

A Prospective Study Of Various Factors Affecting Maternal Weight Gain And Outcome

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Abstract

Maternal weight gain determines maternal and fetal outcome. Lower weight gain is associated with low birth weight of fetus and pre term delivery while higher weight gain is associated with gestational diabetes mellitus higher birth weight and complication related to it. Maternal weight gain itself depends on nutritional intake and also various medical condition like diabetes mellitus, hypertension. The institute of medicine guideline says that required gestational weight gain depends on pre gestational BMI, and it needs to be tailored individually. We have done prospective observational study at Kamla Raje hospital Gwalior from January 2019 to June 2020, in which we studied on 500 women maternal weight gain, factors affecting it and maternal outcome. We found 41% underweight while only 4.2% women were overweight. Maximum women were from 20-29 age group (69.8%) and they commonly gain inadequate weight (71%). 53% of women were rural and 47% were urban. 65% of women who gained inadequately weight were rural while 60% of higher weight gained women are urban. Women with adequate weight gain were associated with adequate weight gain (83%). Most common maternal outcome in inadequate weight gain women was PROM (25%) while in higher weight gain women developed hypertension commonly (38%). 71% of inadequately weight gained women delivered by normal vaginal delivery and 78% of higher weight gained women needed cesarian section. We found that women with inadequate or higher weight gain as per IOM guideline associated with poor maternal outcome. Preconceptional counseling regarding nutrition according to BMI and physical activity to be done and also gestational weight gain according to individual BMI should be advised.

INTRODUCTION- Towards the end of the twentieth century, addressing proper pregnancy nutrition became an important part of prenatal care. The Institute of Medicine (IOM) partnered with the Food and Nutrition Board (FNB) to address a knowledge gap in this area by examining and interpreting existing evidence for the development of guidelines for appropriate gestational weight gain (GWG). Up to this point, all pregnant women had been advised to gain the same amount of weight, regardless of prepregnancy weight status. However, the IOM recognized the need to tailor gestational weight gain based on a woman's prepregnancy body mass index (BMI), and this was reflected in the guidelines released in 1990.

The IOM formulated GWG guidelines with the purpose of minimizing negative outcomes for both mothers and newborns. Gaining below the recommended amount increases the risk of delivering a low-birth-weight (LBW) infant, as well as preterm birth. While, gaining above the recommended range increases the risk of high birth weight (HBW), which may cause complications during delivery. Numerous other studies found that falling above or below the IOM guidelines is associated with significant harms, excess GWG is associated with the development of gestational diabetes mellitus and prolonged hospital stay.

The American College of Obstetricians and Gynecologists (ACOG) has made strong claims against the suitability of the IOM guidelines for obese women of varying degrees of severity, particularly the morbidly obese. ACOG asserts that overweight women with low GWG but a properly developing fetus should not be encouraged to increase weight gain simply to meet IOM recommendations. Instead, they propose an individualized care plan for overweight and obese women based on clinical judgment that balances fetal and maternal complications related to GWG (Committee on Obstetric Practice, 2013). Other research backs the ACOG in their dissent from the IOM's guidelines for overweight and obese women, finding that lower GWG among these women decreases the occurrence of cesarean delivery, LGA, macrosomia, and gestational hypertension. Some studies recommend the formulation of individual guidelines for each class of obesity, while another suggests different rates of gain for different trimesters of pregnancy.

OVERWEIGHT AND OBESITY

For women of reproductive age, overweight and obesity increase the risk of pregnancy complications such as gestational diabetes mellitus, thromboembolism, stillbirth, and hypertensive disorders.

• GESTATIONAL WEIGHT GAIN

Gestational weight gain is the weight gained throughout pregnancy. Weight Gain is the unique and complex biological phenomenon that supports the functions of growth and development of the foetus. Maternal pre-gestational weights, BMI, gestational weight gain are factors determining offspring birth weight, weight for length, and adiposity. (1)

• Guidelines for gestational weight gain

In 2009, Institute of Medicine (IOM) published revised guidelines for total and weight gain rate during pregnancy (2). These guidelines are based on pre-gestational body mass index ranges for underweight, normal weight, overweight and obese women recommended by World Health Organization. To improve maternal and child health outcomes, women not only should be within a normal BMI range when they conceive but also should gain within the ranges recommended in the IOM guidelines.

AIMS AND OBJECTIVES

- To analyze and correlate maternal weight gain during pregnancy with various maternal complication and other parameters.
- To identify factors that determines weight gain in pregnancy.

Materials and Method

Prenatal relevant clinical data has been collected from the OPD paper for those patients who attended antenatal clinics from their 1st trimester follow till delivery at Kamla Raja Hospital, Gwalior. Final parameter of the neonate and mother has been recorded at the time of admission in department of Obst. &Gynae at the time of delivery and immediately after delivery.

Place of study: Department of Obstetrics and Gynaecology, Kamla Raja Hospital, Gwalior (M.P.)

Period of study: January 2019 to June 2020.

Study design: Prospective observational study

Sample size:500

Important maternal and neonatal parameters recorded:-

After detailed history taking and examination of each antenatal woman, maternal characteristics like maternal age, gravidity, parity, initial pregnancy weight and body mass index (BMI kg/m²), gestational weight gain noted.

The weight gain in pregnancy and maternal complications such as preeclampsia, PPROM, gestational cholestasis, gestational diabetes, gestational age at delivery, route of delivery, indications for cesarean delivery (e.g. fetal distress, cephalopelvic disproportion, failed induction of labor, preeclampsia, placental abruption, others), preterm delivery, significant intrapartum events like instrumental delivery, cervical or vaginal tears, atonic PPH etc. has been recorded.

Inclusion criteria-Antenatal women who were admitted in the prelabour ward at Kamla Raja Hospital, Gwalior for delivery are enrolled in the study.

Exclusion criteria

- Patients with inadequate data
- Women whose initial pregnancy weight were not known
- Women with multiple pregnancies
- Women who have fetal and placental anomalies

BMI will be obtained by dividing body weight in kilograms by the square of height in meters (weight and height at the first prenatal visit).

According to BMI woman has been categorized into four groups:

1. Underweight (BMI < 19.8 kg/m²),
2. Normal-weight (19.8 ≤ BMI < 25.2),
3. Overweight (26 ≤ BMI < 30)
4. Obesity (BMI ≥ 30) (1).

Patients included in this study have been divided into three groups according to their weight gain during pregnancy:

Inadequate

Adequate

Excess

Gestational weight gain has been calculated by subtracting each woman's pre-pregnancy weight from her weight at delivery.

As per 2009 Institute of Medicine, Gestational Weight Gain recommendation weight for underweight, normal weight, overweight, and obese women should be 12.5–18 kg, 11.5–16 kg, 7–11.5 kg, and 5–9 kg, respectively.

Statistical analysis

All analyses are performed with the statistical program IBM SPSS Statistics 22.0. One-way Anova test have been used for comparison of the groups with normal distribution in comparison of descriptive statistical methods (Mean, Standard deviation) Chi-square test has been used for comparison of qualitative data. Significance will be assessed at $p < 0.05$ level.

OBSERVATION

Table 1: classification of pregnant women according to Pre-pregnancy Weight and gestational weight Gain

No	Pre-pregnancy Weight n=500	adequate Gestational Weight Gain (178)	Inadequate Gestational Weight Gain (272)	Excess Gestational Weight Gain (50)	Mean \pm S.D	P-value
1	Pre-pregnancy Underweight (205) 41%	73 (35.60%)	112 (54.63%)	20 (9.7%)	205 \pm 46.18	0.0165 Significant
2	Pre-pregnancy Normal Weight (184) 36.8%	66 (35.87%)	101 (54.90%)	17 (9.24%)	183 \pm 42.19	0.0173 Significant
3	Pre-pregnancy Overweight (90) 18%	32 (35.56%)	48 (53.33%)	10 (11.11%)	90 \pm 19.08	0.0147 Significant
4	Pre-pregnancy Obese (21) 4.2%	7 (33.33%)	11 (52.38%)	3 (4.28%)	21 \pm 4	0.0119 Significant

From the above table, Out of 500 pregnant women max.205 (41%) women belongs to pre-pregnancy underweight group and only 21(4.2%) pregnant women belongs to pre-pregnancy obese group and other 184 (36.8%) pregnant women were in pre-pregnancy normal weight group and 90 (18%) pregnant women were in pre-pregnancy overweight group. In our study, more than 50% of pregnant women had inadequate GWG during pregnancy period. The percentages of women with adequate GWG and excessive GWG were 35.6% and 10% respectively. All the p values are found using Chi square -test, which is less than 0.05 statistically significant.

Table 2: Correlation of gestational weight gain with maternal age

Maternal age (years) n=500	Adequate Gestational weight gain (178)	Inadequate Gestational weight gain (272)	Excess Gestational weight gain (50)	Mean±Std. Dev.	P-value
20- 29 349 (69.80%)	125 (70.22%)	194 (71.32%)	30 (60%)	116.33 ± 63.13	0.0001 significant
30 - 39 116 (23%)	40 (22.47%)	64 (23.53%)	12 (24%)	38.67 ± 26.03	0.0001 significant
> 39 35(7%)	13 (7.3%)	14 (5.14%)	8 (16%)	11.67 ± 3.21	0.0124 significant

From the above table we understand that the maximum number of pregnant women belonged to 20-29 years age group that is 349 (69.80%). Also pregnant women belonging to 20-29 age group were found to be more likely to gain inadequate gestational weight that is 194 (71.32%), Pregnant women belonged to >35 year age group were more likely to gain excessive gestational weight that is 8 (24%) out of 35 pregnant women. All the p values are found using Chi square -test, which is less than 0.05 that is statistically significant.

Table 3: Correlation of gestational weight gain with Rural/ Urban

Rural/ Urban n=500	Adequate gestational weight gain (178)	inadequate gestational weight gain (272)	Excess gestational weight gain (50)	Mean ± Std. Dev.	P-value
Rural 267(53.4%)	68 (38.20%)	179 (65.80%)	20 (40%)	89 ± 81.55	0.1993 Not significant
Urban 233(46.6%)	110 (61.80%)	93 (34.19%)	30 (60%)	77.67 ± 42.15	0.0857 Not significant

Out of 500, 267(53.4%) pregnant women were belong to rural area and 233(46.6%) from urban area. Max 179 (65.80%) pregnant women who acquired inadequate GWG were from rural area as compare to 93 (34.19%) from urban area. Max. no 30 (60%) women acquired excessive GWG were from urban area as compare to rural area, these findings were found to be statistically not significant as p value came out more than 0.05.

Table 5: Correlation of gestational weight gain with socioeconomic status

	Socio-economic status n=500	Adequate gestational weight gain (178)	Inadequate gestational weight gain (272)	Excess gestational weight gain (50)
1	Upper			
	10	2	1	7
	(2%)	(1.12%)	(0.36%)	(14%)
2	Upper middle			
	52	14	10	28
	(10.4%)	(7.86%)	(3.67%)	(56%)
3	Lower middle			
	201	99	95	7
	(40.2%)	(55.61%)	(34.92%)	(14%)
4	Upper lower			
	175	45	126	4
	(35%)	(25.28%)	(46.32%)	(8%)
5	Lower			
	62	18	40	4
	(12.4%)	(10.11%)	(14.70%)	(8%)

In our study max.no of pregnant women belonged to lower middle class according modified kappuswamy Socioeconomic scale that is 201 (40.2%) , out of which maximum had inadequate and adequate gestatioanal age group respectively 95 (34.92%) and 99 (55.62%). Only 10 (2%) pregnant women belonged to upper class, out of which maximun had excessive Gestatioanalweight gain that is 7(70%). And than 175 (35 %) pregnant women belonged to upper lower class, out of which max.had inadequate weight gain that is 126 (46.32%).

Table 6: Correlation of gestational weight gain with Folic acid supplement

Folic acid supplement n=500	Adequate gestational weight gain (178)	inadequate gestational weight gain (272)	Excess gestationalweight gain (50)	Mean±Std. Dev.	P-value
Yes 413(82.60%)	145 81.46%	228 88.82%	40 80%)	137.67 ± 94.21	0.1270 Not significant
No 87(17.40%)	33 18.53%	44 (16.18%)	10 (20%)	29 ± 17.35	0.1015 Not significant

Table 7: Correlation of gestational weight gain with Protein supplement

Protein supplement n=500	Adequate gestational weight gain (178)	inadequate gestational weight gain (272)	Excess gestational weight gain (50)	Mean±Std. Dev.	P-value
Yes 272(54.4%)	149 83.71%	88 32.35%	35 70%	90.67 ± 57.05	0.1105 Not significant
No 228(45.6%)	29 (16.30%)	184 (67.65%)	15 305	76 ± 93.79	0.2956 Not significant

In our study after follow up I found max.no of pregnant women were compliant to folic acid supplementation 413(82.60%) as compare to protein supplementation 272(54.4%).Maximum pregnant women with folic acid supplementation acquired inadequate GWG 288 (83.82%) where as max. pregnant women with protein supplementation acquired adequate GWG 149 (83.71)

Table 8: Correlation of gestational weight gain with Gestational age at delivery

n 500	Inadequate GWG N=272	Adequate GWG N=178	Excessive GWG N=50	Mean ± Std.dev.	P
<20-34 weeks 37 (7.4%)	24 (8.82%)	7 (3.93%)	6 (12%)	18.5 ± 14.84	0.0382
>34-37 weeks 140 (28%)	113 (41.54%)	18 (10.11%)	9 (18%)	70 ± 66.27	0.0251
>37-41 weeks 290 (58%)	118 (43.38%)	146 (82.02%)	26 (52%)	145 ± 109.42	0.0070
>41 weeks 33 (6.6%)	17 (6.25%)	7 (3.93%)	9 (18%)	16.5 ± 11.82	0.0483

Out of 500 pregnant women, 37 (7.4%) women went into preterm delivery (>20-34weeks) out of which maximum that is 24 were under inadequate gestational weight gain group. 140 (28%) pregnant women delivered at 34-37weeks out of which max.113 women were under inadequate GWG group. Max. no. of women were 290 (58%) out of 500 went into term delivery (37-41weeks) out of which max.that is 146(82.02%) were belonge to adequateGWG group.

Table 9: Correlation of gestational weight gain with maternal outcome

	Protein suppleme nt n=500	inadequat e gestationa l weight gain (272)	Adequate gestation al weight gain (178)	Excess gestationalweig ht gain (50)	Mean±St d. Dev.	P- value
PROM	116 (23.2%)	69 (25.37%)	33 (18.54%)	24 (48%)	60.5±41.8 0	0.002 8
Gestational Hypertensio n	130 (26%)	63 (23.16%)	48 (26.97%)	19 (38%)	65±47.02	0.039 9
GDM	29 (4.8%)	7 (2.5%)	8 (4.50%)	14 (28%)	14.5±10.1 5	0.024 7
Gestational Cholestasis	29 (5.8%)	2 (0.73%)	11 (6.18%)	16 (32%)	14.5±11.2 7	0.042 3
Placenta Abruptio	59 (11.9%)	45 (16.54%)	8 (4.50%)	6 (12%)	29.5±26.6 1	0.013 3

From the above table we understand there were 500 pregnant women from which 178 (35.6%) women had adequate gestational weight gain, out of which 48 (26.95%) women had developed gestational hypertension, 33(18.54%) women land up into PROM, 11(6.18%) women developed gestational cholestasis and 8 (4.50%) cases acquired gestational diabetes, and 8 (4.50%) women land up in placenta abruptions maternal outcome.

In our study 272 pregnant women had low gestational weight gain from which 69(25.37%) pregnant women had developed PROM, 63(23.16%) women developed gestational hypertension and 45 (16.54%) developed placenta abruptio and only 7 women (2.57%) developed gestational diabetes and only 2 (0.73%) developed gestational cholestasis.

Out of 500, 50 pregnant women were with excess gestational weight gain among them 19 (38%) had developed gestation hypertension and 16 (32%) had developed gestational cholestasis follow by 24(48%) pregnant women had developed PROM and also 14(28.0%) women developed Gestational diabetes and only 6(12%) women developed placenta abruption.

Table 10: Correlation of gestational weight gain with pregnancy outcome

	Protein supplement n=500	inadequate gestational weight gain (272)	Adequate gestational weight gain (178)	Excess gestational weight gain (50)	Mean±Std. Dev.	P- value
Cesarean section	139 (27.8%)	79 (15.8%)	22 (12.36%)	38 (76%)	69.5±52.18	0.026 1
Spontaneous Vaginal delivery	361	193 (70.95%)	156 (87.64%)	12 (24%)	180.5±143.4 4	0.036 4

Out of 500, 50 pregnant women were with excess gestational weight gain group among them 38 (78%) pregnant women underwent cesarean section for this p value is 0.0261 that is statistically significant and 272 pregnant women were with inadequate gestational weight gain group among them 193 (70.95%) pregnant women delivered spontaneously vaginally for this p value is 0.0364 that is statistically significant.

DISCUSSION

In our study, out of 500 pregnant women from which max. 205 (41%) women had pre-pregnant underweight group and minimum 21(4.2%) pregnant women had pre-pregnancy obese group and more than 50% of pregnant women had low weight gain during pregnancy period, Similar study conducted by Princeton University around 40% of Indian women are underweight when they begin their pregnancy (3). Most common causes of underweight in Indian women are severe anemia, malnutrition and sometimes nausea and vomiting during the first trimester of pregnancy. In our study, out of study population (pregnant women) most of women had low weight gain during pregnancy period this is comparable to the similar study by Priyanka Arora and Bani Tamber Aeri at all 2019(4), they had done prospective study of healthy Asian women with a singleton pregnancy which specifically examined fetal-maternal outcome relative to IOM 2009 guidelines were included, they found that majority of pregnant Indian women achieved less GWG than the recommendation. In another a retrospective

study conducted among the Japanese pregnant women who were included in the Japan Society of Obstetrics and gynecology registry system illustrated that majority of pregnant women gained less weight than IOM recommendations.

In our study, maximum number of pregnant women belonged to 20-29 years age group 349 (69.80%). Pregnant women belonging to this group were more gain inadequate gestational weight. Pregnant women belonged to >35 year age group were more gain excessive gestational weight 8 out of 35 pregnant women from which 8, 24%) women had excessive gestational weight gain. This is comparable to the similar study by Mariam Ali Abdulmalik et al (2019)(5) they had done prospective study of healthy Asian women with a singleton pregnancy which specifically examined fetal and maternal outcomes relative to IOM 2009 guidelines, they also found that pregnant women belonged to 20-30 years age group were gain inadequate gestational weight and pregnant women belonged to >35 year age group were gain excessive gestational weight. It can be fact that higher age above 30 years was associated with increased pre gestational weight older age may in fact be accompanied by multiple pregnancies and consequently a higher possibility of weight retention. Similar study done by Naresh P. Motwani (2019) maternal under nutrition is a known to be major factor contributing to adverse pregnancy outcome mean birth weight among young age mother (<20 years) was 2068 gms which was significantly lower than mean birth weight, with increase in gestational weight gain there was a corresponding increase in mean birth weight and this increase was statistically significant maternal age and gestational weight gain had significant impact on newborn anthropometry. Young age (<20 years) and decreased gestational weight gain in associated with increased number of low birth weight babies. Although patient with advanced maternal age are notable, more attentions should be paid to women older than 30 years or younger than 25 years in term of weight control. Another similar result found in study done by Zhebgyan dai et al 2014 (6) the rate of insufficient GWG was higher in women aged below 23 years old ($p < 0.005$) and the rate of excessive GWG was higher in women aged 24-34 years old ($p < 0.05$).

In our study, on the analysis of the cases, we found that 267 (53.4%) pregnant women belonged to rural area from which max.179(65.80%) women acquired inadequate gestational weight gain and 233 (46.80%) belonged from urban area from which 30 (60%) women acquired excessive gestational weight gain as compare to rural area, similar study done by Zhengyan Dai, (2014) to evaluate the situation of pre-pregnancy weight and gestational weight gain (GWG) of women in the urban and rural areas of southwest of China. Total 3391 women whose infants and young children aged 6 - 24 months were selected from urban and rural areas of Kunming, Guiyang and Chengdu cities by stratified cluster random sampling. They found the rate of excessive GWG in urban group was higher than rural group ($P < 0.05$). It should be paid more attention to improve the underweight of pre-pregnancy and abnormal GWG among women belongs to rural area.

Now we had identify on the basis of education there are 500 pregnant women from which 326(65.2%) were illiterate out of which max.197 (60.43%) had inadequate gestational weight gain. Similar study done by Eileen C O'Brien et al 2017, they compared women with high education, women with low educational attainment are at an increased risk of both excessive and inadequate weight gain. Diet based interventions seem the most appropriate choice for these women, and additional support through mixed interventions may also be beneficial.

In our study after follow up, found max.no of pregnant women were compliant to folic acid supplementation 413(82.60%) as compare to protein supplementation 272(54.4%). Maximum pregnant women with folic acid supplementation acquired inadequate GWG 288

(83.82%) where as max. pregnant women with protein supplementation acquired adequate GWG 149 (83.71).

In our study we found, Out of 500 pregnant women, 37 (7.4%) women went into preterm delivery (>20- 34weeks) out of which maximum that is 24 were under inadequate gestational weight gain group. 140 (28%) pregnant women delivered at 34-37weeks out of which max.113 women were under inadequate GWG group. Max. no. of women 290 (58%) out of 500 went into term delivery (37-41weeks) out of which max. that is 146(82.02%) were belongs to adequate GWG group.

Similar study done by Andrea J.sharma et al (2019) they also found association between GWG and preterm birth among women with a BMI <25 and they have suggested that low GWG women is more strongly associated with preterm birth. Other similar study done by Ping Guan et al (2019) (7) they also found that pregnant women in inadequate gestational weight gain group had a higher risk of having preterm birth. The mechanism for this finding could be that inadequate weight gain induces secretion of epinephrine and cortisol which then result in an elevation in corticosterone releasing hormone and prostaglandin production. These are all key factors for preterm delivery.

The study conducted by Priyanka Arora and Bani Tamber Aeri (2019)(8) on gestational weight gain among healthy pregnant women from Asia in comparison with institute of medicine guidelines 2009 among Indian and other asian pregnant women in terms of maternal and fetal outcomes they found majority of pregnant Indian women achieved less GWG than the recommendation.

CONCLUSION-- We found that weight gain lowers than the IOM 2009 recommendations or more than the recommendation could lead to poor maternal and neonatal outcome. Counsel woman about approximate GWG and implementing effective strategies like diet adjustment and increased physical activity to obtain the adequate GWG could help optimize maternal and perinatal outcomes.

Preconception counseling should be done especially for importance of proper physical activity and healthy eating to avoid excessive weight gain and it's adverse effects. Proper training health care providers should be done to inform pregnant women to limit their pre pregnancy BMI.

Excessive weight gain should be avoided as during pregnancy increased the risk of complications but weight loss during pregnancy is not recommended, because sufficient dietary consumption is required for optimal fetal growth and development. So women with a BMI 30 would be encouraged to lose weight before pregnancy.

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