

# THE ANALYSIS STUDY OF INTERPREGNANCY WEIGHT CHANGE AND HYPERTENSION DURING PREGNANCY: A COMPREHENSIVE SYSTEMATIC REVIEW

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## ABSTRACT

**Background:** The established correlation between high pre-pregnancy body mass index (BMI) and maternal and neonatal complications underscores the urgent need for comprehensive weight management strategies among expectant mother. The aim of this study is to investigate existing evidence on the relationship between interpregnancy weight change and hypertensive disorders during subsequent pregnancies based on literatures of the last 10 years.

**Methods:** The study adhered to PRISMA 2020 standards, examining English literature from 2014 to 2024. It excluded editorials, reviews from the same journal, and submissions without a DOI. PubMed, SagePub, SpringerLink, and Google Scholar were utilized as literature sources.

**Result:** Initially retrieving 500 articles from online databases (PubMed, SagePub, SpringerLink and Google Scholar) eight relevant papers were selected after three rounds of screening for full-text analysis. These papers were thoroughly examined to assess the effect of interpregnancy weight change on hypertensive disorders during pregnancy.

**Conclusion:** Interpregnancy weight gain is linked to a heightened risk of hypertensive disorders during pregnancy. By addressing weight-related factors between pregnancies, healthcare providers can significantly improve maternal health outcomes in subsequent pregnancies.

**Keyword:** weight gain, inter-pregnancy, body mass index, hypertensive disorder

## INTRODUCTION

Obesity is a significant global health challenge, affecting more than 1.9 billion adults worldwide. Within the United States, approximately half of women of childbearing age are categorized as overweight or obese.<sup>1</sup> This excess weight during pregnancy is closely associated with a myriad of serious complications, including gestational diabetes, pre-eclampsia, and neonatal death.<sup>2</sup> Conversely, women classified as underweight are at heightened risk of fetal growth restriction and preterm birth, indicating a delicate balance in maternal weight management during the reproductive phase.<sup>3,4</sup>

Hypertensive disorders during pregnancy, particularly preeclampsia, present a substantial burden on maternal and perinatal health globally. Accounting for nearly 18% of maternal deaths worldwide, these disorders manifest with varying incidences, encompassing conditions such as preeclampsia (occurring in 1.4-4% of pregnancies) and gestational hypertension (observed in 3.6-9.1% of cases). Despite advancements in clinical management resulting in a decline in eclampsia, the overall prevalence of these conditions is on the rise. Such disorders pose considerable risks, not only during pregnancy but also in the form of adverse perinatal outcomes and potential long-term health implications for mothers.<sup>5,6</sup>

The established correlation between high pre-pregnancy body mass index (BMI) and maternal and neonatal complications, spanning from gestational diabetes to stillbirth, underscores the urgent need for comprehensive weight management strategies among expectant mothers.<sup>7,8</sup> As the prevalence of these complications escalates in parallel with the global obesity epidemic, which affects more than half of all women of reproductive age in the United Kingdom, addressing maternal weight becomes imperative to alleviate the associated disease burden and healthcare costs. Such interventions are pivotal in ensuring the optimal health outcomes for both women and their offspring, necessitating a multi-faceted approach encompassing education, support, and access to resources.<sup>9,10</sup>

Moreover, the postpartum period introduces its own set of challenges, as pregnancy often triggers weight retention and subsequent increases in BMI.<sup>11,12</sup> However, despite the potential implications for future pregnancies, empirical evidence regarding the impact of weight changes between pregnancies remains scarce. Notwithstanding the limited evidence base, UK National Institute for Health and Care Excellence (NICE) guidelines recommend weight loss support for overweight or obese women during the postnatal period.<sup>13,14</sup> Nonetheless, uncertainty persists regarding the efficacy of such interventions in preventing future pregnancy outcomes.<sup>15</sup>

This study aims to systematically review and synthesize existing evidence on the relationship between interpregnancy weight change and hypertensive disorders during subsequent pregnancies. including examining how weight changes between pregnancies impact the risk of developing conditions such as gestational hypertension and preeclampsia.

## METHODS PROTOCOL

The author carefully followed the rules laid out in the Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA) 2020. This was done to make sure the study met all its standards. The selection of this methodological approach was specifically aimed at ensuring the precision and reliability of the conclusions drawn from the investigation.

## CRITERIA FOR ELIGIBILITY

This systematic review investigate existing evidence on the relationship between interpregnancy weight change and hypertensive disorders during subsequent pregnancies based on literatures of the last 10 years. This study meticulously analyzed data on literatures to provide insights and enhance patient treatment strategies. The primary objective of this paper is to highlight the collective significance of the identified key points.

Inclusion criteria for this study entail: 1) Papers must be in English, and 2) Papers must have been published between 2014 and 2024. Exclusion criteria comprise: 1) Editorials; 2) Submissions without a DOI; 3) Previously published review articles; and 4) Duplicate entries in journals.

## SEARCH STRATEGY

The keywords used for this research are weight gain, inter-pregnancy, body mass index, and hypertensive disorder. The Boolean MeSH keywords inputted on databases for this research are: (*"weight gain"[MeSH Terms] OR ("weight"[All Fields] AND "gain"[All Fields]) OR "weight gain"[All Fields]*) AND (*"inter-pregnancy"[All Fields] AND ("body mass index"[MeSH Terms] OR ("body"[All Fields] AND "mass"[All Fields] AND "index"[All Fields]) OR "body mass index"[All Fields]*) AND (*"hypertension"[MeSH Terms] OR "hypertension"[All Fields] OR ("hypertensive"[All Fields] AND "disorder"[All Fields]) OR "hypertensive disorder"[All Fields]*)

## DATA RETRIEVAL

The authors assessed the studies by reviewing their abstracts and titles to determine their eligibility, selecting relevant ones based on their adherence to the inclusion criteria, which aligned with the article's objectives. A consistent trend observed

across multiple studies led to a conclusive result. The chosen submissions had to meet the eligibility criteria of being in English and a full-text.

This systematic review exclusively incorporated literature that met all predefined inclusion criteria and directly pertained to the investigated topic. Studies failing to meet these criteria were systematically excluded, and their findings were not considered. Subsequent analysis examined various details uncovered during the research process, including titles, authors, publication dates, locations, study methodologies, and parameters.

### QUALITY ASSESSMENT AND DATA SYNTHESIS

Each author independently evaluated the research presented in the title and abstract of the publication to determine which ones merited further exploration. The subsequent stage involved assessing all articles that met the predefined criteria for inclusion in the review. Decisions on including articles in the review were based on the findings uncovered during this evaluation process.

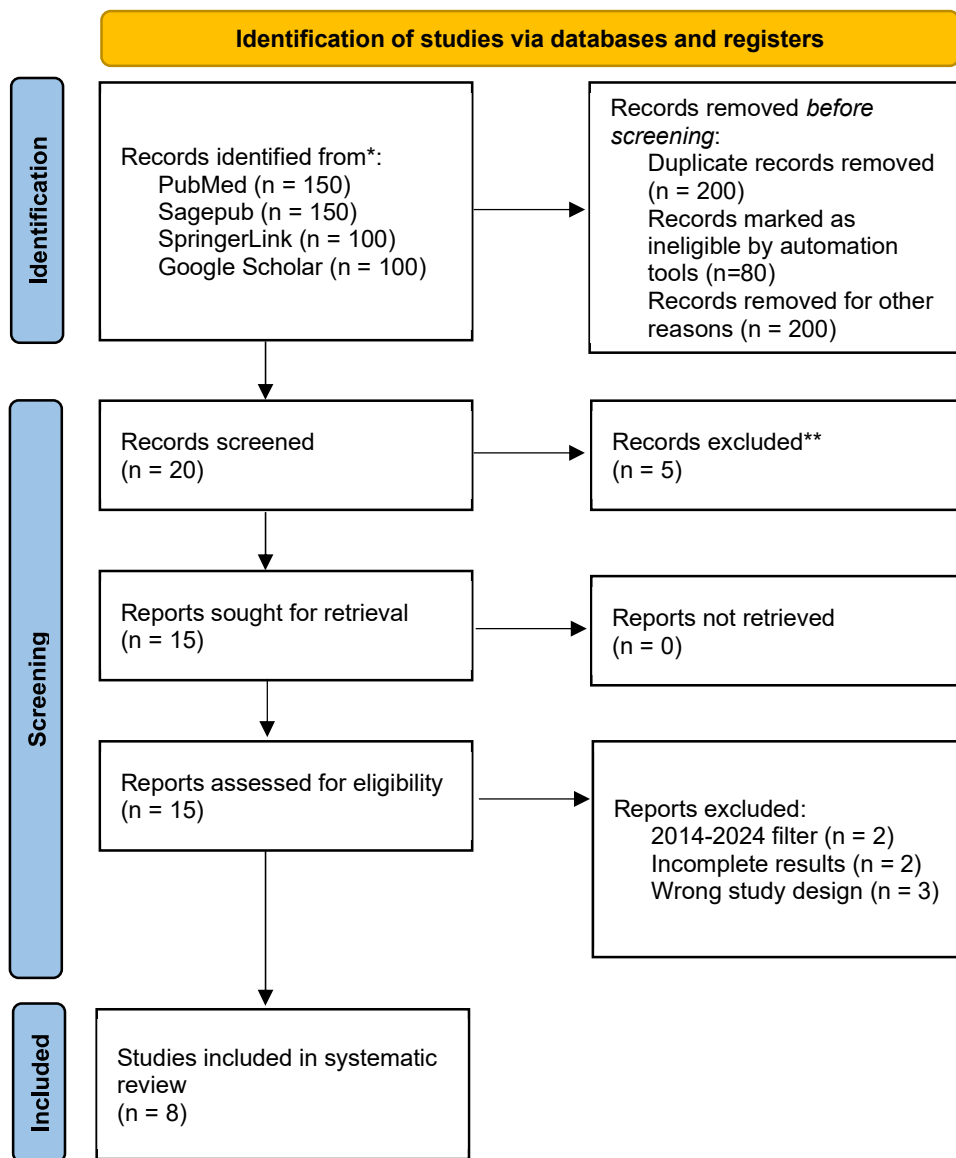


Figure 1. Article search flowchar

### RESULT

The initial number of articles retrieved from online databases (PubMed, SagePub, SpringerLink, and Google Scholar) is 500 articles. After conducting three levels of screening, eight articles that directly relate to the current systematic review have been chosen for further assessment through full-text reading and analysis. Table 1 presents the selected literature included in this analysis.

**Table 1. The literature included in this study**

No.	Author	Origin	Method	Sample	Result
1.	Lynes, et al. <sup>16</sup> (2017)	South Carolina, USA	Retrospective cohort study	114,679 pregnancies	The study aimed to explore the connections between changes in BMI between pregnancies and the occurrence of gestational diabetes mellitus (GDM), pre-eclampsia (PE), gestational hypertension (GHtn), primary cesarean delivery, and successful vaginal birth after cesarean delivery (VBAC). Using modified Poisson regression models, adjusted associations were estimated. Results revealed that every one unit increase in interpregnancy BMI was linked to heightened risks of GDM, PE, GHtn, and primary cesarean delivery, while decreasing the likelihood of successful VBAC in the subsequent pregnancy.
2.	Kawakita, et al. <sup>17</sup> (2020)	New York, USA	Retrospective cohort study	3068 pregnant women	Among the 3068 women analyzed, 11% experienced BMI loss greater than 2 kg/m <sup>2</sup> , 55% had BMI change $\pm 2$ kg/m <sup>2</sup> , and 34% had BMI gain greater than 2 kg/m <sup>2</sup> . Interpregnancy BMI gain greater than 2 kg/m <sup>2</sup> was associated with increased odds of hypertensive disorders compared to BMI loss greater than 2 kg/m <sup>2</sup> . However, interpregnancy BMI loss greater than 2 kg/m <sup>2</sup> was not significantly associated with increased odds of hypertensive disorders compared to BMI change $\pm 2$ kg/m <sup>2</sup> .
3.	Tabet, et al. <sup>18</sup> (2021)	Missouri, US	Population based retrospective cohort study	15,108 women	The results indicated that interpregnancy weight gain was associated with an increased risk of recurrent preeclampsia, LGA, and cesarean delivery. These risks escalated with greater magnitude of interpregnancy weight gain, particularly among women who were underweight or normal weight in the first pregnancy. Conversely, interpregnancy weight loss exceeding 1 BMI unit was linked to an increased risk of SGA among underweight and normal weight women, while weight loss exceeding 2 BMI units was associated with a reduced risk of recurrent preeclampsia among overweight and obese women.
4.	Yamamoto, et al. <sup>19</sup> (2024)	Yokohama, Japan	Retrospective cohort study	2,861 pregnant women	Results showed that an IWC $\geq 1$ unit was associated with an increased risk of gestational diabetes mellitus and delivering a large-for-gestational-age neonate,

					<p>but a decreased risk of preterm birth. Conversely, an IWC &lt; -1 unit was linked to a reduced risk of gestational diabetes mellitus.</p> <p>Subgroup analysis by prepregnancy BMI revealed significant risk reductions for preterm birth with IWC <math>\geq</math> 1 unit in women with a BMI &lt; 18.5 kg/m<sup>2</sup> and for gestational diabetes mellitus with IWC &lt; -1 unit in women with a BMI <math>\geq</math> 25 kg/m<sup>2</sup>.</p>
5.	Crosby, et al. <sup>20</sup> (2017)	Dublin, Ireland	Prospective longitudinal study	280 pregnant women	<p>A total of 280 women delivered a third baby between 2011 and 2015. The study found no significant differences in pregnancy outcomes for the second pregnancy based on interpregnancy weight gain. However, there was a notable increase in birth weight <math>\geq</math>4.0 kg (54.0% vs. 39.6%, p=0.03) among women who gained weight between the second and third pregnancies. Furthermore, women who gained more than the median weight (1.70 kg) between these pregnancies had a significantly higher rate of gestational diabetes (6.5% vs. 1.4%, p=0.03).</p>
6.	Weiss, et al. <sup>21</sup> (2019)	Wisconsin, US	Secondary data analysis	24,795 women	<p>The findings revealed that pregravid weight was weakly and inconsistently associated with weight changes in subsequent periods. However, each 5-kg incremental weight change in the first pregnancy, interpregnancy, and second pregnancy was linked to a 0.75- to 5-kg weight change in later periods. This weight change also corresponded to a 9% to 25% change in risk for adverse maternal outcomes, including gestational hypertension, and an 8% to 47% change in risk for adverse neonatal outcomes. The most significant associations were found among normal-weight and overweight women, indicating that these groups experienced the largest weight fluctuations and associated risks.</p>
7.	Rozario, et al. <sup>22</sup> (2021)	Multi center, US	Cross sectional study	1,046, 350 pregnancy data	<p>The results indicated that both IPI and prepregnancy BMI were significantly associated with PIH, independently and in combination. Specifically, the highest risk for PIH was observed in women with long IPIs combined with obesity, with an adjusted odds ratio (AOR) of 4.01</p>

					(95% CI = 3.84, 4.25). Conversely, a short IPI combined with an underweight BMI was inversely associated with PIH, showing an AOR of 0.64 (95% CI = 0.53, 0.78). These findings suggest that both long intervals between pregnancies and higher BMI significantly increase the risk of developing PIH.
8.	Cohen, et al. <sup>23</sup> (2021)	Denmark	Population-based cohort stud	199,536 first-time mother	Out of 199,536 women with two consecutive singleton births, 4,035 (2.0%) had a child with a major congenital anomaly at the first birth. Women with an anomaly-affected firstborn had a mean maternal BMI of 24.1 kg/m <sup>2</sup> , compared to 23.7 kg/m <sup>2</sup> for those without. By the second pregnancy, about three years later, women with an affected child gained an average of 2.2 kg, while those without gained 1.8 kg, an adjusted difference of 0.26 kg (95% CI 0.10 to 0.42). The greatest difference, 0.59 kg (95% CI 0.02 to 1.16), was seen in women whose first-born had a multi-organ anomaly. Additionally, the odds of moving from a normal BMI (18.5–24.9 kg/m <sup>2</sup> ) to an overweight/obese BMI (25+ kg/m <sup>2</sup> ) by the second pregnancy were 1.18 times higher (95% CI 1.06 to 1.32) for mothers with an anomaly-affected firstborn.

Lynes, et al.<sup>16</sup> (2017) showed that an increase in BMI of three units or more was associated with significantly higher risks of all adverse outcomes and reduced chances of successful VBAC compared to women with minimal changes in BMI. These findings underscore the importance of managing interpregnancy weight to mitigate associated risks.

Kawakita, et al.<sup>17</sup> (2020) concluded that interpregnancy BMI gain greater than 2 kg/m<sup>2</sup> is linked to increased odds of hypertensive disorders, highlighting the potential importance of weight control after pregnancy as a modifiable factor in reducing the risk of these disorders.

Tabet, et al.<sup>18</sup> (2021) indicated that interpregnancy weight gain was associated with an increased risk of recurrent preeclampsia, LGA, and cesarean delivery. These risks escalated with greater magnitude of interpregnancy weight gain, particularly among women who were underweight or normal weight in the first pregnancy. Conversely, interpregnancy weight loss exceeding 1 BMI unit was linked to an increased risk of SGA among underweight and normal weight women, while weight loss exceeding 2 BMI units was associated with a reduced risk of recurrent preeclampsia among overweight and obese women.

Yamamoto, et al.<sup>19</sup> (2024) showed that weight gain during the interpregnancy period increased the risk of gestational diabetes mellitus and delivering a large-for-gestational-age neonate, while weight loss decreased the risk of gestational diabetes mellitus.

Crosby, et al.<sup>20</sup> (2017) showed that maternal interpregnancy weight gain between a second and third pregnancy is associated with an increased likelihood of having a baby with a birth weight ≥4.0 kg. Additionally, gaining more weight than the median interpregnancy weight gain is linked to a higher incidence of gestational diabetes. These findings emphasize the importance of monitoring and managing weight gain between pregnancies to mitigate the risks of fetal macrosomia and gestational diabetes.

Weiss, et al.<sup>21</sup> (2019) concluded that weight changes across two pregnancies significantly affected maternal and neonatal outcomes in the second pregnancy across all BMI categories. Notably, larger weight fluctuations observed in normal and overweight women were linked to a higher risk of adverse outcomes, including gestational hypertension

Rozario, et al.<sup>22</sup> (2021) concluded that the combination of IPI and BMI are crucial risk factors for PIH. The findings highlight that the highest risk of PIH occurs in women who have long IPIs and fall into higher BMI categories. This suggests a need for healthcare professionals to be particularly vigilant in monitoring and managing the health of pregnant women who present with these combined risk factors. The study underscores the importance of considering both IPI and BMI in prenatal care to better predict and potentially mitigate the risk of PIH.

Cohen, et al.<sup>23</sup> (2021) showed that mothers of infants with major congenital anomalies experienced a modestly higher interpregnancy weight gain and were more likely to transition to a higher BMI category between pregnancies. These findings suggest that having an anomaly-affected firstborn is associated with a greater weight trajectory.

## DISCUSSION

The impact of interpregnancy weight gain on hypertensive disorders is evident across several studies. Lynes et al. (2017) highlighted the significant association between interpregnancy BMI increases and heightened risks of hypertensive disorders such as gestational hypertension and pre-eclampsia. Their findings emphasize that every one-unit increase in BMI between pregnancies correlates with increased risks, stressing the importance of weight management in mitigating these risks and promoting better pregnancy outcomes.<sup>16</sup>

Kawakita et al. (2020) further explored this relationship, revealing that interpregnancy BMI gains greater than 2 kg/m<sup>2</sup> were significantly associated with increased odds of hypertensive disorders. This study underscores the necessity for effective weight control strategies post-pregnancy as a modifiable factor to reduce the risk of hypertensive conditions in subsequent pregnancies, highlighting the direct impact of interpregnancy weight gain on maternal health.<sup>17</sup>

Tabet et al. (2021) supported these findings by demonstrating that interpregnancy weight gain was linked to an increased risk of recurrent preeclampsia. This risk was particularly pronounced among women who were underweight or of normal weight during their first pregnancy. The study also noted that interpregnancy weight loss exceeding 2 BMI units among overweight and obese women was associated with a reduced risk of recurrent preeclampsia, suggesting that targeted weight loss could be beneficial for this group in reducing the likelihood of hypertensive disorders.<sup>18</sup>

Rozario et al. (2021) provided insights into the combined effect of interpregnancy interval (IPI) and BMI on hypertensive disorders, particularly pregnancy-induced hypertension (PIH). The study found that women with long IPIs and high BMI categories faced the highest risk for PIH, with an adjusted odds ratio (AOR) of 4.01. Conversely, a short IPI combined with an underweight BMI was inversely associated with PIH (AOR = 0.64). These findings suggest that both long intervals between pregnancies and higher BMI significantly increase the risk of developing hypertensive disorders, indicating a need for healthcare providers to monitor these risk factors closely.<sup>22</sup>

Weiss et al. (2019) examined weight changes across two pregnancies and their effects on maternal outcomes, including gestational hypertension. The study found that each 5-kg weight change in the interpregnancy period significantly altered the risk of adverse maternal outcomes, including gestational hypertension, by 9% to 25%. The most significant associations were found among normal-weight and overweight women, highlighting the critical impact of weight fluctuations on the risk of hypertensive disorders.<sup>21</sup>

These findings underscore the importance of managing weight between pregnancies to mitigate the risk of these conditions. Healthcare providers should prioritize weight management counseling and interventions for women, particularly those who are overweight or obese or have had an anomaly-affected pregnancy, to improve maternal health outcomes in subsequent pregnancies. Further research is needed to develop targeted strategies that address the specific needs of women at higher risk for hypertensive disorders based on their interpregnancy weight changes.<sup>19,20,23</sup>

## CONCLUSION

In summary, research consistently demonstrates that interpregnancy weight gain is linked to a heightened risk of hypertensive disorders during pregnancy. These findings emphasize the critical role of managing weight between pregnancies to reduce the likelihood of developing these conditions. It is imperative for healthcare providers to prioritize weight management counseling and interventions for women, especially those who are overweight or obese, or have experienced anomaly-affected pregnancies. By addressing weight-related factors between pregnancies, healthcare providers can significantly improve maternal health outcomes in subsequent pregnancies.

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