ORIGINAL ARTICLE

Association of Gestational Weight Gain and Pre-Pregnancy Body Mass Index with Adverse Pregnancy Outcome

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ABSTRACT

Objective: To determine the association between gestation weight gain (GWG) and adverse pregnancy outcome in a Pakistani population.

Study Design: Analytical study.

Place and Duration of Study: The Aga Khan University, Karachi, from February 2003 to 2007.

Methodology: This study used secondary data of 4,735 women from a large cohort study on fetal growth. Pre-pregnancy BMI was categorized according to the recommendations from the institute of medicine (IOM, 2009) and gestation weight gain (GWG) was noted. Chi-square test was used to find the association of GWG and pre-pregnancy BMI with low birth weight (LBW), preterm delivery, large for gestational age (LGA), and caesarean section. Logistic regression analysis was performed to control for confounders like age, parity, working status and ethnicity.

Results: The prevalence of LBW decreased with increasing BMI. GWG of the population was noted as 8.5 kg. LBW was observed to have an inverse relationship with GWG. Women below the age of 19 were twice more likely to have LBW than above 35 years of age. Weight gain above the recommended range were twice more likely to have large for dates. Overweight women were 1.5 times more likely to deliver preterm whereas obese women were 1.4 times more likely to undergo caesarean section than women with normal BMI.

Conclusion: The optimal weight gain was estimated to be 8.5 kg to prevent low birth weight in our population. Obese women are more likely to have LGA, caesarean sections and pre-term deliveries.

Key words: *Pre-pregnancy body mass index. Gestational weight gain. Adverse pregnancy outcome. Preterm delivery. Low birth weight.*

INTRODUCTION

Gestational weight gain (GWG) is one of the important determinants of pregnancy outcome.[1-3] Pre-pregnancy weight and GWG have a significant influence on birth weight of the fetus. Pregnancy weight gain is substantially influenced by several factors including maternal, physiological and social characteristics.[4] The rate of weight gain is also variable throughout pregnancy and its timing during pregnancy has an impact on birth weight.

Adequate weight gain during pregnancy is associated with the better neonatal and maternal outcomes.[3] Several studies have ascertained the positive association between lower pregnancy weight gain and the risk of low birth weight and pre-term delivery.[5,6] Increased weight gain on the other hand results in higher chances of large for dates, gestational hypertension and need for augmentation of labour.[1,7] Higher weight gain is also found to be positively associated with overweight and obesity in early childhood.[8]

Institute of medicine (IOM) revised the pregnancy weight gain guidelines in 2009 by including four BMI in kg/m^2 categories such as underweight (< 18.5), normal (18.5 – 24.9), overweight (25 – 29.9) and obese (> 30) instead of three categories (low, medium, high).[2,3] The recommended weight gain (kg) for the four categories are; underweight (12.5 – 18 kg), normal (11.5 – 16 kg), overweight (7 – 11.5 kg), and obese (5 – 9 kg). It is observed that in a vast majority of pregnancies the weight gain is not within the range recommended by these guidelines.[9,10] It is either too little or too much, especially in the obese women the lower risk gains are smaller.[3,11,12]

Limited literature is available on the pattern of pregnancy weight gain of women from developing countries.[11,12] Hence, there is a need to see the contextual relevance of these recommendations to our own population.

This study was conducted to determine the association of pre-pregnancy BMI and gestation weight gain with the adverse pregnancy and neonatal outcome in a Pakistani population.

METHODOLOGY

It was an analytical study with the use of secondary data. The study variables were taken from the database

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of large cohort study conducted on fetal growth at the Aga Khan University Hospital and its affiliated maternity hospitals during February 2003 to February 2007. Every singleton pregnancy with known gestational weight gain indicators and neonatal outcomes were included. Cases with multi-fetal gestation and pregnancies complicated by medical disorders like diabetes and hypertension were excluded.

Booking weight was used as a substitute of pre-pregnancy weight as recommended by other studies on gestational weight gain.[13-15] BMI was calculated by using the standard formula of weight/height^2. The women were categorized into four categories with respect to their BMI as per the standard of institute of medicine 2009. Total weight gain was calculated by subtracting the pre-pregnancy weight from the last measured weight before delivery. Gestational age was recorded by LMP and verified by ultrasound as a routine practice within the institution.

Since the aim of the study was to look at the impact of gestational weight gain on adverse pregnancy outcomes within the study population, data on low birth weight (LBW), preterm delivery, mode of delivery, and large gestational age (LGA) was collated. Pre-term delivery was defined as delivery before 37 weeks of gestation. A birth weight below 2500 grams was considered as LBW, whereas LGA was defined as birth weight above 4000 grams. Birth weight and gender of the baby were noted. Pregnancy weight gain and birth weight were adjusted by using the measured weight values. Table I presents the characteristics of the study population.

The effect of gestational weight gain on adverse pregnancy outcome were compared as per guidelines from the institute of medicine,[3] while controlling for BMI, ethnicity, parity, maternal age and working status. To determine the association of adverse pregnancy outcome with pre-pregnancy BMI and gestational weight gain according to the IOM recommendations chi-square test was used at 0.05 level of significance. Logistic regression was also used to obtain the confounding effects of maternal characteristics (ethnicity, age, parity, working status and pre-pregnancy BMI) on adverse pregnancy outcome. The results were presented as adjusted odd ratios (OR) with 95% confidence interval (CI). Statistical analyses were carried out using Statistical Package for Social Sciences (SPSS) version 19 (IBM, Armonk, NY).

RESULTS

A total of 4735 women were included in this study. Nearly half (46.5%) of these had normal pre-pregnancy BMI. The mean age of the women was 28.2 ± 4.8 years. The vast majority of the subjects (90.7%) were between 19-35 years. About 39.5% of the study subjects were nulliparous. The mean maternal weight gain was 8.5 ± 3.8 kg whereas the mean birth weight was 3163.4 ± 465.2 grams. The majority of women were house-wives. Characteristics of the study population are shown in Table I.

The study subjects were categorized according to the IOM recommendations. Table II illustrates the trends of weight gain in these groups. In the low BMI group only 17.4% of women had gained weight in accordance within the recommendations. Similar trend was seen in the normal BMI group where only 16.3% had normal weight gain. In contrast, almost half of the overweight and obese women (48.2% and 56.0% respectively) had pregnancy weight gain within the recommended range.

The association of adverse pregnancy outcome with pre-pregnancy BMI and gestation weight gain is given in Table III and IV. Both the overweight (5.1% vs. 3.4%, $p = 0.012$) and obese women (7.4% vs. 3.4%, $p < 0.001$) were likely to deliver LGA babies compared to adequate BMI women. Obese women were significantly more likely to undergo caesarean section as compared to women with normal BMI (27.8% vs. 23.6%, $p = 0.011$).

Table I: Characteristics of 4735 pregnant women attending Karachi hospitals for antenatal care.

	Frequency (%)	Mean ± SD
Age (years)		
< 19	67 (1.4%)	28.2 ± 4.8
19 - 35	4293 (90.7%)	
35 and above	375 (7.9%)	
Pre-pregnancy BMI (kg/m^2)		
Less than 18.5	144 (3.1%)	
18.5 to 25	2203 (46.5%)	
25 to 29	1344 (28.3%)	
30 and above	1044 (22.1)	
Parity		
No previous delivery	1870 (39.5%)	
One delivery	1277 (27.0%)	
Two and three deliveries	1248 (26.4%)	
Four or more deliveries	340 (7.2%)	
Working status		
Working	106 (2.2%)	
Housewife	4629 (97.8%)	
Ethnicity by language spoken		
Urdu	3417 (72.2%)	
Sindhi	191 (4.0)	
Balochi	68 (1.4%)	
Pathan	387 (8.2%)	
Punjabi	231(4.9%)	
Others	441 (9.3%)	
Hospitals		
AKU	4217 (89.0%)	
AKHWK	518 (11.0%)	
Weight gain (kg)	–	8.5 ± 3.8
Birth weight (grams)	–	3163.4 ± 465.2
Low birth weight	381 (8.0%)	
Preterm labour	2378 (16.2%)	
Caesarean section	1152 (24.3%)	
Large for gestational age	220 (4.6%)	

Table II: Maternal weight gain based on pre-pregnancy BMI .

Pre-pregnancy BMI	Normal weight gain (within the IOM ranges)	Abnormal weight gain		Mean ± SD
		Below IOM	Above IOM	
< 18.5	25 (17.4%)	112 (78.0%)	7 (4.6%)	10.2 ± 7.3
18.5-24.9	359 (16.3%)	1740 (79.2%)	104 (4.5%)	8.9 ± 3.9
25-29.9	647 (48.2%)	483 (35.9%)	214 (15.9%)	8.1 ± 3.9
> 30	585 (56.0%)	147 (14.1%)	312 (29.9%)	8.0 ± 3.3
Total	1616 (34.1%)	2,482 (52.4%)	637 (13.5%)	8.5 ± 3.8

Table III: Adverse outcome based on pre-pregnancy BMI.

Pre-pregnancy BMI	Neonate Weight		Pre-term	Caesarean	LGA
	LBW	Mean ± SD			
< 18.5	18 (12.5%)	3024.2 ± 429.0	18 (12.5%)	30 (20.8%)	1 (0.7%)
18.5 - 24.9	196 (8.9%)	3108.3 ± 444.2	369 (16.7%)	521 (23.6%)	74 (3.4%)
25 - 29.9	99 (7.4%)	3185.5 ± 465.2	189 (14.1%)	311 (23.1%)	68 (5.1%)***
> 30	68 (6.5%)	3270.5 ± 483.2	189 (18.1%)	290 (27.8%)	77 (7.4%)***

**** P-value < 0.05*

Table IV: Adverse outcome compared with recommended weight gain.

Gestation weight gain*	Low birth weight		Caesarean section	Large for gestation Age (LSA)
	LBW	Preterm		
Below	272 (8.7%)	470 (15.0%)**	739 (23.6%)	104 (3.3%)
Normal	84 (7.3%)	205 (17.8%)	296 (25.7%)	67 (5.8%)
Above	25 (5.5%)	90 (19.7%)	117 (25.6%)	49 (10.7%) **

** The gestation weight gain is based on IOM recommendation 2009 [3]*
*** P-value < 0.05*

For those who gained weight within the recommended range were classified as normal, whereas others classified as below and above IOM recommended weight gain. Each of them was then compared with the normal weight gain group. Women who could not reach the optimal weight as recommended by IOM were at a greater risk of having preterm delivery as compared to those who gained within the recommended ranges (17.8 vs. 15.0%, p = 0.01) and LBW (8.7% vs. 7.3%, p = 0.08). In contrast, women who gained weight above recommendation were more likely to have LGA (10.7% vs. 5.8%, p = 0.001) than women with recommended weight gain.

To obtain the risk of adverse outcome associated with abnormal gestation weight gain while controlling for confounders, logistic regression was used. Results showed that the odds of preterm birth were 1.53 times higher in overweight group as compared to the women with normal BMI (OR = 1.53, CI = 1.13 – 1.82, p = 0.002). Among different ethnic groups, the odds of LBW in Balochi women were substantially higher (OR = 2.35, CI = 1.21-4.56, p = 0.011) compared to the reference group of Urdu speaking women.

The odds of caesarean section were higher in obese women than those with normal BMI (OR = 1.44, p = 0.001, CI = 1.17 – 1.78). Among different ethnicities, the chances of C-sections were somewhat increased in Balochi, Sindhi and Punjabi women than Urdu speaking ethnic group but the results were statistically insignificant.

The likelihood of LGA was substantially higher in overweight women (OR = 1.58, p = 0.008, CI = 1.12 – 2.22) compared with normal BMI group. Likewise women who gained weight above the normal range were two times more likely to deliver LGA as compared to those who gained recommended weight (OR 2.00, p = 0.001, CI = 1.35 – 2.98). When compared with nulliparous, the chances of LGA was 2.17 times higher in multiparous women (OR 2.17, p < 0.001, CI = 1.53 – 3.09), and 1.78 times in primiparous (OR = 1.78, p = 0.002, CI = 1.22 – 2.59).

DISCUSSION

Pre-pregnancy body mass index and gestational weight gain are both considered to be the predictors of the maternal nutritional status and have shown to influence the pregnancy outcome. There is evidence that sub-optimal and excessive weight gain, both are associated with adverse pregnancy outcome. This study explored the characteristics of weight gain during pregnancy in an urban setting in Karachi, Pakistan and compared it with the recommended weight gain by IOM.

Nearly half (46.5%) of the women in this study had a normal BMI at the start of the pregnancy. This is similar to that reported in an Iranian population.[6] However, only one out of four women (24.3%) in this study had normal weight gain according to the IOM guidelines. This is consistent with the work done by other investigators,[6,12] but is much lower than that reported in the Caucasian population.[7,10]

The mean weight gain during pregnancy was 8.5 ± 3.8 kg in this cohort, which is similar to that reported by Winkvist *et al.*[12] Total weight gain during pregnancy remains variable and is influenced by a number of factors. Ethnicity in itself may be responsible for these differences. The vast majority of women in Pakistan embark on pregnancy undernourished. Among the factors contributing to this are: inadequate nutritious intake due to poor access to health care, lack of medical facilities, limited or no knowledge about nutritious diet (in pregnancy), and use of prenatal vitamins.[16-18] The poor dietary intake during pregnancy is similar both in urban and rural setup.[16,17] In another study, carried out at urban slum area of Karachi, reported the regular intake of fruits, vegetables and milk products of pregnant women was below the recommended level.[18]

Both normal BMI and adequate GWG results in reduction in adverse pregnancy outcome. GWG has a direct relationship with birth weight.[19] In this study, lean women were found to be at greater risk of low birth weight. A minimum weight gain of 8.6 kg is needed to prevent low birth weight. These findings are consistent with the study done on Indonesian population.[12]

This study was conducted in a leading tertiary care hospital of a large cosmopolitan city which deals with multi-ethnic population from varied socio-economic

strata. There is evidence that certain ethnic population has reduced weight gain primarily due to poor nutritional status and access to care during the antenatal period. Along with poverty, strong cultural norms play vital role in determining women's health during pregnancy. Aftab *et al*. and Dykes *et al*. discussed about socio-economic and ethno-cultural implication on women's nutritional state during pregnancy.[18,20] In this study, Sindhi and Balochi women are found at higher risk of LBW, especially Balochi women who are significantly higher than the reference category.

Excessive weight gain on the other hand results in large for gestational age (LGA). In the current study overweight women were 1.5 times more likely to have LGA. Heude *et al*. found that obese women were twice more likely to have LGA babies. In addition, those who gained weight above the recommended level are significantly at increased risk of LGA. This could be due to the life style and eating habits of pregnant obese women along with the genetic factors.[21]

National nutritional survey has also reported that obesity is a major concern of urban areas. Women possess limited or no knowledge about the benefits of micronutrient intake during pregnancy and its sources. This accentuates an immense need of antenatal education for pregnant women of all socio-economic and demographic class, so that women with different pre-pregnancy BMI can have a healthy pregnancy.

Obese women in this study were more likely to undergo caesarean section. Other studies have confirmed this association, while others have found obesity to be a weak predictor for labour complications.[22,23]

Weight gain below the recommended ranges is reported to be associated with preterm delivery but the exact mechanism of this is not known. In this study, the women with weight gain below the IOM recommendations were more likely to have preterm delivery. Obese women were found to be more at risk of preterm delivery. This is contrary to that reported in the literature.[11]

The strength of this study is that it is a large data set with multiethnic population of varied socio-economic strata.[18,20] The use of booking weight as an indicator of pre-pregnancy weight is one of the limitation of this study. This one is a widely used method, since practically it is not possible for every woman to know how much they weight, right before their pregnancy.[14] Secondly, only those patients were considered who were registered in their first trimester of pregnancy as the expected weight gain in first trimester was very low. The second limitation of this study was its retrospective nature, due to which some of the socio-demographic details such as maternal education, socio-economic index could not be assessed.

CONCLUSION

The present data suggests that nearly half of the women in the local setup embark on pregnancy with suboptimal BMI. The mean weight gain during pregnancy was 8.5 kg. Both pre-pregnancy BMI and GWG influenced the pregnancy outcomes. Adequate weight gain reduced the likelihood of LBW babies. Obese women were more likely to have LGA and are at an increased risk for caesarean section and preterm delivery. The findings of this study highlight the need for nutritional education and life style medication to improve pregnancy outcomes.

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