

# On the Study of Pre-Pregnancy Body Mass Index (BMI) and Weight Gain as Indicators of Nutritional Status of Pregnant Women Belonging to Low Socio-Economic Category: A Study from Assam

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## ABSTRACT

Women, particularly pregnant women, are the most vulnerable population of the society and their health status is one of the major indicators of development. There were enough studies on pre pregnancy body mass index (IPBMI) and inadequate weight gain during pregnancy (IWGP) of women in other part of the world and India, but none in Assam. In Assam a large number of population are in the category of low socio-economic group, a group most vulnerable to under nutrition. Thus this study was framed with the said indicators to throw light on the factors affecting the health status of pregnant women to accordingly address the situation. A cross sectional study using multistage sampling design with probability proportional to size was made comprising of 461 pregnant women belonging to low socio-economic status. Responses regarding their socio-economic, socio-cultural, health, diet and environmental background were collected and coded. The study revealed that although IPBMI (34.06%) was slightly lower than the reported state, national and global percentage the revealed IWGP (82%) was an astounding figure. The blood samples analyzed showed a high degree of inadequacy in almost all micronutrients (iron 63.1%, calcium 49.5% and copper 39.9%) studied in our survey.

**Keywords:** Nutritional status, pregnancy, pre-pregnancy BMI, risk factors, weight gain

## Introduction

Women and children are the most vulnerable population of the society and their health status is one of the major indicators of development. In India, quite a high number

of women die during pregnancy and child-birth and different factors affect the health status of this group resulting negative pregnancy outcome, particularly for the poor and underprivileged. Anthropometric evaluation of nutritional status during pregnancy is a widely used, low technology procedure that may be expected to generate much valuable information, yet it has seldom been rigorously evaluated.<sup>(1,2)</sup> Anthropometric indicators may be reflective of past events, predictive of future events, or indicative of current nutritional status. Moreover, nutritional evaluation just before pregnancy or in initial stage of pregnancy is expected to reflect the nutritional status

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of the woman directly and the growth of the fetus indirectly.

In Assam a large number of population are in the category of low socio-economic group. The maternal mortality ratio (MMR) is highest among the states of India as per Annual Health Survey 2012-2013. Different programs and schemes have been launched under National Rural Health Mission (NRHM) to reduce the MMR and Infant Mortality Rate (IMR) in the state. Each factor-related to MMR and pregnancy outcome is important to analyze the cause so that it can be reduced.

Many studies indicate that the maternal anthropometric indicators like pre-pregnancy weight, height, and weight gain in pregnancy are important predictors of pregnancy outcomes and lower values of these are leading to greater risk of having low birth weight (LBW) babies.<sup>(3,4)</sup> Similarly, during this period, deficiency of micronutrients has detrimental effect on the health of both pregnant women and the growing fetus.<sup>(5)</sup>

There were enough studies on pre pregnancy body mass index (BMI) and weight gain of pregnant women in other part of the world and India<sup>(6-8)</sup>, but none in Assam. Though there are some studies on nutritional status of pregnant women, but not in this line. Keeping in view of the above, this study was framed with the indicators inadequate pre-pregnancy BMI (IPBMI) and inadequate weight gain during pregnancy (IWGP) to throw light on the factors affecting the health status of pregnant women so that a better picture can be drawn and interventions can be made accordingly to address the situation.

## Materials and Methods

A cross-sectional survey of women who were currently pregnant during the study period, belonging to any trimester, and whose household income were less than or equal to ₹2500/- per month (defined as low socio-economic group in our study) was done, under the guidance and assistance of the NRHM, Assam. Data was collected from rural areas of Kamrup district of Assam between July-September 2010. The sample size (461) was determined using standard formula<sup>(9)</sup> and Systematic Sampling with Population Proportion to Size (PPS) technique was used to resolve the division of this sample size over the different localities visited, since the population under each sub-center was not the same.

Blood samples of approximately 1 ml were collected and other anthropometric measurements like height and weight using standard height measuring tape and adult weighing machine were also taken. Two blocks, having geographic and demographic diversity, namely Boko and Chaigaon of Kamrup district were selected. Thirty

sub-centers, covering around 75 villages, were selected from a total of 88 sub-centers under the blocks so that there was equal representation.

The 24-hour recall method and diet history method for 1 week were used for the diet survey. The average consumption of food stuff along with the consumption of macro- and micronutrients were also calculated by matching the values with the book "Nutritive value of Indian Foods" published by National Institute of Nutrition, India.<sup>(10)</sup> Recommended Dietary Allowance (RDA) suggested by the Indian Council of Medical Research (ICMR) and Gopalan *et al.*, were used to assess the adequacy of the nutrient intake.<sup>(11,12)</sup>

Recommended total weight gains in pregnant women by months of pregnancy (from fourth month onwards) are 1.5, 2.5, 4, 5.5, 7, and 9 kg, respectively.<sup>(13)</sup> Estimation of Fe, Cu, Ca, and Zn of the whole blood samples were determined by using Atomic Absorption Spectrophotometer-7000 (SHIMADZU) and compared with the literature results (Cu 0.8-2 mg/L, Fe 420-560 mg/L, Zn 6-7 mg/L, Ca 80-110 mg/L) as quoted by Prohaska *et al.*<sup>(14)</sup>

The calculation of average consumption of foodstuffs and micro-nutrients were done by using statistical package of social sciences (SPSS) version 13.0 software. Chi-square and *t*-tests were used to examine the relationships between nutritional status and individual characteristics and to test the significance of consumptions of food stuffs and nutrients among the pregnant women.

## Results

Tables 1 and 2 reveal the general profile and bio-chemical status of the surveyed women, grouped according to IPBMI and IWGP. The associations of these two indicators with background parameters were analyzed using chi-square tests. It was observed that factors like type of house, religion, community, trimester, and month of pregnancy had high ( $P = 0.01$ ) significant associations with either IPBMI or IWGP. Amount spent

**Table 1: Profile of the pregnant women surveyed**

		Total N = 461	IPBMI N = 157	IWGP N = 378
		n (%)	n (%)	n (%)
Occupation (self)	Cultivator/ Agrilabour	8(1.7)	2(1.3)	4(1.1)
	Daily wage labour	7(1.5)	1(.6)	5(1.3)
	Other	57(12.0)	10(6.4)	42(11)
	None	389(84.4)	144(91.7)	327(86.5)
Chi			.037**	.028**
Income Level	Up to ₹2500	206(44.7)	73(46.5)	175(46.3)
	above ₹2500	255(55.3)	84(53.5)	203(53.7)
Chi			.321	.086*

Continue

**Table 1: Profile of the pregnant women surveyed (Continued)**

		Total N = 461	IPBMI N = 157	IWGP N = 378
		n (%)	n (%)	n (%)
Amount spent on food	Up to ₹2500	343(74.4)	123(78.3)	288(76.2)
	above ₹2500	118(25.6)	34(21.7)	90(23.8)
Chi			.099*	.043**
Education	Nil	145(31.5)	46(29.3)	128(33.9)
	Primary	44(9.5)	23(14.6)	40(10.6)
	Middle High School	204(44.3)	66(42.0)	159(42.1)
	Matric	48(10.4)	15(9.6)	36(9.5)
	Others	20(4.3)	7(4.5)	15(4.0)
Chi			.121	.029*
Type of House	Pucca	27(5.9)	8(5.1)	19(5.0)
	Kachha	232(50.3)	99(63.1)	204(54.0)
	Semi Pucca	202(43.8)	50(31.8)	155(41.0)
Chi			.000***	.003***
Sewage disposal	Pit toilet	269(58.4)	87(55.4)	225(59.5)
	Sanitary toilet	102(22.1)	38(24.2)	75(19.8)
	Bush	90(19.5)	32(20.4)	78(20.6)
Chi			.635	.034**
Pet animal at home	No	74(24.3)	54(34.4)	113(29.9)
	Yes	230(75.7)	103(65.6)	265(70.1)
Chi			.028**	.031**
Religion	Hindu	275(59.7)	79(49.7)	211(55.8)
	Muslim	184(39.9)	78(49.0)	167(43.9)
Chi value			.005***	.000***
Community	General	106(23.0)	35(22.3)	84(22.2)
	Scheduled Caste	82(17.8)	22(14.0)	65(17.2)
	Scheduled Tribe	71(15.4)	17(10.8)	48(12.7)
	Other	202(43.8)	83(52.9)	181(47.9)
Chi			.022**	.000***
Age group	< 20	71(15.4)	27(17.2)	65(17.2)
	20-30	342(74.2)	117(74.5)	274(72.5)
	31-40	48(10.4)	13(8.3)	39(10.3)
Chi			.463	.073*
Trimester	1	15(3.3)	4(2.5)	0(0)
	2	189(41.0)	56(35.7)	156(41.3)
	3	257(55.7)	97(61.8)	222(58.7)
Chi			.168	.000***
Number of children	0	249(54.0)	88(56.1)	249(54.0)
	1	134(29.1)	45(28.7)	134(29.1)
	2	60(13.0)	19(12.1)	60(13.0)
	3	16(3.5)	5(3.2)	16(3.5)
	4	2(.4)	0(0)	2(.4)
Chi			.838	.020**
Month of pregnancy	1	3(.7)	1(.6)	0(0)
	2	4(.9)	3(1.9)	0(0)
	3	11(2.4)	3(1.9)	0(0)
	4	29(6.3)	5(3.2)	23(6.1)
	5	64(13.9)	14(8.9)	51(13.5)
	6	89(19.3)	31(19.7)	78(20.6)
	7	77(16.7)	27(17.2)	66(17.5)
	8	109(23.6)	35(22.3)	95(25.1)
	9	75(16.3)	38(24.2)	65(17.2)
Chi			.008***	.000***

\* $p < .10$ , \*\* $p < .05$ , \*\*\* $p < .01$ **Table 2: Bio-chemical status of the pregnant women surveyed**

		Total N = 461	IPBMI N = 157 (34.06)	IWGP N = 378 (82)
		n (%)	n (%)	n (%)
Level of iron	below normal	322(69.8)	99(63.1)	263(69.6)
	within normal	139(30.2)	58(36.9)	115(30.4)
Chi value			.01	.449
Level of zinc	below normal	19(4.1)	6(3.8)	15(4.0)
	within normal	442(95.9)	151(96.2)	363(96.0)
Chi value			.516	.456
Level of Calcium	below normal	228(49.5)	74(47.1)	184(48.7)
	within normal	233(50.5)	83(52.9)	194(51.3)
Chi value			.268	.276
Level of Copper	below normal	184(39.9)	68(43.3)	144(38.1)
	within normal	277(60.1)	89(56.7)	234(61.9)
Chi value			.166	.058

on food, women who has self-occupation, sewage disposal, pets, and parity were averagely associated ( $P = 0.05$ ). Finally, income status, education and age group were found to have moderate effects on either IPBMI or IWGP.

The overall presence of IPBMI is 34.06%, whereas the percentage of women with IWGP is as high as 82%. The percentage of pregnant women with IDA in the district is estimated to be very high (63.1%) as revealed from the survey. There existed a fairly strong relationship of IDA with pre-pregnancy BMI ( $P < 0.05$ ). Both the micro nutrients calcium and copper were found to be deficient (49.5% and 39.9%, respectively) in the women surveyed. The level of zinc was relatively better than the rest.

Consumption of food stuff and percentage of pregnant women consuming food stuffs within RDA limits are presented in Table 3. It was found that except for green leafy vegetables, fruits, and flesh foods, no other food stuff was being consumed within RDA limits. The t-tests for each food type revealed overwhelming evidence against the null hypothesis that the foods were being consumed within RDA limits.

Results for nutrient intake [Table 4] revealed that except for Vitamin C and Niacin, all other nutrients are far below the RDA level. The main components of hemoglobin formation are iron and folic acid. Only 0.65% of women were found to consume adequate limits of iron and no women were found to intake the adequate limits of folic acid. Also, no women were found to consume adequate limits of nutrients like copper and zinc. The t-tests revealed that there was highly significant evidence that none of the nutrients were being consumed within the required limits.

**Table 3: Consumption of food stuff within RDA limits**

Sl. No.	Food Stuff	RDA	N = 460		t value
			Mean ( $\pm$ s.d.)	No. (%)	
1	Cereals	362	310.87 ( $\pm$ 62.07)	137 (29.78%)	-17.71**
2	Legumes	27	11.78 ( $\pm$ 12.62)	71 (15.43%)	-25.41**
3	Green Leafy Vegetables	16	25.37 ( $\pm$ 12.01)	321 (69.78%)	12.2**
4	Tuber	55	25.37 ( $\pm$ 12.01)	0 (0%)	-35.56**
5	Other Vegetables	49	25.37 ( $\pm$ 12.01)	0 (0%)	-28.21**
6	Fruit	25	60.11 ( $\pm$ 65.13)	304 (66.09%)	11.61**
7	Milk	87	47.62 ( $\pm$ 56.95)	150 (32.6%)	-14.89**
8	Flesh Foods (Meat, fish, etc)	87	171.52 ( $\pm$ 126.47)	345 (75%)	14.374**

\* $p < .05$ , \*\* $p < .01$ **Table 4: Mean ( $\pm$  S.D.) consumption of macro and micro nutrients within RDA limits**

Sl. No.	Nutrients	RDA	N = 460		t values
			Mean ( $\pm$ s.d.)	No. (%)	
1	Protein	65	60.81 ( $\pm$ 32.65)	146.00 (31.53%)	-2.72**
2	Fat	30	12.47 ( $\pm$ 9.86)	22.00 (4.75%)	-38.24**
3	Energy	2175	1451.01 ( $\pm$ 375.40)	17.00 (3.67%)	-41.34**
4	Calcium	1000	633.79 ( $\pm$ 392.77)	78.00 (16.85%)	-19.87**
5	Iron	38	9.45 ( $\pm$ 6.03)	3.00 (0.65%)	-101.39**
6	Carotene	2400	661.22 ( $\pm$ 602.40)	10.00 (2.16%)	-61.97**
7	Thiamine	1.3	0.92 ( $\pm$ 0.25)	30.00 (6.48%)	-31.91**
8	Riboflavin	1.6	0.68 ( $\pm$ 0.37)	11.00 (2.38%)	-52.42**
9	Niacin	14	14.70 ( $\pm$ 4.13)	225.00 (48.60%)	3.69**
10	Folic Acid	400	66.86 ( $\pm$ 40.60)	0.00 (0.00%)	-175.48**
11	Vitamin C	70	96.11 ( $\pm$ 60.32)	274.00 (59.18%)	9.21**
12	Copper	2	0.78 ( $\pm$ 0.33)	0.00 (0.00%)	-75.44**
13	Zinc	15	5.06 ( $\pm$ 1.26)	0.00 (0.00%)	-165.88**

\* $p < .05$ , \*\* $p < .01$ 

## Discussion

The study has exposed that IPBMI (34.06%) among the women surveyed was almost equal to the reported status of under nutrition amongst pregnant women, both for the state of Assam (36.5%) and India (35.6%).<sup>(16)</sup> The global status of under nutrition among pregnant women is reported to be 41.8%.<sup>(17)</sup> But IWGP has stood out as the major problem area. Out of the 82% cases of women found with inadequate weight gain during pregnancy, we may assume that 34.06% were due to IPBMI. Other studies reveal that pregnant women maintained the classification of nutritional status, i.e., those who started the pregnancy underweight did not reach the adequate weight range, in the same way, the women who started overweight/obese maintained this nutritional status.<sup>(6,15)</sup> Other factors responsible for this severe downslide may be poor dietary habits and others factors like social taboos and poor intake of iron rich foods along with Iron and Folic Acid (IFA) tablets. Vitamin C helps the body to absorb iron. This good quality of Vitamin C is wasted on the women as they do not consume adequate iron-rich

food stuffs. Pathak *et al.* revealed a high prevalence of micro-nutrient deficiencies amongst pregnant women, possibly due to the poor dietary intake of food and low frequency of consumption of food groups rich in micronutrients.<sup>(18)</sup>

Many studies conducted worldwide have revealed the effects of socio-economic, socio-cultural, environmental etc., factors on IPBMI and IWGP.<sup>(19-21)</sup> The same was reflected strongly in our study. As observed, most of the households did not have their own land for cultivation and were worked in others' land or daily wage laborer or miscellaneous engagements. However, job opportunities were not completely unavailable, however menial. Economic independence of the women seems to be a determining factor in contributing to the total income of the household and their decision on adequate nutrition and other care for healthy lifestyle. The amount spent on food is lesser even in the high income group as the household might prioritize other life style requirements instead of food, like purchasing TV, mobile, etc. which involve recurring cost. Moreover, although the women were fairly educated, they do not have awareness regarding nutritional and other needs during pregnancy resulting in inadequate weight gain.

Environmental factors taken widely represent the overall hygiene and sanitation status of the households. Improper hygiene and sanitation directly affects the health status of the individuals, thus contributing to their inadequate nutritional status. The survey was made during the rainy season. It was observed during questioning that certain foods like green herbs, vegetables, and locally available fruits were available free of cost in and around the respondents' residing area. The consumption of tubers and other vegetables were almost 0% mainly because they were not available free but had to be bought from market. Most of the Muslim women's husbands were involved in the meat and fish trading business, which meant the women in these household were consuming some amount of it, however small. Apart from that, the women were not consuming any other food in adequate amount. Moreover, most women had pet (milk producing) animals in the household. In spite of that, the consumption of milk was far from adequate. It was evident that men and children would consume whatever little were left, after selling most of the produced milk.

Most of the women surveyed were in advanced stages of pregnancy and they were mostly first time pregnant. So, they might not have the experience and knowledge about proper care and nutrition requirement leading to their inadequate weight gain during pregnancy.

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