International Journal of Reproduction, Contraception, Obstetrics and Gynecology
Lalu AM et al. Int J Reprod Contracept Obstet Gynecol. 2026 Dec;15(12):4930-4934
www.ijrcog.org
pISSN 2320-1770 | eISSN 2320-1789

DOI: https://dx.doi.org/10.18203/2320-1770.ijrcog20264410

Original Research Article

Gestational weight gain and maternal and neonatal outcomes among women with normal pre-pregnancy BMI: a prospective observational study

Aneetta M. Lalu*, Rachel Mathew

Department of Obstetrics and Gynecology, Pushpagiri Institute of Medical Sciences and Research Centre, Tiruvalla, Kerala, India

Received: 04 October 2026
Accepted: 09 November 2026

***Correspondence:**
Dr. Aneetta M Lalu,
E-mail: aneettaanmary@gmail.com

Copyright: © the author(s), publisher and licensee Medip Academy. This is an open-access article distributed under the terms of the Creative Commons Attribution Non-Commercial License, which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

ABSTRACT

Background: Gestational weight gain (GWG) may influence maternal and neonatal outcomes even among women with normal pre-pregnancy body mass index (BMI). This study assessed the proportion of inadequate, recommended and excessive GWG and their association with maternal and neonatal outcomes.
Methods: This hospital-based prospective observational study included 192 antenatal women aged 18–40 years with singleton pregnancy and normal pre-pregnancy BMI, attending the Obstetrics and Gynecology Department of Pushpagiri Medical College & Research Centre. Weight was monitored during the initial, second and third trimesters and total GWG was categorized according to the Institute of Medicine (IOM) recommendation of 11.5–16 kg for women with normal pre-pregnancy BMI. Maternal complications, mode of delivery, postpartum complications and neonatal outcomes were recorded. Associations were assessed using the chi-square test; $p<0.05$ was considered significant.
Results: Of 192 women, 70 (36.5%) had inadequate GWG, 96 (50.0%) had recommended GWG and 26 (13.5%) had excessive GWG. Gestational diabetes mellitus (GDM) occurred in 25.5%, anemia in 18.2% and hypothyroidism in 16.1% and gestational hypertension in 10%. GDM and gestational hypertension were significantly associated with abnormal GWG category (both $p<0.001$). Overall, 64.1% had normal vaginal delivery, 33.4% underwent cesarean delivery and 2.6% had instrumental delivery. Most neonates (78.1%) weighed 2.5–3.5 kg; 99.5% cried at birth. NICU admission occurred in 26%. Both obstetric and neonatal outcomes did not show any significant association with GWG category.
Conclusions: Abnormal GWG was common among women with normal pre-pregnancy BMI. Excessive GWG was significantly associated with GDM and gestational hypertension. Routine assessment of GWG with individualized nutritional and lifestyle counselling may help identify women at risk of adverse pregnancy outcomes.

Keywords: Gestational weight gain, Gestational diabetes mellitus, Gestational hypertension, Maternal outcome, Neonatal outcome, Pre-pregnancy BMI

INTRODUCTION

Maternal nutritional status before and during pregnancy is an important determinant of pregnancy outcome. Both low and excessive GWG have been associated with adverse maternal and neonatal outcomes. In women with normal pre-pregnancy BMI (18.5–24.9 kg/m²), the IOM recommends a total pregnancy weight gain of 11.5–16 kg.[1] Inadequate gain has been associated with low birth weight, small-for-gestational-age infants and preterm birth, whereas excessive gain has been associated with gestational diabetes, hypertensive disorders, larger birth weight and cesarean delivery.[2] Despite routine antenatal weighing, deviations from recommended GWG remain

frequent. Evidence from previous studies suggests that GWG may independently influence maternal and neonatal outcomes.[3,4] However, studies specifically evaluating women with normal pre-pregnancy BMI in the South Indian setting are limited. The present study therefore assessed the distribution of GWG and its association with maternal and neonatal outcomes in antenatal women with normal pre-pregnancy BMI at a tertiary care centre in South Kerala.

Objectives

To estimate the proportion of women with GWG below, within and above recommendations among antenatal women with normal pre-pregnancy BMI. To assess the association of maternal factors with abnormal GWG. To determine the association of GWG category with maternal and neonatal outcomes.

METHODS

Study design and setting

Hospital-based prospective observational study conducted in the Department of Obstetrics and Gynecology, Pushpagiri Medical College and Research Centre, Tiruvalla, Kerala, from 16 September 2023 to 16 March 2025. Antenatal women aged 18–40 years with singleton pregnancy and normal pre-pregnancy BMI were included in the study. Women with pre-pregnancy BMI <18.5 or >25 kg/m², multiple pregnancy, chronic hypertension, overt diabetes, renal disorders or unwillingness to participate were excluded. A total of 192 participants fulfilling the eligibility criteria were included in the study.

Data collection

A proper history of these patients were through interview method by using a semi structured questionnaire. Height was noted with a stadiometer and pre-pregnancy weight was recorded by maternal recall at the initial visit. Weight measurements closest to 24 weeks and term were also recorded using a weighing scale. Total GWG was categorized as inadequate (<11.5 kg), recommended (11.5–16 kg) or excessive (>16 kg), based on the IOM recommendation for normal BMI.

Maternal blood pressure, routine investigations, 75 g oral glucose tolerance testing, antenatal complications, mode of delivery, postpartum complications, neonatal birth weight, APGAR score, fetal distress and NICU admission were documented.

Statistical analysis

Data were entered in Microsoft Excel and analyzed using SPSS version 27. Categorical variables were expressed as frequency and percentage; quantitative variables were summarized using mean and standard deviation. Associations were assessed using chi-square test. A p value<0.05 was considered statistically significant.

The study was approved by the Institutional Ethics Committee of Pushpagiri Institute of Medical Sciences and Research Centre, Thiruvalla. Written informed consent was obtained from all participants and confidentiality was maintained at every stage of the study. (IEC: PIMSRC/E1/388A/94/2023).

RESULTS

A total of 192 women with normal pre-pregnancy BMI were included in the study after fulfilling the inclusion criteria. According to the IOM recommendation, in women with normal pre-pregnancy BMI category, 70 women (36.5%) had weight gain less than IOM recommendation, 96 women (50%) had weight gain equal to the weight gain recommended by IOM and 26 women (13.5%) gained weight more than IOM recommendation (Table 1).

The majority (54.2%) were aged 25–30 years; 47.9% were primigravidas and 52.1% multigravidas. When study participants were distributed based on antenatal risk factors the most frequent antenatal complications were GDM (25.5%), anemia (18.2%), hypothyroidism (16.1%) and gestational hypertension (5.2%). Pre-eclampsia occurred in 1.0%, preterm labor in 3.1%, PPROM in 3.1%, abnormal Doppler in 1.6% and antepartum hemorrhage and stage 4 fetal growth restriction in 0.5% each. Considering association between antenatal complications and abnormal weight gain , GDM and gestational hypertension were significantly associated with excessive GWG category (p<0.001 for each). However no statistically significant difference was observed in the prevalence of other obstetric complications between the three groups in this study (Table 2).

When proportion of various obstetric outcomes were considered, 36 patients (18.8%) went into spontaneous labor. Labor was induced in 112 patients, out of which 9 (4.7%) were induced only by mechanical method, 65 patients (33.9%) induced by mechanical+ pharmacological method and 38 patients (19.8%) induced by pharmacological methods alone. Overall, 123 women (64.1%) had normal vaginal delivery, 36 (18.8%) elective cesarean delivery, 28 (14.6%) emergency cesarean delivery and 5 (2.6%) instrumental delivery. Postpartum hemorrhage occurred in 8 women (4.1%), including 7 cases of atonic PPH and one combined atonic and traumatic PPH. Then association between GWG and all these obstetric factors were considered. However in the current study ,there were no significant difference between any of these variables were found (Table 3).

Overall, 150 neonates (78.1%) weighed 2.5–3.5 kg, 36 (18.8%) weighed 1.5–2.5 kg and 3 (1.6%) each weighed <1.5 kg and >3.5 kg. Most neonates (99.5%) cried at birth and 95.8% had APGAR 9,9 at 1 and 5 minutes. Fifty

neonates (26.0%) required NICU admission; the commonest documented indications were maternal diabetes (13.0%) and prematurity (8.9%). No perinatal mortality was recorded. We compared neonatal outcomes with GWG. None showed a statistically significant association with GWG category (Table 4).

Table 1: Association between maternal age and parity with gestational weight gain.

Variables	Category	Less than recommended weight gain (n=70) N (%)	Recommended weight gain (n=96) N (%)	More than recommended weight gain (n=26) N (%)	P value
Age group	18-24	14 (20)	14 (14.6)	5 (9.2)	0.852
	25-30	37 (52.9)	55 (57.3)	12 (46.2)	
	31-35	14 (20)	20 (20.8)	8 (30.8)	
	>35	5 (7.1)	7 (7.3)	1 (3.8)	
Parity	Primigravida	33 (47.1)	45 (46.9)	14 (53.8)	0.809
	Multigravida	37 (52.9)	51 (53.1)	12 (46.2)	

Table 2: Distribution of participants according to gestational weight gain.

GWG category	N	%
Inadequate (<11.5 kg)	70	36.5
Recommended (11.5–16 kg)	96	50.0
Excessive (>16 kg)	26	13.5

Table 3: Association between various antenatal complications with gestational weight gain.

Variables	Category	Inadequate GWG	Recommended GWG	Excessive GWG	P value
Anemia	Yes	14 (20)	16 (16.7)	5 (19.2)	0.851
	No	56 (80)	80 (83.3)	21 (80.8)	
GDM	Present	8 (11.4)	27 (28.1)	14 (53.8)	<0.001*
	Absent	62 (88.6)	69 (71.9)	12 (46.2)	
Gestational HTN	Present	1 (1.4)	2 (2.1)	7 (26.9)	<0.001*
	Absent	69 (98.6)	94 (97.9)	19 (73.1)	
Pre-eclampsia	Present	0 (0)	1 (1)	1 (3.8)	0.271
	Absent	70 (100)	95 (99)	25 (96.2)	
Preterm labor	Present	2 (2.9)	2 (2.1)	2 (7.7)	
	Absent	60 (85.7)	91 (94.8)	23 (88.5)	
Abnormal doppler	Present	2 (2.9)	1 (1)	0 (0)	
APH	Present	0 (0)	1 (1)	0 (0)	
Stage 4 FGR	Present	1 (1.4)	0 (0)	0 (0)	
Hypo-thyroidism	Present	12 (17.1)	14 (14.6)	5 (19.2)	0.737
	Absent	58 (82.9)	82 (85.4)	21 (80.8)	

*Statistically significant

Table 4: Association between gestational weight gain and obstetric outcomes.

Variables	Category	Inadequate GWG	Recommended GWG	Excessive GWG	P value
Spontaneous labor	Yes	12 (17.1)	18 (18.8)	6 (23.1)	0.763
	No	58 (82.9)	78 (81.3)	20 (76.9)	
Induced labor	No	31 (44.3)	37 (38.5)	12 (46.2)	0.987
	Mechanical	3 (4.3)	5 (5.2)	1 (3.8)	
	Mechanical+Pharmacological	22 (31.4)	34 (35.4)	9 (34.6)	
	Pharmacological	14 (20)	20 (20.8)	4 (15.4)	
Mode of delivery	**NVD**	46 (65.7)	63 (65.6)	14 (53.8)	0.493
	Elective LSCS	15 (21.4)	16 (16.7)	5 (19.2)	
	Emergency LSCS	8 (11.4)	13 (13.5)	7 (26.9)	

Continued.

Variables	Category	Inadequate GWG	Recommended GWG	Excessive GWG	P value
	Instrumental	1 (1.4)	4 (4.2)	0 (0)	
Atonic PPH	Absent	66 (94.3)	94 (97.8)	24 (92.3)	0.327
	Atonic	3 (4.3)	2 (2.1)	2 (7.7)	
	Atonic+Traumatic	1 (1.4)	0 (0)	0 (0)	

Table 5: Association between gestational weight gain and neonatal outcomes.

Variables	Category	Inadequate GWG	Recommended GWG	Excessive GWG	P value
Cried at birth	Yes	69 (98.6)	96 (100)	26 (100)	0.500
	No	1 (1.4)	0 (0)	0 (0)	
Weight of the neonates	<1.5	2 (2.9)	1 (1)	0 (0)	0.299
	1.5-2.5	17 (24.3)	13 (13.5)	6 (23.1)	
	2.5-3.5	51 (72.9)	79 (82.3)	20 (76.1)	
	>3.5	0 (0)	3 (3.1)	0 (0)	
Fetal distress	Yes	3 (4.3)	1 (1)	0 (0)	0.356
	No	67 (95.7)	95 (99)	26 (100)	
APGAR Score	<9,9	5 (7.1)	2 (2.1)	1 (3.8)	0.262
	9,9	65 (92.9)	94 (97.9)	25 (96.2)	
NICU Admission	Yes	17 (24.3)	22 (22.9)	11 (42.3)	0.124
	No	53 (75.7)	74 (77.1)	15 (57.7)	

DISCUSSION

In this study of women with normal pre-pregnancy BMI, only half achieved the IOM-recommended total GWG, while 36.5% had inadequate and 13.5% had excessive gain. The finding indicates that abnormal GWG is common even when pre-pregnancy BMI is normal. Similar variation in GWG has been reported in previous observational studies of normal-weight and abnormal BMI populations.[4,5]

The strongest associations in the present study were between GWG category and GDM. GDM was present in 53.8% of women with excessive GWG compared with 28.1% with recommended and 11.4% with inadequate GWG ($p<0.001$). Similar studies showed an increased incidence of GDM with abnormal GWG.[6,7] This may be associated with the lifestyle and diet of the population. However few studies failed to find a statistical significance.[8] The present study showed significant association of Gestational hypertension and abnormal GWG. Gestational hypertension occurred in 26.9% of women with excessive GWG compared with 2.1% and 1.4% in the recommended and inadequate groups, respectively ($p<0.001$). These findings are consistent with published evidence linking higher GWG with metabolic and hypertensive complications.[9,10]

Mode of delivery also did not show a statistically significant association with GWG category, although cesarean delivery was more frequent in the excessive-GWG group. Among women who gained excessive weight, the rate of elective lower segment cesarean section (LSCS) was notably high at 18.8%, with an additional 14.6% undergoing emergency LSCS. Excessive weight gain is frequently associated with larger fetal size, which can result in labor complications such as cephalopelvic disproportion, leading to surgical intervention. This finding aligns with data from Kominiarek et al who demonstrated that excessive GWG is a key factor leading to higher cesarean delivery rates.[11]

Age and parity were not significantly associated with GWG in this study. Neonatal outcomes were generally favorable and no significant association was demonstrated between GWG category and birth weight, fetal distress, APGAR score or NICU admission. Some studies had similar results whereas few studies both excessive and inadequate GWG was strongly associated with adverse neonatal outcome.[12] Although the magnitude of association varied substantially across studies, due to use of the different cutoff values for classification of inadequate GWG and different eligibility criteria for selecting participant, these consistent findings highlighted the importance of health physicians to be aware of this adverse outcome and carefully monitor the women who were at risk.

The prospective design and restriction to women with normal pre-pregnancy BMI are strengths. Limitations include the modest sample size, single-centre setting, absence of extended neonatal follow-up and reliance on self-reported pre-pregnancy weight, which may affect generalizability and measurement accuracy. Dietary intake, physical activity and socioeconomic factors were not extensively assessed.

CONCLUSION

This study signifies the impact of GWG on maternal and neonatal health outcomes among women with normal pre-pregnancy BMI. The results demonstrate that both excessive and inadequate GWG are associated with adverse clinical outcomes. Such findings emphasize the essential need for regular monitoring of GWG and counselling of pregnant women on balanced nutrition and physical activity. Adequate weight management during pregnancy can substantially reduce maternal and neonatal complications, improving the overall quality of life for both mother and child. Healthcare professionals must incorporate routine GWG assessment as part of prenatal care and provide interventions for those at risk. Furthermore, education on lifestyle modifications and early identification of deviations from recommended weight gain can help in timely management. Future research with larger, more diverse populations is needed to strengthen current evidence and guide policy formulation for maternal health programs.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

REFERENCES

1. Kamath GD, Kukreja S, Mukherjee P, Kolhapure S, Sathyanarayanan S. Maternal immunization: trends in South and Southeast Asian countries. J Maternal-Fetal Neonatal Med. 2022;35(25):8372-81.
2. Crane JMG, White J, Murphy P, Burrage L, Hutchens D. The effect of gestational weight gain by body mass index on maternal and neonatal outcomes. J Obstet Gynaecol Can. 2009;31(1):28–35.
3. Goldstein RF, Abell SK, Ranasinha S, Misso M, Boyle JA, Black MH, et al. Association of gestational weight gain with maternal and infant outcomes: a systematic review and meta-analysis. JAMA. 2017;317(21):2207–25.
4. Sun Y, Shen Z, Zhan Y, Wang Y, Ma S, Zhang S, et al. Effects of pre-pregnancy body mass index and gestational weight gain on maternal and infant complications. BMC Pregn Childbirth. 2020;20:390.
5. Wu Y, Wan S, Gu S, Mou Z, Dong L, Luo Z, et al. Gestational weight gain and adverse pregnancy outcomes: a prospective cohort study. BMJ Open. 2020;10(9):38187.
6. Omani-Samani R, Sepidarkish M, Safiri S, Esmailzadeh A, Vesali S, Farzaneh F, et al. Impact of gestational weight gain on cesarean delivery risk, perinatal birth weight and gestational age in women with normal pre-pregnancy BMI. J Obstet Gynaecol India. 2018;68(4):258–63.
7. Hedderson MM, Gunderson EP, Ferrara A. Gestational weight gain and risk of gestational diabetes mellitus. Obstet Gynecol. 2010;115(3):597–604.
8. Tovar A, Must A, Bermudez OI, Hyatt RR, Chasan-Taber L. The impact of gestational weight gain and diet on abnormal glucose tolerance during pregnancy in Hispanic women. Matern Child Health J. 2009;13:520–30.
9. Herring SJ, Oken E, Rifas-Shiman SL, Rich-Edwards JW, Stuebe AM, Kleinman KP, Gillman MW. Weight gain in pregnancy and risk of maternal hyperglycemia. American journal of obstetrics and gynecology. 2009;201(1):61.
10. LifeCycle Project-Maternal Obesity and Childhood Outcomes Study Group. Association of gestational weight gain with adverse maternal and infant outcomes. JAMA. 2019;321(17):1702–15.
11. Lackovic M, Jankovic M, Mihajlovic S, Milovanovic Z, Rovcanin M, Mitic N, et al. Gestational weight gain, pregnancy related complications and the short-term risks for the offspring. J Clin Med. 2024;13(2):445.
12. Kominiarek MA, Saade G, Mele L, Bailit J, Reddy UM, Wapner RJ, et al. Association between gestational weight gain and perinatal outcomes. 2019;3:67.
13. Wen T. Inadequate gestational weight gain and adverse pregnancy outcomes among normal weight women in China. Int J Clin Exp Med. 2015;8(2):2881–6
14. Heslehurst N, Rankin J, Wilkinson JR, Summerbell CD. A nationally representative study of maternal obesity in England, UK: trends in incidence and demographic inequalities in 619 323 births, 1989–2007. Int J Obes. 2010;34(3):420–8.
15. Scott-Pillai R, Spence D, Cardwell C, Hunter A, Holmes V. The impact of body mass index on maternal and neonatal outcomes: a retrospective study in a UK obstetric population, 2004–2011. BJOG Int J Obstet Gynaecol. 2013;120(8):932–9.
16. Haikal MN, Subadiyasa IM, Putra NE. Relationship Between Maternal Age, Gravidity, Pregnancy Interval, and Low Birth Weight at Banten Provincial Hospital. Int J Med Public Health. 2026;3(1):51-60.

Cite this article as: Lalu AM, Mathew R. Gestational weight gain and maternal and neonatal outcomes among women with normal pre-pregnancy BMI: a prospective observational study. Int J Reprod Contracept Obstet Gynecol 2026;15:4930-4.