Body mass index on outcomes of nulliparous singleton pregnancies in Brunei Darussalam

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ABSTRACT

Introduction: Studies have shown that both overweight and underweight women are more likely to have adverse pregnancy outcomes compared to those with normal body weight. This study assessed the impact of body mass index (BMI) on pregnancy outcomes among primigravid women who delivered at a tertiary hospital. **Materials and Methods:** All nulliparous women delivering singleton babies at RIPAS Hospital (1st October 2009 to 30th September 2010, *N*=1,290) were included. BMI was classified based on the World Health Organisation classification. For analyses, the BMI groups were categorised into three groups; Low (<20.0 kg/m^2), Normal (20.1 to 24.9) and High (>25.0). The relative risk (RR) for Gestational Hypertension (GHT), Gestational Diabetes Mellitus (GDM), assisted delivery and induction of labour (IOL) were calculated for the different BMI groups. **Results:** Overall, 40.4%, 19.8% and 39.8% were categorised as Normal, Low and High BMI respectively. Hypertension (5.8%) and diabetes mellitus (2%) were more common in the High BMI group, while anaemia was common in the Low (34%) and Normal groups (23.8%). The High group were more likely to have GHT and GDM, IOL and likely to need assisted delivery (all p<0.001). Low BMI group had a lower prevalence of GHT and GDM, higher preterm labour, small for gestational age (SGA) babies, and more normal vaginal delivery (all p<0.05). There were no significant differences in admission to special care baby unit and rates of stillbirth or early neonatal death between the different groups. Multivariate analyses (controlled for maternal age and smoking) showed higher risk for GHT (RR=2.6, 95% CI=1.2-5.4) in the Normal and High BMI groups (RR=3.7, 95% CI=1.8–7.5), and GDM among the high BMI group (RR=2.6, 95% CI=1.1-6.1). The risk for assisted delivery was also higher (RR 2.0, 95% CI=1.4-2.9) compared to the Normal and High BMI group (RR 1.3, 95% CI=0.9-1.6) and IOL was higher among normal BMI (RR 1.5, 95% CI=1.0-2.2) and High BMI (2.7, 95% CI = 1.9-4.0) groups. **Conclusions:** Maternal BMI was strongly associated with pregnancy complications and outcomes. There is a need for an effective programme to increase awareness of the importance of achieving normal BMI for a healthy pregnancy.

Keywords: Pregnancy outcomes, perinatal complications, weight disorders, diabetes

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INTRODUCTION

Obesity has a major impact on pregnancy outcomes, including higher risk of hypertensive

disease (chronic hypertension or pre-gestational hypertension, gestational hypertension (GHT) and pre-eclampsia), diabetes (pre-gestational [PGDM] and gestational [GDM], foetal macrosomia, induction of labour (IOL), dysfunctional labour, lower section caesarean delivery (LSCS) and postpartum haemorrhage (PPH). On the other hand, being underweight is also associated with increased risk of complications, specifically preterm delivery and low birth weight.

Several studies have shown associations between body mass index (BMI) and pregnancy outcomes. In the existing body of research, most studies have assessed overweight or obesity, and maternal underweight. [1-9]

In this study, we examined the prevalence of overweight and underweight primigravid women and compared their pregnancy outcomes with those of normal BMI women. To date this is the first such study in a Bruneian population. In this study, we have compared the pregnancy outcomes of nulliparous women delivering singleton babies at RIPAS Hospital, Brunei Darussalam on the basis of maternal BMI at booking during the study period.

MATERIALS AND METHODS

All nulliparous women delivering singleton babies at the RIPAS Hospital from 1st October 2009 to 30th September 2010 were prospectively recruited. Those who declined to give voluntary informed consent, had multiple pregnancies, or did not know their pre-gestational body weight and booked their antenatal care after 15 weeks of gestation (late booking) were excluded.

Definitions of terms used in the study were:

Nulliparity: no delivery of an infant (live or dead) beyond 24 weeks gestation or 500 gm.

Maternal age: age in completed years at the time of delivery.

Late foetal death: stillbirth occurring at 28 or more completed weeks of gestation.

Early neonatal death: death occurring during the first week after birth.

Preterm delivery: delivery at less than 37 completed weeks of gestation and is classified as very preterm (<32 weeks) or moderately preterm (33 to 36 weeks).

Small-for-gestational-age babies (SGA): birth weight more than two Standard Deviation (SD) below the mean birth weight for the gestational age (less than sex-specific 10th percentile), based on the National reference curve.

Foetal macrosomia: (large-for-gestational-age) birth weight more than 2 SD above the mean birth weight for the gestational age (more than sex-specific 90th percentile), based on the National reference curve.

Gestational diabetes (GDM) - patients who had impaired oral glucose tolerance test or elevated fasting blood sugar meeting the diagnostic criteria of diabetes during pregnancy

Gestational Hypertension (GHT) – Gestational blood pressure of more than 140/90 in patients who had normal blood pressure before pregnancy or not known to have hypertension and diagnosed after 20 weeks of gestation.

The estimated gestational age was based on ultrasound scan performed at no later than 18 completed weeks of gestation.

The World Health Organisation (WHO) classification for weight disorders was used for the study (kg/m^2):

Underweight (BMI <20 kg/m^2)
Normal (BMI 20-24.9)
Overweight (BMI 25-29.9)
Obese (BMI 30-34.9)
Morbidly obese (BMI >35 kg/m^2).

Patient information was extracted from patients' antenatal record and entered into the study proforma. Data collected included maternal age, booking body weight in kilograms before 15 weeks gestation or pre-pregnancy body weight, maternal height in metres, marital status, smoking history (active or passive smoker), any underlying medical diseases and obstetric complications during pregnancy, types of labour, mode of delivery, complications during delivery and perinatal outcomes such as gestational age in weeks, alive or stillbirth, birth weight in kilograms, and admission to Special Care Baby Unit (SCBU) were obtained from the patients' records.

Maternal age was divided into <20, 20 -34, and ≥35 year groups. For the statistical analyses of the outcome, we combined overweight, obese, and morbidly obese categories, leaving just three categories: Underweight (Low BMI), Normal (Normal BMI), and Overweight/Obese/Morbidly obese (High BMI). Obstetric and perinatal outcomes were compared using univariate, bivariate, multivariate analysis and logistic regression analysis. The normal range BMI group (20-24.9 kg/m^2) was used as the reference or comparison group for the analysis.

Ethical approval was obtained for the study from the Medical and Health Research Ethics Committee (MHREC), Ministry of Health prior to participant recruitment. Statistical analysis was conducted using Statistical Package age for Social Scientists (SPSS) Version 17.0.

RESULTS

There were a total of 5,024 deliveries recorded during the study period. Of these, 1,417 (28.2%) were nulliparous pregnancies. Of these, 127 cases were excluded from the study for various reasons; 10 twin pregnancies, and 117 with either no pre-gestational body weight recorded, late bookings, or did not have any antenatal care before delivery. This left 1,290 subjects for the study.

Overall, 40.4% had normal BMI (Normal), whereas 19.8% and 39.8% were categorised as underweight (Low) and overweight (High) respectively. The demographic information of the subjects is shown in Table 1.

Table 1: Demographics of the different categories.

Characteristics	Underweight n=171 (%)	Normal n=606 (%)	Overweight n=335 (%)	Obese n=108 (%)	Morbidly Obese n=70 (%)
Age (years) [a]	22.73 ± 4.1	25.06 ± 5.0	26.49 ± 4.9	27.35 ± 4.5	27.47 ± 5.4
Married	159 (93.0)	580 (95.7)	318 (94.9)	105 (97.2)	68 (97.1)
Smoking	4 (2.3)	19 (3.1)	12 (3.6)	3 (2.8)	5 (7.1)
Passive Smoking	122 (71.3)	371 (61.2)	172 (51.3)	53 (49.1)	37 (52.9)
Medical diseases					
Hypertension	0 (0)	2 (0.4)	7 (2.1)	12 (11.1)	11 (15.8)
Diabetes mellitus	0 (0)	1 (0.2)	2 (0.6)	4 (3.7)	4 (5.8)
Heart disease	2 (0.8)	5 (1)	2 (0.6)	0 (0)	0 (0)
Anaemia	87 (34)	124 (23.8)	49 (14.6)	12 (11.1)	7 (10)
Asthma	4 (1.6)	14 (2.7)	3 (0.9)	5 (4.7)	0 (0)
Renal disease	1 (0.4)	0 (0)	1 (0.3)	0 (0)	0 (0)

Table 2: Comorbid conditions and comparison between the three groups.

	Underweight (<20.0 km^2)	Normal (20-25.0 kg/m^2)	High BMI (>25.0 kg/m^2)	*p* Value
Medical disease				
PGHT	0 (0)	2 (4)	30 (5.8)	<0.001**
PGDM	0 (0)	1 (0.2)	10 (2)	0.021*
Anaemia	87 (34)	124 (23.8)	68 (13.3)	<0.001**

Legends: PGHT: Pregestational gestational hypertension, PGDM; Pregestational gestational diabetes mellitus

Both PGHT and PGDM were significantly more common among those with high BMI than the Normal and Low groups (p<0.05) (Table 2). Anaemia was significantly higher in the underweight group than in the Normal and High groups (p<0.001).

GHT and GDM were significantly more common among the high BMI group compared to the other groups (p<0.001). The high BMI group was more likely to have term delivery compared to the other group (p=0.044), but more likely to have induction of labour (IOL) (p<0.001) and assisted deliveries (p<0.001).

There was no significant difference in the rates of stillbirth and early neonatal death among the BMI groups. The morbidly obese group had the highest pre-term delivery rate whereas the overweight group had the highest rate of post-term deliveries. The underweight group had the highest percentage of small for gestational age (SGA) babies, whereas the obese group had the highest percentage of large for gestational age (LGA) babies.

Newborns of obese women had the highest admission rate to SCBU compared to other groups. Prematurity was the most common reason for admission to SCBU among babies of women in all the BMI groups. Table 4 summarises the neonatal outcomes for the different BMI groups. Underweight women were significantly more likely to have SGA babies (p<0.05).

Table 3: Maternal outcomes for three BMI groups.

	Underweight	Normal	High BMI	p Value
Obstetric complications				
GHT	9 (3.5)	49 (9.4)	87 (17)	<0.001**
Pre-eclampsia	2 (0.8)	6 (1.2)	7 (1.4)	>0.05
GDM	7 (2.7)	16 (3.1)	59 (11.5)	<0.001**
PROM	24 (9.4)	41 (7.9)	45 (8.8)	0.754
Pre-term labour	22 (8.6)	27 (5.2)	22 (4.4)	0.044*
Reduced AFI	6 (2.3)	19 (3.6)	13 (2.5)	0.467
Types of labour				
Spontaneous	198 (77.3)	365 (70.1)	297 (57.9)	<0.001**
Induction of labour	42 (16.4)	122 (23.4)	193 (37.6)	<0.001**
Mode of delivery				
Normal vaginal	205 (80.1)	363 (69.7)	323 (63)	<0.001**
Instrumental (CS/AVBD)	51 (19.9)	158 (30.3)	190 (37)	<0.001**

Legends: GHT: Gestational hypertension, GDM; gestational diabetes mellitus, PROM: premature rupture of membrane, AFI: Amniotic Fluid index, CS; Caesarean section, AVBD: assisted vaginal breech delivery

Table 4: Demographic characteristics of the study population by gender.

	Low (<20.0 kg/m^2)	Normal (20.0-25.0 kg/m^2)	High BMI (>25.0 kg/m^2)	*p* Value
ENND	0 (0)	1 (0.2)	5 (1)	>0.05
Late NND	0 (0)	1 (0.2)	0 (0)	>0.05
Gestational age				
Pre-term	39 (15.2)	69 (13.2)	68 (13.3)	>0.05
Term	213 (83.2)	446 (85.6)	432 (84.2)	>0.05
Post-term	4 (1.6)	6 (1.2)	13 (2.5)	>0.05
Birth weight				
SGA	39 (15.2)	49 (9.4)	43 (8.4)	<0.05*
AGA	214 (83.6)	454 (87.1)	457 (89.1)	<0.05*
LGA	3 (1.2)	18 (3.5)	13 (2.5)	<0.05*
SCBU Admission	22 (8.6)	42 (8.1)	50 (9.7)	>0.05

Legends: GHT: Gestational hypertension, GDM; gestational diabetes mellitus, PROM: premature rupture of membrane, AFI: Amniotic Fluid index, CS; Caesarean section, AVBD: assisted vaginal delivery, SCBU: Special care baby unit.

Using the underweight group as reference, the relative risk of developing GHT progressively increased from 2.6 for the normal BMI group to 3.7 for the high BMI group when confounding factors such as maternal age and smoking were controlled. The risk of developing GDM was 2.6 times higher among the High group, compared to the Low and Normal BMI groups. The relative risk of having abnormal mode of delivery (instrumental delivery, caesarean section, Assisted Vaginal Breech Delivery) was 2.02 times higher in the normal BMI group and 1.25 times higher in the high BMI group. The relative risk of IOL was 1.5 in the Normal and 2.7 in the High group. These are shown in Table 5.

DISCUSSION

In this study, the prevalence of underweight nulliparous pregnant women was 19.8% and, the prevalence of overweight was 39.8%. Among those categorised as high BMI or overweight, the prevalence of overweight, obese and morbidly obese women was 26%, 8.4% and 5.4% respectively. Only 40% of our nulliparous pregnant women had a normal BMI. The prevalence of overweight and obesity among our pregnant women is comparable to national findings. Data from the Integrated Health Screening carried out between 2007 and 2009 looking at over 50,000 civil servants showed that 38.6% were overweight and 25.7% were obese. [1] Another study looking at the patients attending the various clinics in the country also showed that a substantial proportion were overweight. [17] These pose a major concern and have major implication in the future planning of healthcare which must include public health awareness programmes to halt the increase in the prevalence of overweight.

Table 5: Logistic regression results.

	Low BMI	Normal BMI RR (95% CI)	High BMI RR (95% CI)
GHT	1	2.6 (1.2-5.4)	3.7 (1.8-7.5)
GDM	1	1 (0.4-2.5)	2.64 (1.4-6.1)
Assisted delivery	1	2.0 (1.4-2.9)	1.3 (0.96-1.6)
IOL	1	1.5 (1.0-2.2)	2.7 (1.9-4.0)

Legends: GHT: Gestational hypertension, GDM; gestational diabetes mellitus, IOL: Induction of labour.

Such weight problems are also observed in other countries. In a retrospective study in Aberdeen, Scotland, [16] 11.7% of all nulliparous women delivering singleton babies between 1976 and 2005 were found to be un-

derweight, 21.9% overweight, 7.7% obese and 0.6% morbidly obese. In this study, 58.1% were found to have normal BMI. Our findings are much higher than this study but given the time difference along with the increase in the prevalence of obesity, it is very likely that the findings may be comparable now. Rates reported for a Hong Kong Chinese pregnant cohort was 15.8% which is much lower than our rate. [6] In England, the prevalence of obesity in pregnancy rose from 9-10% in the early 1990s to 16-19% in the 2000s [11, 12] In the United States, the incidence of obesity in pregnancy varies from 18.5% to 38.3% depending on the definition used and also the location of the study. [13- 15]

Overweight patients were more likely to have pregestational premorbid conditions such as HT and DM, whereas anaemia was more commonly associated with underweight and normal BMI groups. This is again not unexpected considering being overweight and having HT and DM are all part of the metabolic syndrome. Not surprisingly obstetric complications such as GHT and GDM were more common in overweight, obese or morbidly obese patients. Increase in metabolic demand during pregnancy and further weight gain are important factors and this will push patients who are pre-DM into overt DM. Not unexpectedly, those who are in the underweight group had a lower prevalence of GHT and GDM compared to the normal BMI group given that the risk for developing these obstetrics complications probably follows a linear correlation: the higher the BMI, the higher the risk. A study from St. Thomas's Hospital in London showed that the incidence of GDM and GHT correlated with body weight. [1] It also showed that preterm delivery, PROM and caesarean section rates correlated with a weight problem. Other studies from Europe, America and Hong Kong have also reported similar findings. [2-4, 6]

Apart from the risk of gestational complications such as GDM and GHT, our High BMI patients were also at higher risk for requiring IOL and assisted delivery compared to the Normal or Low BMI groups. The High BMI group had the highest rate of emergency caesarean section. In the Low BMI group, there were more preterm deliveries, but most went on to have normal deliveries. Leung *et al*.[6] looking at a Chinese population (n=29,303) from Hong Kong over a period of 11 years (1995-2005) also reported that overweight increased the risk of pre-eclampsia. Ramos and Caughey, looking at Caucasian population also reported similar findings. [7] Our study looking at a predominantly Malay population found similar findings in every area with the exception of preterm delivery, pre-eclampsia and PROM.

The High BMI group also had higher incidence of large for date baby. Kumari showed that morbid obesity was an independent risk factor for adverse perinatal outcome among Middle East pregnant women.[5] A large Scandinavian study (n=167,750) [8] also found an association in nulliparous women between increased risk of late foetal death and elevated pre-pregnancy BMI. The risk of early neonatal death almost doubled among nulliparous women with higher BMI. We found no significant difference in perinatal outcome between normal and high BMI groups. There were no significant differences in the rate of requirement for admission to SCBU, stillbirth and neonatal death.

Apart from pre-eclampsia, preterm labor, PROM, foetal macrosomia, early neonatal death, late neonatal death and admission to SCBU, there were no differences in the rates of labor complications such as postpartum haemorrhage (PPH), third and fourth degree perineal tear, shoulder dystocia, and retained placenta between the three groups. A possible explanation for the similar prevalence of foetal macrosomia in both high and normal BMI groups in our study was the higher rate of planned IOL among high BMI women whose pregnancy was more likely to be complicated by PGDM or GDM.

Several studies have examined the effect of being underweight on pregnancy outcomes. Our study showed that low BMI was significantly associated with SGA but not with gestational age or admission rate to the SCBU. Sebire *et al* [9] looking at the impact of maternal underweight concluded that only preterm delivery and birth weight below the 5th centile were more frequent in a low BMI group (n=38,182, BMI <20 kg/m^2) compared to women of normal BMI. They also found that underweight women were at lower risk than normal or overweight women of developing complications such as pre-eclampsia, operative delivery and PPH. Sebire *et al*. suggested that lower plasma volume in underweight women might be associated with uteroplacental insufficiency and the increased risk of SGA babies. On the other hand the authors suggested that the altered haemodynamic responses could be protective against the development of pre-eclampsia. In our study underweight women had a high prevalence of anaemia, and SGA babies, but GHT and GDM were significantly less likely to develop than in the normal or high BMI groups, suggesting a protective factor. This was also the most likely group to achieve normal vaginal delivery. There was no less occurrence of pre-eclampsia in this group than in either the normal or high BMI groups.

In our study, we used the WHO classification instead of the Asia-Pacific definition for weight disorder. Using the WHO classification provided a reasonable separation between the groups and also provides a more achievable target when implementing weight reducing programmes among the population. The use of the Asia-Pacific definition would classify more subjects as high BMI and would make measures to achieve targets far more difficult.

In conclusion, our study showed that maternal BMI was strongly associated with pregnancy complications and outcomes among a predominantly Malay Southeast Asian population. This is an important finding given that obesity is common and is increasing. The risk of adverse outcomes increases significantly with an increase in BMI, while lower than normal BMI is associated with some risk of adverse outcome, but appears to constitute a protective factor for other complications such as gestational hypertension and pre-eclampsia. On the basis of these findings we stress the need for programmes aimed at increasing community awareness of the importance of achieving normal BMI in women who wish to have a healthy pregnancy.

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