

Patterns of Weight Gain and Birth Weight Amongst Indian Women

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Abstract

Background: The timing of maternal weight change in pregnancy may be an important determinant of birth weight. The objective of this study was to measure weight gain patterns from early pregnancy until delivery, and to examine the relationship between prenatal weight gain and low birth weight.

Methods: A total of 500 pregnant women within 15-20 days of conception, with confirmed pregnancies and belonging to the middle and high socioeconomic families from Mysore city, India participated in the study. They were followed up for the period of one-week after delivery, and their weight was monitored monthly throughout pregnancy.

Results: Pre-pregnancy body mass index (BMI) and obesity in 16.2% of pregnant women were less than 18.5% and 11.4% respectively. Mean total pregnancy weight gain for all women was 8.1 ± 2.9 kg, whereas 85.2% did not meet the international recommendations regarding weight gain for their BMI. The rate of weight gain was highest during the second trimester (3.6 ± 1.4 kg) and the total weight gain was associated with progressively decreasing birth weight. A significant association was found between mid-upper arm circumference and maternal weight at term, and birth weight.

Conclusion: According to Institute of Medical Guidelines, low weight gains of the mother during pregnancy and mid upper arm circumference below 19 cm are associated with increasing risk of low birth weight.

Iran J Med Sci 2006; 31(2): 94-97.

Keywords • Birth weight • MUAC • pregnancy • weight gain

Introduction

Nutritional status of pre-pregnancy and pregnancy weight gain both affect the health and survival rate of the newborn.¹⁻³ It is generally stated that Maternal Weight Gain (MWG) during the first trimester of pregnancy is unrelated to birth weight,^{4,5} but not in the second and third trimesters.^{5,6} About 30% of women living in South Asia enter pregnancy with severe or moderately severe underweight and do not gain sufficient weight during gestation to allow fetal growth to proceed unimpeded.

The average MWG during a normal pregnancy in India is varied from 5.1 to 8.3 kg,^{8,9} while that of other countries, it is between 8.3-15.6 kg.^{10,11} According to the guidelines for weight gain during pregnancy, provided by Institute of Medicine (IOM), weight gain within the suggested range for each pregravid

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body mass index (BMI) category is associated with more favorable outcomes than the weight gain above or below this range.¹² These outcomes include a reduction in the incidence of low birth weight (LBW), overweight (>4500 g), cesarean and preterm deliveries.^{5,12} Nonetheless, the optimal weight gain during pregnancy remains controversial.¹³ Much less, however, is known about factors that may influence weight gain in women within the recommended range.¹⁴ The purpose of the current study, therefore, was to identify the effect of maternal weight change, in different trimesters of pregnancy, on birth weight of newborns in India.

Subjects and Methods

The subjects for this study were recruited from pregnant women attending out-patient prenatal clinics in private hospitals or nursing homes in Mysore city, India. A total of 500 women volunteered to participate in the study and gave a written consent after becoming informed about the procedure. Those who conceived within 15-20 days of gestation were enrolled and followed up until one-week post-delivery. In this study, women were selected from family of middle and high income classes.

Information about the maternal demographic characteristics like age at conception, educational status, occupation, parity, was obtained using a structured questionnaire. Anthropometric measurements taken according to the standard procedures, included height, weight, and Mid Upper Arm Circumference (MUAC) of the selected individuals.¹⁴ Height was measured once with a stadiometer accurate to 1 cm and weight a calibrated digital balance (Metro Corporation, USA, 1995) accurate to 0.1 kg. MUAC was measured on the left arm with a fiber glass tape accurate to 0.1 cm.

The weight at 15-20 days of conception was considered as the initial weight at conception. Weights used in analysis ranged from 14±2, 28±2 and 38±2 wks of gestation. Height and weight of newborns were recorded in the clinic, soon after delivery. Beam scale was used for weight and infantometer to record height of the infants.

Statistical analyses

Data are expressed as Mean±SD and the differences are determined by using Student's *t* test, and *P*<0.05 was considered as statistically significant. Multiple regression models were also used to assess the independent effects such as age, parity, mother's weight and her weight changes during a trimester. The height and the gender of the newborns in relation to their weight were also considered.

Results

The characteristics of the women participated in the study are as the following. Their mean age was 24.0±4.2 yrs ranging from 17 to 38 yrs, mean height and weight at the initial conception was 155±6 cm and 51.2±7.7 kg, respectively. Mean parity status was 1.6, whereas, 48% of them were multipara. More than 50% of the participated women were high school or college graduates but less than 9% were economically active. The average weight gain during pregnancy was 8.1 kg and the duration of gestation was 39.6±1.3 weeks. The nutritional status of women under study at 15-20 days after conception revealed that 16.2% of pregnant women had pre-pregnancy BMI less than 18.5kg/m² and an obesity of 11.4%.

Anthropometric profile of newborns are; the mean height and weight was 48.3±0.3 cm and 2914±498g respectively with 19.6% of them having LBW (<2500 g).

Factors such as parity and income were found to have the highest impact on weight gain. Weight gain in multipara from high income group was higher than other groups. Parity and income were found to have significant influences on the total weight gain. Women from middle income group gained on the average 6.7±2.2 kg, whereas those from high income group gained 9.5±2.6 kg with their differences being statistically significant.

Initial BMI has a definite influence on the weight gain during the entire course of pregnancy. It was interesting to compare weight gain of women from different BMI categories to those recommended by IOM. It is evident that weight gain in women with initial BMI>26.0 kg/m² from both income categories were comparable to those of IOM,¹² whereas those with normal BMI and belonging to the high income group were below the limits of IOM recommendations. In addition, most women from the study group failed to gain weight regarding IOM recommendation.

The association between total weight gain and pregnancy outcome among selected women is presented in Table 1. A marked difference was noticed in the percentage of women who exhibited poor, moderate and normal weight gain among income groups. As for women from middle income, 59.6% were poor and 38.0% were moderate gainers, with only 2.4% showing desirable weight gain. In high income group, 21.2% were poor gainer, whereas 50% and 28% gained moderate to desirable weight respectively. Women belonging to middle income group with poor weight gain exhibited 30.2% LBW as compared to 28% in high income group. Similarly women

with moderate weight gain had 25% LBW, in comparison with 13% in high income group. These percentages revealed that maternal weight gain improved birth weight.

Table 1: Association between total weight gain (TWG) and pregnancy among selected pregnant women according to their income (INC).

INC	TWG (Kg)	n (%)	BW (%)		BW (g)
			L	N	
Middle	3.6-7.0	149 (60)	30	70	2 717±406
	7.1-10.5	95 (38)	25	75	2872±449
	>10.5	6 (2)	0	100	2900±177
High	3.6-7.0	53 (21)	28	72	2 683±392
	7.1-10.5	127 (51)	13	87	3040±457
	>10.5	70 (28)	9	91	3259±500

BW=birth weight; L= low; N= normal

In order to identify the anthropometric markers influencing birth weight, a correlation analysis was done using maternal MUAC, maternal weight at term, weight gain and birth weight. A significant association with MUAC and maternal weight was found at the third trimester, although at a lower level, in regard to both parameters ($r = 0.347$, $r = 0.311$, $P < 0.01$). Interestingly, maternal MUAC was associated with maternal weight gain ($r = 0.519$, $P < 0.01$), indicating MUAC is a useful marker of maternal health. MUAC at first trimester below 19.0 cm was indicative of "high risk" for LBW babies.

Table 2: Final regression models of the effects of trimester weight gains on newborn weight in relation to the mothers' income.

Variable	Income		P<
	Middle (n=250)	High (n=250)	
	$\beta \pm SE$	$\beta \pm SE$	
Weight gain (kg)			
I trimester	-138.5±39.1	59.6±32.4	0.04
II trimester	44.6±22.8	20.0±19.2	0.01
III trimester	28.7±21.5	95.2±14.2	0.01
No live births	-148.6±57.7	6.7±56.2	0.90
age (y)	21.8±7.6	6.4±6.5	0.32
height (m)	-89.1±396.1	-987±6689	0.14
weight (kg)	15.6±6.0	40.2±7.7	0.01
BMI (kg/m ²)	42.7±12.6	-77.2±18.6	0.01
Constant	2456±691.1	3613±1049	0.01

β = unstandardized coefficients 1 For birth weight, model $F=15.90$, $P < 0.001$, and $R^2=0.372$ For birth weight, model $F= 15.05$, $P < 0.001$, and $R^2=0.36$

Regression analysis was performed to study the extent of association between maternal factors and birth weight. The results revealed that all the parameters were positively associated with birth weight (Table 2). Surprisingly, weight gain in the first trimester had a negative association with birth weight among middle income, as opposed to high income groups, while a strong association ($P < 0.01$) was found between weight gain in the third trimester, and birth weight among high income group. Nevertheless, weight gain in the third trimester exhib-

ited a significant association with birth weight among two income categories. Parity was found to have a negative influence on the birth weight among middle income group, probably multiple pregnancies affected birth weight.

Discussion

Most women began their pregnancies with suboptimal nutritional status. Mean maternal weight gain obtained in this study was in comparable to those reported from other countries.⁸⁻¹¹ Mean weight gain in the two income groups varied during each trimester. Low weight gain during the first trimester is most likely due to low dietary intake resulting from nausea which was observed in a large proportion of the women. These observations were in accordance with the reports of Persson et al.¹⁵ Weight gain was found to be highest during the second trimester, which was in accord with reports from developed countries.^{5,6} Inadequate maternal weight gain was associated with poor fetal growth and lower birth weight.

In the present study, an inverse relationship was found between the percentages of women exhibiting poor, moderate and normal weight gains and their incomes. Women from middle and high income groups with poor weight gain had 30% and 28% LBW babies respectively. Similarly, women with moderate weight gain had 25% and 13% LBW babies in middle and high income groups respectively. These percentages reduced with better maternal weight gains.

Weight gain and nutritional status of the women seem to be reflected in MUAC in that a linear relationship was observed between the MUAC and birth weight. MUAC below 19 cm was indicative of LBW, and identified women with obstetric risks. This suggested that MUAC may be a useful index for assessing nutritional status of pregnant women as stated by Mercypaul.¹⁶

Weight gain in the first trimester was found to have a negative association with birth weight among middle income groups, while a strong association was found between weight gain and birth weight in the third trimester in high income group. Weight gain during trimesters of pregnancy was related to newborn weight. Our study indicated that variables such as birth weight were not related to mother's height in the middle income group, parity, mother's height and age in high income group. These observations were similar to those of other studies.^{4-6,11}

Conclusion

About 16% of Indian women in the selected population during pre-pregnancy period were

undernourished and about 85% of them did not meet the international recommendation regarding weight gain for pre-pregnant body mass index and mid-upper arm circumferences below 19 cm can be indicative of undernourishment.

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