

Gestational Weight Gain as Per Pre-Pregnancy Nutritional Status: Comparison Across Different BMI Categories

Gazala Nisar, Nilofer Khan.

Original Article

Abstract

Background

Gestational weight gain (GWG) is a critical determinant of maternal and fetal outcomes. Pre-pregnancy BMI is the strongest predictor of GWG, but data from Kashmir Valley is limited.

Objectives:

To assess gestational weight gain across different pre-pregnancy BMI categories and compare it with Institute of Medicine (IOM) 2009 recommendations.

Methods

A hospital- based cross sectional study was conducted among 400 pregnant women attending the department of Obstetrics and Gynecology in Kashmir. Pre-pregnancy BMI was calculated and pregnant women were categorized as underweight, normal, overweight and obese as per WHO criteria. Total GWG was recorded on a scientifically designed questionnaire. Data was analyzed using ANOVA and chi-square test. $p < 0.05$ was considered significant.

Results

Overall, only 40.25% of pregnant women met the IOM 2009 recommendations for total gestational weight gain (TGWG), while 37.75% gained less and 22% gained more than recommended. Among underweight women, 82% had inadequate GWG and only 18% met recommendations, with none gaining excess weight. In normal BMI pregnant women, 51.5% gained within and 48.5% gained less than the recommended, with no excess gain. In contrast, 60.5% of overweight and 97.3% of obese pregnant women had excess GWG, while none gained less than recommended. The difference in GWG across BMI categories was statistically significant $9p < 0.001$.

Conclusion

The study reveals a dual burden of inadequate GWG among underweight and normal BMI pregnant women and excessive GWG among overweight and obese pregnant women. Poor adherence to IOM guidelines highlights the need for BMI-specific nutritional counseling during antenatal visits to optimize maternal and fetal outcomes in Kashmir.

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Author Affiliations

Gazala Nisar, Sr. Assistant Professor (Specialisation: Food Science and Nutrition) Institute of Home Science; **Nilofer Khan**, Professor (Specialisation: Extension and Communication), Vice Chancellor, University of Kashmir

Correspondence

Dr Gazala Nisar, Sr. Assistant Professor (Food Science and Nutrition), Institute of Home Science, University of Kashmir. Email: nisargazala@gmail.com. Contact no. 9906834330.

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EMBASE, SCOPUS, IndMED , EBSCO, Google Scholar besides other national and international databases.

Introduction

Weight gain during the course of gestation is an important determinant of fetal growth. Inadequate gestational weight gain is a significant risk factor for intrauterine growth retardation (IUGR) and low birth weight (LBW), birth weight of less than 2.5 kg. Inadequate maternal weight gain during the third trimester of gestation is associated with increased risk of preterm delivery. Gestational weight gain is not the same thing as “getting fat”. Gaining weight is a positive and healthy sign that a woman is giving her baby what it needs to develop in a healthy manner. Pregnant women need not to put on any weight in the first trimester but in order to have a healthy baby, it is necessary for them to gain the normal gestational weight, a total of 25-35 pounds over the course of nine months. Inadequate weight gain or dieting during gestation could have severe ramifications on the health of the growing baby within the womb.

Maternal pre-pregnancy weight, pattern of weight gain throughout the course of gestation and total pregnancy-related weight gain are important factors in determining birth weight of neonates. Birth weight has a major impact on neonatal morbidity, mortality and also appears to affect long-term health and early adult weight[1].

During the entire course of gestation, variable amount of weight gain is a constant phenomenon. In early weeks i.e. during the first trimester, pregnant women may lose weight because of vomiting. During subsequent months the weight gain is progressive until last one or two weeks during the third trimester of gestation, when the weight remains static. The total weight gain (TWG) during the course of a singleton

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Gestational weight gain, Pre-pregnancy BMI, IOM guidelines, Nutritional status.

pregnancy averages 11kg (24 lb). This has been distributed to 1kg in first trimester and 5kg in second and third trimester each. Rapid gain in weight of more than 0.5kg (1lb) a week or more than 2kg (5lb) a month in later months of gestation may be the early manifestation of pre-eclampsia/toxemia. Stationary weight is one of the indicative feature of intrauterine growth retardation (IUGR) or intrauterine death of the fetus. Poor weight gain is too often associated with higher incidence of pre-eclampsia, prematurity and impairment of effective breastfeeding during the course of lactation[2].

Most women gain weight during gestation. However, there are exceptions that some mothers do not gain at all or rather lose weight, in such situations the fetal growth is presumed to be at the cost of the mother. There are fetal and maternal components of weight gain, the maternal components (being due to expansion of blood volume, growth of uterus, breast and fat storage) occurs in 2nd trimester and the fetal component (being due to growth of fetus, placenta and amniotic fluid) occurs in 3rd trimester[3].

In, India the dual burden of under nutrition and over nutrition makes GWG monitoring crucial. In Kashmir, specific dietary patterns, cold climate and limited physical activity during the course of gestation may influence GWG. However, data comparing GWG across BMI categories in this region is very scarce. Therefore, this study aimed to compare gestational weight gain across different pre-pregnancy BMI categories and assess adherence to IOM guidelines.

Materials and methods

Study Design: Cross sectional random study design.

Data Source and Collection: The present study was conducted in a hospital based setting. The sample was primarily collected from Maternity Hospital of Sher-e-Kashmir Institute of Medical Sciences (SKIMS) Soura Srinagar. A structured questionnaire and an interview schedule was devised and used for collecting the primary information from the pregnant women. The Questionnaire was prepared in accordance with the latest standards. A non stretchable measuring tape and a digital weighing scale were also used to collect information regarding the height and weight of the respondents. Weight of the pregnant women was assessed during the three trimesters of pregnancy by using standard weighing machine and recorded in scientifically designed questionnaire. Data collected from secondary sources represented the information obtained from books, published research papers, medical and public health journals and latest information from internet etc.

Sample Size: A minimum sample size of 350 pregnant women was required as study participants. An additional

sample size of 150 (30%) was added to take care of attrition (follow up loss), in order to get power of test 80% and as such the sample size including follow up loss was 500. Out of the total ten districts of Kashmir Valley, five districts were selected randomly keeping in view both urban and rural areas. The sample size was distributed among the selected districts on the basis of probability proportional to size (Table 1).

The sample size was calculated with the help of the following formula:

$$n = \frac{NZ_{\alpha/2}^2 p(1-p)}{d^2(N-1) + NZ_{\alpha/2}^2 p(1-p)}$$

Where,

n = minimum sample size required for the study

N = population size.

Z = 1.96 at level of significance 5%

α = level of significance (5%).

p = proportion of registered Pregnant women in Kashmir valley

d = margin of error at 5%.

The present study included a total no. of 400 pregnant women and their neonates. Out of them 211 were from urban area and 189 from rural area. Pregnant women were selected purposively from the hospital until the desired number of subjects was reached.

Table 1: Distribution of the Sample Subjects

S.No	Districts	Sample size	Follow - up loss (During the three trimester and post-delivery:	Overall Respondents Taken for analysis
1.	Srinagar	153	05	148
2.	Baramulla	127	41	86
3.	Budgam	99	14	85
4.	Ganderbal	55	11	44
5.	Kulgam	66	29	37
Overall		500	100	400

Sample Selection Procedure: Pregnant women attending the department of Obstetrics and Gynecology SKIMS hospital situated in Srinagar district were selected for data collection. From among all pregnant women attending the OPD, randomly every 3rd pregnancy was included as per the inclusion/exclusion criteria (purposive sampling method). The whole process of selection was completed within 8 to 12 weeks. The pregnant women selected were followed throughout their pregnancy till term.

A well formulated interview schedule was used to elicit the information pertaining to socio-demographic characteristics, maternal health prior to pregnancy, reproductive history, history of present conception, anthropometric assessment, weight gain pattern during current pregnancy, particulars of neonates at birth and dietary assessment of the selected pregnant women. All respondents were given an information sheet detailing the objective and nature of the study. Informal consent was obtained from the selected pregnant women prior to their participation. The following inclusion and exclusion criterion was used in the selection of the sample.

Selection Criteria

Inclusion Criterion

- Singleton Normal Pregnancy
- Pregnant women free from any medical illness or Obstetric complications.
- Pregnant women without pregnancy related complications like pre-eclampsia, eclampsia, gestational diabetes, hyperemesis gravidarum, metabolic or chronic disease and so on.

Tools Used

The tool used in the present study devised as per objectives of the study was essentially a questionnaire supplemented by an interview schedule. After a thorough and detailed study of the problem and the review of literature, a preliminary questionnaire was framed. This was pre-tested on 10% of the sample size to ensure the validity and feasibility and was then used in the study. The questionnaire was administered to the pregnant women through face-to-face interview during the morning hours.

Operational Definition and Calculation of Gestational Weight Gain

Total Gestational Weight Gain (TGWG) as defined by the **Institute of Medicine (IOM) 1990 and 2009** guidelines,⁴ is the amount of weight a pregnant women gains between the time of conception and the onset of labor. Total Gestational weight gain was recorded as the difference between the last recorded Maternal weight (Taken at the end of the last trimester during the 4th prenatal visit) and the Maternal pre-pregnancy weight, which was recorded at the first prenatal visit during the time of registration/enrollment of pregnant women in the hospital. The 1st prenatal visit was not later than the first month of pregnancy (20-25 days of conception). According to the Total Gestational Weight Gain, pregnant women were categorized as Ideal/within, poor/below and excess /above the IOM recommendations as per four Asian pacific BMI groups given by WHO.⁵ In 2009, the Institute of Medicine (IOM) recommended weight gain guidelines for singleton pregnancy based on pre-pregnancy body mass index (BMI) classes. That is for underweight mothers, a recommended GWG of 12.5-18 kg, 11.5-16kg for normal weight, 7-11.5 kg for overweight and 5-9kg for obese mothers.

TGWG

= Weight of the Pregnant Women at the last visit
(at around the nine month 37 to 40 weeks)
of gestation

– Weight taken at the First Prenatal Visit
(20 – 25 days of conception)

Ethical considerations: Confidentiality was assured and anonymity was maintained, no participants were identified in any report or publication under this study. Informed consent was sought prior to the individual's participation in the study. Participants were assured that their participation is voluntary and they can withdraw at any point during the study. Data collected from participants was kept confidential and only researcher and supervisor had access to the data. Ethics committee approval was not required since no-human samples were taken from the respondents. Proper permission from the head of the concerned hospital was taken before the conduct of the study.

Data Analysis: For analysis of data in the present study, Microsoft Excel and statistical package SPSS version 22 was used. After collecting the data, coding of the responses of the questions was imperative for statistical analysis. Every item of the questionnaire was coded and was entered into Microsoft-Excel sheet. The data thus generated was tabulated and presented as per the objectives of the study. The data was analyzed using mean, standard deviation and subjected to various tests of significance like Pearson chi-square, ANOVA, t test. Tests were considered significant for p value <0.05. Further correlation coefficient (r) of various variables with gestational weight gain was also computed. Multivariate logistic regression analysis was also applied to identify most specific determinant influencing pregnancy weight gain and neonatal birth weight. Some of the observations are presented in graphic forms also.

Results 52.8% and 47.2% of the respondents were from urban and rural area respectively. Majorities i.e. 78.2% of the respondents were from nuclear family and only 21.8% were belonging to joint family. Majority i.e. 81% of the respondents were literate and only 19% were illiterate. Among literate respondents, 28% were graduate, followed by 14.50% and 14.20% were middle pass and 10+2 respectively. Only 13.50% were post graduates. Majorities i.e. 60.20% of the respondents were housewives and only 39.8% were working. Among working respondents, 17.50% and 14.50 were skilled and semi-skilled workers respectively. Only 2.8% were professional.

Table 2 reveals that majority i.e. 58% of the respondents who were underweight (BMI <18.5kg/m²) at the time of pregnancy gained 8-11kg of weight throughout the course of pregnancy and only 5% gained 14-17kg of weight. Whereas, half or more than half the number i.e. 50.7%, 52.3%, and 54.1% of respondents who were having healthy weight (BMI 18.5-22.9 kg/m²), overweight (BMI 23-24.9 kg/m²) and obese (BMI ≥ 25 kgs/m²) respectively gained 11-14kg of weight throughout the entire course of gestation. The

Table2: Mean Gestational Weight Gain of the respondents in relation to Pre-pregnancy Nutritional Status

Variable	Category	N	Mean GWG±SD	Min.	Max.	Range	F	df	P-value
BMI (Kg/m ²)	<18.5 (Under weight)	50	10.80±1.67	8.0	16.0	8	6.67	3,396	0.0001*
	18.5-22.9 (Normal Weight)	227	11.92±1.77	8.0	16.0	8			
	23-24.9 (Over weight)	86	12.12±1.79	8.0	16.0	8			
	≥25 (Obese)	37	11.95±1.73	9.0	16.0	8			
	Overall	400	11.82±1.80	8.0	16.0	8			

*significant at 5%. **Note:** Body Mass Index (BMI kg/m²) WHO 2004

Table 3 shows that while the overall weight gain among the studied mothers was 11.82±1.80kg, it was significantly low among under nourished mothers i.e. 10.80±1.67kg and in no way better or more among obese women i.e. 11.95±1.73 kg.

Table 3: Gestational Weight Gain in relation to Pre-pregnancy Nutritional Status (BMI Kg/m²)

BMI (Kg/m ²)	Gestational Weight Gain(kg)			X ²	Df	p-value
	8-11	11-14	14-17			
	N (%)	N (%)	N (%)			
<18.5 (Under weight)	29 (58.0)	16 (32.0)	5 (10.0)	22.13	6	0.001*
18.5-22.9 (Normal Weight)	60 (26.4)	115 (50.7)	52 (22.9)			
23-24.9 (Over Weight)	23 (26.7)	45 (52.3)	18 (20.9)			
≥25 (Obese)	8 (21.6)	20 (54.1)	9 (24.3)			
Overall	120(30.0)	196(49.0)	84(21.0)			

*Significant at 5% **Note:** Body Mass Index (BMI kg/m²)-WHO2004.

Table 4: Comparison of Weight Gain across different Body Mass Index Categories. (N=400)

Variable	Category	Recommended Total GWG ** (kg)	Total Gestational Weight Gain			X ²	df	p-value
			Ideal	Poor	Excess			
			N (%)	N (%)	N (%)			
BMI(kg/m ²)	<18.5 Under weight	12.5-18	9 (18.0)	41(82.0)	0.0	319.70	6	<0.0001*
	18.5-22.9 Normal weight	11.5-16	117(51.5)	110(48.5)	0.0			
	23-24.9 Overweight	7-11.5	34 (39.5)	0.0	52(60.5)			
	≥25 Obese	5-9	1 (2.7)	0.0	36(97.3)			
Overall			161(40.25)	151(37.75)	88(22.0)			

*Significant at 5%.

**Total Gestational Weight Gain(TGWG)Recommended Ranges as per Pre-pregnancy

BMI-Institute of Medicine & National Research Council (IOM &NRC) 2009.

difference between the groups with respect to weight gain was found to be statistically significant.

Overall majority i.e. 49% of the respondents gained 11-14kg of weight during the course of pregnancy.30% gained 8-11kg and only 21% gained 14-17kg of weight.

Table 3 shows comparison of Gestational weight gain (GWG) across different BMI in relation to Recommended Total Gestational Weight Gain (TGWG) given by IOM 2009.

Table 4 and shows comparison of Gestational weight gain (GWG) across different BMI in relation to Recommended Total Gestational Weight Gain (TGWG) given by IOM 2009.

It is quite clear that less than half i.e. 40.25% of the respondents met the recommendations for weight gain and 37.75% gained less than recommended during the course of pregnancy. Only 22% gained more weight. Further the table 4 reveals that none of the underweight and normal weight pregnant women gained more weight during the course of pregnancy.82%, which formed the majority of underweight respondents gained

less than recommended weight i.e. less than 12.5 -18kg recommended by IOM. Only a minor section i.e. 18% of underweight pregnant women gained TGW within (ideal weight gain) the recommendations. As far as health pregnant women are concerned, half of them i.e. 51.5% and 48.5% gained within and less than the recommended TGWG given by IOM 2009. None of the overweight and obese pregnant women gained less (poor weight gain) than the recommended weight. More than half i.e. 60.5% of overweight pregnant women gained excess (above the recommended TGW) weight and 39.5% gained within recommended weight during the entire course of pregnancy. Almost all i.e. 97.3% of obese pregnant women gained more weight during the course of pregnancy.

Discussion

Maternal weight gain and pattern of weight gain during pregnancy influence pregnancy outcome such as birth weight of the neonate. Pre-pregnancy body mass index (BMI), maternal nutrient intake during the course of gestation and age determine the weight gain during gestation.

40% of weight gain is due to the fetus and placenta. 60% of weight gain is associated with maternal changes during pregnancy. Women with a high pre-pregnancy BMI have infants with higher birth weights and heavier babies have a higher body fat mass. Except for the very overweight group, birth weight is strongly correlated to maternal weight gain during the entire course of gestation [6,7].

Higher energy intake during pregnancy is associated with increased maternal weight gain, increased risk of hypertension such as eclampsia, Gestational diabetes mellitus (GDM), Cesarean deliveries and macrosomia. Whereas insufficient energy intake during pregnancy is for gestational age (SGA) or low birth weight (LBW) [8]. Obesity has become very much common in pregnant women. Obesity in pregnancy is linked to severe maternal complications such as its effects on delivery as well as many complications affecting the developing fetus and newborn [9]. Obese pregnant women are at a elevated risk of gestational diabetes mellitus [10,11], higher incidences of preeclampsia/toxemia [12-14] and C section [15-16]. Complications related to too much gestational weight gain (GWG) also include foetal macrosomia, resulting in the delivery of a large for gestation age (LGA) neonates [17-19]. Likewise, too much weight gain during the entire course of gestation may raise the risk of weight retention and obesity after pregnancy [20,21] which may be further increased by early termination of breastfeeding among those who gain excess weight during gestation [22-23]. Maternal excessive weight gain during gestation is linked with an elevated risk of the children being overweight/obese [1,24-26].

Body Mass Index (BMI) and Gestational Weight Gain (GWG) are indicators of maternal nutritional status.

Total weight gain throughout the course of gestation among underweight respondents was 10.80 kg. Mean total weight gain was significantly better among healthy

and overweight respondents, with average weight gain of 11.92kg and 12.12kg respectively. However, obese respondents did not gain significantly more weight during pregnancy and remained at an average of 11.95kg, which is much better than the underweight pregnant mothers. The findings are in agreement with a study conducted by Koh *et al.* (2013) [27] who revealed that underweight pre-pregnancy body mass index (BMI kg/m^2) increased the risk of insufficient gestational weight gain. Whereas overweight pre-pregnancy body mass index decreased this risk and resulted in much better gestational weight gain in comparison with underweight pregnant mothers. Crane *et al.* (2009) [28] revealed in his study that pregnancy weight gains of 6.7-11.2kg in overweight women and less than 6.7kg in obese pregnant women are associated with a reduction in the risk of adverse pregnancy outcome.

In the present study less than half i.e. 40.25% of the respondents met the recommendations for weight gain and 37.75% gained less than recommended during the course of pregnancy. Only 22% gained more weight.

Further the study reveals that none of the underweight and normal weight pregnant women gained more weight during the course of pregnancy. 82%, which formed the majority of underweight respondents gained less than recommended weight i.e. less than 12.5 -18kg recommended by IOM. Only a minor section i.e. 18% of underweight pregnant women gained TGW within (ideal weight gain) the recommendations. As far as health pregnant women are concerned, half of them i.e. 51.5% and 48.5% gained within and less than the recommended TGWG given by IOM 2009. None of the overweight and obese pregnant women gained less (poor weight gain) than the recommended weight. More than half i.e. 60.5% of overweight pregnant women gained excess (above the recommended TGW) weight and 39.5% gained within recommended weight during the entire course of pregnancy. Almost all i.e. 97.3% of obese pregnant women gained more weight during the course of pregnancy. Asvanarunat (2014) [29] found in his study that 34.9% had weight gain within, 36.5% above and 28.7% below IOM guidelines. Results of the study conducted by Crane *et al.* (2009) [28] revealed that only 30.6% of women gained the recommended amount of weight during the entire course of pregnancy, 52.3% of women gained additional than recommended and 17.1% gained less than recommended. A study conducted by Nachvak *et al.* (2012) [30] revealed that 86.1% of underweight & 77.7% of normal weight pregnant women gained weight during pregnancy below the lower limits of recommended range, while weight gain in none of the underweight pregnant women was more than the new (2009) IOM recommendations. About 1.1% of normal weight, 17.8% of overweight & 36.4% of obese women gained weight more than the upper limits of the recent 2009 IOM recommendations.

Conclusion

The study concludes that adherence to IOM recommendations for GWG is suboptimal in Kashmir. There is a dual burden of inadequate GWG among

underweight and normal BMI women, and excess GWG among overweight and obese women. Pre-pregnancy BMI is significantly associated with total GWG [$p < 0.001$]. These findings underscore the importance of addressing maternal nutritional status before and during pregnancy.

Recommendations

Measures recommended in Pre-pregnancy stage

Details of various pre-pregnancy measures remain beyond the scope of present recommendations yet following few important needs a mention.

- ✓ Pre-pregnancy weight of mother being an important variable affecting birth weight of neonate, the women of reproductive age group need to be counseled regarding its significance in this context.
- ✓ A complete and comprehensive care of girl child right from her childhood, through adolescence and adulthood to ensure that she becomes a healthy adult girl is of paramount importance.
- ✓ Effort to encourage, promote and ensure female literacy is highly advisable.
- ✓ Measures to Improve overall socio-economic status of women and ensuring women empowerment for right decision at right time will take care of women's health and nutrition in pregnancy.
- ✓ Ensuring utilization of services provided under Nutrition intervention program directed towards young females and at risk population as to improve pre-conceptual maternal nutritional status may be more beneficial than those during pregnancy.
- ✓ Sensitizing adult female through mass awareness and education on role and importance of pregnancy weight gain for mother and newborn.
- ✓ Popularizing concept of postponement of first pregnancy after marriage and spacing between the pregnancies appears to be a feasible and achievable goal to ensure better reproductive health in absence of increasing age at marriage as well repeated conceptions especially in rural areas.

Measures recommended in Pregnancy

- ✓ Nutritional care during the course of pregnancy contributes significantly to an adequate nutritional status preventing negative impacts on maternal and neonatal health resulting from low or excess gestational weight gain than the recommended.
- ✓ In order to ensure a thorough pregnancy monitoring, prenatal care should begin during the first trimester (before 13 weeks). It is equally very much important to emphasize that not only is early prenatal care imperative but regular care at the same time is just as fundamental. For low-risk pregnancy, women seeking all prenatal visits, provides better opportunity to keep an eye on

gestational weight gain and undertake nutrition education for them so that they will adopt healthy eating habits

- ✓ Ensure all pregnant mothers are registered early in the pregnancy and remain under regular medical supervision for better pregnancy care.
- ✓ Ensure all 'at risk' and 'high risk' mothers are identified to provide special care during pregnancy and at delivery.
- ✓ Ensure balanced dietary intake and nutrition supplementation throughout the pregnancy by regular counseling and awareness activities.
- ✓ Ensure institutional deliveries for better pregnancy outcome.
- ✓ Ensure to meet all the essential nutrient needs within calorie limits, choose a variety of nutrient-dense foods across and within all the major food groups in recommended amounts as specified by the ICMR.
- ✓ Pregnant women should be advised regarding recommended weight gain ranges during the antenatal visits.
- ✓ Ensure that a pregnant woman maintains ideal gestational weight gain throughout pregnancy.
- ✓ Ensure that pregnancy progresses normally during antenatal period and all deliveries are conducted in an institution for better intra natal and newborn outcome.

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