Factors Associated with the Occurrence of Hypertension in Pregnant Women

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ABSTRACT

Hypertension in pregnancy is a major cause of maternal and fetal morbidity and mortality, especially in developing countries. Various risk factors such as maternal age, parity, and obesity are thought to contribute to the incidence of gestational hypertension. Purpose: This study is a literature review study with an analytical approach. Methods: Data were obtained from 15 articles published between 2014–2020 and accessed through the PubMed, GARUDA, and Google Scholar databases. Inclusion criteria included publications discussing the relationship between age, parity, obesity, and gestational hypertension in full-text form. Results Most of the study results showed that pregnant women aged <20 years or >35 years had a higher risk of developing hypertension. Extreme parity (primiparity and multiparity ≥3) was also significantly associated with increased blood pressure during pregnancy. Obesity (BMI ≥27) was found to be a dominant risk factor, with a six-fold increase in the risk of hypertension. Implications: According to this study, antenatal care services should include screening for hypertension risk based on the age, parity, and nutritional condition of expectant mothers in order to more effectively and early prevent pregnancy problems. Conclusion : There is a significant relationship between age, parity, and obesity with the incidence of hypertension in pregnancy.

Keywords: Maternal Age, Parity, Obesity, Gestational Hypertension

INTRODUCTION

The World Health Organization (WHO) states that hypertension or high blood pressure is a serious medical condition that significantly increases the risk of heart, brain, kidney, and other diseases. The incidence of hypertension in the world in 2021 is estimated at 1.28 billion adults aged 30-79 years worldwide suffering from hypertension, most of whom (two-thirds) live in low and middle income countries (World Health Organization (WHO), 2021) . According to the Ministry of Health of the Republic of Indonesia (2022), the leading cause of maternal death in Indonesia is hypertension during pregnancy, which comes in second only to hemorrhage (27.1%)(Kementrian Kesehatan Republik Indonesia, 2022). This illness highlights the importance of paying close attention to prevention initiatives and risk factor identification early on.

 Hypertension in pregnancy is defined as systolic blood pressure ≥140 mmHg and/or diastolic blood pressure ≥90 mmHg that appears after 20 weeks of gestation in women who were previously normotensive (Gynecologists, 2020) . Hypertension can appear in the form of gestational hypertension, preeclampsia, or chronic hypertension with superimposed preeclampsia. Complications that arise include impaired kidney function, risk of premature labor, intrauterine growth retardation (IUGR), and intrauterine fetal death (Haidar Alatas, 2019) .

Factors that can influence the incidence of hypertension in pregnancy are very diverse. Some of them are maternal age, parity (number of previous births), and obesity. Pregnant women aged <20 years or >35 years have a higher risk of experiencing pregnancy complications, including hypertension (Silda, 2020). In addition, women with extreme parity (first time or fourth and above) also have a higher tendency to experience hypertension due to immunological factors and physiological fatigue of the reproductive organs (Agustna Ningsi, Afriani, 2023) .

Obesity is one of the significant risk factors that are often associated with the occurrence of hypertension in pregnancy. Obesity causes increased blood volume, systemic vascular resistance, and activation of the renin-angiotensin system which triggers increased blood pressure (Astriana, 2016). Research by Imaroh showed that pregnant women with a body mass index (BMI) >27 have almost five times the risk of experiencing hypertension compared to pregnant women with normal BMI. With the increasing prevalence of obesity, the risk of gestational hypertension is also increasing (Imaroh, 2018).

Previous research by Sukfitrianty stated that pregnant women with extreme ages (<20 or >35 years), unsafe parity (1 or ≥3), and obesity are groups that are vulnerable to hypertension. Therefore, it is important to conduct a literature study to summarize and analyze the available scientific evidence regarding the relationship between these factors and the incidence of hypertension in pregnancy. This literature study is expected to provide a basis for developing more targeted prevention and education policies for pregnant women(Sukfitrianty, 2016).

Previous studies have shown that in addition to age, parity, and obesity, genetic factors, inflammatory status, and modern lifestyles such as consumption of ultra-processed foods and chronic stress also have significant contributions to the incidence of hypertension in pregnancy. Previous studies have identified that genetic expression of *angiotensinogen* and *eNOS polymorphisms*
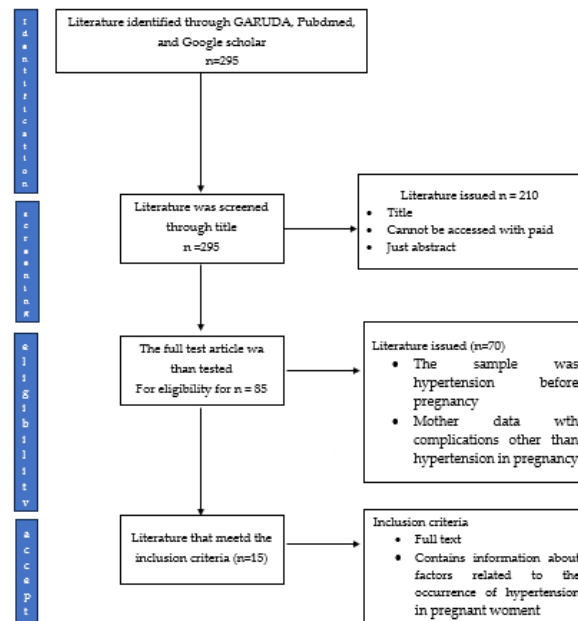
can increase the susceptibility of pregnant women to preeclampsia (Olaniyan et al., 2024) . In addition, other studies have also highlighted that sedentary lifestyles and high sodium consumption are strongly correlated with gestational hypertension, especially in developing countries (O'Nan et al., 2024) .

However, the main limitation of most recent studies is the observational nature of the design and the inability to strictly control confounding factors , making it difficult to definitively prove causal relationships. In addition, some studies are still limited to local populations and are small in scale, making generalization of results to a wider population less than optimal (Eyl, 2023) . Some studies also use inconsistent definitions and diagnostic criteria, making it difficult to compare across studies and systematically integrate data into *evidence-based policy* .

Considering the importance of early identification of the risk of hypertension in pregnancy, this study aims to summarize the results of existing studies on the relationship between age, parity, and obesity with the incidence of hypertension in pregnant women. It is hoped that the results of this study can be a reference in improving early detection efforts and preventive interventions by health workers, especially midwives, in antenatal care services.

METHODS

The type of research used is analytical survey research with a study literature review research design. Data were collected from national and international scientific journals with inclusion criteria: (1) publications in 2014–2020, (2) discussing the relationship between age, parity, obesity, and hypertension in pregnancy, and (3) available in full-text form. Following selection, the analysis and synthesis of the literature can be viewed beginning with the abstract at the start of the paper. This will facilitate the process and enable a determination of whether it is worthwhile to proceed. A total of 295 articles were found. The next step is to do a comprehensive analysis of the text. Following the process of scanning the PubMed, GARUDA, and Google Scholar databases for the title/abstract and full study contents, 15 papers were found to be pertinent to the research issue (figure 1).

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Figure 1. Prism Diagram of the Literature Search Process

RESULTS

A number of previous studies have investigated the risk factors associated with hypertension in pregnancy, using various research designs such as cross-sectional, case-control, cohort, and retrospective approaches. These studies aimed to identify maternal characteristics that may contribute to the development of hypertension during pregnancy, including factors such as age, parity, obesity, and gravidity. A summary of the key findings from these studies is presented in Table 1.

Table 1. Summary of Studies on Risk Factors Associated with Hypertension in Pregnancy

No	Author(s) and Year	Design	Sample	Output
1	(Fahruddin, 2018)	Cross-sectional	73	Age significantly associated with hypertension (p=0.000)
2	(Jumaiza, Elvira, D., & Panjaitan, 2018)	Cross-sectional	40	Obesity significantly associated with hypertension (p=0.026)
3	Sukfitrianty et al. (2016) (Sukfitrianty, A., Aswadi, & Song, 2016)	Case control	68 cases + 68 controls	High risk age associated with 2,566 times hypertension risk
4	(Pemiliana, PD, & Nasution, 2019)	Cohort	55	Age and parity associated with hypertension (p<0.05)
5	(Imaroh, II, & Nugraheni, 2018)	Case control	22 cases + 22 controls	Age, parity, obesity significantly associated (ORs up to 9.067)

6	(Basri et al, 2018)	Cross-sectional	138	Age associated with hypertension (p=0.000)
7	(Philip, 2018)	Retrospective	72	Age and parity associated with hypertension (p=0.02; p=0.000)
8	(Puspitasari, DR, Setyabudi, MT, & Rohmani, 2015)	Cross-sectional	43	Age and obesity associated (p=0.004; p=0.005)
9	(Alwiningsih, 2016)	Case control	33 cases + 33 controls	Gravidity associated with hypertension (p=0.001)
10	(Astriana, 2016)	Case control	91 cases + 91 controls	Obesity associated with 5,977 times hypertension risk (p=0.000)
11	(Lail, 2015)	Cross-sectional	60	Parity significantly associated (p=0.000)
12	(Juaria, 2015)	Cross-sectional	65	Age and parity associated (p=0.004; p=0.000)
13	(Bardja, 2017)	Cross-sectional	76	Age and parity associated (p=0.005; p=0.000)
14	(Radjamuda, N., & Montolalu, 2014)	Retrospective	207	Age and parity associated (p=0.002; p=0.000)
15	(Rambe, 2018)	Case control	36 cases + 36 controls	Age and parity associated (ORs 3.353 and 3.000)

DISCUSSION

A. Mother's Age

Based on the results of the analysis of 15 reviewed journals, most of them showed that the age of the mother at risk, namely <20 years or >35 years, has a significant relationship with the incidence of hypertension in pregnancy. studies carried out by Fahruddin that there was a significant relationship between maternal age and the incidence of hypertension in pregnant women (p = 0.000)(Fahruddin, 2018). A similar finding was found in the study of research by Imaroh with an OR value = 4.911 (CI 95%: 1.325–18.205), indicating that mothers with ages outside the range of 20–35 years have almost five times the risk of experiencing hypertension compared to safe ages(Imaroh, 2018). Meanwhile, research by Sukfitrianty trengthens this finding with OR = 2.566 for pregnant women at high risk of age(Sukfitrianty, 2016).

In addition to the findings of Fahruddin (2018) and Imaroh et al. (2018), several other studies have also confirmed a significant relationship between maternal age and gestational hypertension. Research by Sukfitrianty et al. (2016) using a *case-control design* with a sample of 68 cases and 68

controls, found that mothers with extreme ages had an odds ratio (OR) of 2.566 for experiencing gestational hypertension, indicating a more than two-fold increase in risk. This study is important because control of other variables is carried out quite well through a balanced comparison of cases and controls.

Research by Puspitasari ith a *cross-sectional design* on 43 respondents showed a significant relationship between age and the incidence of hypertension (p = 0.004). This study highlights the group of mothers aged >35 years as the most vulnerable population, especially in the context of provincial referral hospitals, adding important value because of its more severe clinical context(Al, 2015).

Meanwhile, Basri conducted a study on 138 pregnant women in Makassar city and found that age had a very significant relationship to hypertension (p = 0.000). The strength of this study lies in the large sample size and even distribution of respondents based on demographic characteristics(Basri et al, 2018).

Study by Philip also confirmed similar findings in a retrospective study of 72 respondents at Wates Kulon Progo Regional Hospital, which showed that maternal age was a strong predictor of gestational hypertension (p=0.005). This retrospective study provides a longitudinal picture of risk based on documented medical records(Philip, 2018).

Research by Radjamuda and Montolalu at Prof. Dr. VL Ratumbuysang Mental Hospital involved 207 samples and showed that maternal age had a significant effect (p=0.002). The large scale and unique hospital setting enrich the context of the study results, especially in high-risk groups(Radjamuda, N., & Montolalu, 2014). Study by Alwiningsih used a *case- control design* on 36 cases and 36 controls, finding an OR of 3.353 for mothers of extreme age. This study adds strength to the data because its design minimizes selection bias(Alwiningsih, 2016). On an international scale, study by Hasanzadeh in Iran also found that women aged ≥35 years had a 2.3 times greater risk of experiencing gestational hypertension, indicating that the risk of old age is universal across populations.

Across all these studies, there is consistency that age <20 years and >35 years are significant risk factors. This is thought to be due to hormonal imbalance, immaturity or degeneration of the cardiovascular system, and the additional physiological burden of non-ideal age. The authors concluded that extreme age groups should be prioritized in antenatal screening and intervention.

B. Parity

Parity is also one of the variables that shows a significant relationship with the incidence of hypertension in pregnancy. The results of studies by Lail (2015) and Juaria (2015) found that mothers with parity 1 or ≥3 have a higher risk of experiencing hypertension compared to safe parity (2–3). Imaroh et al. (2018) reported OR = 9.067 (95% CI: 2.306–35.650), which shows that extreme parity can increase the risk of hypertension almost ninefold. In addition, Bardja (2017) and Philip (2018) also stated that the higher the parity, the higher the tendency of mothers to experience hypertension complications.

In addition to the findings of Lail (2015) and Imaroh et al. (2018), there are several other studies that strengthen the significant relationship between parity and hypertension in pregnancy. Research by Juaria (2015) with a *cross-sectional design* involving 65 respondents and showed a significant relationship between parity and the incidence of hypertension ($p = 0.000$). This study highlights that primipara and extreme multipara (≥ 4) have a higher risk because they have not formed a stable immunological tolerance to fetal antigens or because of physiological fatigue due to repeated pregnancies.

Research by Sukfitrianty using a *case-control design* with a total of 136 respondents (68 cases and 68 controls) found that unsafe parity (1 or ≥ 3) significantly increased the risk of hypertension. This study is important because it uses strict control of external variables, resulting in a more valid OR value to assess the effect of parity.

The study by Philip was retrospective and involved 72 pregnant women. This study showed that parity had a positive correlation with hypertension ($p = 0.000$), which supports the assumption that multiparity contributes to increased blood pressure due to cumulative hemodynamic stress.

Study by Puspitasari, in their study of 43 samples, also showed that parity has a significant relationship to gestational hypertension. They found that extreme parity increases vascular load and reduces uterine blood vessel elasticity, increasing the risk of preeclampsia.

Research by Radjamuda and Montolalu on 207 respondents at referral facilities showed that mothers with parity ≥ 3 had a higher tendency to experience hypertension ($p=0.000$). This finding is reinforced by the large sample size and the context of secondary services that allow for high-accuracy case identification.

Study by Bardja and Alwiningsih also provide strong evidence. Bardja found that multiparity is closely related to increased blood pressure through chronic inflammation and mild hypoxia due to suboptimal uterine perfusion. Research Alwiningsih noted an OR of 3,000 in mothers with high parity in a *case-control design* , indicating that the risk of hypertension increases threefold in this group.

Meanwhile, research by Fahruddin, although primarily focused on age, also noted that the majority of hypertension cases occurred in mothers with unsafe parity. These results support that parity is not just a demographic variable, but also a biological variable that reflects long-term vascular adaptation.

From all these studies, it is clear that extreme parity both primipara and multipara ≥ 3 plays an important role in the pathogenesis of gestational hypertension. This is thought to be because in the first pregnancy, the maternal immune system has not recognized fetal antigens, thus increasing inflammatory reactivity. In contrast, in extreme multipara, there is an accumulation of oxidative stress, increased vascular resistance, and decreased uterine elasticity. Thus, this group should be a priority in education and close monitoring during pregnancy.

Research by Kristina Baker shows that pregnant women aged <20 years and >35 years have a significant risk of preeclampsia compared to the 20–34 year age group. This study shows that extreme age groups have a 1.8-fold increased risk (Adjusted OR = 1.84; 95% CI: 1.32–2.55) of

hypertension in pregnancy due to hormonal imbalance and immaturity of the reproductive system at a young age and degeneration of reproductive organs at an old age .

Meanwhile, a study by Hasanzadeh et al. (2023) in Iran found that women aged ≥35 years were 2.3 times more likely to experience hypertension in pregnancy. This risk is associated with decreased endothelial function, insulin resistance, and increased chronic inflammation in older women (Dietl & Farthmann, 2015) .

A study by Johson stated that women with parity 1 (primipara) or ≥4 have twice the risk of experiencing preeclampsia compared to women with parity 2–3. Immunological imbalance between mother and fetus in the first pregnancy and accumulation of reproductive organ fatigue in extreme multipara are the main explanations for this finding (Johnson et al., 2022) .

Research conducted by Gold also strengthens these results. They found that women with parity ≥3 had a 2.6-fold increased risk of hypertension in pregnancy (95% CI: 1.68–3.87). This is due to an imperfect immune response to placental antigens and increased uteroplacental vascular resistance as pregnancy progresses(Gold et al., 2014) .

Researchers assume that the first pregnancy causes maternal immune system sensitivity to fetal antigens, which can cause inflammatory reactions and endothelial dysfunction. While in extreme multipara, repeated uterine stretching can disrupt vascular elasticity and perfusion, and increase physiological stress leading to gestational hypertension.

Researchers suspect that very young mothers (<20 years) do not have physiological and psychological readiness to face pregnancy, thus increasing vulnerability to stress and impaired blood circulation adaptation. Conversely, in older mothers (>35 years), degenerative processes and accumulation of chronic disease risks such as chronic hypertension contribute to worsening cardiovascular adaptation during pregnancy, causing gestational hypertension.

C. Obesity

Obesity is a significant factor contributing to the incidence of hypertension in pregnancy. Astriana & Susilawati (2016) in their study found that pregnant women who are obese have a 5.977 times greater chance of experiencing hypertension compared to mothers with normal BMI (p = 0.000). Research by Imaroh et al. (2018) also stated the same thing, with an OR value of 4.667 (CI 95%: 1.299–16.761). Jumaiza et al. (2018) showed a significant relationship between body weight and the incidence of hypertension (p = 0.026), while Rambe (2018) strengthened it with the result of OR = 3.143. This shows that obesity before and during pregnancy is a strong risk factor for hypertension.

In addition to the findings of Astriana & Susilawati (2016) and Imaroh et al. (2018), there are a number of other studies that strengthen the evidence that obesity is a major risk factor for hypertension in pregnancy. Research by Jumaiza et al. (2018) used a *cross-sectional design* with a sample size of 40 respondents and found a significant relationship between obesity and hypertension with a p value of 0.026. Although the sample size is relatively small, the strength of this study lies in its emphasis on the third trimester of pregnancy, where metabolic changes are most evident.

Research by Puspitasari, involving 43 respondents, showed a significant relationship between body mass index (BMI) and the incidence of hypertension in pregnancy (p=0.005). This study used a hospital approach, so the cases observed tended to be more severe and required medical intervention, highlighting the importance of BMI screening early in pregnancy.

Study by Imaroh reported that pregnant women with BMI >27 had an odds ratio of 4.667 (95% CI: 1.299–16.761), indicating an almost five-fold increase in risk. *The case-control design* used allowed for a more systematic comparison between hypertensive and non-hypertensive groups. This study also controlled for external variables such as age and parity, thus strengthening the validity of the results.

Research by Astriana & Susilawati noted that obesity increases the risk of hypertension by 5.977 times (p=0.000). This study used data from the Health Center, providing a picture of the general population with various demographic characteristics. The advantage of this study lies in the use of primary data through calibrated anthropometric measurements, not just medical records.

Research by Rambe with a *case-control design* also identified obesity as a significant risk factor, with an OR of 3.143. This study used data from the Health Center in Deli Serdang Regency and showed an increasing trend in the incidence of hypertension in obese pregnant women in suburban areas, emphasizing the importance of community-based interventions.

Research conducted by Verasita in the *Indonesian Journal of Global Health Research* found that every 5-unit increase in BMI was associated with a 1.7-fold increase in the risk of preeclampsia (p <0.001). This study used prospective cohort data and took into account changes in weight during pregnancy, providing a dynamic picture of the contribution of obesity to gestational hypertension(Prissy Verasita, 2024).

Meanwhile, reseacrh by Baker Sole in a multinational study published through ClinicalKey emphasized that obesity is an independent risk factor for preeclampsia with an adjusted OR of 3.1. This study expands the global context and shows that the influence of obesity is cross-ethnic and geographical(Kristina Baker Sole, 2021).

From all these findings, it is clear that obesity triggers hypertension through various physiological mechanisms such as increased blood volume, insulin resistance, activation of the renin angiotensin system, and chronic inflammation due to visceral fat accumulation. Activation of proinflammatory cytokines such as TNF-α and IL-6 causes endothelial damage and increases systemic blood pressure. Therefore, monitoring weight during pregnancy should be an integral part of antenatal care, especially in areas with high obesity prevalence.

Research from Prissi shows that obesity in pregnant women (BMI ≥30) is closely related to an increased risk of preeclampsia(Prissy Verasita, 2024). They found that every 5-unit increase in BMI increased the risk of preeclampsia by 1.7 times (p <0.001). Another study stated that obesity is an independent risk factor for hypertension in pregnancy by (Kristina Baker Sole, 2021) . Their study showed that obese women have a 3.1 times higher risk of preeclampsia than women with normal weight. This occurs due to the activation of the inflammatory system, oxidative stress, and metabolic disorders that trigger endothelial damage.

Obesity causes disturbances in the cardiovascular and metabolic systems, including increased blood volume, insulin resistance, and activation of chronic inflammation that play a major role in the pathogenesis of gestational hypertension. Excess visceral fat also increases the production of proinflammatory cytokines that damage endothelial function and increase systemic blood pressure.

CONCLUSIONS

Based on the results of the literature review, it can be concluded that there is a significant relationship between the variables of maternal age, parity, and obesity with the incidence of hypertension in pregnancy:

1. Pregnant women aged <20 years or >35 years have a much higher risk of experiencing hypertension in pregnancy compared to mothers aged 20–35 years. This is caused by factors such as immaturity or degeneration of the reproductive system, hormonal imbalance, and suboptimal cardiovascular adaptation. Most studies show high and significant odds ratio values, reinforcing age as a major determinant in pregnancy risk screening.

2. Extreme parity, both primipara (parity 1) and multipara ≥3, contribute significantly to the incidence of gestational hypertension. The underlying mechanisms include immunological sensitivity to fetal antigens in the first pregnancy and physiological fatigue and chronic inflammation in multipara. Findings from several studies indicate a 9-fold increase in risk in mothers with unsafe parity.

3. Obesity (BMI ≥27) is one of the strongest risk factors for hypertension in pregnancy. The studies analyzed showed that pregnant women with obesity have a 3 to almost 6 times greater chance of experiencing hypertension compared to mothers with normal weight. This is related to metabolic disorders, systemic inflammation, and vascular resistance caused by visceral fat accumulation.

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