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Research Article

IMPACT OF BODY MASS INDEX AND GESTATIONAL WEIGHT GAIN ON PREGNANCY-INDUCED HYPERTENSION: A PROSPECTIVE OBSERVATIONAL STUDY

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ABSTRACT

Hypertensive disorders during pregnancy, particularly Pregnancy-Induced Hypertension (PIH), are a significant contributor to maternal and fetal morbidity and mortality, especially in developing countries. This prospective observational study investigates the relationship between Body Mass Index (BMI), gestational weight gain, and the occurrence of PIH among antenatal patients at Sri Lakshmi Narayana Institute of Medical Sciences, Pondicherry. A total of 250 pregnant women were included in the study, categorized based on their BMI and monitored for weight gain throughout pregnancy. Data on PIH incidence, mode of delivery, and neonatal outcomes were collected and analyzed. The results indicate a statistically significant association between BMI and PIH, with both underweight and obese women showing higher risks of developing PIH. Additionally, both inadequate and excessive gestational weight gain were found to be significant predictors of PIH. Women with higher BMI were also more likely to undergo Caesarean section or Instrumental Vaginal Delivery (IVD) compared to those with normal BMI. The study highlights the critical role of BMI and gestational weight gain in influencing pregnancy outcomes, emphasizing the need for targeted interventions and continuous monitoring to mitigate the risks associated with PIH. These findings underscore the importance of preconception counseling and antenatal care focusing on weight management for improving maternal and neonatal outcomes.

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

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INTRODUCTION

Hypertensive disorders of pregnancy are a significant public health concern, particularly in developing countries where they contribute to maternal and fetal morbidity and mortality [1]. Pregnancy-induced hypertension (PIH), a specific type of hypertensive disorder, is one of the most common medical complications during pregnancy [2]. Globally, the incidence of hypertensive disorders during pregnancy varies between 5% and 10%, with developing countries experiencing higher rates compared to developed regions [3]. Despite lower maternal mortality in developed countries, approximately 16% of maternal deaths worldwide are still attributed to hypertensive disorders [4]. The identification of risk factors associated with PIH is crucial for improving maternal and fetal outcomes. Several risk factors have been identified as contributing to the development of PIH, including nulliparity, advanced maternal age, high body mass index (BMI), gestational diabetes, multiple gestation, assisted reproduction, and pre-existing medical conditions such as chronic hypertension, antiphospholipid syndrome, and renal disease [5].

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Among these, BMI is a critical factor. BMI is a simple and widely used anthropometric measure that represents the height/weight characteristics of an individual, often serving as an index of fatness [6]. Obesity, defined as a pregravid BMI greater than 30, is increasingly common among women of reproductive age and poses significant risks for both the mother and the child during pregnancy [7].

Obesity during pregnancy has been associated with a range of adverse outcomes, including gestational diabetes, preeclampsia, cesarean delivery, and fetal macrosomia [8]. Recent studies have highlighted the global prevalence of obesity, with over 1.9 billion adults classified as overweight and 650 million as obese [9]. Obesity-related complications account for approximately 2.8 million deaths annually, making it a critical public health issue [10]. In India, more than 135 million individuals are affected by obesity, driven by factors such as increased consumption of energy-dense foods, sedentary lifestyles, and inadequate healthcare services [11]. These trends have significant implications for maternal and child health, particularly in the context of hypertensive disorders during pregnancy.

Over the past two decades, large-scale epidemiological studies have established a clear link between obesity and hypertensive disorders during pregnancy [12]. Specifically, the risk of preeclampsia, a severe form of PIH, has been shown to double with every 5-7 kg/m² increase in pre-pregnancy BMI [13]. The underlying mechanisms linking obesity and PIH are complex and multifactorial. Proposed pathways include increased cytokine-mediated inflammation, oxidative stress, dyslipidemia, and heightened sympathetic activity, all of which contribute to the development of hypertensive disorders during pregnancy [14]. The interest in the relationship between obesity and hypertensive disorders in pregnancy has grown significantly since the early 1990s, becoming a major public health concern by the 21st century [15]. Preeclampsia associated with obesity not only increases the risk of cardiovascular and metabolic diseases in mothers but also has long-term implications for the offspring [16]. This underscores the importance of addressing maternal BMI as a modifiable risk factor for improving pregnancy outcomes.

AIM & OBJECTIVES

Aim:

The primary aim of this study is to investigate the correlation between body mass index (BMI), gestational weight gain, and the occurrence of pregnancy-induced hypertension (PIH) in a cohort of antenatal patients at Sri Lakshmi Narayana Institute of Medical Sciences, Pondicherry.

Objectives:

1. To determine the occurrence of PIH among overweight and obese pregnant women: This objective focuses on assessing the prevalence of PIH in women with different BMI categories (normal weight, overweight, and obese) and evaluating the extent to which high BMI contributes to the risk of developing PIH.
2. **To examine the relationship between gestational weight gain and the development of PIH**: This objective aims to explore how gestational weight gain, categorized as inadequate, adequate, or excessive, correlates with the incidence of PIH in pregnant women. The study seeks to determine whether excessive gestational weight gain is a significant predictor of PIH.

Methodology

This study was designed as a prospective observational study conducted at Sri Lakshmi Narayana Institute of Medical Sciences, Pondicherry, over a one-year period from May 1, 2015 to June 30, 2016. The study population comprised 250 antenatal patients who registered during their first trimester and met the inclusion criteria. The study aimed to collect comprehensive data on the participants' BMI, gestational weight gain, and the occurrence of PIH, among other variables.

Inclusion Criteria

1. **Antenatal patients who registered before or at 12 weeks of gestation**: This criterion ensures that the study population includes only those patients who were under medical supervision from the early stages of pregnancy, allowing for accurate baseline measurements and monitoring.
2. **Patients attending the Antenatal Outpatient Department at** Sri Lakshmi Narayana Institute of Medical Sciences, Pondicherry: This criterion ensures that all participants received standardized care and follow-up at the same medical facility, allowing for consistent data collection.

Exclusion Criteria

1. **Pregnant women who were unbooked**: Unbooked patients, or those who did not register for antenatal care, were excluded to ensure that all participants had consistent medical follow-up throughout their pregnancies.
2. **Pregnant women who registered after 12 weeks of gestation**: Late registrants were excluded to avoid the potential confounding effects of unmeasured early pregnancy variables.
3. **Patients with chronic hypertension**: Chronic hypertension is a known risk factor for PIH, and

excluding these patients helped isolate the effect of BMI and gestational weight gain on PIH.

4. **Patients with other medical disorders**: Conditions such as diabetes, renal disease, heart disease, and multiple pregnancies were exclusion criteria to minimize confounding factors that could influence the development of PIH.

Data Collection

During the initial visit, baseline measurements of height and weight were taken in the first trimester. Weight was measured using an analog weighing machine, and height was measured accurately using a stadiometer. BMI was calculated using the formula: weight (kg) divided by the square of height (m^2). Gestational weight gain was monitored throughout the pregnancy, and its correlation with the development of PIH was analyzed using statistical methods. A structured proforma was used to collect data on various parameters, including age, parity, socioeconomic status (using the Modified Kuppuswamy Scale, 2020), blood pressure, BMI, gestational weight gain, mode of delivery, birth weight, and neonatal outcomes such as NICU admissions . Investigations and management were carried out following standardized departmental protocols to ensure consistency in data collection and patient care.

Statistical Analysis

The collected data were tabulated and analyzed using appropriate statistical methods. Descriptive statistics were used to summarize the data, while inferential statistics, such as chi-square tests and Fisher's exact tests, were employed to assess the associations between BMI, gestational weight gain, and the occurrence of PIH. The significance level was set at $p < 0.05$ for all statistical tests.The table 1. presents the relationship between Body Mass Index (BMI) categories and the presence of Pregnancy-Induced Hypertension (PIH) in a study population of 250 individuals. In the underweight category (BMI <18.5), 10.2% of the individuals had PIH, while 16.4% did not, making up 15.2% of the total population. The Fischer's Exact Test value for this group is 7.264, with a p-value of 0.022, indicating a statistically significant relationship between BMI and PIH. In the normal weight category (BMI 18.5-24.9), 59.2% had PIH, and 67.2% did not, comprising 65.6% of the study population. In the overweight category (BMI 24.9-29.9), 18.4% had PIH, while 12.9% did not, representing 14.0% of the total population. In the obese category (BMI >30), 12.2% had PIH, while 3.5% did not, accounting for 5.2% of the total population. Overall, 49 individuals in the study had PIH, making up 100% of the PIH-present population, while 201 individuals did not have PIH, representing 100% of the PIH-absent population. The significant p-value of 0.022 suggests a statistically significant relationship between BMI categories and the presence of PIH. The highest percentage of PIH cases is observed in the normal weight category (59.2%), followed by overweight (18.4%), underweight (10.2%), and obese (12.2%) categories. These findings highlight the importance of monitoring BMI in pregnant women, as both extremes of BMI (underweight and obese) are associated with different risks of developing PIH. This underscores the need for further research to explore the underlying mechanisms and develop targeted interventions for women at risk.

The table examines the relationship between gestational weight gain and the presence of Pregnancy-Induced Hypertension (PIH) in a study of 250 individuals. Among those with inadequate weight gain during pregnancy, 44.9% developed PIH, while 61.7% did not, accounting for 58.4% of the total study population. The Chi-Square value for this group is 8.633, with a p-value of 0.007, indicating a statistically significant association between inadequate weight gain and the development of PIH.

In the group with adequate weight gain, 30.6% of the individuals had PIH, while 27.4% did not, representing 28.0% of the total population. Although this group showed a lower percentage of PIH compared to the inadequate weight gain group, it still highlights a notable relationship between weight gain and PIH risk.

For those with excessive weight gain, 24.5% developed PIH, while 10.9% did not, making up 13.6% of the total population. This suggests that both inadequate and excessive weight gain are associated with higher risks of PIH compared to adequate weight gain. Overall, 49 individuals in the study had PIH, comprising 100% of the PIH-present population, while 201 individuals did not have PIH, making up 100% of the PIH-absent population. The significant p-value of 0.007 indicates a strong association between gestational weight gain and the likelihood of developing PIH. These findings underscore the importance of monitoring and managing gestational weight gain during pregnancy to reduce the risk of PIH, as both inadequate and excessive weight gain are linked to higher PIH prevalence.

The table explores the relationship between Body Mass Index (BMI) categories and the mode of delivery in a study population of 250 individuals. The modes of delivery are categorized as Normal Vaginal Delivery (NVD), Caesarean section, and Instrumental Vaginal Delivery (IVD). In the underweight category (BMI <18.5), 35 individuals (24.1%) had NVD, 4 individuals (4.7%) underwent Caesarean section, and 5 individuals (25.0%) had IVD. This group accounts for 17.6% of the total study population. The Fisher's Exact Test value for this group is 10.452, with a p-value of 0.023, indicating a statistically significant association between BMI and the mode of delivery. In the normal

weight category (BMI 18.5-24.9), 86 individuals (59.3%) had NVD, 52 individuals (61.2%) had a Caesarean section, and 7 individuals (35.0%) had IVD, making up 58.0% of the total study population. This category represents the majority of participants and shows a diverse distribution of delivery methods. For the overweight category (BMI 24.9-29.9), 18 individuals (12.4%) had NVD, 22 individuals (25.9%) underwent Caesarean section, and 5 individuals (25.0%) had IVD. This group represents 18.0% of the total population and has a higher proportion of Caesarean sections compared to normal weight and underweight categories.

In the obese category (BMI >30), 6 individuals (4.1%) had NVD, 7 individuals (8.2%) underwent Caesarean section, and 3 individuals (15.0%) had IVD, making up 6.4% of the total study population. This group shows the highest proportion of Caesarean sections and IVD relative to its size. Overall, 145 individuals had NVD, 85 had a Caesarean section, and 20 had IVD, comprising 100% of the study population across the different delivery modes. The statistically significant p-value of 0.023 suggests that BMI is strongly associated with the mode of delivery. The findings indicate that individuals with higher BMI are more likely to have Caesarean or Instrumental Vaginal Deliveries compared to those with lower BMI, highlighting the importance of considering BMI as a factor in delivery planning and management.

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%)	7.264	0.022
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%)		
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 investigate the correlation between Body Mass Index (BMI), gestational weight gain, and the occurrence of Pregnancy-Induced Hypertension (PIH) in a cohort of antenatal patients. The findings demonstrate a statistically significant association between BMI and the development of PIH, as well as the mode of delivery. Notably, the normal weight category (BMI 18.5-24.9) exhibited the highest percentage of PIH cases, while both underweight and obese categories also showed notable associations with PIH. These results align with existing literature, which suggests that both low and high BMI are risk factors for adverse pregnancy outcomes, including hypertensive disorders [17-18].

The study further explored the relationship between gestational weight gain and PIH, revealing that both inadequate and excessive weight gain are significantly associated with a higher incidence of PIH.

This is consistent with previous research, which has shown that inadequate weight gain can be linked to nutrient deficiencies and placental insufficiency, while excessive weight gain is often associated with increased fat accumulation and metabolic disturbances, both of which contribute to PIH [19-20].

Regarding the mode of delivery, the study found that higher BMI is associated with a higher likelihood of Caesarean section and Instrumental Vaginal Delivery (IVD). Obese women, in particular, showed a significantly higher rate of Caesarean sections compared to their normal-weight counterparts. This finding corroborates previous studies that have reported an increased risk of Caesarean delivery among obese pregnant women, often due to complications such as macrosomia, dystocia, and increased surgical risks [21-22].

The association between BMI, gestational weight gain, and adverse pregnancy outcomes underscores the importance of managing weight before and during pregnancy. This study highlights the need for healthcare providers to offer targeted interventions to pregnant women with abnormal BMI or gestational weight gain, potentially reducing the risk of PIH and other complications.

CONCLUSION

In conclusion, this study identifies a significant relationship between BMI, gestational weight gain, and the occurrence of PIH. The findings suggest that both underweight and obese women are at increased risk for developing PIH, and that abnormal gestational weight gain further exacerbates this risk. Additionally, higher BMI is associated with an increased likelihood of Caesarean section and Instrumental Vaginal Delivery, indicating the need for careful monitoring and management of pregnant women with high BMI. These results emphasize the importance of preconception counseling and antenatal care focusing on weight management to improve maternal and fetal outcomes. Further research should aim to elucidate the underlying mechanisms linking BMI, gestational weight gain, and PIH, and to develop effective strategies for mitigating these risks in clinical practice.

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