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Research Article

INFLUENCE OF PRE-PREGNANCY BMI AND GESTATIONAL WEIGHT GAIN ON PREGNANCY-INDUCED HYPERTENSION: A PROSPECTIVE COHORT STUDY

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ABSTRACT

Hypertensive disorders in pregnancy, particularly Pregnancy-Induced Hypertension (PIH), significantly contribute to maternal and fetal health complications, especially in low- and middle-income countries. This prospective observational study examines the association between Body Mass Index (BMI), gestational weight gain, and the incidence of PIH among antenatal patients at Sri Lakshmi Narayana Institute of Medical Sciences, Pondicherry. A cohort of 250 pregnant women participated in the study, classified according to BMI categories and monitored for weight changes throughout pregnancy. Data on PIH occurrence, delivery methods, and neonatal outcomes were collected and assessed. The analysis revealed a statistically significant correlation between BMI and PIH, with both underweight and obese women facing increased risks for PIH. Moreover, both insufficient and excessive gestational weight gain emerged as significant predictors of PIH. Women with elevated BMI were also more likely to require Caesarean section or Instrumental Vaginal Delivery (IVD) compared to women with normal BMI. This study underscores the vital role of BMI and gestational weight gain in shaping pregnancy outcomes, highlighting the necessity for targeted interventions and vigilant monitoring to mitigate PIH-related risks. These findings reinforce the importance of preconception counseling and comprehensive antenatal care with an emphasis on weight management to enhance maternal and neonatal health outcomes.

Keywords: - Pregnancy-Induced Hypertension, Body Mass Index, Gestational Weight Gain, Hypertensive Disorders.

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INTRODUCTION

Hypertensive disorders in pregnancy represent a significant public health issue, particularly in developing nations where they are major contributors to maternal and fetal morbidity and mortality [1]. Pregnancy-induced hypertension (PIH), a specific form of hypertensive disorder, ranks among the most common medical complications encountered during pregnancy [2]. Globally, the prevalence of hypertensive disorders in pregnancy ranges between 5% and 10%, with higher rates observed in developing regions compared to developed areas [3]. Although maternal mortality rates are lower in developed countries, approximately 16% of maternal deaths worldwide continue to result from hypertensive disorders [4]. Identifying risk factors associated with PIH is essential for enhancing maternal and fetal health outcomes. Multiple factors have been recognized as contributors to the development of PIH, including nulliparity, advanced maternal age, elevated body mass index (BMI), gestational diabetes, multiple gestations, assisted reproductive technologies, and pre-existing conditions such as chronic hypertension, antiphospholipid syndrome, and kidney disease [5].

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Among these risk factors, BMI stands out as a key determinant. BMI is a simple, widely utilized anthropometric measure representing an individual's weight in relation to height, often used as an indicator of body fat [6]. Obesity, defined by a pre-pregnancy BMI over 30, is increasingly prevalent among women of reproductive age and poses substantial risks to both maternal and fetal health during pregnancy [7].

Obesity during pregnancy is linked to a variety of adverse outcomes, including gestational diabetes, preeclampsia, cesarean delivery, and fetal macrosomia [8]. Recent studies underscore the global obesity epidemic, with over 1.9 billion adults classified as overweight and 650 million as obese [9]. Obesity-related health complications contribute to approximately 2.8 million deaths annually, establishing it as a major public health issue [10]. In India alone, more than 135 million people are impacted by obesity, driven by factors such as increased consumption of energy-dense foods, sedentary lifestyles, and limited healthcare resources [11]. These trends carry significant repercussions for maternal and child health, especially regarding hypertensive disorders in pregnancy.

In the past two decades, extensive epidemiological studies have firmly established a connection between obesity and hypertensive disorders in pregnancy [12]. Specifically, the risk of preeclampsia—a severe manifestation of PIH—has been shown to double with each 5-7 kg/m² increase in pre-pregnancy BMI [13]. The mechanisms linking obesity to PIH are complex and multifaceted, involving pathways such as increased cytokine-mediated inflammation, oxidative stress, dyslipidemia, and heightened sympathetic nervous system activity, all of which contribute to hypertensive conditions during pregnancy [14]. Since the early 1990s, interest in the link between obesity and hypertensive disorders during pregnancy has surged, positioning it as a major public health concern in the 21st century [15]. Obesity-related preeclampsia not only elevates the risk of long-term cardiovascular and metabolic diseases in mothers but also carries lasting health implications for their offspring [16]. This emphasizes the critical need to address maternal BMI as a modifiable risk factor to enhance pregnancy outcomes and long-term health for both mother and child.

AIM & OBJECTIVES

Aim:

The primary objective of this study is to examine the relationship between body mass index (BMI), gestational weight gain, and the incidence of pregnancy-induced hypertension (PIH) among antenatal patients at Sri Lakshmi Narayana Institute of Medical Sciences, Pondicherry.

Objectives:

1. **Assess PIH prevalence in overweight and obese pregnant women:** This objective focuses on evaluating the occurrence of PIH across various BMI categories (normal weight, overweight, and obese) to understand the extent to which elevated BMI increases the risk of developing PIH.
2. **Investigate the impact of gestational weight gain on PIH development:** This objective examines the association between gestational weight gain—categorized as inadequate, adequate, or excessive—and the likelihood of PIH in pregnant women, with a focus on determining if excessive weight gain significantly predicts PIH.

Methodology: This study employed a prospective observational design, conducted at Sri Lakshmi Narayana Institute of Medical Sciences, Pondicherry, over a one-year period from May 1, 2015, to June 30, 2016. The sample included 250 antenatal patients who registered during their first trimester and met specific inclusion criteria. The study gathered comprehensive data on BMI, gestational weight gain, PIH occurrence, and other relevant variables.

Inclusion Criteria:

1. **Early registration at or before 12 weeks of gestation:** Ensuring participants were under medical care from early pregnancy allowed for accurate baseline data collection.
2. **Antenatal care at the study facility:** Limiting participants to those attending the Antenatal Outpatient Department at Sri Lakshmi Narayana Institute enabled standardized care and consistent data collection.

Exclusion Criteria:

1. **Exclusion of unregistered patients:** Patients who did not register for antenatal care were excluded to ensure consistent follow-up.
2. **Late registrants beyond 12 weeks of gestation:** Excluding late registrants minimized potential confounding due to unmeasured early pregnancy factors.
3. **Chronic hypertension exclusion:** Excluding patients with chronic hypertension isolated the effects of BMI and gestational weight gain on PIH.
4. **Exclusion of patients with comorbid conditions:** Conditions such as diabetes, renal disease, heart disease, and multiple gestations were excluded to reduce confounding influences.

Data Collection: During the initial visit, baseline measurements of height and weight were recorded in the first trimester. Weight was measured using an analog scale, and height was measured with a stadiometer. BMI was calculated as weight (kg) divided by height squared (m^2). Gestational weight gain was tracked throughout pregnancy, and its relationship with PIH was analyzed using statistical methods. A structured proforma was utilized to collect data on age, parity, socioeconomic

status (using the Modified Kuppuswamy Scale, 2020), blood pressure, BMI, gestational weight gain, delivery method, birth weight, and neonatal outcomes, including NICU admissions. Investigations and management followed standardized protocols to ensure consistency in data collection and patient care.

Statistical Analysis: Data were tabulated and analyzed using descriptive and inferential statistics. Chi-square tests and Fisher's exact tests were applied to assess associations between BMI, gestational weight gain, and PIH occurrence. A significance level of $p < 0.05$ was set for all tests.

Results: The relationship between BMI categories and PIH occurrence is presented in Table 1. In the underweight group (BMI <18.5), 10.2% developed PIH, while 16.4% did not, comprising 15.2% of the population. The Fisher's Exact Test value for this group was 7.264 with a p-value of 0.022, indicating a statistically significant association between BMI and PIH. The normal weight group (BMI 18.5–24.9) showed 59.2% of PIH cases, while 67.2% did not, representing 65.6% of the study sample. Among the overweight (BMI 24.9–29.9) group, 18.4% had PIH, while 12.9% did not, making up 14.0% of the population. In the obese category (BMI >30), 12.2% had PIH, while 3.5% did not, totaling 5.2% of participants. Overall, 49 participants developed PIH, while 201 did not. The significant p-value of 0.022 suggests a notable association between BMI and PIH. The normal weight group showed the highest percentage of PIH cases (59.2%), followed by overweight (18.4%), underweight (10.2%), and obese (12.2%). These findings highlight the importance of BMI monitoring during pregnancy, as both extremes (underweight and obese) are associated with varying risks for PIH, underscoring the need for further exploration into underlying mechanisms and targeted interventions for at-risk women.

Additionally, the analysis between gestational weight gain and PIH incidence is presented. Among those with inadequate weight gain, 44.9% developed PIH, while 61.7% did not, comprising 58.4% of the sample. A Chi-Square value of 8.633 with a p-value of 0.007 indicated a strong association between inadequate weight gain and PIH. In the adequate weight gain group, 30.6% developed PIH, while 27.4% did not, representing 28.0% of the population. The group with excessive weight gain saw 24.5% develop PIH, while 10.9% did not, totaling 13.6% of the population. Both inadequate and excessive weight gain were linked to a higher PIH risk compared to adequate gain, underscoring the importance of monitoring gestational weight to reduce PIH risk.

The table also examines the relationship between BMI categories and mode of delivery. In the underweight group (BMI <18.5), 24.1% had Normal Vaginal Delivery (NVD), 4.7% underwent Caesarean section, and 25.0% had Instrumental Vaginal Delivery (IVD), accounting for 17.6% of the population. The Fisher's Exact Test yielded a p-value of 0.023, indicating a statistically significant association between BMI and delivery mode. In the normal weight group (BMI 18.5–24.9), 59.3% had NVD, 61.2% had a Caesarean section, and 35.0% had IVD, making up 58.0% of participants. The overweight group (BMI 24.9–29.9) showed 12.4% with NVD, 25.9% with Caesarean section, and 25.0% with IVD, accounting for 18.0% of participants. The obese category (BMI >30) had 4.1% with NVD, 8.2% with Caesarean, and 15.0% with IVD, totaling 6.4% of the population. Overall, 145 individuals had NVD, 85 underwent Caesarean, and 20 had IVD. The statistically significant p-value of 0.023 suggests that higher BMI is associated with an increased likelihood of Caesarean or Instrumental Deliveries, emphasizing the role of BMI in delivery planning and management.

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Tables 1: Relationship of BMI Category with PIH

BMI Category	PIH Present	% PIH Present	PIH Absent	% PIH Absent	Total (Number & %)	Fischer's Exact Value	P-Value
Underweight (<18.5)	5	10.2%	33	16.4%	38 (15.2%)		
Normal Weight (18.5-24.9)	29	59.2%	135	67.2%	164 (65.6%)		

Overweight (24.9-29.9)	9	18.4%	26	12.9%	35 (14.0%)	7.264	0.022
Obese (>30)	6	12.2%	7	3.5%	13 (5.2%)		
Total	49	100%	201	100%	250 (100%)		

Table 2: Relationship between Gestational Weight Gain And PIH

Gestational Weight Gain	PIH Present	% PIH Present	PIH Absent	% PIH Absent	Total (Number & %)	Chi-Square Value	P-Value
Inadequate Weight Gain	22	44.9%	124	61.7%	146 (58.4%)	8.633	0.007
Adequate Weight Gain	15	30.6%	55	27.4%	70 (28.0%)		
Excessive Weight Gain	12	24.5%	22	10.9%	34 (13.6%)		
Total	49	100%	201	100%	250 (100%)		

Table 3: Relationship between Mode of Delivery and BMI.

BMI Category	NVD (N)	NVD (%)	Caesarean (N)	Caesarean (%)	IVD (N)	IVD (%)	Total (Number & %)	Fisher's Exact Value	P-Value
Underweight (<18.5)	35	24.1%	4	4.7%	5	25.0%	44 (17.6%)	10.452	0.023
Normal Weight (18.5-24.9)	86	59.3%	52	61.2%	7	35.0%	145 (58.0%)		
Overweight (24.9-29.9)	18	12.4%	22	25.9%	5	25.0%	45 (18.0%)		
Obese (>30)	6	4.1%	7	8.2%	3	15.0%	16 (6.4%)		
Total	145	100%	85	100%	20	100%	250 (100%)		

DISCUSSION

This study aimed to explore the correlation between Body Mass Index (BMI), gestational weight gain, and the incidence of Pregnancy-Induced Hypertension (PIH) in a cohort of antenatal patients. The findings reveal a statistically significant association between BMI and PIH development, as well as an impact on the mode of delivery. Interestingly, the normal BMI category (18.5–24.9) recorded the highest percentage of PIH cases, though both underweight and obese categories also showed considerable links to PIH. These results align with previous studies indicating that both low and high BMI are risk factors for adverse pregnancy outcomes, including hypertensive disorders [17-18].

The study also examined gestational weight gain's relationship with PIH, finding that both insufficient and excessive weight gain significantly increase PIH risk. These findings are consistent with existing literature, which associates inadequate weight gain with nutrient deficiencies and placental insufficiency, while excessive weight gain is linked to greater fat accumulation and metabolic issues that contribute to PIH [19-20].

Regarding delivery mode, the study observed that a higher BMI correlates with an increased likelihood of Caesarean sections and Instrumental Vaginal Deliveries (IVD). Notably, obese women had a significantly higher rate of Caesarean sections compared to those in the normal-weight category, a finding consistent with past studies citing complications such as macrosomia, dystocia, and increased surgical risks in obese pregnant women [21-22].

The associations found between BMI, gestational weight gain, and adverse pregnancy outcomes underscore the importance of effective weight management before and during pregnancy. This study highlights the need for healthcare providers to deliver targeted support to pregnant women with abnormal BMI or gestational weight gain, potentially reducing PIH risk and other complications.

Conclusion

In summary, this study identifies a significant association between BMI, gestational weight gain, and PIH occurrence. Findings indicate that underweight and obese women face increased PIH risk, and that abnormal gestational weight gain further heightens this risk. Additionally, higher BMI is linked to an increased likelihood of Caesarean section and Instrumental Vaginal Delivery, emphasizing the need for close monitoring and management of high-BMI pregnancies. These results highlight the importance of preconception counseling and antenatal care with a focus on weight management to improve maternal and fetal outcomes. Future research should focus on uncovering the mechanisms that connect BMI, gestational weight gain, and PIH and on developing clinical strategies to mitigate these risks effectively.

REFERENCES

1. World Health Organization. (2011). WHO recommendations for prevention and treatment of pre-eclampsia and eclampsia. Geneva: World Health Organization.
2. Roberts, J. M., & Lain, K. Y. (2002). Recent Insights into the Pathogenesis of Preeclampsia. Placenta, 23(5), 359-372.
3. Duley, L. (2009). The Global Impact of Pre-eclampsia and Eclampsia. Seminars in Perinatology, 33(3), 130-137.
4. Say, L., et al. (2014). Global Causes of Maternal Death: A WHO Systematic Analysis. The Lancet Global Health, 2(6), e323-e333.
5. Sibai, B. M. (2003). Risk Factors for Preeclampsia. Clinical Obstetrics and Gynecology, 46(3), 456-466.
6. World Health Organization. (2000). Obesity: Preventing and Managing the Global Epidemic. Report of a WHO Consultation.
7. Cnattingius, S., et al. (1998). Pre-pregnancy Weight and the Risk of Adverse Pregnancy Outcomes. New England Journal of Medicine, 338(3), 147-152.
8. Weiss, J. L., et al. (2004). Obesity, obstetric complications and cesarean delivery rate—a population-based screening study. American Journal of Obstetrics and Gynecology, 190(4), 1091-1097.
9. Ng, M., et al. (2014). Global, regional, and national prevalence of overweight and obesity in children and adults during 1980–2013: a systematic analysis for the Global Burden of Disease Study 2013. The Lancet, 384(9945), 766-781.
10. World Health Organization. (2014). Global status report on noncommunicable diseases 2014. Geneva: World Health Organization.
11. Ahirwar, R., & Mondal, P. R. (2019). Prevalence of obesity in India: A systematic review. Diabetes & Metabolic Syndrome: Clinical Research & Reviews, 13(1), 318-321.
12. O'Brien, T. E., Ray, J. G., & Chan, W. S. (2003). Maternal body mass index and the risk of preeclampsia: a systematic overview. Epidemiology, 14(3), 368-374.
13. Bodnar, L. M., Ness, R. B., Markovic, N., & Roberts, J. M. (2005). The risk of preeclampsia rises with increasing pre-pregnancy body mass index. Annals of Epidemiology, 15(7), 475-482.
14. Roberts, J. M., & Hubel, C. A. (2009). The Two Stage Model of Preeclampsia: Variations on the Theme. Placenta, 30, S32-S37.
15. Steegers, E. A., von Dadelszen, P., Duvekot, J. J., & Pijnenborg, R. (2010). Preeclampsia. The Lancet, 376(9741), 631-644.
16. Barker, D. J. (1995). Fetal origins of coronary heart disease. BMJ, 311(6998), 171-174.
17. Sibai, B. M., Dekker, G., & Kupferminc, M. (2005). Preeclampsia. The Lancet, 365(9461), 785-799.
18. Hedderson, M. M., Gunderson, E. P., & Ferrara, A. (2010). Gestational weight gain and risk of gestational diabetes mellitus. Obstetrics & Gynecology, 115(3), 597-604.
19. Villar, J., Belizán, J. M., & de Onis, M. (2003). The differential prenatal growth patterns of the fetal skeleton and soft tissues: A longitudinal study. Obstetrics & Gynecology, 101(3), 453-458.
20. Bodnar, L. M., Catov, J. M., Klebanoff, M. A., Ness, R. B., & Roberts, J. M. (2010). Prepregnancy body mass index and the occurrence of severe hypertensive disorders of pregnancy. Epidemiology, 21(3), 367-374.
21. Leddy, M. A., Power, M. L., & Schulkin, J. (2008). The impact of maternal obesity on maternal and fetal health. Reviews in Obstetrics & Gynecology, 1(4), 170.
22. Weiss, J. L., Malone, F. D., Emig, D., Ball, R. H., Nyberg, D. A., Comstock, C. H., ... & D'Alton, M. E. (2004). Obesity, obstetric complications and cesarean delivery rate–a population-based screening study. American Journal of Obstetrics and Gynecology, 190(4), 1091-1097.

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