

Content available at: <https://www.ipinnovative.com/open-access-journals>

Indian Journal of Obstetrics and Gynecology Research

Journal homepage: [www.ijogr.org](http://www.ijogr.org)

## Original Research Article

# Is there any materno- foetal risks in mothers with gestational weight gain (WHO & IOM) based on their pre-pregnancy body mass indices? Our experience in a tertiary care teaching institution in North Kerala

Heera Shenoy Trivikrama<sup>1\*</sup>, Remash K<sup>2</sup>, Nirupama A Y<sup>3</sup>, Naseemabeevi A<sup>1</sup>, Swapnalakshmi Durvasula<sup>1</sup>

<sup>1</sup>Dept. of Obstetrics and Gynaecology, KMCT Medical College, Kozhikode, Kerala, India

<sup>2</sup>Dept. of General Medicine, Malabar Medical College, Kozhikode, Kerala, India

<sup>3</sup>Indian Institute of Public Health, Hyderabad, Telangana, India



## ARTICLE INFO

## Article history:

Received 07-12-2023

Accepted 11-01-2024

Available online 11-05-2024

## Keywords:

Asian Indians

Gestational weight gain

Institute of Medicine

Pregnancy outcomes

World Health Organization

## ABSTRACT

**Objective:** This research was done to learn the impact of pre-pregnancy BMI and gestational weight gain (GWG) on subsequent risks of adverse pregnancy outcomes in a tertiary care teaching institution in North Kerala, India.

**Design:** A descriptive study in a tertiary care teaching institution in Kozhikode, North Kerala.

**Participants:** 296 singleton pregnant women with BMI categorised as per Asian Standards and adverse maternal outcomes were looked out for.

**Results:** Pregnant women were underweight (82.8%) achieved less than recommended weight during pregnancy as compared to 18.4% obese mothers. Mothers with high BMI gained more than recommended weight during pregnancy as compared to the underweight and normal weight woman. GDM was 3.03 times ( $p=0.019$ ) and Hypertensive disorders of pregnancy was 1.116 times more common in higher pre-pregnancy BMI mothers. In the present study, gestational weight gain had no impact on maternal anaemia, Gestational diabetes, Gestational hypertension, foetal growth restriction and rate of caesarean deliveries. A statistically significant positive correlation was obtained between pre-pregnancy BMI and baby weight,  $p<0.001$ . A statistically significant positive correlation was obtained between gestational weight gain and baby weight,  $p=0.005$ .

**Conclusions:** Weight gain during pregnancy had no significant impact on maternal pregnancy outcomes and caesarean delivery.

This is an Open Access (OA) journal, and articles are distributed under the terms of the [Creative Commons Attribution-NonCommercial-ShareAlike 4.0 License](https://creativecommons.org/licenses/by-nc-sa/4.0/), which allows others to remix, tweak, and build upon the work non-commercially, as long as appropriate credit is given and the new creations are licensed under the identical terms.

For reprints contact: [reprint@ipinnovative.com](mailto:reprint@ipinnovative.com)

## 1. Introduction

Nutritional status of women has been given due importance in the health of mother and foetus. Women who conceive in the under-weight (UW) category have been noted to have earlier births and babies were of low birth weight, whereas gestational diabetes mellitus (GDM), gestational hypertension (GHTN), and preeclampsia were more

frequent in the overweight/obese category of mothers.<sup>1,2</sup>

Pre-pregnancy BMI is known to have an impact on infant weight at birth. Weight gain during pregnancy also is said to have a role in determining the pregnancy outcome.<sup>3</sup> Gaining desirable gestational weight has been known to be effective in supporting the foetal growth and development. Excessive GWG has been associated with a higher fat mass in childhood and continued add-on of fat reserves.

\* Corresponding author.

E-mail address: [heeraprabhu@gmail.com](mailto:heeraprabhu@gmail.com) (H. S. Trivikrama).

WHO in 2004<sup>4</sup> and Institute of medicine (IOM) revised the gestational weight gain guidelines in 2009. Four categories of BMI in kg/m<sup>2</sup> categories such as underweight (< 18.5), normal (18.5 - 22.9), overweight (23 - 24.9) and obese (> 25)<sup>5</sup> were categorised. The recommended weight gain (kg) in the underweight is 12.5 - 18 kg, 11.5 - 16 kg in average /normal, 7 - 11.5 kg in overweight category. 5 - 9 kg is the expected weight gain in obese BMI group.<sup>6</sup>

## 2. Materials and Methods

This descriptive study was conducted at the Department of Obstetrics and Gynaecology, KMCT Medical College Hospital over a period of 6 months from September 1, 2021 to March 31, 2022. Three hundred pregnant women attending the hospital, either in antenatal clinic or ward, at or beyond 12 weeks with documented pre-pregnancy body weight were the participants. There were four subjects who were lost to follow up. WHO in 2004 and Institute of medicine (IOM) revised the pregnancy weight gain guidelines in 2009 by including four categories of BMI in kg/m<sup>2</sup> categories such as underweight (< 18.5), normal (18.5 - 22.9), overweight (23 - 24.9) and obese (> 25). Mothers with singleton pregnancies willing to participate and had fetus presenting by vertex were selected for this research.

The ethics committee approval was given by the following institutions, KMCT Medical College, and conducted according to the principles of the Helsinki Declaration. [KMCT/RP 2021/ IEC/39. Bodyweight was measured at the first visit and at subsequent check-ups and documented. Presence of maternal medical disorders were enquired and carefully surveilled for any growth disorders in the foetus. Need for operative delivery, new - born birth weight, gestational age at birth were asked. Days of stay in the NICU was taken as the predictor of foetal morbidity. Based on the gestational weight gain for their respective BMI, three categories, i.e. below recommended gestational weight gain (GWG), recommended GWG and above recommended GWG group were the headings under which 296 mothers could be placed.

GWG recommendations according to IOM 2009 guideline were used on BMI recommendation for Asian population, as described in (Table 3). Statistical evaluation performed with standard statistical methods.

## 3. Results

The recommended weight gain (kg) – underweight (12.5 - 18 kg), normal (11.5 - 16 kg), overweight (7 - 11.5 kg), and obese (5 - 9 kg) were in these four categories.<sup>6</sup> (Table 1)

Pre-pregnancy weight (Mean-SD): 55.2 (0.7)

1. Weight at delivery (Mean-SD): 63.8 (0.8)
2. BMI (Mean-SD): 23.0 (0.3)
3. Pregnancy weight gain (Mean-SD): 8.6 (0.2)

Proportions of below, recommended, or excessive gestational weight gain cases according to maternal pre-pregnancy {GWG and BMI category.

82.8% under- weight women gained less than recommended weight, 15.5% gained recommended weight and only 1.7% gained above recommended weight in BMI <18.5.

84% normal weight women gained less than recommended weight, 14.2% gained recommended weight and only 1.9% gained above recommended weight.

46.9% women in obese group gained above recommended weight and 11.8% women in overweight group gained above recommended weight. (Table 2), implying that majority of obese mothers put on more than that was expected in that category.

**Pre-pregnancy BMI and GDM:** A statistically significant higher odds of 3.03 of developing GDM was computed with per unit increase in pre-pregnancy BMI.

**Pre-pregnancy BMI and Anaemia:** A statistically significant difference was not noted in pre-pregnancy BMI between anaemic and non-anaemic groups of women.

**Gestational weight gain and Anaemia:** A statistically significant difference was not noted in Gestational weight gain between anaemic and non-anaemic groups of women.

**Pre-pregnancy BMI and HTN:** A statistically significant higher odds of 1.116 of developing Hypertensive disorders of pregnancy was computed with per unit increase in pre-pregnancy BMI.

**Gestational weight gain and HTN:** A statistically significant difference was not noted in gestational weight gain between hypertensive and non-hypertensive groups of women.

**Pre-pregnancy BMI and LSCS outcomes:** A statistically significant difference was not noted in pre-pregnancy BMI between LSCS and non- LSCS outcomes.

**Gestational weight gain and LSCS outcome:** A statistically significant difference was not noted in gestational weight gain between LSCS and non- LSCS outcomes.

**Pre-pregnancy BMI and IUGR:** A statistically significant difference was not noted in pre-pregnancy BMI between IUGR and non-IUGR outcomes of pregnancy.(Figure 1)

Interpretation: A statistically significant positive correlation was obtained between pre-pregnancy BMI and baby weight.(Figure 2)

Interpretation: A statistically significant positive correlation was obtained between gestational weight gain and baby weight.(Figure 2 )

## 4. Discussion

In the present study, underweight BMI mothers achieved less than recommended weight during pregnancy [82.8%] as

**Table 1:**

Pre-Preg BMI	Below GWG /LOW GWG	RecommendedGWG in Kg	Above GWG/High GWG in Kg
<18.5	<12.5 kg	12.5-18 kg	>18 kg
18.5-22.9	<11.5 kg	11.5-16 kg	>16 kg
23-24.9	<7kg	7-11.5 kg	>11.5 kg
>25	<5kg	5-9kg	>9 kg

**Table 2:** Pre-pregnancy BMI and gestational weight gain

Pre-pregnancy BMI	Low GWG		Recommended GWG		High GWG		Total	Recommended Range In kg
	[N=]	%	[N=]	%	[N=]	%		
<18.5	48	82.8	09	15.5	01	1.7	58	12.5-18
18.5-22.9	89	84.0	15	14.2	02	1.9	106	11.5-16
23-24.9	16	47.1	14	41.2	04	11.8	34	7-11.5
>= 25	18	18.4	34	34.7	46	46.9	98	5-9

**Table 3:** BMI and Morbidities

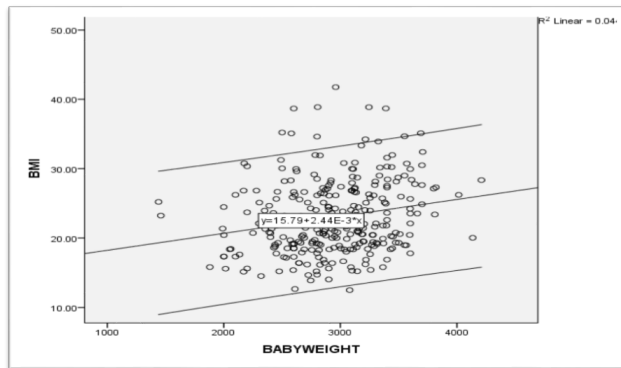
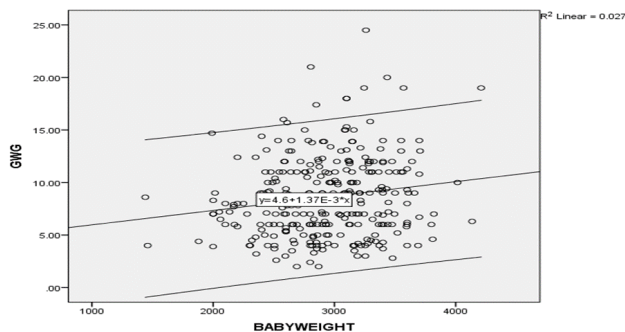
Gestational Diabetes	BMI<18.5	BMI 18-22.9	BMI 23-24.9	BMI >25	Total	p-Value
Yes	9(15.5%)	23(21.7%)	8(21.2%)	28(28.5%)	68(22.9%)	p=0.019*
No	49(84.5%)	83(78.3%)	26(78.8%)	70(71.5%)	228(77.1%)	
	58	106	34	98	296	
Hypertensive disorders in Pregnancy	BMI<18.5	BMI 18-22.9	BMI 22.9-24.9	BMI>25	Total	
Yes	6(10.3%)	8(7.5%)	5(15.2%)	17(17.0%)	36(12.1%)	P=0.008*
No	52(89.7%)	98(92.5%)	29(84.8%)	81(83.0%)	260(87.9%)	
	58	106	34	98	296	
Anaemia	BMI<18.5	BMI 18-22.9	BMI 22.9-24.9	BMI >25	Total	
Yes	10(17.2%)	21(19.8%)	6(18.2%)	15(17.0%)	52(18.2%)	P=0.765
No	48(82.8%)	85(80.2%)	28(81.8%)	83(83.0%)	244(81.8%)	
	58	106	34	98	296	
Foetal growth restriction/ FGR	BMI <18.5	BMI18-22.9	BMI 22.9-24.9	BMI >25	Total	
Yes	25(43.1%)	29(27.4%)	8(24.2%)	24(25.0%)	86(29.3%)	P=0.054
No	33(56.9%)	77(72.6%)	26(75.8%)	74(75.0%)	210(70.7%)	
	58	106	34	98	296	
Caesarean Delivery	BMI <18.5	BMI 18-22.9	BMI 22.9-24.9	BMI>25	Total	
Yes	11(19.0%)	21(19.8%)	8(24.2%)	28(26.0%)	68(22.2%)	P=0.057
No	47(81.0%)	85(80.2%)	26(75.8%)	70(74.0%)	228(77.8%)	
	58	106	34	98	296	

**Table 4:** Adverse outcome based on pre-pregnancy BMI

Pre-Preg BMI	Neonatal weight			Preterm	Cesarean	Large-for gestational age/LGA
	Normal Birth weight	Low birth weight (<2499g)	MEAN +/- SD			
<18.5	45	13(28.3%)	2142.69±178.811	6(27.3%)	11(16.7%)	1(3.4%)
18.5-22.9	89	17(37.0%)	2347.94±144.071	4(18.2%)	21(31.8%)	7(24.1%)
23-24.9	28	6(13.0%)	2137.33±367.059	3(13.6%)	8(12.1%)	5(17.2%)
>25	86	10(21.7%)	2207.00±301.894	9(40.9%)	26(39.4%)	16(55.2%)
		46		22	66	29

**Table 5:** Adverse outcome based compared with recommended gestational weight gain

Gestational weight gain	Low birth weight		Caesarean	LGA (>3500)
	LBW	PRETERM (<37)		
Below	30(65.2%)	12(54.5%)	28(42.4%)	13(44.8%)
Normal	16(34.8%)	9(40.9%)	35(53.0%)	14(48.3%)
Above	0(0.0%)	1(4.5%)	3(4.5%)	2(6.9%)

**Figure 1:** Correlation between pre-pregnancy BMI and Birth weight of Baby Pearson correlation:  $r = + 0.209$ ,  $p < 0.001$ **Figure 2:** Correlation between Gestational weight gain and Birthweight of baby (95% CI) Pearson correlation:  $r = + 0.163$ ,  $p = 0.005$ 

compared to obese women [18.4%]. Mothers who weighed on the higher side [46.9%] had excess weight gain in their gestation in comparison to women with BMI < 16 [1.7%] and those with normal BMI [1.9%] in this analysis as well as that observed in Heerman et al.<sup>7</sup> Singh K et al.<sup>8</sup> Mishra KG et al.<sup>5</sup> also supported these observations.

Li et al.<sup>9</sup> opined that overweight and obese women who gained extra kilograms than required in the present pregnancy had 16 to 22 fold risk of gestational diabetes than those with normal weight gain. Singh et al.<sup>10</sup> had shown similar results. A statistically significant higher odds of 3.03 in development of GDM was computed with per unit increase in pre-pregnancy BMI in the present study as well as that in Najafi et al. [2018] where 4% increased risk of

GDM with per unit increase in BMI was noted.<sup>11</sup>

A large multicentric prospective study in women during pregnancy made it clear that women who belonged to the obese category were 2.5 times and 1.6 times more likely to develop gestational hypertension and preeclampsia, respectively.<sup>12</sup> Rahman et al. conducted a meta-analysis in which overweight and obese mothers were at higher odds of developing pre-eclampsia<sup>13</sup> as in the present research. As every unit is added to pre-pregnancy BMI, total body fat content multiplies resulting in metabolic morbidities such as gestational diabetes mellitus and hypertensive disorders in pregnancy<sup>14–16</sup> which bring a negative impact to the quality of life.

Rate of LSCS and operative vaginal delivery was compared between the groups as in Singh K et al. and Rosemarie Farquharson et al.<sup>17</sup>

Pre-pregnancy BMI was not a predictor of caesarean according to this study as well as in Edwards et al.<sup>18</sup> and Graham et al.<sup>19</sup> Seligman and Bhavadharini noted that greater weight gain among obese women during pregnancy was particularly associated with higher risk of caesarean delivery in contrast to the present study.<sup>20,21</sup>

Underweight women are known to deliver preterm infants. In addition, underweight women gaining less weight than recommended can have higher risk of delivering low birth weight infants as in Patel K et al which is in contrast to that in our study.<sup>22</sup> A statistically significant positive correlation was obtained between pre-pregnancy BMI and baby weight in the present study as in Gul R et al.<sup>23</sup>

## 5. Conclusions

Gestational weight gain had no impact on maternal pregnancy outcomes and caesarean delivery.

## 6. Author Contribution

Dr. Heera Shenoy T has prepared the conceptual framework, designed the draft and collected the data. Dr. Remash K and Naseemabeevi A has done manuscript writing and final editing. Dr. Nirupama AY has done the statistical analysis.

## 7. Ethical Consideration

The ethical approval for the research was provided by the following institutions, KMCT Medical College and conducted according to the principles of Helsinki

Declaration.

## 8. Source of Funding

None.


## 9. Conflict of Interest

None.

## References

- Lynch CM, Sexton DJ, Hession M, Morrison JJ. Obesity and mode of delivery in primigravid and multi gravid women. *Am J Perinatol*. 2008;25(3):163–7.
- Frederick IO, Williams MA, Sales AE, Martin DP, Killien M. Pre-pregnancy body mass index, gestational weight gain, and other maternal characteristics in relation to infant birth weight. *Matern Child Health J*. 2008;12(5):557–67.
- Nohr EA, Vaeth M, Baker JL, Sørensen TL, Olsen J, Rasmussen KM. Combined associations of prepregnancy body mass index and gestational weight gain with the outcome of pregnancy. *Am J Clin Nutr*. 2008;87(6):1750–9.
- World Health Organization. Regional Office for the Western Pacific. The Asia-Pacific perspective : redefining obesity and its treatment. Sydney: Health Communications Australia; 2000. Available from: <https://iris.who.int/handle/10665/206936>.
- Mishra KG, Bhatia V, Nayak R. Maternal Nutrition and Inadequate Gestational Weight Gain in Relation to Birth Weight: Results from a Prospective Cohort Study in India. *Clin Nutr Res*. 2020;9(3):213–22.
- Arora P, Aeri BT. Gestational Weight Gain among Healthy Pregnant Women from Asia in Comparison with Institute of Medicine (IOM) Guidelines-2009: A Systematic Review. *J Pregnancy*. 2019;2019:3849596.
- Heerman WJ, Bian A, Shintani A, Barkin SL. The interaction between maternal pre-pregnancy bmi and gestational weight gain shapes infant growth. *Acad Pediatr*. 2014;14(5):463–70.
- Singh K, Goel A, Narain A. Gestational weight gain and its effect on foetomaternal outcome. *Int J Reprod Contracept Obstet Gynecol*. 2020;9:4477–81.
- Li N, Liu E, Guo J, Pan L, Li B, Wang P, et al. Maternal pre-pregnancy body mass index and gestational weight gain on pregnancy outcomes. *PLoS One*. 2013;8(12):82310.
- Najafi F, Hasani J, Izadi N, Hashemi-Nazari SS, Namvar Z, Mohammadi S, et al. The effect of pre-pregnancy body mass index on the risk of gestational diabetes mellitus: A systematic review and doseresponse meta-analysis. *Obes Rev*. 2018;20(3):472–6.
- Singh A, Kujur A, Roy A. Body mass index and gestational weight gain in pregnant women with gestational diabetes and its relation with adverse maternal and fetal outcome. *Int J Reprod Contracept Obstet Gynecol*. 2020;9:4256–61.
- Weiss JL, Malone FD, Emig D, Ball RH, Nyberg DA, Comstock CH, et al. Obesity, obstetric complications and cesarean delivery rate - A population-based screening study. *Am J Obstet Gynecol*. 2004;190(4):1091–7.
- Rahman MM, Abe SK, Kanda M, Narita S, Rahman MS, Bilano V, et al. Maternal body mass index and risk of birth and maternal health outcomes in low-and middle- income countries: a systematic review and meta-analysis. *Obes Rev*. 2015;16(9):758–70.
- Pal R, Maiti M, Roychoudhury B, Sanyal P, Chowdhury B. Association of Preeclampsia and Antenatal Weight Gain With Pregnancy Outcome: A Prospective Observational Cohort Study. *Int J Women's Health Reprod Sci*. 2017;5(1):37–40.
- Yazdani S, Yosofniyapasha Y, Nasab BH, Mojaveri MH, Bouzari Z. Effect of maternal body mass index on pregnancy outcome and newborn weight. *BMC Res Notes*. 2012;5:34. doi:10.1186/1756-0500-5-34.
- Neumann K, Indorf I, Härtel C, Cirkel C, Rody A, Beyer DA. C-Section Prevalence Among Obese Mothers and Neonatal Hypoglycemia: a Cohort Analysis of the Department of Gynecology and Obstetrics of the University of Lübeck. *Geburtshilfe Frauenheilkd*. 2017;77(5):487–94.
- Bush RA, Connelly CD, Farquharson HR, Johnson M, Estrada J, Tardiel K. Maternal characteristics & gestational weight gain. *J Nurs Res Pract*. 2018;2(3):15–20.
- Edwards LE, Hellerstedt WL, Alton IR, Story M, Himes JH. Pregnancy complications and birth outcomes in obese and normal-weight women: Effects of gestational weight change. *Obstet Gynecol*. 1996;87(3):389–94.
- Graham LE, Huber LRB, Thompson ME, Ersek JL. Does amount of weight gain during pregnancy modify the association between obesity and cesarean section delivery? *Birth*. 2014;41(1):93–9.
- Seligman LC, Duncan BB, Branchtein L, Gaio DS, Mengue SS, Schmidt MI. Obesity and gestational weight gain: cesarean delivery and labor complications. *Rev Saude Publica*. 2006;40(3):457–65.
- Bhavadharini B, Anjana RM, Deepa M, Jayashree G, Nrutya S, Shobana M. Gestational weight gain and pregnancy outcomes in relation to body mass index in Asian Indian women. *Indian J Endocr Metab*. 2017;21:588–93.
- Patel K, Chaudhari M, Shah M. Effect of gestational weight gain on pregnancy outcome of Indian mothers. *Int J Reprod Contracept Obstet Gynecol*. 2020;9(4):1681–5.
- Gul R, Iqbal S, Anwar Z, Ahdi S, Ali SH, Pirzada S. Pre-pregnancy maternal BMI as predictor of neonatal birth weight. *PLoS One*. 2020;15(10):e0240748.

## Author biography

**Heera Shenoy Trivikrama**, Professor  <https://orcid.org/0000-0001-6197-0236>

**Remash K**, Associate Professor

**Nirupama A Y**, Lecturar

**Naseemabeevi A**, Professor

**Swapnalakshmi Durvasula**, Assistant Professor

**Cite this article:** Trivikrama HS, Remash K, Nirupama A Y, Naseemabeevi A, Durvasula S. Is there any materno- foetal risks in mothers with gestational weight gain (WHO & IOM) based on their pre-pregnancy body mass indices? Our experience in a tertiary care teaching institution in North Kerala. *Indian J Obstet Gynecol Res* 2024;11(2):157-161.