Research Article

The Impact of Gestational Weight Gain on Preeclampsia during COVID-19 Pandemic

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Abstract

Objective: To determine the impact of weight gain in pregnant women on the incidence of preeclampsia during the COVID-19 pandemic at the West Lombok District Health Center

Methods: This research is an analytical observational study using a case control study. The design began by identifying patients with impacts (preeclampsia and/or eclampsia) and groups without impacts (not experiencing preeclampsia and/ or eclampsia), then exploring risk factors in 3 Community Health Centers located in West Lombok Regency, NTB Province, Indonesia, especially Narmada Health Center, Kediri and Gunung Sari. Analysis was carried out using the SPSS application.

Results: A total of 120 samples were collected, comprising 60 case samples and 60 control samples. During the 2020-2021 COVID-19 pandemic, individuals with weight gain that did not meet the recommended guidelines exhibited a higher incidence of preeclampsia, with 56 individuals (93.3%) affected, compared to 32 individuals (53.3%) in the control group without preeclampsia. The calculated odds ratio (OR) was 12.25, with a 95% confidence interval of 3.941 to 38.078.

Conclusion: There is an increased risk of preeclampsia in pregnant women during the COVID-19 pandemic, which is associated with gestational weight gain. Early screening for preeclampsia is essential if future pandemic outbreaks alter daily human activity patterns.

Keywords: COVID-19, eclampsia, gestational weight gain, preeclampsia.

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INTRODUCTION

The maternal mortality rate (MMR) reflects the health and mortality status of mothers during pregnancy and childbirth. MMR is influenced by both direct and indirect causes. Direct causes include complications arising from pregnancy or childbirth. Indirect causes encompass pre-existing diseases or conditions acquired during pregnancy that impact the course of pregnancy and childbirth.[1]

In 2017, fifteen countries—South Sudan, Somalia, Central African Republic, Yemen, Syria, Sudan, Democratic Republic of the Congo, Chad, Afghanistan, Iraq, Haiti, Guinea, Zimbabwe, Nigeria, and Ethiopia—were classified as being on "very high alert" or "high alert" due to elevated maternal mortality rates (MMR). The MMR for these countries ranged from 31 to 1150 per 100,000 live births.[2] Young women under the age of 15 face the highest risk of maternal death. Those aged 10 to 19 are more likely to experience complications during pregnancy and childbirth compared to women aged 20 to 24.[2,3]

Since February 2020, the COVID-19 pandemic has impacted every country globally. Pregnant women are more susceptible to severe illness during the COVID-19 pandemic compared to non-pregnant women. Changes in lifestyle and activity patterns have been necessary to adapt to pandemic conditions, particularly regarding food consumption, dietary habits, and the shift to work from home (WFH) and learn from home (LFH) activities. These adjustments have led to an increased risk of weight gain, obesity, and elevated Body Mass Index (BMI) due to an

imbalance between food intake and physical activity.[4] Additionally, COVID-19 transmission can exacerbate pre-existing conditions and negatively affect pregnancy outcomes. Adverse pregnancy outcomes, such as preeclampsia and eclampsia, are among the risks heightened by the pandemic.[5]

Preeclampsia, which can progress to eclampsia, is one of the three primary causes of morbidity and mortality among pregnant women globally.[6] Maternal risk factors such as hydatidiform moles, nulliparity, multiple pregnancies, chronic hypertension, diabetes mellitus, and kidney disease increase the incidence of preeclampsia. The risk of developing severe preeclampsia or eclampsia is three times higher in mothers over 35 compared to those under 35. Additionally, preterm pregnancies are 2.4 times more likely to experience severe preeclampsia or eclampsia deterioration compared to term pregnancies, despite the higher risk of severe preeclampsia-eclampsia in term pregnancies.[7]

Health services focused on managing COVID-19 in affected countries have led to a decline in various medical services, including obstetrics and gynecology clinics. Therefore, pregnant women require increased attention to their pregnancy status. Nutritional status during pregnancy is a significant concern. Insufficient maternal weight gain can result in children being born to malnourished mothers, who are then at risk of malnutrition and infection, potentially leading to malnourished adults. Conversely, excessive weight gain during pregnancy can cause complications and poor maternal outcomes.[8]

However, there is limited research on preeclampsia during the COVID-19 pandemic or other similar health crises. This study aims to investigate the impact of gestational weight gain, influenced by changes in daily activity patterns during the COVID-19 pandemic, on preeclampsia. The research will be conducted at three Community Health Centers in West Lombok Regency, Indonesia.

METHODS

This case-control study utilized data from the Narmada, Kediri, and Gunung Sari Health Centers, three community health centers in West Lombok Regency, West Nusa Tenggara Province, Indonesia. Data collection was obtained from medical records from August to September 2022. The study aimed to identify patients affected by preeclampsia and/or eclampsia (case group) and those unaffected (control group). The study population comprised pregnant women aged 20 to 35 years registered at the West Lombok District Health Center during the 2020–2021 period, in their second or third trimester. All diagnosed cases of preeclampsia and eclampsia during this period were included. The sample size of 58 for each group (case and control) was determined using the paired case-control formula in the Epi Info software developed by the Centers for Disease Control and Prevention (CDC). A total of 125 samples were collected: 60 from the case group, 60 from the control group, and 5 were excluded due to incomplete medical records.

Pregnant women diagnosed with eclampsia or preeclampsia comprised the case group in this study, while those without these diagnoses constituted the control group. Preeclampsia can be further classified into early-onset and late-onset groups based on gestational age (GA), typically categorized using cutoff points at GA 34 weeks or GA 37 weeks. This classification allows for subgroups of early-onset (GA < 34 weeks) and late-onset (GA ≥ 34 weeks) preeclampsia.

Independent variable was maternal body mass index (BMI) increase during pregnancy, tracked through recorded weight gain data from medical records. The dependent variable was the incidence of preeclampsia and/or eclampsia. BMI classifications used in this research were based on World Health Organization (WHO) criteria for Asians and body mass index criteria from the Republic of Indonesia's Ministry of Health. These classifications included underweight (<18.5 kg/m^2), normal weight (18.5-22.9 kg/m^2), overweight (23-24.9 kg/m^2), grade 1 obesity (25.0-29.9 kg/m^2), and grade II obesity (≥30.0 kg/m^2).

The Institute of Medicine's recommendations, which are shown in the following table (Table 1), served as the study's reference for increasing body weight. The Statistical Product and Service Solutions (SPSS) program is then used to process the acquired data, and the chi-square statistical test is used to analyze the data both univariately and bivariately.

RESULTS

Table 1. Category of Weight Gain during Pregnancy Based on BMI

Categories	Gestational Weight Gain based on BMI (kg/m²)			
	BMI			
	<18.5	18.5-24.9	25.0-29.9	≥30.0
Deficient	< 12.7	< 11.3	< 6.8	< 5.0
Appropriate	12.7-18.1	11.3-15.8	6.8–11.3	5.0–9.1
Exceed	> 18.1	> 15.8	> 11.3	> 9.1

BMI: Body Mass Index (kg/m²), kg: kilogram

Table 2. Impact of Sample Characteristics on Preeclampsia and Eclampsia

Sample Characteristics	Preeclampsia/ Eclampsia (Cases)		Normal (Control)		Normal (Control)	*P-Value*
	n	%	n	%		
Age (Years)	Mean (SD) = 2.25 (0.73622)					
20-25	10	16.7	11	18.3		
26-30	17	28.3	31	51.7		
31-35	33	55	18	30	-	0.105
Amount	60	100	60	100		
Gravida Status	Mean (SD) = 1.8083 (0.91022)					
Multigravida	57	95	59	98.3		
Grandemultigravida	3	5	1	1.7	-	0.619
Amount	60	100	60	100		
Jobs	Mean (SD) = 1.55 (1.36493)					
Unemployment	52	86.7	48	80		
Private	0	0	3	5		
Self-Employed	3	5	1	1.7		
Civil Servants	1	1.7	1	1.7	-	0.413
Teachers	2	3.3	4	6.6		
Traders	2	3.3	3	5		
Amount	60	100	60	100		
BMI Before Pregnancy	Mean (SD) = 3.225 (1.18437)					
Underweight	2	3.4	5	8.3		
Normal	13	21.6	21	35		
Overweight	7	11.7	15	25		
Obesity 1	25	41.7	14	23.4	2.3	0.013
Obesity 2	13	21.6	5	8,3		
Amount	60	100	60	100		
Trimester	Mean (SD) = 1.9333 (0.25049)					
TM-2	8	13.3	0	0		
TM-3	52	86.7	60	100	-	0.003
Amount	60	100	60	100		

BMI: Body Mass Index, SD : Standard deviation, CI : Confidence Interval, OR : Odds Ratio

Table 3. Impacts of Weight gain on the incidence of preeclampsia

Gestational Weight Gain Mean (SD) 1.7333 (0.44407)	Preeclampsia				OR 95% CI	*P-Value*
	Yes		No			
	n	%	n	%		
Appropriate	4	6.7	28	46.7	12.250	0.000002
Inappropriate	56	93.3	32	53.3	(3.941-38.078)	
Total	60	100	60	100		

DISCUSSION

Impact of Sample Characteristics on Preeclampsia and Eclampsia

Preeclampsia was found to be highly prevalent among women aged 31 to 35 during the COVID-19 pandemic. The analysis conducted in the catchment areas of Narmada, Kediri, and Gunung Sari Health Centers indicated no significant correlation between age and the incidence of preeclampsia and eclampsia (P-value = 0.105). These findings align with a study conducted at RSI Ibnu Sina Simpang Ampek, West Pasaman Province, West Sumatra, by Maya Fernanda Dielsa, which similarly found no association between maternal age within the non-risk range (20-35 years) and preeclampsia.[9] The optimal age range for pregnancy and childbirth is typically considered to be between 20 and 35 years. During this period, maternal reproductive organs are fully developed and functional. However, pregnancies at younger than twenty or older than thirty-five years carry higher risks, impacting fertility and maternal outcomes.[9,10]

During the COVID-19 pandemic, multigravida women showed a higher incidence of preeclampsia. However, the study's analysis found no significant correlation between gravida status and the incidence of preeclampsia and eclampsia (P-value = 0.619). These findings align with research conducted at RSUP Dr. M. Djamil Padang from 2012 to 2013, which indicated 1.3 times fewer cases of preeclampsia among multigravida women compared to primigravida women. Mothers with multiple pregnancies exhibit an immune response involving HLA-G (human leukocyte antigen G), which generates antibodies that inhibit certain substances targeting placental antigens formed during previous pregnancies. This mechanism potentially enhances trophoblast implantation into the mother's decidual tissue compared to first pregnancies.[10]

Pregnant women who were not employed showed a higher incidence of preeclampsia, based on the number of cases observed within each occupational group. However, in the catchment areas of Narmada, Kediri, and Gunung Sari Health Centers, there was no significant correlation between the incidence of preeclampsia and eclampsia and employment status, as indicated by research analysis results (P-value = 0.413). This lack of association holds true regardless of whether the COVID-19 pandemic was occurring.[11]

This finding suggests that the incidence of preeclampsia is not directly linked to employment status but rather to stress levels. Pregnant women who are not employed may be at higher risk of experiencing preeclampsia due to stress associated with various household issues such as economic difficulties, family problems, and anxiety related to pregnancy and childbirth.[12] Furthermore, individuals who have lost their jobs during a pandemic may also experience weight gain due to stress arising from financial insecurity, which affects their ability to afford daily nutritional needs.[13]

During the COVID-19 pandemic, preeclampsia was notably prevalent among women classified with grade 1 obesity, as observed in the number of pregnant women affected compared to those without preeclampsia, based on their pre-pregnancy BMI status. Analysis of the study's data revealed a significant correlation between the incidence of preeclampsia and eclampsia and pre-pregnancy BMI status (P-value = 0.013, OR 2.3, CI = 1.056-4.985). These findings are consistent with another study conducted at the Sepatan Health Center in Tangerang Regency, which also identified a link between preeclampsia incidence and maternal BMI prior to pregnancy (P-value = 0.007, OR 12.250, CI = 2.185-68.692).[14]

The study's findings support the hypothesis that elevated BMI levels contribute to insulin resistance, characterized by hyperinsulinemia, hyperlipidemia, hypertension, and endothelial dysfunction. Higher BMI correlates with increased lipid peroxide levels and reduced pregnancy-related antioxidants, potentially damaging endothelial cell membranes.[15] Researchers suggest that the COVID-19 pandemic has led to a shift in social activity patterns towards sedentary behaviors, which may contribute to increased body weight and BMI.

From 60 patients in the case group, 52 patients experienced preeclampsia in the third trimester compared to patients in the same group who experienced preeclampsia in the second trimester (Table 2). The analysis of this study's data also revealed a significant correlation between the incidence of preeclampsia and eclampsia and the trimesters of pregnancy (P-Value = 0.003). The findings of this investigation are consistent with those of other studies. Preeclampsia incidence during the COVID-19 pandemic was influenced by gestational age in the years leading up to and including the pandemic (2019–2020) (P-Value =

0.002; OR=3.59).[16]

The theory that higher gestational age increases the risk of preeclampsia and eclampsia is supported by the prevalence of these conditions, which are more common in the third trimester of pregnancy. In a normal physiological pregnancy, spiral arteries in the decidua undergo cell turnover facilitated by endovascular trophoblasts. This turnover process ensures that the arteries remain open, providing continuous blood flow, adequate nutrition, and balanced oxygen levels. Ideally, this cell turnover should be completed by the 16th week of pregnancy, coinciding with the completion of placental formation. In cases of preeclampsia or eclampsia, inadequate invasion of trophoblasts occurs, particularly in the uterine arteries, leading to restricted blood flow. This uteroplacental ischemia results in insufficient delivery of nutrients and oxygen to the placenta, exacerbating the condition.[17]

The Impact of Weight Gain on the Incidence of Preeclampsia and Eclampsia in the COVID-19 Pandemic

A significant correlation (P-value of 0.000002, <0.05) was found between weight gain and the incidence of preeclampsia during the COVID-19 pandemic, based on research analysis results. The study also determined an Odds Ratio of 12.25 (95% Confidence Interval, 3.941-38.078), indicating that pregnant patients who did not meet recommended weight gain guidelines during the COVID-19 pandemic were 12.25 times more likely to experience preeclampsia compared to those who adhered to the recommended weight gain guidelines.

Late-onset preeclampsia, occurring at ≥34 weeks of gestation (3rd trimester), predominantly affects pregnant women who have had multiple pregnancies. In contrast, early-onset preeclampsia is more common among women experiencing their first pregnancy. This observation suggests that prolonged exposure to sperm may confer a protective effect against preeclampsia, in line with the immune maladaptation theory. According to this theory, women who have been pregnant multiple times are less likely to develop preeclampsia compared to those in their first pregnancy. However, while multiparas generally have a lower risk, it does not eliminate the possibility of preeclampsia.[18] Late-onset preeclampsia is primarily linked to factors such as increased maternal body mass index (BMI), gestational weight gain, and associated clinical features like metabolic syndrome.[19]

The COVID-19 pandemic, impacting the global population since 2020, has precipitated significant alterations in lifestyle habits. These changes have largely resulted from lockdown measures, widespread social restrictions, and directives to remain at home. The consequence of prolonged home confinement includes unintended outcomes such as weight gain, reduced physical activity, and increased social isolation.[20]

Two significant factors are associated with changes in lifestyle habits during the COVID-19 pandemic. First, staying at home necessitates remote learning, telecommuting, or extended computer use without outdoor activities. Second, food storage at home becomes crucial due to restrictions on outdoor food purchases. Moreover, disruptions to work schedules during quarantine can lead to boredom, which may contribute to increased calorie consumption. Elevated stress levels during the pandemic may also lead to overeating, particularly of carbohydrate-rich foods, thereby increasing the risk of obesity.[21]

Excessive weight gain in mothers leads to an increase in adipocyte accumulation. Adipose tissue secretes leptin and adiponectin; leptin exhibits pro-inflammatory properties, while adiponectin exerts anti-inflammatory effects by reducing the expression and release of pro-inflammatory cytokines.[22] Consequently, elevated weight gain and BMI levels contribute to insulin resistance, characterized by hyperinsulinemia, hyperlipidemia, hypertension, and endothelial dysfunction.[15] Individuals with high BMI, metabolic syndrome, and type 2 diabetes mellitus typically exhibit reduced plasma adiponectin levels and increased levels of pro-inflammatory cytokines such as TNF-α and interleukin-6 (IL-6). This inflammatory state contributes to endothelial dysfunction and insulin resistance.[22]

Obesity or excess body weight not only elevates blood cholesterol levels but also contributes to insulin resistance. This insulin resistance can raise blood pressure during pregnancy by activating the sympathetic nervous system, promoting renal sodium retention, and increasing cation transport. It is also associated with endothelial dysfunction, which can lead to multi-organ abnormalities. The syndrome of insulin resistance plays a significant role in the pathogenesis of preeclampsia. This is consistent with previous studies that have linked elevated levels of all lipid profile parameters with an increased incidence of preeclampsia.[23]

Endothelial dysfunction can induce microvascular damage to target organs, intravascular inflammation characterized by a cytokine storm, and activation of thrombin. These processes collectively contribute to the multisystemic nature of the syndrome, involving manifestations such as seizures and central nervous system dysfunction alongside renal complications. Consequently, infections that target the endothelium can lead to syndromes like preeclampsia and eclampsia.[24]

Severe hypertension, headache, ankle clonus, epigastric or right upper quadrant pain, and visual disturbances are among the common early signs of eclampsia. Research investigating the relationship between these symptoms and significant risk factors for eclampsia development in patients already diagnosed with severe preeclampsia is limited. It's important to note that the severity of hypertension alone does not reliably indicate the likelihood of developing eclampsia..[25]

LIMITATIONS

This study utilizes secondary data, which comes with inherent limitations such as variables that were not directly measured by researchers. The data obtained from patients' medical records also includes limitations that are beyond the researchers' control. Additionally, certain variables have not been studied, including the presence of edema in preeclampsia, stress factors related to the COVID-19 pandemic, and exposure to SARS-CoV-2 among pregnant women. These factors could potentially influence the incidence of preeclampsia and eclampsia during the COVID-19 pandemic.

CONCLUSIONS

This study proposes that the COVID-19 pandemic increases the likelihood of preeclampsia in pregnant women due to gestational weight gain. Early screening for preeclampsia is crucial in the event of future pandemic outbreaks that alter daily human activity patterns. Community Health Centers can play a pivotal role as the primary providers of preeclampsia screening for pregnant women.

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