้งครรภ์ทั้งในมารดาและทารกแรกคลอด

ผลการศึกษา: ได้หญิงตั้งครรภ์เดี่ยวจำนวน 2,733 ราย เป็นกลุ่มที่มีดัชนีมวลกายก่อนตั้งครรภ์ปกติและดัชนีมวลกายสูงจำนวน 1,840 รายและ 893 ราย ตามลำดับ อายุเฉลี่ยเป็น 27.81 ± 5.67 และ 29.48 ± 13.03 ปี ตามลำดับ โดยส่วนใหญ่ทั้งสองกลุ่มเป็นการตั้งครรภ์แรกและมีดัชนีมวลกายเฉลี่ยเป็น 20.27 ± 1.42 และ 26.66 ± 3.45 กิโลกรัมต่อตารางเมตรตามลำดับ หลังการวิเคราะห์แบบตัวแปรพหุสัมพันธ์พบว่า กลุ่มที่มีดัชนีมวลกายสูงหรือมีภาวะอ้วนก่อนตั้งครรภ์เพิ่มความเสี่ยงต่อภาวะเบาหวานขณะตั้งครรภ์ ภาวะความดันโลหิตสูงขณะตั้งครรภ์ การชักนำการคลอด การยึดเยื่อของการคลอดระยะที่สอง รวมทั้งการคลอดโดยใช้หัตถการช่วยคลอดหรือผ่าท้องคลอดอย่างมีนัยสำคัญทางสถิติ (อัตราเสี่ยงสัมพัทธ์และช่วงความเชื่อมั่น 1.54 เท่า (1.30-1.84), 1.17 เท่า (1.12-1.23), 1.41 เท่า (1.04-1.90), 1.28 เท่า (1.11-1.48)) ตามลำดับ นอกจากนี้ยังพบว่ากลุ่มที่มีดัชนีมวลกายสูงหรือมีภาวะอ้วนก่อนตั้งครรภ์มีความเสี่ยงต่อภาวะทารกตัวโตกว่าอายุครรภ์ และเสี่ยงต่อการตกเลือดหลังคลอดอย่างมีนัยสำคัญทางสถิติ (อัตราเสี่ยงสัมพัทธ์และช่วงความเชื่อมั่นที่ 1.46 เท่า (1.28-1.65) และ 1.86 เท่า (1.01-3.43) ตามลำดับ

สรุป: ภาวะดัชนีมวลกายสูงก่อนตั้งครรภ์ โดยใช้เกณฑ์ดัชนีมวลกายตามองค์การอนามัยโลกกำหนดให้สำหรับประชากรเอเชีย เพิ่มความเสี่ยงต่อภาวะแทรกซ้อนของการตั้งครรภ์ทั้งในมารดาและทารกแรกคลอด การศึกษานี้เป็นการศึกษานานาชาติใหญ่ในหญิงตั้งครรภ์ไทย ซึ่งยังมีข้อมูลภาวะแทรกซ้อนของการตั้งครรภ์ทั้งในมารดาและทารกแรกคลอดน้อย
