Original article:

Association Between Neck Circumference and Preeclampsia In Pregnant Women

Dwi Apriyanti[1], Uki Retno Budihastuti[2], dan Kusnandar[3]*

Abstract

The nutritional status of a person can be measured by neck circumference. This measurement uses a tape measure that is looped around the neck just below the larynx and perpendicular to the length of the neck. The parameters of neck circumference used to assess nutritional status are > 34 cm in women with BMI > 25 kg/m^2 and > 36.5 cm in women with BMI > 30 kg/m^2 with an accuracy rate of 99%. Being overweight and obese during pregnancy and childbirth will increase the risk of chronic disease in both mother and child. Pregnant women with obesity are at risk for pregnancy complications such as gestational hypertension, preeclampsia, gestational diabetes mellitus, and more often undergo cesarean delivery due to a baby born prematurely. An observational study with a case-control design using a cross-sectional approach was carried out by measuring neck circumference in 130 pregnant women with gestational age above 20 weeks which was divided into 65 respondents of pregnant women with preeclampsia and 65 respondents of pregnant women without complications. This research was conducted on pregnant women in Tangerang Regency. The chi-square test is used to analyze the data with a significant value of 0.05. The results of the Chi-Square test obtained a p-value of 0.000 (p<0.05), indicating a relationship between neck circumference and the occurrence of preeclampsia in pregnant women. The Contingency Coefficient value of 0.493 indicates the impact of obesity on the occurrence of preeclampsia by 49.3%, while other factors that influence preeclampsia are 50.7%. Neck circumference can be used as a method to assess nutritional status in pregnant women to prevent preeclampsia.

Keywords: Neck Circumference, Preeclampsia, Obesity

Introduction

Based on Indonesia's health profile in 2020, it can be seen that the increase in MMR cases in Indonesia from 4,221 deaths in 2019 increased to 4,726 in 2020. The main factors causing the high mortality include 25% bleeding in as many as 1,330 cases, 24% hypertension in pregnancy including preeclampsia, eclampsia, PEB in as many as 1,110 cases, 8% disorders of the blood circulation system in as many as 230 cases (Ministry of Health of the Republic of Indonesia, 2021), (Nur &Adhar, 2017). Preeclampsia is one of several health problems that exist during pregnancy and has the potential for complications in 2-3% of pregnancies (Sukmariah et al., 2019). Preeclampsia is a serious medical condition that can affect 3-5% of pregnancies and is a contributing factor to more than 35,000 maternal deaths in the

1. The Study Program of Nutrition Science, Master's Degree Program, SebelasMaret University, Surakarta, Indonesia.
2. The Study Program of Obstetric and Gynecology, Faculty of Medical Science, SebelasMaret University, Surakarta, Indonesia (RSUD Dr. Moewardi)
3. The Study Program of Agribusiness, Faculty of Agriculture, SebelasMaret University, Surakarta, Indonesia

Correspondence to: DwiApriyanti, The Study Program oh Nutrition Science, Master's Degree program, SebelasMaret University, Surakarta, E-mail : dwiapriyanti@student.uns.ac.id

world every year. Preeclampsia can affect the work of other organs causing an increased risk of complications in pregnancy (Wen et al., 2018).

The World Health Organization (*WHO*) stated that the incidence of preeclampsia is 7 times higher in developing countries compared to developed countries. The prevalence of the incidence of preeclampsia in developed countries is 1.3% - 6% while in developing countries it is about 1.8% - 18%. The latest WHO report states that preeclampsia accounts for 70,000 maternal deaths every year in the world (Arikah, Rahardjo& Widodo, 2021). The risk factors for preeclampsia are primigravida pregnancy risk 4,654 times greater than that of multigravida pregnant women, age, gestational age, obesity, history of hypertension, pregnancy visits or *Antenatal Care*, family income, and the use of hormonal contraceptives (Nur and Arifuddin, 2017).

The prevalence of overweight and obesity is becoming a global health problem today. Obesity is significantly associated with the development of chronic disorders such as cardiovascular disease (CVD), type II diabetes mellitus, insulin resistance, hypertension, and cholesterol. Early detection is indispensable to prevent long-term effects that can be detrimental, especially for those with an unhealthy lifestyle (Ferrari et al., 2019). As many as a quarter to one-third of pregnant women are obese and have a BMI of > 30 kg/m^2 in developed countries. Obesity can significantly increase the risk of non-emergency and emergency cesarean delivery (You-Ten et al., 2015). Based on the description above, it can be seen that being overweight and obese greatly affects the condition of pregnant women and risks causing preeclampsia and other chronic diseases during pregnancy. Therefore, efforts are needed to prevent obesity in pregnant women, one of which is by measuring neck circumference to monitor the nutritional status of pregnant women in addition to seeing weight gain during pregnancy. Neck circumference measurements can be used as an early screening for obesity. This can be early intervention in preventing preeclampsia and hypertension in pregnancy so that it does not become a condition of severe preeclampsia to cause conditions that can harm the health of the mother and fetus. *The aims*

This study aims to see if there is a relationship between neck circumference and the incidence of preeclampsia in pregnant women.

Methods

This study is an observational study with *a case-control* research design using a *cross-sectional* approach. This performance grouped samples into cases and controls carried out at the same time(Probandari et al., 2020). This research wasconducted in July 2022 in Tangerang Regency. Sel was taken using a multistage sampling technique and obtained a study sample of 130 pregnant women respondents which was divided into 65 respondents of normal pregnant women and 65 respondents of pregnant women with preeclampsia. Data collection used primary data obtained by measuring the neck circumference of respondents and looking at data on pregnant women through the MCH book. Data analysis was performed to see the relationship between the research variables.The measurement of neck circumference is carried out by measuring at a point just below the larynx (thyroid cartilage) and perpendicular to the axis The length of the neck (with a band line in front of the neck at the same height as the band line of the back of the neck). The tool used is an inelastic tape measure in centimeter units. Measurements are carried out twice to ensure accuracy and use the average value for analysis. If two readings are far different from the predetermined point (0.5 cm) then a third measurement is taken (Ferrari *et al*., 2019).

The hypothesis in this study is the assumption that the neck circumference can be used as one of the screenings for determining nutritional status and its relationship with the incidence of preeclampsia during pregnancy.

Result and Discussion

This study aims to find out whether there is a relationship between neck circumference and the incidence of preeclampsia in pregnant women. The data used in this study were primary data taken on pregnant women with a gestational age of more than 20 weeks in Tangerang Regency. The following are the results of the research obtaine.

Characteristics of respondents

Table 1. Characteristics of respondents (n=130)

Characteristics		Amount (n)	Percentage (%)
Age of respondents (Year)	15 – 19	4	3.1
	20 – 35	100	76.9
	>35	26	20
Gestational age (Sunday)	22 - 28	61	49.9
	29 - 42	69	50.1
Parity	1-3	104	80
	≥ 3	26	20
Neck circumference (cm)	≤ 34	45	34.6
	> 34	85	65.4

Source: Primary data,2022

Table 1 explained the characteristics of the study respondents, where respondents with risky pregnancies at the age of 15-19 years as many as 4 people with a percentage of 3.1% and aged over 35 years as many as 26 people with a percentage of 20%. Respondents with a productive gestational age of 100 people at the age of 20-35 years with a percentage of 76.9%. The gestational age of the respondents in this study was a pregnancy of more than 20 weeks. Respondents with a gestational age of2 2 – 28 weeks were 61 people with a percentage of 61% and a gestational age of > 28 weeks as many as 69 people with a percentage of 69%. The lowest gestational age is 20 weeks and the highest is 40 weeks.

Respondents with a parity of more than 3 children were 26 people with a percentage of 20%, while respondents who had children 1 to 3 children were 104 people with a percentage of 60.8%. pregnant women with a parity of more than 3 children are at risk of pregnancy complications in the next pregnancy compared to pregnant women with a parity of fewer than 3 Neck circumference

characteristics are used to see the nutritional status of pregnant women, where the neck circumference is ≤ 34 cm as many as 45 people with a percentage of 34. 6% and > 34 cm as many as 85 people with a percentage of 65.4%. Neck circumference data shows that at 20 weeks of gestation and above pregnant women begin to increase weight where the nutritional status of obesity is more than the normal nutritional status. children. *Neck circumference with preeclampsia*

Source: Primary data, 2022 Table 2 shows the relationship of neck circumference with the incidence of preeclampsia in pregnant women. Pregnant women who experienced preeclampsia with obesity as many as 60 people or 70.6% and pregnant women with normal conditions were obese as many as 25 people with a percentage of 29.4%. These results show that mothers with preeclampsia have an obese nutritional status compared to pregnant women without complications. A study on the relationship of excess weight gain to the risk of preeclampsia showed that women who had preeclampsia experienced more weight gain than women who did not experience preeclampsia with a difference of 3.5 kg in total body fluids observed at week 36 but were inversely proportional between fat mass and the possibility of preeclampsia (Hillesund et al., 2018).

In this study, the results of the p-value of 0.000 with a significant 0.05 which means that the p<0.05 value shows a relationship between measuring nutritional status using neck circumference and the occurrence of preeclampsia in pregnant women. The numerical parameters used on a woman's neck circumference are that a person with a BMI > of 25 kg/m^2 has a *cut of point> 34 cm* and a BMI of > 30 kg/m^2 with a *cut of point> 36.5 cm*. From the validation results that have been carried out, neck circumference can be used as one of the obesity

Table 2. Relationship of neck circumference withpreeclampsia in pregnant women

Variable		Neck Circumference				Sum		X^2	P Value
		Normal		Obesity					
		n	%	n	%	n	%		
Pregnancy status	Normal	40	88.9	25	29.4	65	50	39.3	0.000
	Preeclampsia	5	11.1	60	70.6	65	50		
Sum		45	100	85	100	130	100		

screening methods with a sensitivity of 98%, specificity of 89%, the accuracy of 94% for men, and 99% for women (Par'i*et al*., 2017). Obesity is one of the risk factors for the occurrence of preeclampsia 2 times every increase in body weight by 5-7 kg and an increase in BMI which is associated with the risk of preeclampsia and severe preeclampsia by 64%. This risk can increase two to three times due to an increase in BMI from 20 kg/m^2 to 30 kg/m^2 (David et al., 2016),(Zahra and Rodiani, 2016).

The *Contingency Coefficient* value of 0.493 in this study showed the effect of obesity on the occurrence of preeclampsia by 49.3%, while other factors that affect preeclampsia but are not explained in this study were 50.7%. Some of the risk factors associated with the development of preeclampsia include extreme age (too young / too old), parity, previous history of preeclampsia, a distance of pregnancy, IVF, family history of preeclampsia, obesity, having a comorbid medical history including gestational diabetes, previous chronic hypertension, kidney disease as well as autoimmune diseases such as systemic lupus erythematosus and antiphospholipid syndrome (Poon et al., 2019). A study showed that pregnant women with obesity have a risk factor for preeclampsia 5,632 times greater than pregnant women without obesity (Nur and Arifuddin, 2017).

In the human body whether pregnant or not, endothelial dysfunction occurs due to obesity. This leads to endothelial damage and further provokes the occurrence of preeclampsia in pregnant women. A woman who has preeclampsia has a lesion of the uteroplasent artery. These lesions have the characteristic presence of parts that undergo fibrinoid necrosis including macrophage cells that are lipid phagotiated. Lesions that occur in the glomerulus are related to the occurrence of proteinuria. Changes in fat metabolism play a role in the destruction of endothelial lesions in people with preeclampsia. The severity of hypertension and proteinuria describes the severity of endothelial damage (Poon et al., 2019),(Wafiyatunisa Zahra and Rodiani, 2016). Overweight and obese before and during pregnancy have a negative impact on fertility, during pregnancy and childbirth and increase the risk of developing chronic diseases for the mother and child. Women with overweight and obese increase the risk of developing complications such as gestational hypertension, preeclampsia, gestational diabetes mellitus and more often having cesarean delivery (Timmermans et al., 2019).

Conclusion

From the results of this study, there is a relationship between neck circumference and the occurrence of preeclampsia in pregnant women based on *the cutoff point* of nutritional status of obesity at gestational age above 20 weeks. This research was carried out in Tangerang Regency in June 2022 with a total sample of 130 people. Of the total number of respondents with a neck circumference of > 34 cm as many as 85 people (64.5%), preeclampsia pregnant women with obesity as many as 60 people (70.6%), and normal pregnant women with obesity as many as 25 people (29.4%). The p-value of 0.000 and *Contingency Coefficient* of 0.493 indicated the relationship between obesity and preeclampsia, where the effect of obesity on the occurrence of preeclampsia was 49.3%, while other factors affecting preeclampsia but not explained in this study were 50.7%. Suggestions for further research on the effect of neck circumference on lipid profiles with different characteristics of respondents.

Conflict of interest

The authors stated there was no conflict of interest in the study.

Ethical Clearance

This Study has been approved by the Research Ethics Committee of the Faculty of Medicine SebelasMaret UniversityNumber 35/UN27.06.11/KEP/EC/2022.

Authors' contribution

DwiApriyanti conceptualized and designed the study, prepared the draft of the manuscript and reviewed of the manuscript. UkiRetnoBudihastuti assisted in drafting of the manuscript, reviewed of manuscript. Kusnandar conducted the study, data analysis and interpretation and reviewed of the manuscript.

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