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Research

Vitamin D Status in Madura Pregnant Women with Hypertension: A Case Control Study

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ABSTRACT

Background: Vitamin D deficiency is inversely related to blood pressure and may contribute to the genesis and maintenance of hypertension. However, in many clinical studies the relationship between vitamin D status and blood pressure has not shown consistent results. This study aims to analyze differences in vitamin D status in Madurese ethnic pregnant women with hypertension and non-hypertension.
Subjects and Method: This research is an analytical observational design with a case control study. The target population in this study were pregnant women who came from the Madurese ethnicity. The affordable population is pregnant women who come from the Madurese ethnicity in the Work Area of the Bangkalan District Health Office. The study was conducted in the period from May 2019 to March 2020. The sampling technique used was consecutive sampling. The sample size was 105 pregnant women with hypertension and 105 controls. The independent variables included consumption of food sources of vitamin D and exposure to ultraviolet B rays. The dependent variable was vitamin D levels. Data on consumption of foods that were sources of vitamin D was obtained using the Food Frequency Questionnaire (FFQ). Data on exposure to ultraviolet B (UV B) rays were obtained by questionnaire. Data on vitamin D levels were obtained from the collection of blood serum which was then analyzed by ELISA Kit. Independent Sample T and chi square test were used to analyze the differences in variables between the two groups.
Results: The mean value of vitamin D levels in the case and control groups were 37.87 ng/mL and 37.89 ng/mL, respectively. Subjects with vitamin D insufficient status were more in the case group (19.00%) than the control group (16.20%). The results showed that there was no significant difference between the two groups in vitamin D levels (p= 0.984) and vitamin D status (p= 0.587). Insufficient exposure to UV B provides a 3.95 times greater risk of experiencing insufficient vitamin D.
Conclusion: The conclusion of this study is that the role of vitamin D in the incidence of hypertension in pregnancy has not been determined.

Keywords: hypertension pregnancy, pregnancy, UV B exposure, consumption patterns, vitamin D

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BACKGROUND

Hypertension in pregnancy is a cause of severe morbidity, disability and death of mothers and babies. Nearly one-tenth of all maternal deaths in Asia and Africa are related to gestational hypertension (World Health Organization, 2011). In Indonesia, HDK is one of the five biggest causes of maternal mortality. It was recorded that from 2010 to 2013 the proportion of maternal deaths due to HDK increased from 21.50% to 27.10% (Ministry of Health, 2016). Meanwhile, the maternal mortality rate in East Java Province is 89.81 per 100000 live births with the highest cause being preeclampsia/ eclampsia (31.15%) (East Java Provincial Health Office, 2020).

Several studies have found an association of low maternal serum vitamin D concentrations with an increased risk of preeclampsia. Vitamin D may play an important role in changes in the immune and cardiovascular systems in pregnancy. However, there is insufficient evidence to establish a causal relationship, and adequate clinical trials are still needed (Hyppönen et al., 2014).

Vitamin D deficiency is inversely related to blood pressure and may contribute to the genesis and maintenance of hypertension. However, although it has been shown in animal studies, in many clinical studies the relationship between vitamin D status and blood pressure has not shown consistent results. These differences may be related to methodological differences including patient selection, sample size and duration of data collection, differences in the vitamin D supplement used, dosage, and dosing interval (Rostand, 2014).

In many areas of the world, serum vitamin D deficiency is a common occurrence. This reflects a woman's lifestyle and several other factors such as skin pigmentation, location of residence, and climate. But the most important factor is sun exposure (Wagner et al., 2012). Several studies have shown the prevalence of serum vitamin D levels < 25 nmol/L among pregnant women including 42% in North India (Sachan et al., 2005), 61% in New Zealand (Judkins & Eagleton, 2006), 89.50% in Japan (Shibata et al., 2011), and 60% in the Netherlands, whereas normal serum vitamin D levels are 80 nmol/L (Meer et al., 2006). Other studies have shown that the prevalence of serum vitamin D levels < 50 nmol/L among pregnant women is 96.30% in India (Marwaha et al., 2011), 96.80% in Beijing (Song et al., 2013) and 75% in the UK (Holmes et al., 2009).

In this study, researchers conducted a study on pregnant women with hypertension and without hyertension among Madurese ethnicity. The Madurese are one of the major ethnic groups in Indonesia. This ethnicity comes from the province of East Java. The spread of this ethnicity to other regions in Indonesia and abroad occurs rapidly due to the habit of wandering (Rochana, 2012).

SUBJECTS AND METHOD

1. Study Design

This was an analytic observational with a case control study design. The research is located in the work area of the Bangkalan District Health Office. The sampling sites include the Mother and Child Hospital (RSIA) Hikmah Sawi and the Independent Practice Midwife (BPM) Yuni Hermanto. The place for checking vitamin D levels is at the UGM Biochemistry Laboratory. Research started in May 2019 and finished in March 2020.

2. Population and Sample

The target population in this study were pregnant women who came from the Madurese ethnicity. The affordable population in this study were pregnant women who came from the Madurese ethnicity in the Work Area of the Bangkalan District Health Office. The sample in the case group was pregnant women with gestational hypertension (systolic blood pressure 140 mmHg and diastolic blood pressure 90 mmHg). Sampling from the case group was carried out at RSIA Hikmah Sawi which is a reference place for pregnant women with gestational hypertension disorders. Samples in the control group were pregnant women without hypertension disorders. Sampling from the control group was carried out at BPM Yuni Hermanto. The sample size was 210 people including 105 pregnant women with hypertension and 105 controls. The sample size was calculated using the Lemeshow formula with= 0.05, power of the test= 0.80 and P1= 0.30 and P2= 0.49 values. The proportion value was obtained from previous studies (Baker, Haeri, Camargo, Espinola, & Stuebe, 2010). The sampling technique used in this study is consecutive sampling.

3. Study Variables

The independent variables in this study were the consumption of food sources of vitamin D and exposure to UV B rays. The dependent variable in this study was the level of vitamin D.

4. Operational Definition of Variables

Consumption of food sources of vitamin D is the frequency of consumption of food sources of vitamin D during the past month. Food consumption scores are data with a ratio scale. The pattern of food consumption is data with a nominal scale.

Exposure to UV B rays is the level of adequacy of exposure to part of the body's surface by sunlight (UV B). UV B exposure status is data with a nominal scale.

Vitamin D levels are levels of 25-hydroxycholecalciferol in blood serum with criteria for vitamin D levels, namely sufficient (Sufficient) if >30ng/ml – 100 ng/mL, insufficient (Insufficient) if 10 ng/mL – 30 ng/ml and deficiency if < 10 ng/mL. Vitamin D levels are data with a ratio scale. Vitamin D status is data with nominal scale.

5. Study Instruments

Data on food consumption sources of vitamin D were collected using the Food Frequency Questionnaire (FFQ). UV B exposure data were collected by means of a questionnaire. Determination of serum vitamin D levels by blood serum collection and analyzed using ELISA Kit (Calbiotech).

6. Data Analysis

Independent Sample T Test was used to analyze the score of vitamin D food consumption and vitamin D levels between the two groups. Dietary consumption patterns of vitamin D and vitamin D status for case and control groups were compared using chi-square analysis. Logistic regression test was used to determine the odds ratio. All tests were performed using SPSS version 16. Statistical significance was defined at $p<0.05$.

7. Research Ethics

Research ethical issues including consent, anonymity and confidentiality were handled with care throughout the research process. This research was approved by the Medical and Health Research Ethics Committee, Faculty of Medicine, Public Health and Nursing, Universitas Gadjah Mada (Ref: KE/FK/0423/EC/2018).

RESULTS

1. Sample Characteristics

Characteristics of research subjects include age, Body Mass Index (BMI), systolic and diastolic blood pressure, vitamin D food consumption and UV B exposure. Characteristics of research subjects are shown in Table 1.

Table 1. Characteristics of Subjects in Case and Control Groups

	HDK	Control
Age (year)	29.10 ± 6.90	27.07 ± 6.03
Body Mass Index	24.48 ± 4.00	22.27 ± 3.14
Systolic Blood Pressure (mmHg)	158.29 ± 17.40	106.67 ± 8.62
Diastolic Blood Pressure (mmHg)	100.19 ± 6.35	71.43 ± 6.85
Vitamin D Food Consumption Score	20.81 ± 15.08	26.62 ± 14.64
Dietary Consumption Patterns of Vitamin D		
Lacking	56 (53.30%)	31 (29.50%)
Good	49 (46.70%)	74 (70.50%)
Ultra Violet B Exposure		
Insufficient	75 (71.40%)	64 (61.00%)
Sufficient	30 (28.60%)	41 (39.00%)

The results showed that the mean age, BMI, systolic and diastolic blood pressure in the case group (HDK) were higher than the control group (Table 1).

2. Bivariate Analysis

There was no significant difference between the two groups in vitamin D levels and status. However, from these data it can be seen that pregnant women who experience insufficient vitamin D are still quite a lot, namely 19.00% in the HDK group and 16.20% in the control group (Table 2).

Table 2. Test of Different Levels and Status of Vitamin D in Case and Control Groups

	HDK	Control	p
Level of Vitamin D (ng/mL)[a]	37.87 ± 6.32	37.89 ± 7.04	0.984
Status of Vitamin D[b]			
Insufficient	20 (19.00%)	17 (16.20%)	0.587
Sufficient	85 (81.00%)	88 (83.80%)	

Logistic regression test was conducted to analyze the risk of dietary vitamin D consumption patterns and UV B exposure status as independent variables on vitamin D status as the dependent variable. The test results between vitamin D food consumption patterns and UV B exposure status with vitamin D status are presented in Table 3. The results of the analysis show that insufficient UV B exposure provides a 3.95 times greater risk of experiencing insufficient vitamin D (Table 3).

Table 3. Logistics Regression Test of Food Consumption Patterns of Vitamin D Sources and Status of UV B Exposure with Vitamin D Status

Variable	Insufficient n (%)	Sufficient n (%)	OR (CI 95%)	p
Pola Konsumsi Pangan Sumber Vitamin D				
Lacking	15 (40.5%)	72 (41.6%)	0.96 (0.46-1.97)	0.904
Good	22 (59.5%)	101 (58.4%)		
Exposure of UV B				
Insufficient	32 (86.5%)	107 (61.8%)	3.95 (1.46-10.64)	0.007
Sufficient	5 (13.5%)	66 (38.2%)		

DISCUSSION

In this study, no significant difference was found between the two groups in vitamin D levels and status. However, from these data, it can be seen that the subjects of pregnant women who experienced insufficient vitamin D were still quite a lot in both groups. Several studies that show high rates of vitamin D deficiency among pregnant women include 87% in Basra, Iraq (Mahfooth, et al., 2020), 89.50% in Japan (Shibata et al., 2011), 96.30% in India (Marwaha). et al., 2011), 96.80% in Beijing (Song et al., 2013) and 75% in the UK (Holmes et al., 2009). Another study conducted by Ponsonby, et al. (2010) found that pregnant women with dark skin pigmentation or skin that is often covered by clothing increase the risk of vitamin D deficiency, unless their vitamin D intake is adequate.

Although it has received less attention, serum vitamin D deficiency is in fact common in many countries in the world. The factor that most often causes a person to suffer from serum vitamin D deficiency is due to lack of sun exposure (Wagner et al., 2012). However, there are several other factors such as location of residence, climate, skin pigmentation, and also the lifestyle of women that can be the cause of serum vitamin D deficiency. In this study also proved that women who did not get enough UV B exposure had a 3.95 times greater risk of experiencing insufficient vitamin D, and this relationship was statistically significant.

UV B light with a wavelength of 270-300 nm will convert 7-dehydrocholesterol precursor compounds in the skin into cholecalciferol compounds. Humans need 10-15 minutes of daily exposure to sunlight to produce adequate vitamin D. The body parts that are recommended to get sun exposure are the face, hands, arms and back (Marmi, 2013). The increase in 25(OH)D after UV B exposure was dose dependent but not dose rate (1-20 min). A significant increase in 25(OH)D was achieved with very low UV B doses (Bogh, et al., 2011; Hawk, 2020). Low doses of UV B in Indonesia are found in sunlight in the morning at 07.00 – 10.00 and in the afternoon after 15.00 – 17.00 (Judistiani et al., 2019).

A study conducted by Mendes et al. (2021) in women in Brazil found that women exposed to UV B had no effect on the increase in 25(OH)D ($p=0.139$). The increase in 25(OH)D had a significant effect when women were given moderate cholecalciferol supplementation 15 g/day while being exposed to UV B for 14 days ($p<0.001$). Another study states that there is no doubt that vitamin D intake from sunlight is certainly better for the health of the mother and fetus than taking vitamin D supplementation. If pregnant women live in areas that rarely get sunlight, then supplementation may be necessary (Wagner , et al., 2012).

A systematic review was conducted to analyze the relationship of vitamin D intake and status with the risk of hypertensive disorders of pregnancy in observational and interventional studies. The results show that no firm conclusions can be drawn regarding the potential of vitamin D to prevent gestational hypertensive disorders (O'Callaghan & Kiely, 2018). A randomized controlled trial in Bangladesh showed that vitamin D supplementation from mid-pregnancy did not affect systolic or diastolic blood pressure until late in pregnancy. The results of these studies do not support the clinical use of vitamin D in pregnancy to lower maternal blood pressure (Subramanian, et al., 2021). In addition, another study conducted by Purswani, et al. (2017) actually found that high levels of UV B obtained in the first trimester of pregnancy increase the risk of hypertension in pregnancy. An RCT study conducted on 400 women showed that vitamin D supplementation did not provide a significant benefit in preventing preeclampsia in pregnancy, where one of the signs and symptoms of preeclampsia is high blood pressure (Ministry of Health, 2018).

The weakness in this study is that the sample size in this study is still relatively small due to limited research resources and time in completing the final research report. Therefore, furthermore other researchers need to involve a larger sample to be able to confirm the results of the study. This study can also be the basis for replication studies in a larger population.

Vitamin D levels in subjects with hypertension in pregnancy were not significantly different from subjects with normal pregnancies. Therefore, it can be concluded that the role of vitamin D in the incidence of hypertension in pregnancy has not been determined. This may be because vitamin D is not the only factor that plays a role in the incidence of hypertension in pregnancy. In addition, from the results of the study it was found that insufficient exposure to UV B risks increasing the incidence of insufficient vitamin D. Therefore, it is recommended for the public to spend time in the sun or get exposure to ultraviolet B rays so that their vitamin D needs are fulfilled.

AUTHOR CONTRIBUTION

DS designs and conducts research, analyzes and interprets data and compiles manuscripts. PH and DSN designed the research and compiled the manuscript. LAP conducted research and compiled manuscripts.

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CONFLICT OF INTEREST

There is no conflict of interest in this study.

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