Source details

Biochemical and Cellular Archives

Scopus coverage years: from 2011 to 2021
(coverage discontinued in Scopus)
Publisher: DR. P. R. YADAV
ISSN: 0972-5075 E-ISSN: 0976-1772
Subject area: Biochemistry, Genetics and Molecular Biology: Biochemistry
Biochemistry, Genetics and Molecular Biology: Cell Biology
Source type: Journal

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0.2

SJR 2020
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PUBLICATION TYPE	ISSN	COVERAGE
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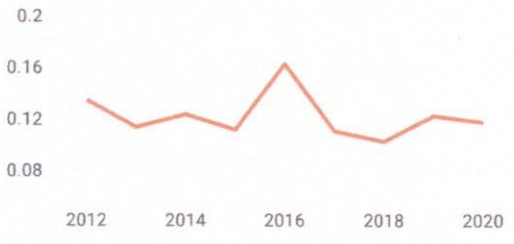

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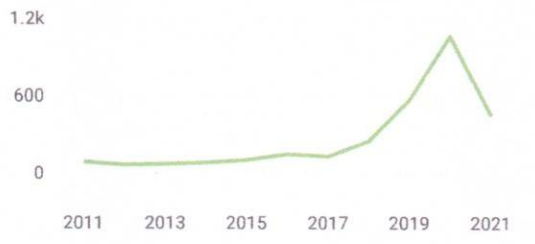

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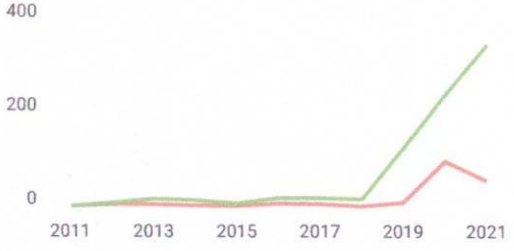

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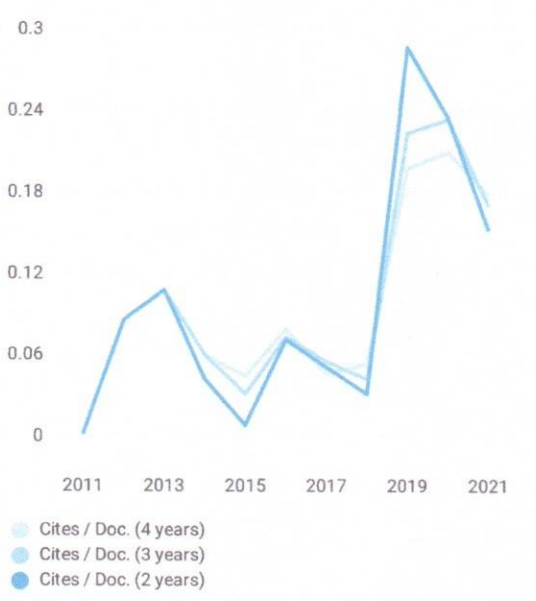

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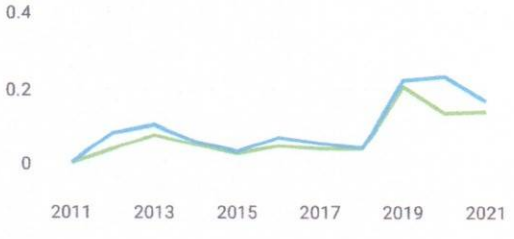

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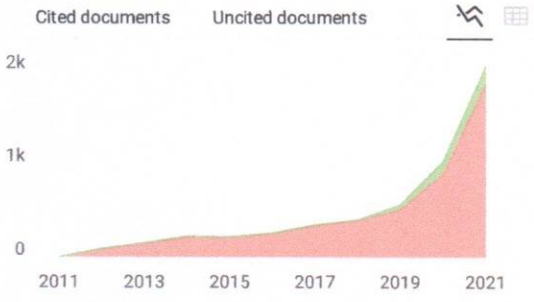

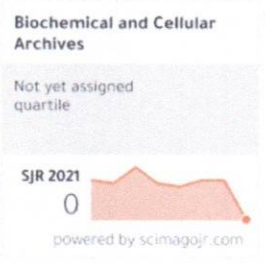

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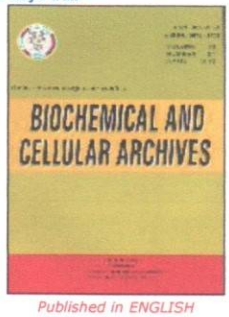

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DOI : 10.35124/bca.2019.19.S2.4721

Biochem. Cell. Arch. Vol. 19, Supplement 2, pp. 4721-4728, 2019 | www.connectjournals.com/bca | *ISSN 0972-5075*

MATERNAL CARDIOVASCULAR RISK IN EARLY AND LATE ONSET OF PREECLAMPSIA PATIENTS FIVE YEARS AFTER LABOR : A COMPARATIVE STUDY

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(Received 20 August 2019, Revised 20 October 2019, Accepted 25 October 2019)

ABSTRACT : Preeclampsia still remains an important topic in relation to the cardiovascular system in more than 300 million women worldwide, with both short and longterm mobidities. The purpose of this study was to compare maternal cardiovascular risk of early and lateonsets of preeclampsia 5 years after labor. It was a retrospective cohort study of preeclampsia patients within the period of January 2013 to January 2014, who delivered at Dr. Soetomo General Hospital. The maternal cardiovascular risk assessment include; body mass index (kg/m^2), waist circumference (cm), blood pressure (mmHg), fasting blood sugar levels (mg/dL), HDL cholesterol levels (mg/dL), LDL cholesterol levels (mg/dL), blood *triglyceride* levels (mg/dL), total cholesterol levels (mg/dL) and ATP-III Framingham scores. There was a higher and significant cardiovascular risk factors in relations to hypertension and/or metabolic syndrome (p 0.031) in the early-onset of severe preeclampsia group, which also supported an increase of 1.47 folds of cardiovascular risks (RR 1..471; CI 95 [1.071-2.019]) compared with the late-onset group. The incidence of metabolic syndrome 5 years after preeclampsia was higher in the early-onset of preeclampsia group compared with the late-onset. Also, the cardiovascular risk factors related to hypertension and / or metabolic syndrome were higher in the early-onset group and supported an increase in cardiovascular risk factors of 1.47 times compared with the late-onset group.

Key words : Preeclampsia, early onset of severe preeclampsia, late onset of severe preeclampsia, cardiovascular risk, hypertension, metabolic syndrome.

INTRODUCTION

Preeclampsia is a major obstetric problem, which is usually the main cause of 15 to 20% of maternal death and morbidity (both acute and long-term), perinatal death, preterm labor, and stunted fetal growth in most developing countries (Sibai *et al*, 2005). Maternal and perinatal outcomes in severe preeclampsia depend on some factors which include; gestational age at disease onset, disease severity, quality of management and the presence or absence of previous medical complications (Duley, 2004). According to previous studies, women with preeclampsia have a higher risk of developing cardiovascular complications later in life (Haukkamaa *et al*, 2002). However, it could be avoided with changes in lifestyle and by avoiding being exposed to the risk factors (Sattar and Greer, 2002). Also, the influence of cardiovascular risk factors over time, from pregnancy to manifestations of cardiovascular disease, requires serious evaluation. The focus of most studies has been on short-term (less than 6 months) and long-term (more than 10 years) cardiovascular risk factors after pregnancy, there is no study which compares the risk factors in post severe-early onset preeclampsia to severe-late onset within any population in Indonesia. Hence, the purpose of this study is to determine maternal outcomes of cardiovascular risks within a period of 5 years after the diagnosis of early-onset and late-onset of severe pre-eclampsia, where early cardiovascular disease is expected to develop.

METHODS

This is a retrospective cohort study with the study sample made up of pregnant women with early-onset of severe preeclampsia and late-onset of severe preeclampsia, who carried out pregnancy termination in

dr. Soetomo General Hospital of Surabaya in 2013 to January 2014. There were 452 cases of severe preeclampsia taken from obstetric medical record data. All patients were contacted and monitored at their residence address, after assenting to the informed consent. However, patients with previous comorbidities of either of chronic hypertension, diabetes mellitus, obesity, congenital heart disease, rheumatism, or autoimmune diseases, those residing outside the city of Surabaya, patients that have died or those that refused participation were all excluded from this study. 17 samples were included in the category of early-onset of severe preeclampsia and 25 included in the slow-onset of severe preeclampsia group. The basic data used include age, history of pregnancy and childbirth, blood pressure and early-pregnancy BMI, and data taken at the time the patient was admitted through register, maternal and child health books, serial morning reports, surgery reports, as well as medical records.

The maternal cardiovascular risks were measured in the form of the body mass index (kg/m^2), waist circumference (cm), blood pressure (mmHg), fasting blood sugar levels (mg / dL), HDL cholesterol levels (mg / dL), LDL cholesterol levels (mg / dL), blood *triglyceride* levels (mg/dL), total cholesterol levels (mg / dL) and ATP-III Framingham scores.

A certificate of ethical eligibility was obtained from the research ethics committee of dr. Soetomo General Hospital of Surabaya. Both qualitative and quantitative analyses were performed. The normality of the data was determined through the Saphiro-Wilk test and the normally distributed data was analized using the T test analysis. Then, the Mann-Whitney test was used for the abnormally distributed data, while the Chi square or Fisher's exact test was used for analising the categorical data. The relative ratio (RR) and 95% confidence interval (CI) were also calculated, while the p value <0.05 was taken as the significant statistical value.

RESULTS

Characteristics of research subjects

The average age of the sample at the time of severe preeclampsia diagnosis was in the range of 20-35 years, and the average age in the early-onset of severe preeclampsia group was older compared with the late-onset. Also, the majority of the groups were multigravida.

There was only 1 patient (5.9%), who had experienced stillbirth in the group of early-onset of severe preeclampsia, and 3 patients with history of preeclampsia in both groups. Then, none of the patients in both groups had history of smoking.

The examination of the early systolic blood pressure at the time of pregnancy revealed that the group of early-onset of severe preeclampsia had a higher and more significant mean compared to late-onset, with p = 0.044. Additionally, the diastolic pressure at the time of antenatal care registration, as well asnd the highest systolic blood pressure during pregnancy was found to be higher in the group of early-onset of severe preeclampsia. However, the mean diastolic pressure was slightly higher in the late-onset of severe preeclampsia group compared with the early-onset. In addition, the complications that arise during pregnancy include HELLP syndrome, eclampsia and pulmonary oedema.

Furthermore, the output of cesarean section numbers were found in more than half of the cases in the two groups, but no significant differences were found between them. There was also a significant difference in the gestational age at termination and infant weight at birth (p <0.001) in both groups, with outcomes of infant mortality found to be more frequent in early-onset of severe preeclampsia compared with the late-onset.

The systolic blood pressure was significantly higher in the group with early-onset of severe preeclampsia compared with late-onset, with the p value = 0.004. Likewise, there was a significant difference in the mean diastolic pressure between the two groups, with p = 0.002. Higher BMI and waist circumference were found in the group of early-onset of severe preeclampsia, but no significant difference was found in the incidence of obesity (BMI> 30 kg/m^2).

Furthermore, the biomarker assessment was carried out to determine the presence or absence of a metabolic syndrome that could overlap in a large assessment of cardiovascular risk. Examination of lipid profiles which included the levels of HDL cholesterol, LDL cholesterol, triglycerides and total cholesterol revealed no significant difference between the two groups. Similarly, there was no significant difference in the mean fasting blood sugar levels of the two groups.

In the cardiovascular risk assessment, according to the NCEP-ATP III modification of the Asian population, the incidence of hypertension was higher in the group of early-onset of severe preeclampsia at 88.2% compared with the late-onset ones at 64%. In this study, the incidence of hypertension was assessed through the use of antihypertensive drugs used in the group of early-onset of severe preeclampsia and systolic blood pressure measurements> 140 mmHg and / or diastolic blood pressure> 90 mmHg. The results showed that the incidence of stage I hypertension was not much different

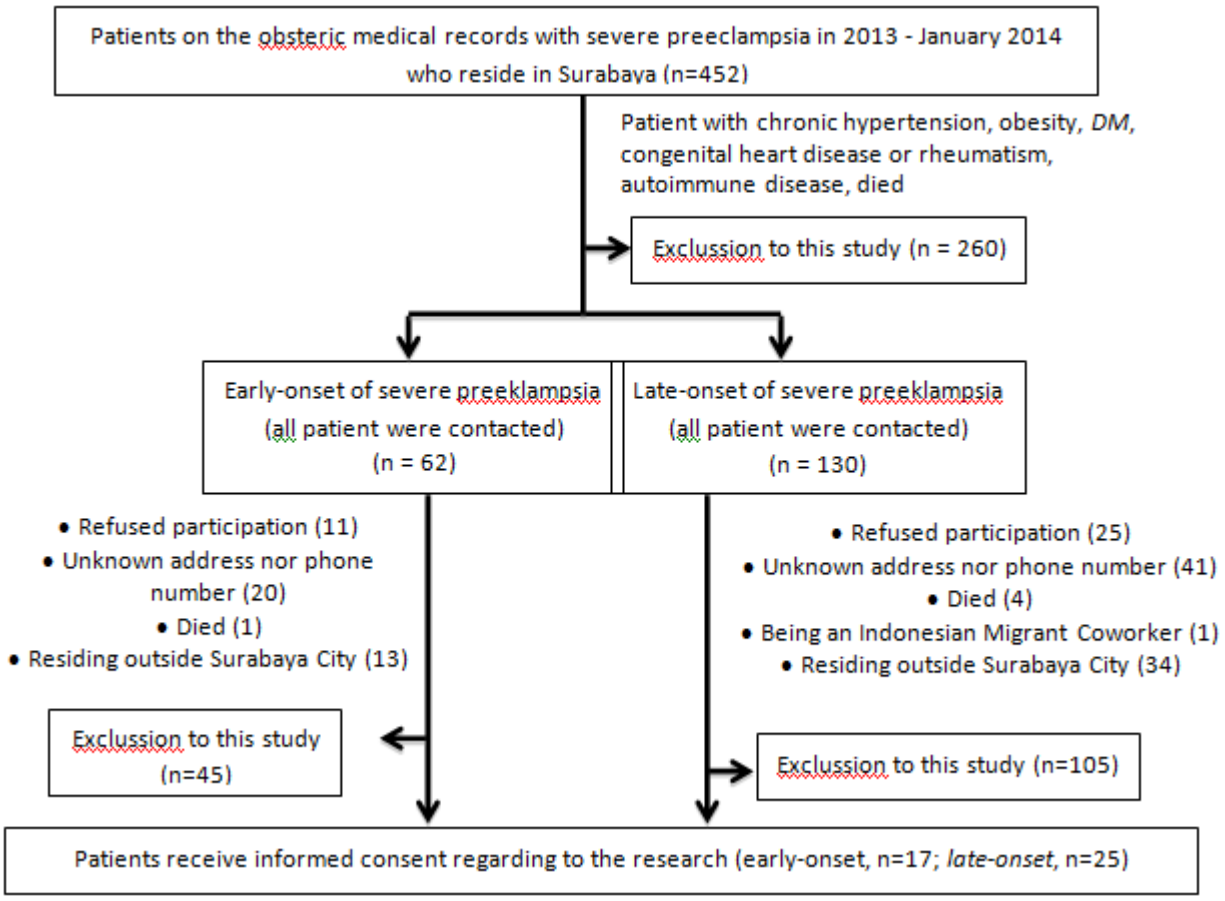

Fig. 1 : Research Flowchart.

between the two groups, but the incidence of stage II hypertension were higherin the early-onset of severe preeclampsia group. Also, an individual in the early-onset group was found to have a history of stroke in 2017, associated with persistent post-preeclampsia hypertension.

However, in the metabolic syndrome assessment, a higher number was found in the early-onset of severe preeclampsia group compared to late-onset, although not statistically significant. Whereas, there was a significant difference between the groups in the assessment of cardiovascular risk factors through the presence of hypertension and/or metabolic syndrome with a p-value of 0.031 and 1.47 times higher (RR 1,471 [1,071-2,019]) in the group of in early-onset of severe preeclampsia compared with the late-onset at 94.1% vs 64%.

DISCUSSION

In developing countries, women with preeclampsia have a higher risk of death than in developed countries. The most common causes of this death are hypertension and stroke (Amaral *et al*, 2015). It is also known that preeclampsia is classified into early-onset and late-onset, which distinguishes the two different clinical forms with specific pathophysiological features. The preeclampsia which develops in early pregnancy i.e early-onset, is associated with placental insufficiency and vascular remodeling disorders, but late-onset is usually experienced with vascular maladaptation (Stergiotou *et al*, 2013; Savvidou *et al*, 2010; Orabona *et al*, 2018). Initially, preeclampsia was considered as a limited disorder in pregnancy, hence, there was no specific treatment for it except the early delivery of the baby and placenta (Enkhmaa *et al*, 2016). Additionally, preeclampsia, especially the severe one, is associated with the development of cardiovascular diseases and stroke in women after reproductive age, therefore, preeclampsia is a risk factor for long-term health in women (Ahmed *et al*, 2014).

Based on the average age characteristics of the two severe preeclampsia groups treated at Dr. Soetomo Genreal Hospital of Surabaya, the majority are in the reproductive age, i.e 20-35 years, with an older age in the early-onset group. In some patients with multiparous, the age was recorded at the time of diagnosis of severe preeclampsia more than 35 years, primipaternity, and had a history of stillbirth and previous preeclampsia.

Table 1 : Characteristics of the sample at the time of severe preeclampsia diagnosis.

Characteristics	Severe Preeclampsia Group		P value (p<0.05)
	Early-onset (n=17)	Late-onset (n=25)	
Age while severe preeclampsia was diagnosed (yo), average ± SD	32.12 ± 6.827	28.2 ± 7.890	0.104
Parent			
Primigravida	5 (29.4%)	11 (44%)	0.527
Multigravida	12 (70.6%)	14 (56%)	
Preeclampsia History	3 (17.6%)	3 (12%)	0.672
Stillbirth History	1 (5.9%)	-	-
Family Disease History			
Hypertension in Gestation	12 (70.6%)	13 (52%)	0.376
Myocard Infarction	-	-	-
Stroke	-	1 (4%)	-
BMI early-gestation (kg/m^2), average±SD	25.076 ± 3.4232	23.732 ± 3.3714	0.215
Blood Pressure			
Systolic BP in early-gestation (mmHg),average±SD	128.53 ± 24.734	118.92 ± 13.571	0.044*
Diastolic BP in early-gestation (mmHg), average ±SD	80.59 ± 11.974	75.6 ± 8.206	0.192
Highest systolic BP in gestation (mmHg), average ±SD	183.82 ± 25.710	178.4 ± 17.720	0.665
Highest diastolic BP in gestation (mmHg), average ±SD	103.53 ± 12.217	104 ± 15.546	0.915
Complications			
HELLP Syndrome	1 (5.9%)	1 (4%)	1.000
Eclampsia	-	1 (4%)	-
Pulmonary oedema	1 (5.9%)	2 (8%)	1.000
Output			
Gestational age in termination (weeks), average± SD	32.818 ± 1.7749	38.404 ± 1.9321	<0.001*
Caesarean Section	11 (64.7%)	14 (56%)	0.807
Infant weigh (g), average ±SD	1729.41 ± 443.022	3064 ± 635.662	<0.001*
Neonatal death	5 (29.4%)	2 (8%)	0.099

*: significancy (p <0.05).

Table 2 : Sample characteristics in 5 years after diagnosis of severe preeclampsia.

Characteristics	Severe Preeclampsia Group		P value (p<0.05)
	Early-onset (n=17)	Late-onset (n=25)	
Recent age (yo), average ± SD	37.06±6.805	33.2±7.890	0.108
Time after delivery (yr), average ± SD	5.2953±0.27178	5.3604±0.31191	0.614

*: significancy (p <0.05)

In this study, more than half of the cases in both groups had a history of hypertension in pregnancy in first-degree relatives (mothers), although with no significant differences. According to a research conducted by Endeshaw *et al* (2016), an individual with family history of hypertension has a risk of 11 times of it developing into preeclampsia (Endeshaw *et al*, 2016) at 11.16; 95% CI 5.41-41.43. Likewise, a study reports that a person with a family history of stroke has a greater *alpha* and *beta-adrenergic response* (p 0.02) and an increase in cardiac output (p 0.04) compared with those without a family history of stroke (McBride *et al*, 2014). In this study, 1 patient was found in the slow-onset of severe preeclampsia group with family history of stroke.

Also, there was a significant difference in the mean systolic blood pressure at the time of initial registration of antenatal examination in this study. However, there was no significant difference in the mean of diastolic blood pressure at the time of the initial registration of antenatal examination. In addition, there was no significant difference in the highest systolic and diastolic blood pressure before delivery. Then, the short-term complications as a result of the severe preeclampsia include *HELLP syndrome* and pulmonary edema in both groups, and eclampsia in the late-onset group.

In addition, early labor can be beneficial to the mother, but endangers the premature fetus (Sibai and Barton, 2007). Neonatal outcomes in pregnancies complicated by preeclampsia are mostly related to gestational age at delivery, and gestational age is the strongest predictor of

Table 3. The mean of cardiovascular risk variable 5 years after delivery with severe preeclampsia

Variable	Severe Preeclampsia Group		P value (p<0.05)
	Early-onset (n=17)	Late-onset (n=25)	
Systolic BP (mmHg), mean ± SD	158.29 ± 26.083	136.12 ± 20.903	0.004*
Diastolic BP (mmHg), mean ± SD	101.88 ± 16.725	85.84 ± 15.057	0.002*
Mean arterial pressure (mmHg),mean ± SD	120.69 ± 18.264	102.56 ± 16.141	0.002*
BMI (kg/m^2), mean ± SD	28.176 ± 4.34212	25.892 ± 3.956	0.081
BMI >30 (kg/m^2)	6 (35.3%)	5 (20%)	0.305
Waist circumference (cm), mean ± SD	90.47 ± 9.288	83.48 ± 9.283	0.021*
Smoking	-	-	-
Biomarker			
HDL (mg/dL), mean ±SD	45.82 ± 13.135	50.36 ± 11.254	0.238
LDL (mg/dL),mean ±SD	117.65 ± 59.948	115.76 ± 79.538	0.599
Triglycerides (mg/dL),mean ±SD	275 ± 303.883	172.8 ± 149.761	0.091
Total cholesterol (mg/dL), mean ± SD	217.53 ± 95.773	200.6 ± 103.024	0.377
Fasting blood sugar (mg/dL), mean ± SD	105.59 ± 42.872	109.48 ± 86.794	0.214

*: significancy (p <0.05)

Table 4 : Number of cardiovascular risk in the form of hypertension and metabolic abnormalities in 5 years after delivery with severe preeclampsia according to NCEP-ATP III modification of Asian population.

Variable	Severe Preeclampsia Group		P value(p<0.05)	RR (95% CI)
	Early-onset (n=17)	Late-onset (n=25)		
Cardiovascular Risk[a]	16 (94.1%)	16 (64%)	0.031*	1.471 (1.071-2.019)
Hypertension[b]	15 (88.2%)	16 (64%)	0.151	
Use of antihypertensive drugs	9 (52.9%)	5 (20%)	0.059	
Systolic BP ≥140 mmHgand/or diastolic BP≥90 mmHg	13 (76.5%)	14 (56%)	0.303	
HT *stage* I	7 (41.2%)	11 (44%)	1.000	
HT *stage* II	8 (47.1%)	5 (20%)	0.128	
Metabolic Syndrome[c]	10 (58.8%)	11 (44%)	0.346	
HDL <50 mg/dL	9 (52.9%)	13 (52%)	1.000	
TG ≥150 mg/dL	10 (58.8%)	10 (40%)	0.377	
GDP ≥126 mg/dL	4 (23.5%)	4 (16%)	0.694	
Waist circumference >80 cm	15 (88.2%)	18 (72%)	0.271	

*: significancy (p <0.05)

[a]: Presence of hypertension and/or metabolic syndrome

[b]: Current use of antihypertensive drugs and / or blood pressure> 140/90 mmHg at the time of risk assessment

[c]: A set of symptoms with at least 3 criteria; (1) abdominal obesity (waist circumference> 88 cm), (2) increase in blood triglyceride levels (≥150 mg / dL), (3) decrease in blood HDL cholesterol levels (in women <50 mg / dL), (4) increase blood pressure (systolic blood pressure ≥140 mmHg, diastolic blood pressure ≥90 mmHg or currently on anti-hypertensive drugs), (5) Increased fasting blood glucose in the blood (fasting glucose level ≥126 mg/dL or taking anti-diabetes drugs).

perinatal mortality and morbidity (Van Esch *et al*, 2017). Based on the results of this study, there was a significant difference in the gestational age at termination and infant weight at birth in both groups. The study samples also show that the neonatal mortality was higher in the early-onset group compared with the late-onset, although not statistically significant. This result is in consistent with other studies, where neonates born to preeclamptic mothers in early-onset were found to have higher perinatal mortality (13% vs 7%, p = 0.03) and infant mortality (16% vs 9%, p = 0.03), 20% lower birth weight (1150 vs 1430 grams, p <0.001), less frequent gestation (22% vs 9%, p <0.001) and have more neonatal complications compared to neonates born to mothers without preeclampsia (14). Then, for the method of labor, there were no significant differences in the rates of cesarean section in the two

groups of severe preeclampsia and were chosen according to the obstetric indications of each patient.

Furthermore in this study, a five-year postpartum with severe preeclampsia was examined, however, there was no significant difference in the mean time between the two groups. Understanding cardiovascular risk early (in the first year) and medium term (up to 10 years) after pregnancy with preeclampsia, can provide insight into the development of long-term cardiovascular consequences and the optimal timing of postpartum prevention strategies. Unfortunately, most studies of the relationship between preeclampsia and cardiovascular risk focus on long-term risk, as research on initial and medium-term risks are very limited. Also, a retrospective cohort study involving over 300,000 women revealed that preeclampsia was associated with 42% risk of cardiovascular disease in the first 5 years postpartum, even after adjusting with respect to other demographic, socioeconomic and cardiovascular risk factors (Cain *et al*, 2016). Gestational hypertension is associated with an 18% increase in 5-year cardiovascular risk, but it is not significant. In addition, women with hypertension during pregnancy have been found to have a 2.4 times greater chance of being hospitalized due to cardiovascular disease in the initial 3 years postpartum compared with those without hypertension during pregnancy (Jarvie *et al*, 2018).

The results of this study as well revealed that the determinant variables measured at 5 years after delivery, e.g systolic and diastolic blood pressure, mean arterial pressure, body mass index (BMI), waist circumference, as well as the history of severe preeclampsia had significant effects in influencing future cardiovascular implications in both in groups.

In this study also, a higher systolic and diastolic blood pressure was found in early-onset of severe preeclampsia group compared with the late-onset, which was also statistically significant with $p < 0.05$. Similarly, an increase in mean arterial pressure was evident in the early-onset with $p = 0.002$. This is in accordance with a study conducted by Lykke *et al* (2009), which stated that the risk of chronic or persistent hypertension was greatest in women with previous severe preeclampsia compared with those without it with RR 6.07 vs 3.61. Also, a study conducted by Veerbeek *et al* (2015) found persistent postpartum hypertension at a region close to 50% in women with history of early onset preeclampsia and gestational hypertension. This reinforces the hypothesis that the cardiovascular risk profile after pregnancy will reflect the cardiovascular risk in later life, especially the risk of chronic hypertension.

Additionally, metabolic syndrome is associated with doubling the risk of cardiovascular mortality and stroke, and 1.5 times increasing the risk of death. Hence, patients with metabolic syndrome have a higher risk of having cardiovascular events than all other causes of death (Mottillo *et al*, 2010). The results of this study revealed that the average body mass index in the early-onset of severe preeclampsia group was higher but not statistically significant when compared with the late-onset group. However, the waist circumference measurement showed a significantly higher mean in the early-onset group compared with the late-onset with $p = 0.021$. In general, waist circumference is an evaluation parameter for central obesity. The mean waist circumference in the early-onset group were more than the standard in women, > 80 cm, which is a reflection of the presence of central obesity in this group. Also, NCEP-ATP III Asian population modification and International Diabetes Federation (IDF) emphasize central obesity as one of the components underlying the metabolic syndrome. It is suspected that central obesity causes systemic hypertension and dyslipidemia independently, through the induction of insulin resistance. Therefore, insulin resistance and central obesity are postulated to be key components of the metabolic syndrome, and the both thereby leading to glucose intolerance and dysglycemia (Chobanian *et al*, 2003; IDF, 2006).

Also, pregnancy is physiologically associated with conditions of hyperlipidemia and relative hyperglycemia. Several studies have shown that preeclampsia has a higher risk of developing into metabolic syndrome. Another study reported that persistent hyperlipidemia due to preeclampsia at postpartum is associated to both the abnormalities with endothelial dysfunction and metabolic syndrome, such as insulin resistance and dyslipidemia (Stekkinger *et al*, 2009). There was no statistically significant decrease in blood HDL cholesterol levels in both groups as $p = 0.238$, where a decrease was more pronounced in the early-onset of severe preeclampsia group. Similarly, in the measurement of blood triglyceride levels, it was found that the mean increase was normal in both groups, with a higher increase in the early-onset group. However, the mean blood sugar levels were found to be within the range of normal and no significant differences between the two groups. Then in the measurement of total cholesterol levels, both groups were found with mean cholesterol levels in the borderline of high category (200-230 mg/dL), although the average LDL cholesterol level was still in the *optimal above* category (100-129 mg/dL).

Despite the fact that there were no statistically

significant differences from the group of late-onset of severe preeclampsia, a trend of decreasing HDL cholesterol levels and increasing blood triglyceride levels in the early-onset of severe preeclampsia group may indicate that dyslipidemia occurs more advance in this group. The question will be as to whether this is secondary to the "acquired"metabolic syndrome during pregnancy or premature aging of the "inherited" cardiovascular system. A study conducted by Clausen *et al* (2001) confirmed that dyslipidemia before 20 weeks of gestation was associated with early-onset of preeclampsia (Clausen *et al*, 2001). However, a study conducted by Lampinen *et al* (2008) reported that the severity and gestational age at the time of preeclampsia were associated with insulin sensitivity later in life (Lampinen *et al*, 2008). In women with history of severe preeclampsia, an increase in central obesity with a poor lipid profile tends to decrease the insulin sensitivity in the early-onset group. This data not only supports the view of pre-existing metabolic syndrome in pregnancy that accelerates the emergence of vascular-related complications in pregnancy, but also shows that the initial form of the disease in women with metabolic syndrome may be associated with an increased risk of developing cardiovascular morbidity at a later age. Thus, the results of this study revealed a higher incidence of metabolic syndrome in the early-onset group, although not significantly different in statistic (p 0.253). Then, the percentage reaching half the total sample is an indication that metabolic syndrome can occur in both groups of severe preeclampsia and has value in the implications of cardiovascular risk factors.

Furthermore, the presence of persistent hypertension and / or the occurrence of a metabolic syndrome has the capacity to affect cardiovascular implications in women with history of preeclampsia. In this study, it was discovered that cardiovascular risk factors associated with hypertension and / or metabolic syndrome were higher and more significant at p = 0.031, in the early-onset group and supported a 1.47-fold increase in cardiovascular risk factors (RR 1.471 [1.071-2.019]) compared with the late-onset. This is in line with several studies being conducted and the study that preeclampsia, both in early and late onset, results in different structural and functional vascular changes, in accordance to each pathophysiology.

Then, the patterns of maternal vascular remodeling and response show different vascular adaptations between the early and late onset preeclampsia. For example, women with early-onset preeclampsia show higher total vascular resistance compared with those with late-onset. Increased vascular resistance can cause systolic and diastolic dysfunction, which can also be a mechanism for developing chronic hypertension. This shows that pregnancy is a stress test for heart health and with hypertension, patients are more susceptible to cardiovascular disease later in life. However, more severe endothelial damage and inflammatory stress in early-onset group that causes permanent vascular damage compared with the late-onset group, cannot be ignored. This difference in permanent vascular damage can contribute to the pathogenesis of cardiovascular disease later in life and also explains the differences in the prevalence of cardiovascular disease in both groups of preeclampsia.

The limitation of this study is the fact that the lipid profile and fasting and postprandial blood sugar levels of the patientswere not measured before the pregnancy or when they were diagnosed with severe preeclampsia. This was due to the fact that this assessment has not become a standard initial examination procedure before pregnancy nor when diagnosed. Secondly, the high mobility in population common in Indonesia made the research difficult. Many patients were seasonal residents, changed their phone numbers after moving to another location, thereby making it hard to know their where abouts. This led to the fewer patients taking part in the study. Thirdly, the lack of data regarding personal nutrition fulfillment habits and socioeconomic status, which can also influence the confounding factors in this study. However with these limitations, this study concludes that early-onset of severe preeclampsia has a higher cardiovascular risk factor than the late-onset.

CONCLUSION

Based on the results of this research, it can be concluded that the incidence of metabolic syndrome 5 years after preeclampsia is higher in the early-onset of preeclampsia group compared with the late-onset group. Also, the cardiovascular risk factors related to hypertension and / or metabolic syndrome were higher in the early-onset group and supported an increase in cardiovascular risk factors of 1.47 times compared with the late-onset group. Therefore, this can lead to an increased risk for cardiovascular diseases if no postpartum lifestyle modification is carried out.

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