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 thousands 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

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

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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 (m\(^2\)). A person with BMI between 25.0 and 29.9 kg/m\(^2\) is considered as overweight and if BMI \(>\)30.0 kg/m\(^2\) 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 \(>\)25 kg/m\(^2\), 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/m\(^2\). 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/m\(^2\), 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/m\(^2\)) and 893 (32.67%) as high pre-pregnancy BMI (BMI \(>\)23 kg/m\(^2\)).

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

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Pre-pregnancy BMI</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Normal BMI group (18.5-22.9 kg/m²) (n = 1,840)</td>
<td>High BMI group (≥23 kg/m²) (n = 893)</td>
</tr>
<tr>
<td>Age (years)</td>
<td>27.81±5.67</td>
<td>29.48±13.03</td>
</tr>
<tr>
<td>Parity (%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nulliparous</td>
<td>1,148 (62.39)</td>
<td>518 (58.01)</td>
</tr>
<tr>
<td>Multiparous</td>
<td>692 (37.61)</td>
<td>375 (41.99)</td>
</tr>
<tr>
<td>Gestational age at first ANC (weeks)</td>
<td>15.98±8.13</td>
<td>17.04±8.77</td>
</tr>
<tr>
<td>Average pre-pregnancy BMI (kg/m²)</td>
<td>20.27±1.42</td>
<td>26.66±3.45</td>
</tr>
<tr>
<td>Gestational age at delivery (weeks)</td>
<td>38.49±7.14</td>
<td>38.45±1.83</td>
</tr>
<tr>
<td>Family history of diabetes or hypertension</td>
<td>396 (21.52)</td>
<td>183 (20.49)</td>
</tr>
</tbody>
</table>

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
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 cutoff 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 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

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

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

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### 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

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

อินทรพิทย์ สมประดิษฐ์, ชานาญ แทนประเสริฐภูฏ, นัยน์รัตน์ รัตนศิริ, ปิยะมาศ ทิพศรีรัตนโย, ภาวิ สังคกุล, เอกชัย ใจวิสิทธิ์, ประดิษฐ์ พันชาย, จุฑารัตน์ รัตน์

วัตถุประสงค์: เพื่อศึกษาผลของการติดเชื้อภูฏของกลุ่มมาร์ดาโดยใช้เครื่องมือคั้นมเวลาภูฏตามองกร

วัสดุและวิธีการ: ทำการศึกษาผู้ติดเชื้อภูฏของกลุ่มมาร์ดาโดยใช้เครื่องมือคั้นมเวลาภูฏตามองกร

ผลการศึกษา: ได้รับผลค้นพบมีการติดเชื้อภูฏกลับในกลุ่มมาร์ดา 2,733 ราย คิดเป็น 8.33% และมีการติดเชื้อภูฏกลับในกลุ่มมาร์ดา 893 ราย คิดเป็น 2.82% ของกลุ่มตัวอย่างทั้งหมด ผลการตรวจพบมีการติดเชื้อภูฏกลับในกลุ่มมาร์ดา 1,840 ราย คิดเป็น 6.43% ของกลุ่มตัวอย่างทั้งหมด ผลการตรวจพบมีการติดเชื้อภูฏกลับในกลุ่มมาร์ดา 893 ราย คิดเป็น 2.82% ของกลุ่มตัวอย่างทั้งหมด ผลการตรวจพบมีการติดเชื้อภูฏกลับในกลุ่มมาร์ดา 1,840 ราย คิดเป็น 6.43% ของกลุ่มตัวอย่างทั้งหมด ผลการตรวจพบมีการติดเชื้อภูฏกลับในกลุ่มมาร์ดา 893 ราย คิดเป็น 2.82% ของกลุ่มตัวอย่างทั้งหมด ผลการตรวจพบมีการติดเชื้อภูฏกลับในกลุ่มมาร์ดา 1,840 ราย คิดเป็น 6.43% ของกลุ่มตัวอย่างทั้งหมด ผลการตรวจพบมีการติดเชื้อภูฏกลับในกลุ่มมาร์ดา 893 ราย คิดเป็น 2.82% ของกลุ่มตัวอย่างทั้งหมด ผลการตรวจพบมีการติดเชื้อภูฏกลับในกลุ่มมาร์ดา 1,840 ราย คิดเป็น 6.43% ของกลุ่มตัวอย่างทั้งหมด ผลการตรวจพบมีการติดเชื้อภูฏกลับในกลุ่มมาร์ดา 893 ราย คิดเป็น 2.82% ของกลุ่มตัวอย่างทั้งหมด ผลการตรวจพบมีการติดเชื้อภูฏกลับในกลุ่มมาร์ดา 1,840 ราย คิดเป็น 6.43% ของกลุ่มตัวอย่างทั้งหมด ผลการตรวจพบมีการติดเชื้อภูฏกลับในกลุ่มมาร์ดา 893 ราย คิดเป็น 2.82% ของกลุ่มตัวอย่างทั้งหมด