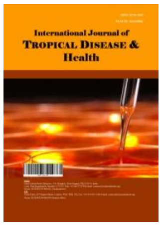

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Association of Foetal Outcome with Maternal Body Mass Index (BMI)

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Authors' contributions

This work was carried out in collaboration with the authors. Author TIC designed the study, wrote the protocol, performed the analyses of the study and revised the manuscript. Author TRC prepared the first draft of the manuscript and managed the literature searches. Both authors read and approved the final manuscript.

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ABSTRACT

Background: The worldwide obesity epidemic continues to be a major public health challenge, particularly in women of childbearing age. There is a need to understand the associations between maternal BMI and perinatal outcome.

Objectives: To evaluate recent trends in maternal body mass index (BMI) and to quantify its association with foetal outcome.

Methodology: It is a cross sectional study including a total of 384 pregnant women who were primi gravida and carry singleton pregnancy admitted at term in the department of Obstetrics and Gynaecology of DMCH for the management of labour. All the mothers were chosen by purposive sampling. The study populations were classified into four groups according to BMI. Group-I stands for 44 mothers who are underweight, Group-II consists of 234 mothers who are normal weight, Group III represents to 81 mothers who are overweight and Group IV signifies for 25 mothers who are obese. The women with multiple pregnancies, preterm labour and hypertension or diabetes

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were excluded from the study. Data regarding socio demographic, clinical, obstetrical and foetal outcome were recorded, afterwards the data were edited, managed and analyzed. The observations were plotted into tabular and figure form. The categorical variable was analyzed by chi square test and the quantitative variables were analyzed by ANOVA test. At all level 95% confidence interval & level of significance was p <0.05. The statistical analysis was done by SPSS version 23.

Results: The mean BMI of mothers in different groups (Group I, Group II, Group III and Group IV) were 18.37±1.06 kg/m^2, 23.77±2.03 kg/m^2, 26.54±2.47 kg/m^2 and 32.15±1.17 kg/m^2 respectively. The average BMI of total 384 mothers was 22.75±4.56 kg/m^2. The highest 84% newborn had birth weight >2.5 kg in Group IV whereas 72.7% had ≤2.5 kg birth weight in Group I. Maximum (57%) mothers underwent NVD in Group I as long as the paramount (71%) mothers endured LSCS in Group III. Out of 384, total 180(46.9%) mothers had NVD and 204(53.1%) mothers deferred LSCS. APGAR score ≤7 was found 31.8%, 12.8%, 38.3% and 20% in Group I, Group II, Group III and Group IV independently. The P-value showed statistically significant of the groups (P=0.00016). Among 204 LSCS, 167(81.9%) mother sustained emergency and 37(18.1%) undertook elective LSCS. 52.9% of mothers went through LSCS were due to meconium staining liquor in Group IV which was subsequently followed by 46.6% in Group-III. 25.0%, 9.8%, 32.1% and 16% neonates required NICU admission in Group I, Group II, Group III and Group IV severally. There was a moderately positive significant correlation between maternal BMI and neonatal birth weight (r=+.383, p<0.001). All the statistics of requirements of NICU between one another group showed statistically significant difference.

Conclusion: Our study shows that maternal BMI has an effect on foetal outcome. Low BMI is associated with adverse perinatal outcome in terms of low birth weight while high BMI is associated macrosomia, LSCS and neonatal NICU admission. Regarding NICU requirements overweight mothers had more association with foetal outcome rather than obese. Therefore, definitely there is a role of pre pregnancy counseling regarding maintenance of weight of women especially during reproductive age group to maintain normal BMI as to have better perinatal outcome.

Keywords: Body mass index; foetal; maternal; Apgar score.

1. INTRODUCTION

The obesity epidemic is a chronic disorder which is associated with metabolic disease, nutritional deficiency, musculoskeletal complications and carcinomas [1]. These obesity-related health issues extent to pregnancy where they are responsible for producing a variety of medical and obstetric complications resulting in an increased incidence of maternal and foetal adverse outcomes [2]. A number of systems have been used to classify obesity. The body mass index (BMI) is also known as Quetelet's Index. WHO describes obesity as one of the most blatantly visible, yet most neglected, public health problems that threaten to overwhelm both more and less developed countries. Obesity is a major public health issue and as per WHO, it is a killer disease at par with HIV and malnutrition.

There has been a dramatic increase in the prevalence of obesity in the past 2 decades in developed countries. The World Health Organization (WHO) estimated that in 2008, about 205 million men and 297 million women over the age of 20 were obese, a total of more than half a billion adults worldwide [3]. In the WHO Regions of the Americas, >62% of the population over the age of 20 were overweight (body mass index [BMI] > 25 kg/m^2) and 26% were obese (BMI > 30 kg/m^2) [3].

In developing countries, the transition from rural agrarian to urban economies has accelerated the appearance of obesity [4], which is accompanied by a shift in overall health burden from infectious diseases and under nutrition to Western chronic diseases such as cardiovascular disease, cancer, and diabetes. The rise in obesity, thus, portends a worldwide. The prevalence of obesity has steadily increased between males and females, all ages, and all educational levels. Maternal obesity has been associated with adverse perinatal outcome.

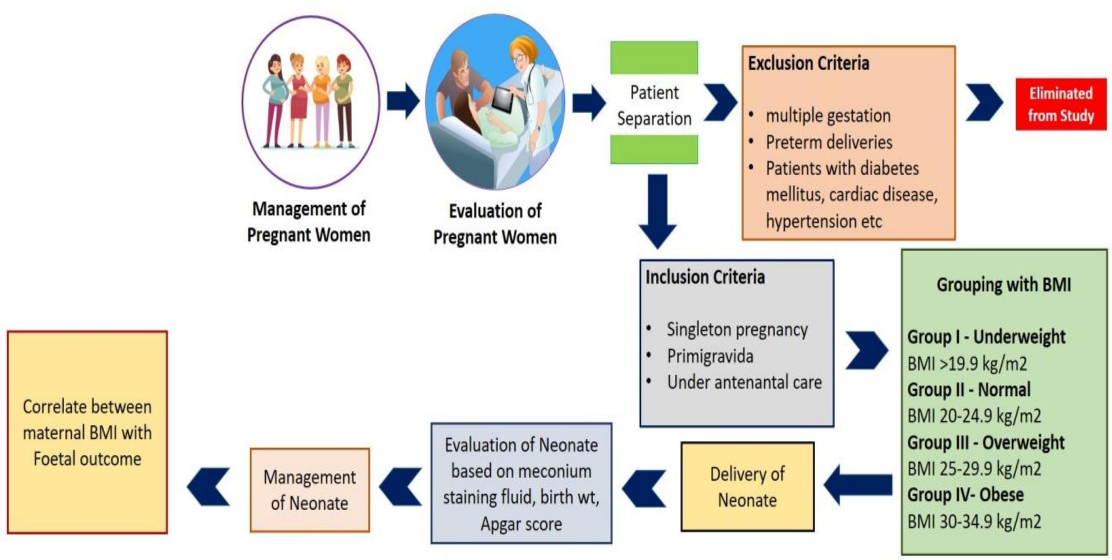
The BMI is calculated as weight in kilograms divided by the height in meters squared. Categories of BMI are as follows: BMI of 20-24.9 kg/m^2- normal, BMI of 25-29.9 kg/m^2- overweight, and BMI of >30 kg/m^2-obese [5]. The obese women when compared with women with a normal BMI have a greater risk of medical diseases during pregnancy [6]. The mechanism appears to be related to the endocrine milieu associated with obesity (increased levels of insulin, androgens and leptin [7].

Chronic inflammatory process associated with obesity extends to the placenta during pregnancy, with recently described direct adverse foetal effects [8]. Adipose tissue is capable of producing a significant amount of pro-inflammatory cytokines such as tumor necrosis factor (TNF)-α, interleukin (IL)-6, and adipokine hormones such as leptin and adiponectin [9]. The relative increase in adipose hypertrophy and hyperplasia during obese pregnancy leads to dysregulated release of adipokines, plasma free fatty acids, and inflammatory markers [10]. Adiponectin is exclusively produced by adipocytes, and lower levels are associated with insulin resistance independently from adiposity and other confounding factors [11]. Although not released by the placenta, subcutaneous adipose tissue biopsies have shown that adiponectin mRNA (messenger ribonucleic acid) expression levels decrease over the course of pregnancy. The placenta is an important source of leptin, TNF-α, and ILs. Analysis of placentas from obese pregnant women have found increased infiltration of macrophages and increased expression of inflammatory markers [12]. Taken together, the relative increase in pro-inflammatory cytokine production by the adipose tissue and placentas of obese women may exaggerate physiological adaptations in pregnancy, ultimately leading to increased availability of nutrients for the foetus. This may also mean that offspring of obese women may be exposed to increased inflammation in utero, with potential harmful effects.

Obese women are more likely to have induction of labor, prolonged labor, shoulder dystocia and cesarean deliveries [13]. Anesthetic hazards are high [14]. There is increased chance of puerperal urinary tract infection, PPH, deep vein thrombosis, poor wound healing and lactation failure in obese women [15].

Foetal macrosomia is common in pregnant women with high BMI which increase the risk of shoulder dystocia and foetal birth injury. Immediate neonatal complications such as hypoglycaemia, hyperbilirubinaemia and respiratory distress syndrome are also associated with raised maternal BMI. Congenital anomalies like neural tube defects, orofacial abnormalities, cardiac defects, limb reduction defects and intestinal tract anomalies such as anorectal atresia and omphalocele are also more common. There is also an increased risk of NICU admission [16].

Pregnancy weight gains of 6.7–11.2 kg (15–25lb) in overweight and obese women, and less than 6.7 kg (15lb) in morbidly obese women are associated with a reduction in the risk of adverse outcome.



Graph 1. Graphical abstract of the study

Some researchers have agreed with the Institute of Medicine's initial recommendations for maternal weight gain during gestation [17]; however, recent studies suggest that lower gestational weight gain may be preferable [18,19]. In developing Asian countries, such as Iran, women generally have a lower BMI and/or a smaller gestational weight gain than in developed countries. In the USA, for example, 2% of pregnant women have a BMI < 18.5 and more than 50% have a BMI > 25 [20]. Hence, BMI seems to differ across populations. Taking this into account in combination with the possible effects of maternal BMI on pregnancy outcome [20], there is a requirement to examine whether the current recommendations for pregnant women from the USA also apply to women from other countries such as Iran [21]. In such context of controversy in our country there have been limited study regarding the association of maternal BMI with foetal outcome. The objectives of the study are (a) to evaluate the rate of various foetal outcome associated with the maternal BMI during pregnancy, (b) to measure the birth weight of babies to find out the interrelation with maternal BMI, (c) to estimate the APGAR score of the newborn and to correlate the findings with maternal BMI, (d) to assess the frequency of meconium stained fluid during delivery as an indicator of foetal stress & its association with different maternal BMI groups and (e) to calculate the frequency of the Neonatal Intensive Care Unit (NICU) admission of neonates in various maternal BMI groups.

2. MATERIALS AND METHODS

2.1 Design of the Study

This cross sectional study was carried out on January 2017 to December 2017 in the department of Obstetrics and Gynaecology, Dhaka Medical College Hospital (DMCH), Dhaka, Bangladesh.

2.2 Study Population

The study population includes the pregnant women attending the antenatal clinic and admitted in the department of Obstetrics and Gynaecology of DMCH for the management labour. Study population was divided into 4 groups depending on their BMI [3].

Underweight (group I): Less than or equal to BMI 19.9 kg/m^2
Normal (group II): BMI 20-24.9 kg/m^2
Overweight (group III): BMI 25-29.9 kg/m^2
Obese (group IV): BMI 30-34.9 kg/m^2

2.3 Sampling Method

Purposive sampling was accomplished according to the availability of the patients who fulfilled the inclusion criteria.

2.4 Sample Size Determination

The Sample size was determined by using following formula,

$n=Z^2pq/d^2$

n = desired sample size
z = standard normal deviate usually set at 1.96
p = proportion in the population (as there was limited study in our perspective so we let p=50%).
q = 1-p
d = Degree of accuracy which is considered as 0.05

$$n = \frac{(1.96)^2 \times 0.5 \times 0.5}{(0.05)^2}$$

$$= \frac{3.8416 \times 0.25}{0.0025}$$

= 384.16

The sample size should be ≥384

So, 384 sample size was taken for our study purpose.

2.5 Selection Criteria

2.5.1 Inclusion criteria

Eligibility criteria included: Singleton pregnancy, primigravida, under antenatal care in DMCH, Dhaka as well as admitted for the management of labour, four groups according to the BMI.

2.5.2 Exclusion criteria

The women with multiple gestation, preterm deliveries and patients with known medical complications like diabetes mellitus, cardiac disease, hypertension, chronic renal diseases and endocrinal dysfunctions, pre eclampsia, eclampsia, gestational diabetes mellitus were excluded in this study.

2.5.3 Variables

The participants were examined for various variables including (a)socio-demographic variables (age, socioeconomic status (monthly income), life style (occupation, educational level, residing) (b) anthropometric variables (BMI = Wt. (kg)/Ht. (m^2)), (c) Obstetric Variables (mode of delivery), (d) Outcome Variables (birth weight of baby, APGAR score at 1 and 5 minutes, admission to NICU, meconium stained fluid as an indicator to foetal stress) and were recorded on performas designed for the purpose of study. Structured questionnaire was prepared for this purpose, which included all the variables of interest.

2.6 Study Procedure

In this cross sectional study, 384 pregnant women were recruited for this study, admitted in the department of Obstetrics and Gynaecology, DMCH, Dhaka for the governance of child birth. During the study period (after approval of protocol) and they were divided into 4 categories depending on their BMI. Method of sampling was purposive according to the availability of the patients fulfilling the selection criteria. For every subject separate data collection sheet, was prepared. Body Mass Index is a simple calculation using a person's height and weight. The formula is BMI = kg/m^2 where kg is a person's weight in kilograms and m^2 is their height in metres squared. The purpose and procedure of the study was discussed with the patient. Written consent was taken from those who agreed to participate in the study. On receipt of the informed written consent, data was collected from the patients on variables of interest using the structured design by interview, observation, clinical examination and the samples were weighed and height was measured for BMI in the third trimester when patients admitted for the management of labour. The neonatal outcomes included: birth weight, the Apgar score, meconium stain and admission to the neonatal intensive care unit. The APGAR test is done by a doctor, midwife, or nurse. The health care provider examines the baby's breathing effort, heart rate, muscle tone, reflexes, skin color etc.

2.7 Statistical Analysis

Collected data were checked and edited first. Statistical analysis was performed using the Statistical Package for Social Sciences (SPSS, Chicago, IL) version 23 software for Windows. Descriptive statistics were performed, and all data were expressed as mean ± SD and percentage ratio. The quantitative values were compared by using ANOVA test and the qualitative values were compared by using the Chi-square test (X^2) among the different groups. A p-value of <0.05 was considered statistically significant.

The entire study subject was thoroughly appraised about the nature, purpose and implications of the study, as well as entire spectrum of benefits and risks of the study. There are minimum physical and psychological risks during physical examinations; proper consent was taken. Interest of the study subjects was compromised to safeguard their rights and health. During physical examination and interview privacy was maintained. For safeguarding confidentiality and protecting anonymity each of the patients was given a special ID number which was followed in each and every step of the procedure. All study subjects were assured of adequate treatment of any complications developed in relation to study purpose and freedom to withdraw themselves from the study any time. A data sheet (enclosed) was prepared for which a short interview of 15-30 minutes was required. Drug or placebo was not used for this study.

3. RESULTS

3.1 BMI Distribution

Our study showed (Table 1) that the mean BMI of mothers in different group where 18.37±1.06 kg/m^2, 23.77±2.03 kg/m^2, 26.54±2.47 kg/m^2 and 32.15±1.17 kg/m^2 were the mean BMI of Group I, Group II, Group III and Group IV mothers respectively. The mean BMI of total 384 mothers was 22.75±4.56 kg/m^2. Therefore the groups were as follows:

Group I - Underweight BMI ≥19.9 kg/m^2
Group II - Normal BMI 20-24.9 kg/m^2
Group III - Overweight BMI 25-29.9 kg/m^2
Group IV- Obese BMI 30-34.9 kg/m^2

Table 1. Distribution of mothers according to BMI (N=384)

	Group-I (n=44)	Group-II (n=234)	Group-III (n=81)	Group-IV (n=25)	Total (N=384)
BMI (kg/m^2)	18.37±1.06	23.77±2.03	26.54±2.47	32.15±1.17	22.75±4.56

3.2 Birth Weight Distribution

This study revealed that, maximum (84%) newborn had >2.5 kg birth weight in Group IV whereas maximum (72.7%) had ≤2.5 kg birth weight in Group I (Table 2). As a result, prevalence of low birth weight was more in underweight group whereas obese and overweight group had maximum number of babies with birth weight >2.5 kg. The mean birth weight was the highest in Group IV. All the values showed statistically significant difference with one another from the perspective of distribution of newborn number in each group according to birth weight and from the perspective of mean birth weight.

3.3 APGAR Score

In Table 3, it has been showed that 31.8%, 12.8%, 38.3% and 20.0% neonates had APGAR score ≤7 in Group I, Group II, Group III and Group IV respectively. The P-value showed statistically significant difference between one another group (P=0.00016).

Table 2. Distribution of newborns of different groups according to birth weight (N=384)

Birth weight (in kg)	Group-I (n=44) No. (%)	Group-II (n=234) No. (%)	Group-III (n=81) No. (%)	Group-IV (n=25) No.(%)	P-value
≤2.5	32(72.7%)	93(39.7%)	13(16.0%)	4(16.0%)	**<0.002^{S}**
>2.5	12(27.3%)	141(61.3%)	68(84.0%)	21(84.0%)	
Mean birth weight±SD (in kg)	2.03±0.64	2.71±0.29	2.87±0.35	3.010.45	0.04^{S}

p-value was calculated by chi square test (categorical variable) and student's t test (quantitative variable)S: Significant, p-value was significant at <0.05

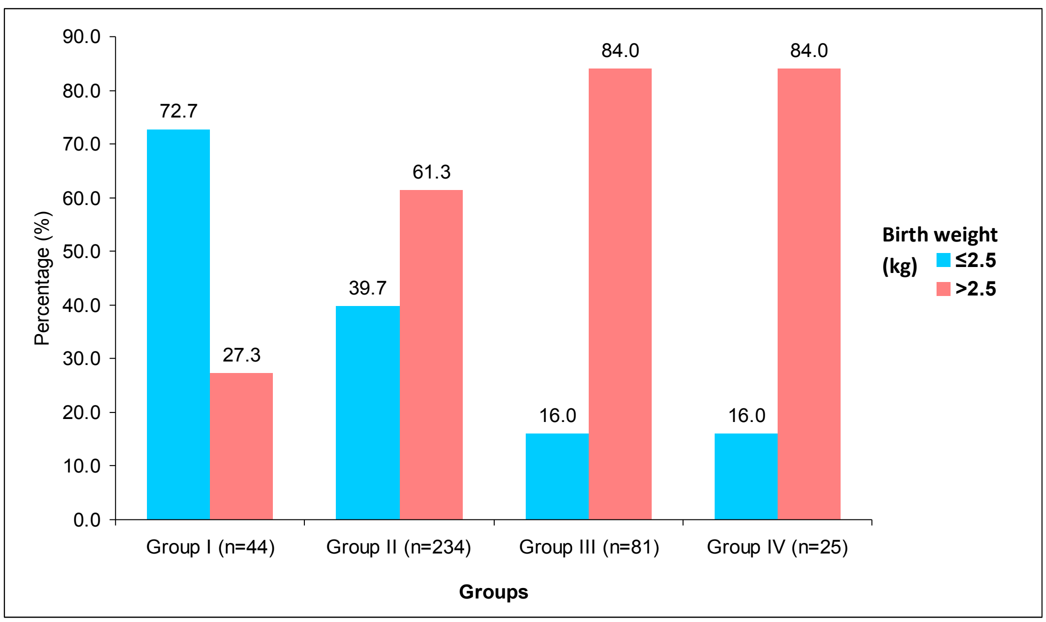


Fig. 1. Bar diagram showing the birth weight in different groups (n=384)

Table 3. Distribution of neonates according to APGAR score at 5 minutes (N=384)

APGAR score at 5 minutes	Group-I (n=44) No. (%)	Group-II (n=234) No. (%)	Group-III (n=81) No. (%)	Group-IV (n=25) No. (%)	P-value
≤7	14(31.8%)	30(12.8%)	31(38.3%)	5(20.0%)	**0.00016^{S}**
>7	30(68.2%)	204(87.2%)	50(61.7%)	20(80.0%)	

P-value was calculated by chi square test, S: Significant, P-value was significant at <0.05

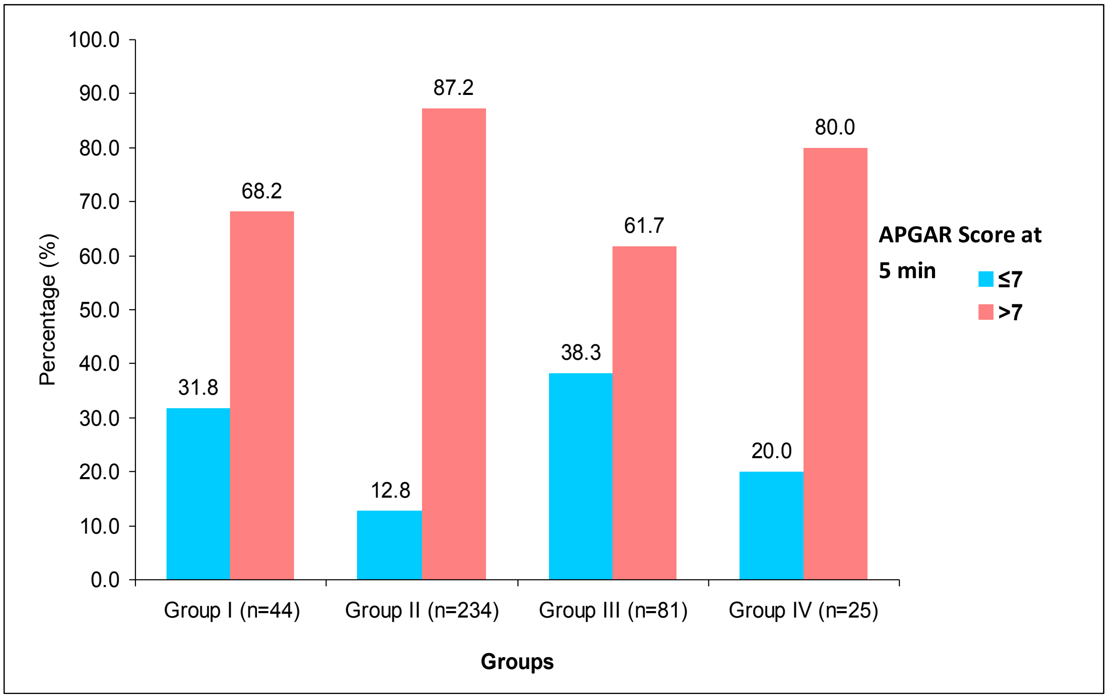


Fig. 2. Bar diagram showing the distribution by APGAR score at 5min among different groups (N=384)

Table 4. Distribution of mothers with meconium staining revealed foetal distress among mothers underwent LSCS (N=204)

Meconium staining	Group-I (n=19) No. (%)	Group-II (n=110) No. (%)	Group-III (n=58) No. (%)	Group-IV (n=17) No. (%)	P-value
Yes	7 (36.8%)	29 (26.4%)	27 (46.6%)	9 (52.9%)	**0.024**[S]
No	12 (63.2%)	81 (73.6%)	31 (53.4%)	8 (47.1%)	

P-value was calculated by chi square test, S: Significant, P-value was significant at <0.05

Table 5. Distribution of neonates according to requirements of NICU (N=384)

Requirements of NICU	Group-I (n=44) No. (%)	Group-II (n=234) No. (%)	Group-III (n=81) No. (%)	Group-IV (n=25) No. (%)	P-value
Required	11(25.0%)	23(9.8%)	26(32.1%)	4(16.0%)	**0.001**[S]
Not required	33(75.0%)	211(90.2%)	55(67.9%)	21(84.0%)	

P-value was calculated by chi square test, S: Significant, P-value was significant at <0.05

3.4 Meconium Staining

Our study evaluated that 52.9% of mothers underwent LSCS were due to meconium staining in Group IV which was subsequently followed by 46.6% in Group-III (Table 4). Meconium staining and foetal distress were more in overweight and obese groups. And at the same time foetal distress were more in all groups except normal weight group. All the values showed statistically significant difference between one another (P=0.024).

3.5 NICU Admission

Table 5 shows that 25.0%, 9.8%, 32.1% and 16% neonates required Neonatal Intensive Care Unit (NICU) admission in Group I, Group II, Group III and Group IV respectively for low birth weight and foetal distress. All the statistics of requirements of NICU between one another group showed statistically significant difference.

3.6 Correlation between Maternal BMI and Neonatal Birth Weight

Distribution of maternal BMI and neonatal birth weight is illustrated in Fig. 3. There was a moderately positive significant correlation between maternal BMI and neonatal birth weight (r=+.383, p<0.001).

4. DISCUSSION

Maternal obesity and related comorbid conditions have serious impact on the health and development of obese women's offspring. The incidence of maternal obesity at the start of pregnancy is increasing worldwide [22]. International studies show a prevalence of maternal obesity ranging from 1.8% to 25.3% across countries [23]. Approximately 50% of pregnant women have a body mass index (BMI) >25 kg/m [23]. The recent National Health and Nutrition Examination Survey (NHANES) found that in the United States, more than 50% of pregnant women are overweight or obese and 8% of reproductive-aged women are extremely obese [24]. Compared to developed countries, maternal obesity is less of an epidemic in developing ones; however, Bangladeshi women of reproductive age have shown a trend of increasing BMI [25]. A survey conducted among this subpopulation found obesity prevalence increased from 2.7% to 8.9% between 1996 and 2006 [25].

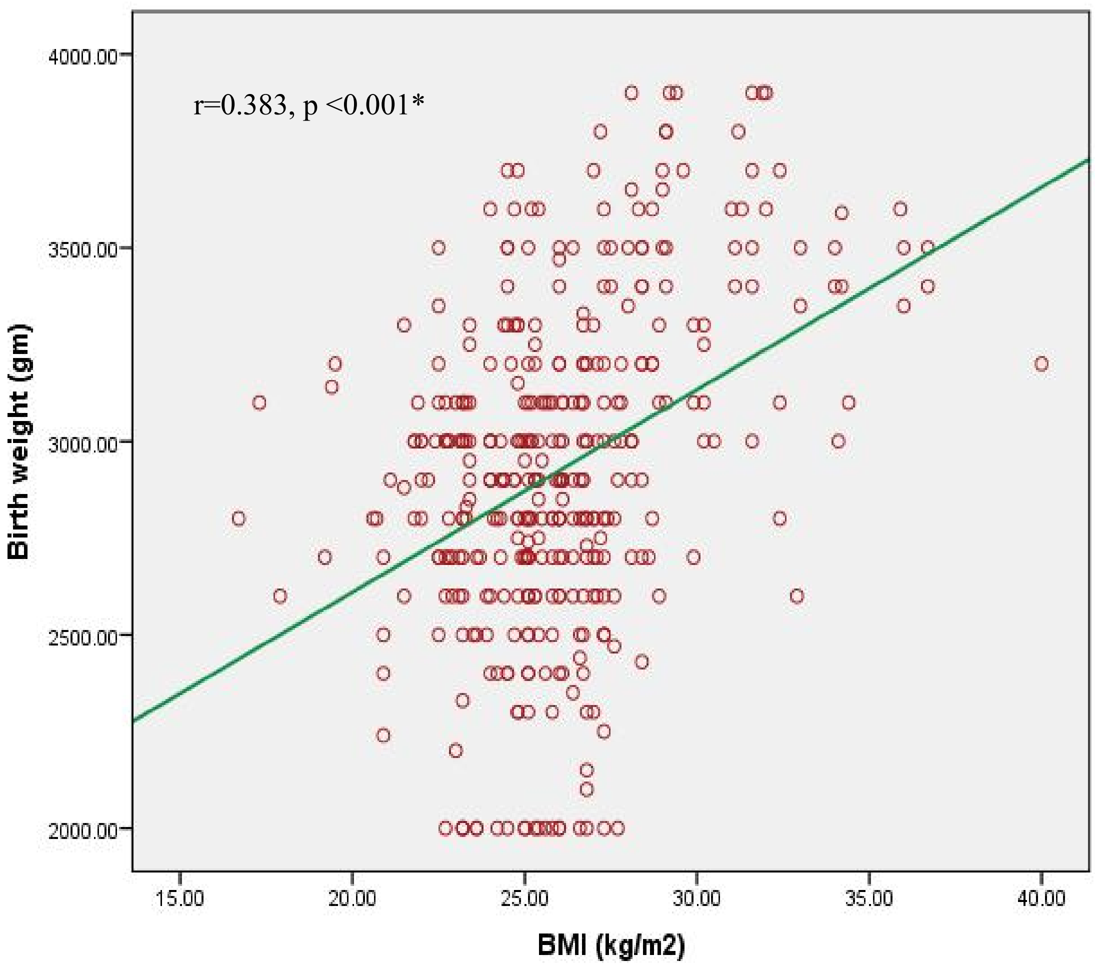


Fig. 3. Correlation of maternal BMI with foetal birth weight

In our study, we have determined the total sample size 384 which was divided 4 groups namely Group I (n=44), Group II (n=234), Group III (n=81) and Group IV (n=25). These 4 groups revealed the BMI proclaiming under nutrition, normal nutrition, overweight and obese respectively. But when the overall pregnant women are in account the scenario of statistics are not such an equal event. The findings of the study conducted by Shatabdi Goon in [26], on the obesity status of Bangladeshi pregnant women revealed that approximately 40% of pregnant women are overweight in their first trimester of pregnancy, whereas 21.2% are obese in the same time period [26]. These findings mirror those of other literature. For example, Fattah et al. [27] showed an obesity prevalence of 19% in a study of 1,000 Caucasian pregnant women. Another study, conducted on pregnant women receiving maternal care in Bangladesh, showed an obesity prevalence of 23% [28]. Furthermore, A retrospective cohort study including 8,176 pregnant women showed an obesity prevalence of 17.7% [29], Lastly, a cohort study of 4,830 patients with gestational diabetes (GDM) showed an obesity prevalence of 15.7% [24,30] showed the prevalence of obesity among US women of 35.8% in 2009-2010. While the Centre for Maternal and Child Enquiries published that more than 1 in 20 pregnant women in US are severely obese [31], this is one of the first studies that has been conducted in Bangladesh to evaluate the current data on maternal obesity.

Although the mean age in those who were obese did not significantly differ from the comparison group in this study, it has been reported that increasing age is an added risk factor for obesity [32]. This is evident from the confidential enquiries into maternal deaths 1997–1999, which reported more pregnancies occurring in women of more than 25 years of age in 1997–1999 compared with 1988–1990 [33].

The weight of the infant at birth is a powerful predictor of infant's growth and survival. Low birth weight babies are more prone for neuro-developmental and growth impairment, neonatal infections, feeding difficulties, hyperbilirubinemia. Also, maternal obesity is linked with macrosomic infants [34] which increases the chances of childhood obesity [5,35], which in turn, increase the risk of the child having future problems with diabetes, heart disease and stroke.

In present study, we found that maternal BMI showed association with the birth weight of their babies. We found that whatever be the cause of low BMI-either undernourishment or genetic predisposition, under-weight mothers are associated with increased risk to give low birth weight babies. The mean birth weight in case of Group I was 2.03±0.64 kg whereas the same parameter was observed in Group IV as 3.01±0.45 kg. This correlates well with the study conducted by [36] which also mentions that "low maternal weight was associated with increased prevalence of low birth weight".

Results of our study show significantly higher rates of cesarean section in higher BMI groups (Group III & IV) rather than lower BMI groups (Group I & II). In Group III & IV the LSCS were required in 71% and 69% cases respectively whereas in Group I & II the LSCS were required in 43% and 47% cases respectively. In group III, meconium staining, foetal distress and low APGAR score were more than group IV so that higher incidence of NICU admission.

Our results could be compared with those of [13] said that the incidence of cesarean delivery increased from 21.3% in the BMI less than 30 group to 29.8% in the BMI 30-39.9 group and 36.5% in the BMI 40 or higher group.

Also, Kominiarek et al. [37] said that the risk for cesarean section increased as BMI increased for all subgroups, $P < .001$. The risk for cesarean increased by 5%, 2%, and 5% for nulliparous and multiparous with and without a prior cesarean, respectively, for each 1-kg/m^2 increase in BMI. Though this sort of graduation comparison was beyond scope of our study.

In present study associated factors e.g. multiple gestation, preterm deliveries, diabetes mellitus, cardiac disease, hypertension, chronic renal diseases and endocrinal dysfunctions, pre eclampsia, eclampsia, gestational diabetes mellitus of mother or any underlying medical illness were excluded. We found that obese and overweight mothers tend to give birth to babies with higher birth weight. This correlates well with the study conducted by Cedergren [38].

There are various studies that shows that women who were overweight, obese, or morbidly obese had increased chances for induced labour, cesarean section delivery, low APGAR score, low birth weight [31,39,40]. This could be because maternal obesity is associated with risk factors like gestational diabetes, placental insufficiency, pregnancy-related hypertension, and pre eclampsia.

Diabetes in pregnancy causes hyper insulinaemia in the foetus which increases foetal metabolic rate and oxygen requirement in the presence of several factors such as hyperglycemia, ketoacidosis, preeclampsia, and maternal vasculopathy, which can reduce placental blood flow and foetal oxygenation contributing to intrauterine asphyxia. Hypertensive disorders, in pregnancy are associated, with low birth weight, preterm delivery and increased rates of Small for gestational age [41]. Rate of Cesarean delivery is higher because of increased use of induction of labor.

Thus presence of the above complications like gestational diabetes, placental insufficiency, pregnancy-related hypertension increases the chances of induced labor, Cesarean section delivery, low birth weight and low APGAR score. However, in our study, we found no association between maternal BMI with mode of delivery and APGAR score which could be because of the fact that all the cases included in our study had no complications or any underlying medical illness.

In our study no congenital abnormality was found. No national survey or hospital based statistics regarding congenital anomalies in Bangladesh. Major congenital anomalies occur in approximately 2–3% of births with a variable frequency in different populations ranging from 1.07% in Japan to 4.3% in Taiwan. Congenital anomalies or birth defects are relatively common, affecting 3% to 5% of live-births in the United States (USA) and 2.1% in Europe. These account for 8% to 15% of perinatal deaths and 13% to 16% of neonatal deaths in India. For more than two decades, congenital anomalies have been the leading cause of infant mortality in the USA. The morbidity and disability experienced by surviving children also has a major public health impact [42,43].

In present study showed a moderately positive significant correlation between maternal BMI and neonatal birth weight ($r=+.383$, $p<0.001$). In consistent with this study [44] reported a positive significant association between maternal BMI and newborn birth weight.

In present study showed significant association between higher BMI with requirements of NICU admission. Similarly, Anjana Verma and her colleagues (2012) reported the neonatal ICU admission rate was more in obese group (25%) [40].

5. CONCLUSION

This study revealed that maternal BMI had an effect on foetal outcome. Low BMI was associated with adverse perinatal outcome in terms of low birth weight while high BMI occured macrosomia, LSCS and neonatal NICU admission. Regarding NICU requirements overweight mothers had more alliance with foetal outcome rather than obese. So, definitely there is a role of pre pregnancy counseling regarding maintenance of weight of women especially during reproductive age group to maintain normal BMI as to have better perinatal outcome. This investigation will open some opportunities to the researchers interested in foetal outcome depending on maternal BMI. The time has come to realize that healthy pregnancy is a foundation for the health of the future generation and a key solution to ever-rising health care costs.

CONSENT AND ETHICAL APPROVAL

This study was approved by the Ethical Committee of Dhaka Medical College (No: MEU-DMC/ECC/2017/182). A signed informed consent was taken from the patient convincing that privacy of the patient was maintained.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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