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GESTATIONAL WEIGHT GAIN AND OBSTETRIC OUTCOME IN A TERTIARY CARE CENTRE.

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Abstract

Background: GWG plays an important role in determining maternal and neonatal outcomes. Both less than adequate and excessive weight gain are associated with adverse obstetric complications such as GDM, HDP, increase cesarean section in mothers and SGA, LGA, FGR NICU ADMISSIONS in neonates. ***Aim:*** To evaluate GWG and obstetric outcome in a tertiary care CENTRE. ***Material and Methods:*** This prospective observational study was conducted on 547 antenatal women with singleton pregnancies enrolled at <=12 weeks of gestation, of whom 47 were lost to follow up leaving 500 participants for final analysis. GWG was calculated using the difference between weight at delivery and first trimester weight. First trimester weight was used as a surrogate for pre-pregnancy weight. GWG was categorized according to IOM recommendation. The IOM GWG recommendations are based on WHO BMI cut offs. So in our study BMI was categorized as per WHO (1998) classification for adult europoid in light of paucity of recommended GWG for Asian population. Participants were followed till delivery, and maternal and Neonatal outcomes were analysed. Data was compiled and statistically analysed. ***Results:*** Excessive GWG (45.2%) was observed in the majority of participants, followed by adequate (22.0%) and less than adequate GWG (32.8%). A significant association was found between BMI and GWG. Excessive GWG was associated to increased risk of GDM, HDP and cesarean delivery, LGA. Less than adequate GWG was associated with LBW, SGA infants, and FGR. Both extremes were associated with higher neonatal complications and NICU admissions. ***Conclusion:*** Optimal GWG is essential for favorable pregnancy outcomes. Regular monitoring and individualized management of weight gain during pregnancy are necessary to reduce maternal and neonatal complications. Population specific guidelines may be required for better applicability in local-settings.

Keywords: GWG, IOM, BMI, Obstetric outcome

INTRODUCTION

GWG is a critical determinant of maternal and neonatal health in both the short and long term. An increasing proportion of women now entering pregnancy in an overweight or obese state, making GWG a key clinical concern. Both excessive and less than adequate GWG are linked to adverse obstetrics outcomes—excessive GWG is related to macrosomia, LGA, GDM, HDP, caesarean delivery (LSCS), PPWR, and long-term risks such as obesity, cardiovascular disease, and diabetes. In contrast, less than adequate GWG is related to LBW, small-for-gestational-age (SGA) infants, fetal growth restriction (FGR) and NICU admissions.[1]

GWG is influenced by pre-pregnancy BMI. Weight gain during pregnancy is multifactorial and results from maternal fat stores, fetal growth, placenta, amniotic fluid, and increased blood volume. IOM 2009 provides BMI-specific GWG recommendations Table 1, while WHO BMI classification 1998 Table 2 is commonly used for stratification. However, there are currently no asian-specific GWG guidelines, and existing recommendations are largely based on Western populations, limiting their applicability.[2]

Table 1: Iom Weight Gain Recommendations For Pregnancy (2009)[3]

Pre-pregnancy BMI (kg/m²)	Total Weight Gain		Incremental Weight Gain (2nd & 3rd Trimester)	
	Range (kg)	Range (lbs)	Mean (range) kg/week	Mean (range) lbs/week
Underweight (<18.5)	12.5 – 18.0	28 – 40	0.51 (0.44 – 0.58)	1.0 (1.0 – 1.3)
Normal weight (18.5–24.9)	11.5 – 16.0	25 – 35	0.42 (0.35 – 0.50)	1.0 (0.8 – 1.0)
Overweight (25.0–29.9)	7.0 – 11.5	15 – 25	0.28 (0.23 – 0.33)	0.6 (0.5 – 0.7)
Obese (≥30.0)	5.0 – 9.0	11 – 20	0.22 (0.17 – 0.27)	0.5 (0.4 – 0.6)

Table 2: Who Classification According To Bmi[4]

Classification	WHO BMI (kg/m²)
Underweight	< 18.5
Normal range	18.5 – 24.9
Overweight	≥ 25
Pre-obese / At risk	25 – 29.9
Obese Class I	30 – 34.9
Obese Class II	35 – 39.9
Obese Class III	≥ 40

Abnormal GWG also affects long-term child health, contributing to altered growth patterns, obesity risk, and metabolic disorders. Both excessive and less than adequate GWG increases NICU admissions due to complications such as macrosomia or growth restriction-related morbidity. Overall, maintaining appropriate GWG through individualized nutritional counselling and antenatal monitoring is necessary for optimizing maternal, fetal, and long-term health outcomes. This study was therefore designed to evaluate GWG and its association with obstetric outcomes in pregnant women attending the institute due to limited regional data.

MATERIALS AND METHODS

This prospective study was conducted in the Department of Obstetrics and Gynaecology at Sri Guru Ram Das University of Health Sciences and Research, Amritsar, from July 2024 to December 2025. A total of 547 antenatal women with singleton pregnancies of ≤12 weeks gestation were enrolled after informed consent, and 500 participants were included in the final analysis after 47 were lost to follow-up.

Objectives:

1. To assess gestational weight gain in study participants
2. To study the association of GWG with Maternal and Neonatal outcomes.

Inclusion Criteria

Antenatal patients with singleton pregnancy with gestation <=12 weeks

Exclusion Criteria

1. Antenatal patients presenting beyond 12 weeks of gestation.
2. Antenatal patients with known case of thyroid disorders, diabetes mellitus, chronic hypertension, congenital malformation in fetus, psychiatric and auto immune disorders.
3. Antenatal patients with multiple gestation.

At enrolment, detailed history, clinical examination, and anthropometric measurements were recorded. First trimester weight (≤12 weeks) was used as a proxy for pre-pregnancy weight,5and BMI was calculated using WHO (1998) criteria. Maternal weight was measured in the OPD or ward using a portable digital weighing scale as per WHO guidelines. The scale was placed on a firm, flat surface, and participants removed footwear and heavy items before measurement. Weight was recorded in kilograms with the participant standing upright and still on the scale. GWG was determined as the difference between delivery weight minus first trimester weight and classified according to IOM guidelines.

Participants were followed till delivery, and neonates were followed for 4 weeks postpartum. Maternal outcomes assessed included HDP (as per ISSHP classification)6, GDM (diagnosed using IADPSG criteria)7and mode of delivery. Neonatal

outcomes included birth weight categories (SGA, AGA, LGA)8, fetal growth restriction (based on Delphi criteria)9and NICU admissions

STATISTICAL ANALYSIS

Statistical analysis was performed using SPSS version 26.0. Data were presented using descriptive statistics such as mean ± standard deviation, range, frequencies, and percentages. Normality of data distribution was analysed using the Kolmogorov–Smirnov test. For non-parametric quantitative variables, the Kruskal–Wallis test was used, followed by post hoc analysis with Tukey's test for independent samples. Categorical variables were analysed using the chi-square test. A p-value of <0.05 was considered statistically significant.

RESULTS

This prospective study was conducted in the department of Obstetrics and Gynecology at Sri Guru Ram Das University of Health Sciences and Research, Vallah, Sri Amritsar, from July 2024 to December 2025. The total number of study participants recruited at the beginning were 547, of whom 47 were lost to follow up, leaving 500 participants for final analysis.

Table 3, shows the sociodemographic and clinical profile of the pregnant women included in the analysis. Among the 500 pregnant women, the majority aged between 20–25 years (43.2%), followed by 26–30 years (29.0%) and ≥30 years (26.4%), while only 1.4% were below 20 years of age. Most participants belonged to the lower-middle socioeconomic class (74.4%), with the remaining 25.6% in the upper-middle class. Predominant proportion of study participants were from rural area (94.2%) and only 5.8% from urban areas. BMI was classified according to WHO (1998) criteria due to limited GWG guidelines for Asian populations. Majority had a normal BMI (44.6%), Overweight women constituted 21.8%, while obesity was present in a significant proportion, including 26.4% in Obese Class I and 1.4% in Obese Class II, with no cases in Obese Class III. Only 5.8% of participants were underweight. Maternal anthropometric data showed that the first trimester visit (used as a proxy for pre-pregnancy) weight ranged from 38 to 90 kg, with a mean of 64.18 ± 12.00 kg. BMI ranged from 15.22 to 36.26 kg/m², with a mean BMI of 25.83 ± 4.82 kg/m².

Table 3: Sociodemographic And Clinical Profile Of Study Participants

Variable	No. of participants (n=500)	Percentage (100%)
AGE		
< 20	7	1.4%
20–25	216	43.2%
26–30	145	29.0%
≥ 30	132	26.4%
SOCIOECONOMIC STATUS		
Upper Class	0	0.00%
Upper Middle Class	128	25.60%
Lower Middle Class	372	74.40%
Upper Lower Class	0	0.00%
Lower Class	0	0.00%
RESIDENCE		
Rural	471	94.2%
Urban	29	5.8%
BMI		
Underweight (<18.5)	29	5.8%
Normal (18.5– 24.9)	223	44.6%
Overweight (25–29.9)	109	21.8%
Obese Class I (30–34.9)	132	26.4%
Obese Class II (35–39.9)	7	1.4%
Obese Class III (≥40)	0	0%

Table 4, demonstrates GWG among participants ranged from 5 to 22 kg, with a mean of 12.91 ± 4.26 kg. Nearly half of the women (45.2%) had excessive GWG, while 32.8% achieved adequate weight gain. In contrast, 22.0% had less than adequate GWG.

Table 4, shows the association between BMI and GWG which was statistically significant ($\chi^2 = 281.987$, $p = 0.001$). Most underweight women (75.86%) had less than adequate GWG, while none had excessive gain. Women with normal BMI showed a more balanced distribution, though adequate GWG was most common (42.60%). Among overweight women, the majority (56.88%) achieved adequate GWG. In contrast, all obese women (100%) had excessive GWG.

Table 4: Distribution Of Gestational Weight Gain (Gwg) As Per Iom Recommendations And Its Association With Bmi

(a) Distribution of GWG

GWG Group	No. of participants (n=500)	Percentage (100%)
Less than adequate (Group 1)	110	22.0%
Adequate (Group 2)	164	32.8%
Excess (Group 3)	226	45.2%

(b) Association of GWG with BMI

GWG group	Underweight (<18.5)	Normal (18.5–24.9)	Overweight (25–29.9)	Obese (≥30)	Total	χ^2 value	p-value
Less than Adequate (Group 1) (N=110)	22 (75.86%)	69 (30.94%)	19 (17.43%)	0 (0.00%)	110	281.987	0.001
Adequate (Group 2) (N=164)	7 (24.14%)	95 (42.60%)	62 (56.88%)	0 (0.00%)	164		
Excess (Group 3) (N=226)	0 (0.00%)	59 (26.46%)	28 (25.69%)	139 (100.00%)	226		
Total (N=500)	29 (100.00%)	223 (100.00%)	109 (100.00%)	139 (100.00%)	500		

Table 5, demonstrates 21.6% of women had GDM and 15.4% experienced HDP. Most participants (62.4%) underwent LSCS, while 37.2% had vaginal deliveries and only 0.4% underwent operative vaginal deliveries. The association between GWG and maternal outcomes was statistically significant. Most GDM cases (94.4%) occurred in the excess GWG group, with only 5.6% in the less than adequate group and none in the adequate group. HDP was also highest in the excess GWG group (46.8%), followed by less than adequate (40.3%), and lowest in the adequate group (13.0%). Regarding delivery, LSCS was most common in the excess GWG group (52.6%), compared to adequate (26.9%) and less than adequate (20.5%). Vaginal deliveries were more frequent in the adequate (42.6%) and less than adequate (24.5%) groups, while lower in the excess GWG group (33.0%). Operative vaginal deliveries were only seen in excess GWG group. Overall, excess GWG was associated with higher risks of GDM, HDP and cesarean delivery.

Table 5: Association Of Gwg With Maternal Outcomes

(a) GDM and HDP

GWG group	GDM		HDP	
	Present	Absent	Present	Absent
Less than adequate (n=110) (Group 1)	6 (5.6%)	104 (26.5%)	31 (40.3%)	79 (18.7%)
Adequate (n=164) (Group 2)	0 (0.0%)	164 (41.8%)	10 (13.0%)	154 (36.4%)
Excess (n=226) (Group 3)	102 (94.4%)	124 (31.6%)	36 (46.8%)	190 (44.9%)
Total (n=500)	108 (100.0%)	392 (100.0%)	77 (100.0%)	423 (100.0%)
χ^2 value	136.023		24.735	
p-value	0.001		0.001	

(b) Mode of Delivery

GWG group	LSCS	Vaginal	Operative vaginal delivery
Less than adequate (n=110) (Group 1)	64 (20.5%)	46 (24.7%)	0 (0.00%)
Adequate (n=164) (Group 2)	84 (26.9%)	80 (43%)	0 (0.00%)
Excess (n=226) (Group 3)	164 (52.6%)	60 (32.3%)	2 (100%)
Total (n=500)	312 (100.0%)	186 (100.0%)	2 (100%)
χ^2 value	19.527		

Table 6, demonstrates that majority of neonates had a normal Apgar score (≥7), accounting for 91.8%, while 8.2% had a score <7 at 5 minutes. Most new-borns were appropriate for gestation age (AGA) (82.0%), with smaller proportions being SGA (8.0%) and LGA (7.0%). FGR was observed in 4.4% of neonates. About 22.2% required NICU admission, while 77.8% did not. Neonatal mortality was 2.4%, with a survival rate of 96.4%. GWG showed a statistically significant association with neonatal outcomes. Less than adequate GWG was linked to the majority of SGA (87.5%) and FGR (86.4%) cases, and 100% of NICU admissions in that group. Adequate GWG was associated only with AGA (37.8%) and LGA (25.7%) outcomes, with no SGA or FGR cases. Excess GWG contributed mainly to LGA (57.1%), with smaller contributions to SGA (12.5%) and FGR (13.6%). Significant associations were observed for SGA, AGA, FGR, and NICU admission ($p = 0.001$), while LGA showed no significant association.

Table 6: Association Of Gwg With Neonatal Outcomes

GWG group	SGA	AGA	LGA	Fetal Growth Restriction (FGR)	NICU Stay
Less than Adequate (Group 1)	35 (87.5%)	57 (13.9%)	6 (17.1%)	19 (86.4%)	12 (100%)
Adequate (Group 2)	0 (0.0%)	155 (37.8%)	9 (25.7%)	0 (0.0%)	0 (0.0%)
Excess (Group 3)	5 (12.5%)	198 (48.3%)	20 (57.1%)	3 (13.6%)	0 (0.0%)
Total no. of cases	40 (100.0%)	410 (100.0%)	35 (100.0%)	22 (100.0%)	12 (100.0%)
χ^2 value	109.334	90.104	2.167	55.954	43.592
p-value	0.001	0.001	0.338	0.001	0.001

DISCUSSION

This prospective observational study evaluated GWG and its association with maternal and neonatal outcomes among 500 antenatal women. First trimester weight was used as a surrogate for pre-pregnancy weight, which is supported by studies such as Kominiarek MA et al10. and Retnakaran R et al. (2022)5, demonstrating a strong correlation between early pregnancy and pre-conceptional weight.

In the present study, 45.2% of women had excessive GWG, 22.0% had inadequate GWG, and only 32.8% achieved recommended weight gain, closely aligning with findings from Goldstein RF et al.11, who reported similar global trends (45% excessive, 23% inadequate, and 32% adequate GWG). A significant association between BMI and GWG ($p < 0.001$) was observed, with underweight women more prone to less than adequate GWG and overweight/obese women, particularly the latter, showing a strong tendency toward excessive GWG. These findings were consistent with Bhavadharini B et al., Kominiarek MA et al.10and Goldstein RF et al.11, who identified pre-pregnancy BMI as a key determinant of GWG.

Excessive GWG was significantly associated with adverse maternal outcomes, including higher rates of GDM (21.6%), hypertensive disorders (15.4%), and cesarean delivery. Similar associations have been reported by Singh K et al., Ramoniene G et al12, and Kominiarek MA et al.10, attributing these outcomes to increased maternal adiposity, insulin resistance, and metabolic disturbances.

Regarding neonatal outcomes, most neonates were AGA (82%), with smaller proportions of SGA (8%) and LGA (7%). Less than adequate GWG was significantly associated with SGA, fetal growth restriction (FGR), and increased NICU admissions, consistent with findings from Goldstein RF et al. and Chowdhury R et al.13. Conversely, excessive GWG was linked to macrosomia and LGA, as also reported by Ajit R et al.14

Overall, the study findings were in agreement with existing literature, demonstrating that both less than adequate and excessive GWG adversely affect maternal and neonatal outcomes. These results emphasize the importance of appropriate nutritional counselling, early identification, BMI-based monitoring to achieve optimal GWG and improve pregnancy outcomes.

CONCLUSION

GWG patterns in this study were similar to global trends, with a high prevalence of excessive and less than adequate weight gain. BMI was the key determinant of GWG and related outcomes. Excessive GWG was associated with adverse maternal outcomes (GDM, HDP, cesarean delivery), while less than adequate GWG was linked to poor neonatal outcomes (SGA, FGR). Overall, achieving BMI-appropriate GWG through early antenatal counselling, proper nutritional guidance and regular monitoring of maternal weight is essential to improve maternal and neonatal outcomes.

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