

Chronic Hypertension as a Risk Factor for Peripartum Cardiomyopathy (PPCM): Insights from a Case-Control Study in Indonesia

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SOUHRN

Kontext: Peripartální kardiomyopatie (PPCM) je vzácná, ale závažná příčina mateřského srdečního selhání. Hypertenze představuje jeden z hlavních přispívajících faktorů vzniku PPCM, avšak důkazy z Indonésie jsou dosud omezené.

Cíl: Cílem této studie bylo prozkoumat souvislost mezi chronickou hypertenzí a vznikem PPCM ve dvou referenčních nemocnicích v Cirebonu (západní Jáva) v letech 2019–2024.

Metoda: Studie využila uspořádání případ–kontrola a zahrnovala 84 žen s diagnózou PPCM dle kritérií Evropské kardiologické společnosti (ESC) a 336 kontrol bez PPCM. Bylo provedeno párování podle nemocnice. K posouzení nezávislého rizika chronické hypertenze pro PPCM byla použita multivariační nepodmíněná logistická regresní analýza.

Výsledky: Chronická hypertenze vykazovala silnou souvislost s PPCM (cOR 22,2; 95% CI 6,21–79,31), která zůstala statisticky významná i po adjustaci na věk matky, obezitu před těhotenstvím a nemocnici (aOR 17,13; 95% CI 3,71–79,14). Chronická hypertenze je tedy nezávislým rizikovým faktorem pro rozvoj PPCM.

Závěr: Zjištění zdůrazňují význam kardiovaskulárního hodnocení rizik a optimální kontroly krevního tlaku u žen s chronickou hypertenzí s cílem snížit riziko PPCM a zlepšit mateřské výsledky.

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ABSTRACT

Background: Peripartum cardiomyopathy (PPCM) is a rare but serious cause of maternal heart failure. Hypertension is a major contributing factor of PPCM, but evidence from Indonesia remains limited.

Objective: This study examined the association between chronic hypertension and PPCM in two referral hospitals in Cirebon, West Java, from 2019 to 2024.

Method: A case-control design included 84 women diagnosed with PPCM according to the European Society of Cardiology (ESC) criteria and 336 controls without PPCM. Frequency matching based on hospital was conducted. Multivariable unconditional logistic regression was performed to assess the independent risk of chronic hypertension for PPCM.

Results: Chronic hypertension showed a strong association with PPCM (cOR 22.2; 95% CI 6.21–79.31), which remained significant after adjusting for maternal age, pre-pregnancy obesity and hospital (aOR 17.13; 95% CI 3.71–79.14). In conclusion, chronic hypertension is an independent risk factor for PPCM.

Conclusion: These findings highlight the importance of cardiovascular risk assessment and optimal blood pressure control in women with chronic hypertension to reduce PPCM risk and improve maternal outcomes.

Keywords:

Chronic hypertension

Maternal health

Peripartum cardiomyopathy

Pregnancy

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Introduction

Peripartum cardiomyopathy (PPCM) is a rare but serious form of heart failure that occurs during late pregnancy or in the months following delivery. It is characterized by left ventricular systolic dysfunction without another identifiable cause of cardiomyopathy. Although its incidence varies globally, PPCM remains an important cause of maternal morbidity and mortality. The burden is particularly high in low- and middle-income countries, where delayed diagnosis and limited resources contribute to poor outcomes. Understanding risk factors associated with PPCM is essential to support early recognition, prevention, and timely management.^{1,2}

Previous studies have identified several maternal and obstetric risk factors associated with PPCM, including advanced maternal age, multiparity, multiple gestation, anemia, and hypertensive disorders of pregnancy. Meta-analyses demonstrated strong associations between PPCM and pre-eclampsia or gestational hypertension.^{3,4} However, research on the association between chronic hypertension and PPCM remains very limited, particularly in Indonesia. This highlights a significant knowledge gap, as chronic hypertension is increasingly common in women of reproductive age, mainly due to the rising prevalence of obesity and metabolic syndrome.^{3,5-7}

Chronic hypertension refers to hypertension that existed before pregnancy or was diagnosed before 20 weeks of gestation. It also includes women who used antihypertensive medication prior to pregnancy or whose elevated blood pressure persists for more than 12 weeks after delivery, as defined by the American College of Obstetricians and Gynecologists.^{8,9} It may predispose to PPCM through prolonged pressure overload, endothelial dysfunction, and maladaptive cardiac remodelling. Unlike gestational hypertension or pre-eclampsia, which develop acutely during pregnancy, chronic hypertension exerts continuous hemodynamic stress on the myocardium beginning before conception and persisting throughout gestation. While gestational hypertension and pre-eclampsia have been extensively investigated as risk factors for PPCM, the contribution of chronic hypertension remains insufficiently explored.^{4,10}

Research on PPCM in Indonesia remains limited, primarily based on single-center retrospective studies or isolated case reports. PPCM presents a major maternal health concern, particularly with the increasing burden of cardiovascular disease-related maternal mortality.^{11,12} To address this gap, we conducted a case-control study in two tertiary hospitals in Cirebon, Indonesia. This study aimed to investigate the association between chronic hypertension and PPCM.

Materials and methods

Study design and setting

This was a hospital-based case-control study that was conducted at two tertiary hospitals in Cirebon, West Java, Indonesia. Both hospitals were the primary referral centers for maternal and cardiovascular cases in the region,

receiving patients from primary health centers and secondary hospitals within Cirebon City and Cirebon Regency, as well as from surrounding districts. The first study site was Waled District General Hospital (RSUD Waled), which serves as the main referral hospital in Cirebon Regency and provides advanced maternal, obstetric, and cardiology services. The second site, Gunung Jati Regional General Hospital (RSD Gunung Jati) is the principal referral hospital in Cirebon City, accommodating a large volume of high-risk obstetric patients and offering comprehensive cardiovascular care. These hospitals collectively provide healthcare services to a wide catchment area and serve as the primary centers for the management of maternal complications and cardiovascular emergencies in the Cirebon region.

Study population and eligibility criteria

The study included women who delivered or were hospitalized during pregnancy or within five months postpartum at the participating hospitals between January 2019 and December 2024. Cases included all women diagnosed with PPCM according to the European Society of Cardiology (ESC) criteria: (1) development of heart failure toward the end of pregnancy or within five months postpartum, (2) left ventricular ejection fraction (LVEF) <45%, and (3) absence of another identifiable cause of heart failure.¹³ Women who delivered or were hospitalized but did not meet the diagnostic criteria for PPCM were eligible as controls. **Frequency matching was performed based on hospital.** A case-to-control ratio of 1 : 4 was applied to increase statistical power and improve the precision of effect estimates. Patients with incomplete medical records were excluded.

Data collection

Data were collected retrospectively from paper-based medical records at the participating hospitals. In this study, PPCM data at RSUD Waled were only available for 2023 and 2024, as cardiovascular services were initiated in 2023. Data from RSD Gunung Jati were collected over a longer period, from 2019 to 2024. Information collected included maternal age, place of residence, parity, twin pregnancy, pre-pregnancy obesity, type 2 diabetes mellitus (T2DM), and chronic hypertension. Chronic hypertension was defined as a documented diagnosis of hypertension prior to pregnancy or before 20 weeks of gestation, or documented use of antihypertensive medication before pregnancy, in accordance with ACOG criteria.^{8,9} The diagnosis was based on information recorded in the patients' medical records by the treating physicians. In this study, the severity of chronic hypertension was not classified. Blood pressure levels recorded in the medical records may vary over time and may be influenced by ongoing antihypertensive treatment and clinical conditions, which could lead to misclassification of hypertension severity. Therefore, chronic hypertension was analyzed as a binary variable based on documented diagnosis.

The hospitals did not yet use standardized computerized medical record systems. Therefore, all information was manually extracted from patients' paper charts. Data were abstracted using a standardized data collection form to ensure consistency and completeness across hos-

pitals. To ensure data accuracy, all extracted data were independently verified by a research assistant and the principal investigator before analysis.

Statistical analysis

Categorical variables were summarized as frequencies with percentages. Comparisons between cases and controls were performed using the chi-square test or Fisher's exact test, as appropriate. Bivariable analyses were conducted using unconditional logistic regression to examine the crude OR and 95% confidence intervals (CI) between each independent variable and PPCM. The independent association between chronic hypertension and PPCM was examined using multivariable unconditional logistic regression. The model was adjusted for the matching variable (hospital) to mitigate potential negative confounding effects that arise from matched design, as well as for covariates including maternal age and pre-pregnancy obesity. Results were reported as aOR and 95% CI. All analyses were conducted using Stata version 17.0 (StataCorp, College Station, TX, USA).

Results

In this study, a total of 84 women with PPCM were included, consist of 56 cases from RSD Gunung Jati and 28 cases from RSUD Waled. The selection of study participants is illustrated in **Figure 1**.

Baseline characteristics of the study sample are showed in **Table 1**. Among the 84 women diagnosed with PPCM, the majority were aged 20–35 years (60.71%), followed by those older than 35 years (35.71%) and younger than 20 years (3.57%). Most PPCM cases resided in Cirebon Regency (77.38%). Approximately 70.24% of PPCM cases were multiparous, and twin pregnancies occurred in 2 cases (2.38%). Regarding nutritional status, 17.86% of patients were overweight, 13.10% had class I obesity, and 8.33% had class II obesity. Type 2 DM was present

in 4 cases (4.76%), and chronic hypertension was noted in 14 PPCM cases (16.67%). Among patients with chronic hypertension, no cases of secondary hypertension were documented in the medical records. All patients with chronic hypertension ($n = 17$) received methyldopa. Two patients received methyldopa as monotherapy, while nine received methyldopa in combination with nifedipine and six received methyldopa in combination with amlodipine. Given the small number of patients and overlapping treatment regimens, antihypertensive medication use was presented descriptively and was not included in further analyses.

Statistically significant differences between cases and controls were observed in maternal age distribution ($p = 0.012$), pre-pregnancy obesity ($p = 0.003$), T2DM ($p = 0.002$), and chronic hypertension ($p \leq 0.001$). Place of residence, parity, and twin pregnancy did not differ significantly between cases and controls.

In bivariable analysis, several factors were significantly associated with PPCM, as presented in **Table 2**. Chronic hypertension showed the strongest association, with an cOR of 22.2 (95% CI 6.21–79.31). Women with pre-pregnancy obesity (class I–II) also had higher odds of developing PPCM compared to those with underweight to overweight (cOR 3.00; 95% CI 1.57–5.74). Maternal age >35 years was associated with an increased risk of PPCM (cOR 2.15; 95% CI 1.28–3.61). While twin pregnancy and multiparity were not significantly associated with PPCM.

The results of the multivariable analysis are presented in **Table 3**. After adjusting for maternal age, pre-pregnancy obesity, and hospital, chronic hypertension remained strongly associated with PPCM (aOR 17.13; 95% CI 3.71–79.14).

Discussion

This case-control study identified chronic hypertension as a strong independent risk factor for PPCM, even after ad-

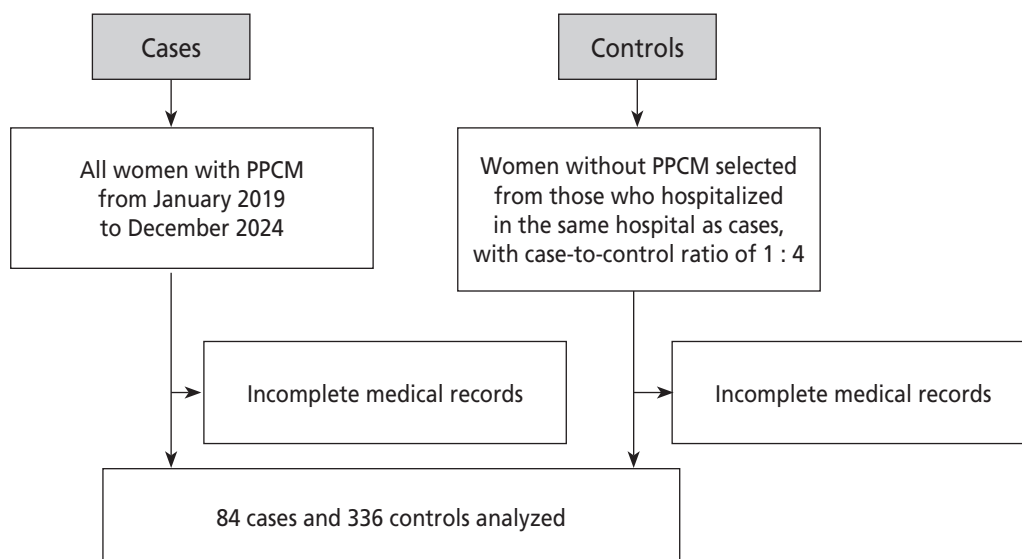


Fig. 1 – Sample selection process.

Table 1 – Baseline characteristics of study sample

Characteristics	Total (n = 420)	PPCM (n = 84)	Controls (n = 336)	p-value
Maternal age				0.012
<20 years	23 (5.48)	3 (3.57)	20 (5.95)	
20–35 years	298 (70.95)	51 (60.71)	247 (73.51)	
>35 years	99 (23.57)	30 (35.71)	69 (20.54)	
Place of residence				0.103
Cirebon City	48 (11.43)	11 (13.10)	37 (11.01)	
Cirebon Regency	299 (71.19)	65 (77.38)	234 (69.64)	
Outside Cirebon	73 (17.38)	8 (9.52)	65 (19.35)	
Parity				0.792
Primiparity	130 (30.95)	25 (29.76)	105 (31.25)	
Multiparity	290 (69.05)	59 (70.24)	231 (68.75)	
Twin pregnancy				0.345
No	414 (98.57)	82 (97.62)	332 (98.81)	
Yes	6 (1.43)	2 (2.38)	4 (1.19)	
Pre-pregnancy obesity				0.003
Underweight & normal	288 (68.57)	51 (60.71)	237 (70.54)	
Overweight	86 (20.48)	15 (17.86)	71 (21.13)	
Obesity class I	33 (7.86)	11 (13.10)	22 (6.55)	
Obesity class II	13 (3.10)	7 (8.33)	6 (1.79)	
T2DM				0.002
No	416 (99.05)	80 (95.24)	336 (100)	
Yes	4 (0.95)	4 (4.76)	0 (0)	
Chronic hypertension				<0.001
No	403 (95.95)	70 (83.33)	33 (99.11)	
Yes	17 (4.05)	14 (16.67)	3 (0.89)	
Antihypertensive medication among patients with chronic hypertension				
Methyldopa	2 (11.8)			
Methyldopa + nifedipine	9 (52.9)			
Methyldopa + amlodipine	6 (35.3)			

T2DM – type 2 diabetes mellitus.

Table 2 – Bivariable analysis (cOR) of risk factors for PPCM

Characteristics	PPCM (n = 84)	Controls (n = 336)	cOR (95% CI)	p-value
Maternal age				0.004
≤35 years	54 (64.29)	267 (79.46)	Reff.	
>35 years	30 (35.71)	69 (20.54)	2.15 (1.28–3.61)	
Parity				0.792
Primiparity	25 (29.76)	105 (31.25)	Reff.	
Multiparity	59 (70.24)	231 (68.75)	1.07 (0.64–1.81)	
Twin pregnancy				0.420
No	82 (97.62)	332 (98.81)	Reff.	
Yes	2 (2.38)	4 (1.19)	2.02 (0.36–11.24)	
Pre-pregnancy obesity				0.001

Table 2 – Bivariable analysis (cOR) of risk factors for PPCM

Characteristics	PPCM (n = 84)	Controls (n = 336)	cOR (95% CI)	p-value
Underweight–overweight	66 (78.57)	308 (91.67)	Reff.	
Obesity class I–II	18 (21.43)	28 (8.33)	3.00 (1.57–5.74)	
Chronic hypertension				<0.001
No	70 (83.33)	33 (99.11)	Reff.	
Yes	14 (16.67)	3 (0.89)	22.20 (6.21–79.31)	

Table 3 – Multivariable unconditional logistic regression (aOR) for PPCM

Characteristics	Adjusted OR	95% CI (lower–upper)	p-value
Chronic hypertension	17.13	3.71–79.14	<0.001
Maternal age	1.26	0.68–2.32	0.458
Pre-pregnancy obesity	2.22	2.06–4.63	0.002

Results were adjusted for matching variable (hospital).

justing for maternal age and pre-pregnancy obesity (aOR 17.13; 95% CI 3.71–79.14). Our findings are consistent with recent meta-analyses demonstrating that hypertensive disorders, particularly chronic hypertension, significantly increase the risk of PPCM by amplifying hemodynamic and vascular stress during pregnancy (pooled OR 4.73; 95% CI 3.33–6.73).¹⁴ Chronic hypertension induces persistent pressure overload and endothelial dysfunction, leading to left ventricular remodelling and impaired myocardial recovery. These maladaptive alterations may manifest clinically when further stressed by marked plasma volume expansion of late pregnancy and the hemodynamic shifts of the postpartum period.^{15,16}

The pathophysiological link between chronic hypertension and PPCM may also involve systemic inflammation, oxidative stress, and altered angiogenic signalling. Chronic hypertension induces microvascular damage and myocardial fibrosis, impairing myocardial contractility and limiting cardiac reserve.¹⁷ Advanced maternal age further exacerbates these processes due to vascular stiffening, higher prevalence of comorbidities, and diminished myocardial adaptation to pregnancy-related volume overload. Similarly, obesity and diabetes mellitus remain biologically plausible contributors through mechanisms of metabolic dysregulation and increased cardiovascular strain.^{18–20}

The coexistence of multiple comorbidities may exert a synergistic effect in predisposing women to PPCM. Previous studies suggest that the combination of chronic hypertension, obesity, and multiparity imposes an additive burden on the cardiovascular system by increasing myocardial workload, metabolic demand, and oxidative stress during pregnancy. This cumulative strain can compromise myocardial adaptation and impair recovery in the peripartum period.^{4,21}

Meta-analysis showed that pre-pregnancy obesity was significantly associated with an increased risk of PPCM compared to normal-weight women (pooled OR 1.79; 95% CI 1.16–2.76). Subgroup analysis showed that women with pre-pregnancy obesity class I had a higher

risk of PPCM (pooled OR 1.58; 95% CI 1.20–2.07), while those with class II and III obesity had an even greater risk (pooled OR 2.65; 95% CI 2.04–3.45) compared to normal-weight women.²² Additionally, the meta-analysis demonstrated that multiparity was a significant risk factor for PPCM (pooled OR 1.79; 95% CI 1.21–2.67).⁴

Increasing parity and higher pre-pregnancy BMI are associated with progressive metabolic dysregulation, including insulin resistance, lipid abnormalities, and an imbalance between reactive oxygen species production and antioxidant defense. Repeated pregnancies may exacerbate physiological insulin resistance, leading to endothelial injury and maladaptive cardiac remodelling.^{21,23,24} These mechanisms together may explain why women with coexisting chronic hypertension, obesity, or multiparity have a markedly higher susceptibility to PPCM. Although multiparity and twin pregnancy were not significantly associated with PPCM in the bivariable analysis of the present study, pre-pregnancy obesity remained significantly associated (cOR 3; 95%CI 1.57–5.74). The lack of significant association for multiparity or twin pregnancy in this study may be due to the limited sample size. However, these factors should not be disregarded, as they remain biologically plausible contributors to PPCM risk.

These findings highlight the need for an integrated approach to maternal cardiovascular health. Screening for chronic hypertension, obesity, and metabolic disorders before and during pregnancy should be prioritized to identify women at elevated risk for PPCM. Early blood pressure control, optimization of metabolic status, and patient education on cardiovascular symptoms may help prevent disease onset or enable earlier detection. In resource-limited settings, targeted echocardiographic surveillance and multidisciplinary collaboration between obstetricians and cardiologists could further improve maternal outcomes.

To the best of our knowledge, this is the first study in Indonesia to specifically evaluate the association between chronic hypertension and peripartum cardiomyopathy PPCM. The study collected PPCM data from referral

hospitals in the Cirebon region, Indonesia over a six-year period, providing a comprehensive overview of patient characteristics and risk factors within a real-world clinical setting. By employing a case-control design and standardized diagnostic criteria, this study strengthens the evidence on the role of chronic hypertension as an independent risk factor for PPCM in a low- and middle-income country context. The use of multivariable unconditional logistic regression further enhances the internal validity of the findings.

This study has several limitations. The retrospective design relies on medical record data, which may be incomplete or subject to documentation bias. However, the number of missing records was small for both cases and controls, suggesting that potential selection bias affecting internal validity is likely minimal. The relatively small sample size may limit the statistical power, particularly for subgroup analyses. Additionally, as this was a hospital-based study, the results may not be fully generalizable to the broader population of pregnant women in the community. Furthermore, the onset and duration of chronic hypertension were difficult to determine, as many patients were first identified as having hypertension at their initial antenatal visit before 20 weeks of gestation. Consequently, information on the onset and duration of chronic hypertension prior to pregnancy was not consistently available in the medical records. In addition, whether hypertension was controlled or uncontrolled could not be reliably assessed, as repeated blood pressure measurements over time were not consistently available for all patients.

Conclusions

This study demonstrates that chronic hypertension is a strong and independent risk factor for PPCM in Indonesian women. The findings emphasize the need for early cardiovascular risk assessment and optimal management of blood pressure before and during pregnancy to prevent PPCM. Integrating cardiac evaluation into antenatal care, particularly for women with a history of hypertension may help reduce the burden of PPCM and improve maternal outcomes in resource-limited settings. Screening for chronic hypertension should also be conducted at the primary healthcare level (Puskesmas), with timely referral to hospitals equipped with the capacity and facilities to assess the risk of PPCM. This enables more intensive patient monitoring and earlier recognition of PPCM, **thereby** preventing maternal complications and mortality. Future research should investigate maternal and long-term cardiovascular outcomes among PPCM patients with a history of chronic hypertension, particularly in low- and middle-income countries.

Author contributions

Conceptualization: W.P.; methodology: W.P., Y.P.R., A.C.A, S.R. and A.M.S; validation: W.P. and Y.P.R.; formal analysis: W.P., A.C.A, S.R. and A.M.S; investigation: W.P. and Y.P.R.; resources: W.P. and Y.P.R.; data curation: W.P.; writing: original draft preparation, W.P., Y.P.R., A.C.A, S.R. and A.M.S; writing: review and editing, W.P.,

Y.P.R., A.C.A, S.R. and A.M.S.; visualization: W.P.; supervision: A.C.A, S.R. and A.M.S.; project administration: W.P.; funding acquisition: W.P. and Y.P.R. All authors have read and agreed to the published version of the manuscript.

Conflict of interest

The authors declare no conflicts of interest.

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Ethical statement

The study was conducted in accordance with the Declaration of Helsinki, and approved by the Ethics Committee of RSD Gunung Jati Cirebon City No. 057/LAIKETIK/KEP-PKRSGJ/IX/2024 on 30 September 2024.

Informed consent

Patient consent was waived due to the retrospective nature of the study and the use of anonymized medical record data. All data were handled in accordance with ethical standards to ensure patient confidentiality. Written informed consent for publication was not required as no identifiable patient information is included in this article.

Data availability statement

Data is contained within the article or supplementary material.

References

1. Ardisino M, Halliday BP, De Marvao A. The Global Landscape of Peripartum Cardiomyopathy: Morbidity, Mortality, Recovery and Inequity. *Eur J Heart Fail* 2024;26:43–45.
2. Arany Z. Peripartum Cardiomyopathy. Leopold JA, editor. *N Engl J Med* 2024;390:154–164.
3. Schaefer V, Hilfiker-Kleiner D, Keil C. Hypertension in Pregnancy. *Cardiovasc Med* 2023;26:80–86.
4. Wang X, Zheng K, Zhang Q. Risk Factors for Peripartum Cardiomyopathy: A Systematic Review and Meta-Analysis. *Heart Lung Circ* 2025;34:e125–e133.
5. Octaria Y, Khomsan A, Tanzihah I, Sukandar D. Prevalence and Determinants for Hypertension among Rural Women of Reproductive Age in Indonesia. *Jurnal Gizi dan Pangan*. 2020;15:71–80.
6. Vohra JG, Pathania A, Vohra P, et al. Prevalence of Metabolic Disorders Among Women in Reproductive Age Group in Hilly Rural Area of North India. *J Family Med Prim Care* 2024;13:579–584.
7. Mohebi A, Pathirana M, Khoja A, et al. Prevalence of Metabolic Syndrome Among Pregnant Women: A Systematic Review and Meta-Analysis. *Endocrine* 2025;88:398–409.
8. Seely EW, Ecker J. Chronic Hypertension in Pregnancy. *Circulation* 2014;129:1254–1261.
9. Richard KL, Benjamin PK. Hypertension in Pregnancy. In *StatPearls Publishing*; 2025. Online. Available from: <https://www.ncbi.nlm.nih.gov/books/NBK430839/>. [cited 2025-10-21].
10. Jackson AM, Petrie MC, Frogoudaki A, et al. Hypertensive Disorders in Women with Peripartum Cardiomyopathy: Insights from the ESC EORP PPCM Registry. *Eur J Heart Fail* 2021;23:2058–2069.
11. Arfianda D, Wicaksono B, Gumilar KE, Andrianto A. Characteristics of Peripartum Cardiomyopathy (PPCM) Pregnancy and Preeclampsia in Dr Soetomo Hospital, Surabaya, Indonesia, 2014–2016. *Majalah Obstetri & Ginekologi* 2019;27:40.

12. Prameswari HS, Purnomowati A, Aprami TM. Prevalence, Characteristics, and Risk Factor of Patient with Peripartum Cardiomyopathy in Hasan Sadikin Hospital Bandung. *Indonesian Journal of Cardiology* 2016;36:38–44.
13. De Backer J, Haugaa KH, Hasselberg NE, et al. 2025 ESC Guidelines for the Management of Cardiovascular Disease and Pregnancy. *Eur Heart J* 2025;46:4462–4568.
14. Huang W, Syahrudin SS, Johansyah AA, et al. Association of Hypertensive Disorders of Pregnancy and their Clinical Features with Peripartum Cardiomyopathy: A Systematic Review and Meta-analysis. *Curr Cardiol Rev* 2025;21:1–12.
15. Ferreira AF, Azevedo MJ, Saraiva FA, et al. The PERInatal MYocardial Remodeling (PERIMYR) Cohort Study Protocol: A Prospective Study of Cardiac Remodeling and “Recovery” in Pregnancy as a Model to Understand the Impact of Comorbidities in Cardiac Remodeling and Reverse Remodeling. *Rev Port Cardiol* 2023;42:585–596.
16. Di Martino DD, Stampalija T, Zullino S, et al. Maternal Hemodynamic Profile During Pregnancy and in the Post-Partum in Hypertensive Disorders of Pregnancy and Fetal Growth Restriction. *Am J Obstet Gynecol MFM*. 2023;5:1–10.
17. Sigauke FR, Ntsinjana H, Tsabedze N. Peripartum Cardiomyopathy: A Comprehensive and Contemporary Review. *Heart Fail Rev* 2024;29:1261–1278.
18. Wooldridge AL, Chan C, Spaans F, et al. Increased Stiffness of Omental Arteries from Late Pregnant Women at Advanced Maternal Age. *Bioscience Reports* 2023;43:1–8.
19. Patel D, Avesani M, Johnson MR, et al. Maternal Cardiovascular Adaptation to Pregnancy in Obese Pregnant Women. *Acta Obstet Gynecol Scand* 2024;103:907–916.
20. Echouffo-Tcheugui JB, Guan J, Retnakaran R, Shah BR. Gestational Diabetes and Incident Heart Failure: A Cohort Study. *Diabetes Care* 2021;44:2346–2352.
21. Cho SH, Leonard SA, Lyndon A, et al. Pre-pregnancy Obesity and the Risk of Peripartum Cardiomyopathy. *Am J Perinatol* 2021;38:1289–1296.
22. Putra ICS, Irianto CB, Raffaello WM, et al. Pre-pregnancy obesity and the risk of peripartum cardiomyopathy: A systematic review and meta-analysis. *Indian Heart J* 2022;74:235–238.
23. Lopez-Yañez Blanco A, Díaz-López KM, Vilchis-Gil J, et al. Diet and Maternal Obesity Are Associated with Increased Oxidative Stress in Newborns: A Cross-Sectional Study. *Nutrients* 2022;14:746.
24. Khan SS, Petito LC, Huang X, et al. Body Mass Index, Adverse Pregnancy Outcomes, and Cardiovascular Disease Risk. *Circ Res* 2023;133:725–735.