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AUTHOR'S AFFILIATIONS
Undergraduate Program in Medicine, Faculty of Medicine, Universitas Sumatera Utara[1]
Department of Pediatrics, Faculty of Medicine, Universitas Sumatera Utara[2]

CORRESPONDING AUTHOR
Fathia Meirina, Department of Child Health, University of North Sumatera
 E-mail:
fathia.meirina@usu.ac.id

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The Association between Vitamin D Intake in Expectant Women and Neonatal Birth Weight

Cindy Rolexza[1], Fathia Meirina[2]*

Abstract

Background: Insufficient maternal consumption of vitamin D can have adverse effects on fetal development and increase the likelihood of low birth weight. This research aimed to establish the correlation between the quantity of vitamin D consumed by expectant mothers and the weight of newborns. **Methods:** This study utilized an analytical observational design with a cross-sectional approach, collecting data from August to November 2022. Information on Vitamin D intake and birthweight was obtained via questionnaire interviews with 96 pregnant women delivering at the University of North Sumatera Hospital or Maharani Women's and Children Hospital. Semi-Food Frequency Questionnaires (FFQs) served as the data collection instrument. Non-probability consecutive sampling was employed. Statistical techniques, including Chi-square and Fisher's Exact test, were used for data analysis. Findings indicated a prevalence of inadequate vitamin D intake among mothers (3.125%). The mean daily consumption of vitamin D among expectant women was 19.99 µg/day. Mother's education level did not significantly influence the outcome (p=0.589). **Results:** The results of this study suggest that there was no significant association between maternal age at pregnancy (p=0. 135), gestational age (p=0. 771), parity (p=0958), and baby's sex (p=0. 448) with birth weight. **Conclusion:** An observed association existed between the prenatal intake of vitamin D and neonatal birth weight in expectant mothers.

Keywords: vitamin D; intake; pregnancy; birth; weight

Original Research Article

INTRODUCTION

Vitamin D insufficiency represents a prevalent concern on a global scale. According to Palacios and Gonzalez (2014), the prevalence of vitamin D deficiency is estimated to affect roughly one billion individuals globally. According to Hovsepian et al. (2011), there is a notable incidence of vitamin D insufficiency, ranging from 14 to 59%, among the general populace. The highest occurrence of this deficit is predominantly observed in Asian countries (Ahmed et al., 2021). Vitamin D insufficiency during pregnancy is a widely recognized phenomenon that has garnered global attention. Extensive research has demonstrated a prevalence rate ranging between 18-84% among pregnant women. Adequate intake of calcium and vitamin D during pregnancy is essential for maintaining calcium homeostasis, promoting fetal maturation, and facilitating bone mineralization (Abbasian et al, 2016)

Insufficient levels of vitamin D have been associated with an elevated risk of numerous adverse outcomes during pregnancy, including preeclampsia, gestational diabetes, premature delivery, fetal growth retardation, spontaneous abortion, and low birth weight (Flood-Nichols et al., 2015).

Inadequate nutrient intake during pregnancy was associated with brain defects, an increased risk of abnormal behavior, neuropsychiatric disorders, altered cognition, visual impairment, and motor deficits (Labh et al., 2014). Indicator for assessing maternal nutritional intake during pregnancy such as pre-pregnancy body mass index, maternal gestational weight gain, and fetal growth including baby's birth weight. Research shows that cord blood vitamin D deficiency was found in 97.7% of mothers, and insufficiency was found in 2.3%. Babies born to deficient vitamin D mothers had a birth weight of 2.7 kg, 2.9 kg in insufficient mothers, and 3.0 kg in sufficient mothers on average. None of the mothers with adequate levels of vitamin D gave birth to babies weighing <2.5 kg, while of the babies born weighing <2.5kg, 94.7% of their mothers had vitamin D deficiency, and 5.3% had insufficiency (Arora et al., 2018). The mortality rate in these neonates is 35 times higher than that in those born with normal weight (Meliati et al., 2016). There is a need for recommendations for vitamin D supplementation throughout pregnancy (Zamal & Manazir, 2019).

The present study sought to investigate the potential correlation between the intake of vitamin D among pregnant women and the weight at birth, drawing on the data outlined above. The present study aimed to provide empirical evidence and serve as a fundamental framework for the development of educational materials targeted towards expecting mothers, aimed at raising knowledge and understanding of the significance of vitamin D consumption during pregnancy in reducing the likelihood of low birth weight infants and growth impediments. In a previous study conducted in 2022, it was found that maternal pre-pregnancy BMI, gestational weight gain, and placental weight exhibited a positive correlation with neonatal birth weight. However, the novel aspect of this current study lies in its utilization of a questionnaire centered around the consumption of foods rich in vitamin D (Costanza et al., 2022).

MATERIALS AND METHODS

This present investigation constitutes an analytic observational study wherein a cross-sectional approach was employed. The present investigation was conducted from August to November 2022, at the facilities of the University of North Sumatera Hospital and the Maharani Women's and Children's Hospital. The participants of this study consisted exclusively of pregnant women who delivered at the University of North Sumatera Hospital and the Maharani Women's and Children's Hospital. The sampling technique used in this research was a non-probability sampling method with a consecutive sampling type. The inclusion criteria for this research were women with primigravidas or multigravidas, full-term pregnancy, and giving birth to live babies in August to November 2022. While the exclusion criteria in this research were mothers who gave birth to twins, mothers with pregnancy complications such as gestational diabetes, preeclampsia, and eclampsia also babies born with congenital abnormalities. There were 96 mothers selected. All the chosen mothers were interviewed to gather their baseline characteristics, including age and education level, vitamin D intake, birthweight, parity, and gestational age.

All data were collected by interview. Vitamin D intake was identified through questionnaires and interviews. The research instrument used in this study was semi-Food Frequency Questionnaires (semi-FFQs) globally standardize. The questionnaire consisted of 15 lists of food containing vitamin D and the usual individual frequency of consumption over a period queried. Maternal vitamin D intake was categorized as adequate (≥15 μg/day) or inadequate (<15 μg/day) (Pérez-López et al., 2020). Birthweight was classified into low (<2500 g), normal (2500-4000 g), and excess (>4000 g) groups (Sakala & Kaombe, 2022). Mother's education level included categories: absent elementary education/not in school, completion of primary education, completion of junior secondary education, completion of senior secondary education, and completion of tertiary education. Age was grouped as

<20 years old or >35 years old and 20-35 years old. Parity was divided into 1-3 and ≥4. Gestational age was categorized as <40 or ≥40.

The implementation of univariate analysis provided a quantitative description of the data. The bivariate analysis examined the association between the intake of vitamin D among pregnant mothers and the birthweight of their offspring. This research utilized the Chi-square test along with the Fisher's exact test as an alternative for carrying out the bivariate analysis. In order to investigate the correlation between vitamin D consumption during pregnancy and neonatal birth weight, the present study examined the interplay among maternal educational attainment, maternal age at conception, parity, gestational age, and infant gender with respect to birth weight. The present study has obtained ethical approval from the University of North Sumatera's ethical committee, identified by the reference number No. 647/KEPK/USU/2022.

RESULTS

Characteristics of respondents based on age, education level, parity, gestational age, intake of vitamin D, and baby's gender are presented in Table 1. Most of the respondents were aged 20-35 years (86.5%), had a college education level (56.3%), parity 1-3 (95.8%), gestational age <40 weeks (77.1), adequate vitamin D intake of (≥ 15 µg/day (96.9%) and had girl babies (55.2%).

Table 1. Distribution of Research Data Based on Age of Covid-19 Patients at the Surabaya Islamic Hospital

Characteristics	n	Mean ± SD
Age (years)		30.28±4.785
Women's education		
Completion of junior secondary education	1 (1)	
Completion of senior secondary education	41 (42.7)	
Completion of tertiary education	54 (56.3)	
Parity		
1-3	92 (95.8)	1.98±0.94
≥4	4 (4.2)	
Gestational age (weeks)		
<40	74 (77.1)	38.71±1.085
≥40	22 (22.9)	
Maternal vitamin D intake		
Adequate (≥ 15 µg/day)	93 (96.9)	
Inadequate (< 15 µg/day)	3 (3,1)	19.9854±5.009
Baby's gender		
Male	43 (44.8)	
Female	53 (55.2)	
Birthweight (gram)		
Low (<2500)	1 (1)	
Normal (2500-4000)	88 (91.7)	3288.65±447.099
Excess (>4000)	7 (7.3)	

Based on the Fisher Exact test (Table 2), a lack of association between education level and vitamin D intake in pregnant women was observed.

Table 2. The association between education attainment and vitamin D consumption in pregnant women

Women's Education Level	Vitamin D Intake				Total		p-value
	Adequate		Inadequate				
	n	%	n	%	n	%	
Completion of junior secondary education		100.0	0	0.0	1	100.0	
Completion of senior secondary education	39	39.7	2	4.9	41	100.0	0.589
Completion of tertiary education	53	52.3	1	1.9	54	100.0	
Total	93	96.9	3	3.1	96	100.0	

There existed no significant association between birth weight and various factors, namely maternal age at pregnancy, gestational age, parity, and baby's gender based on the Fisher Exact test (Table 3).

Table 3. The association among mother's age at pregnancy, gestational age, parity, and baby's gender regard to birth weight

Characteristics	Birth Weight				p-value
	Normal+Excess		Low		
	n	%	n	%	
Mother's age at pregnancy (years)					
<20 atau >35	12	92.3	1	7.7	0.135
20-35	83	100	0	0	
Gestational age (weeks)					
<40	73	9.6	1	1.4	0.771
≥40	22	100	0	0	
Parity					
1-3	91	98.9	1	1.1	0.958
≥4	4	100	0	0	
Baby's gender					
Male	42	97.7	1	2.3	0.448
Female	53	100	0	0	

A notable correlation was observed between the consumption of vitamin D by expecting mothers and the weight at birth of their infants (p-value=0. 031, OR=15).

Table 4. The Association between maternal intake of vitamin D during pregnancy and birth weight of infants

Vitamin D Intake	Birth Weight				Total		p-value	Odds ratio
	Normal+Excess		Low					
	N	%	n	%	n	%		
Adequate	93	100.0	0	0.0	93	100.0		
Inadequate	2	66.7	1	33.3	3	100.0	0.031	1.5
Total	95	99.0	1	1.0	96	100.0		

DISCUSSION

This study's statistical analysis to examine the relationship between maternal education level and maternal vitamin D intake showed no relationship (p=0.589 or p>0.005) between the two. This study's results align with research conducted by Wang et al., who randomly assigned 125 pairs of mothers and

children in 2 different hospitals (p=0.007 or p>0.005) which said that the mother's level of knowledge did not affect the mother's vitamin D intake. The findings of the study indicate that there are significant maternal determinants that are associated with vitamin D deficiency, which include being born in winter, insufficient exposure to sunlight, high maternal body mass index during delivery, inadequate consumption of eggs, insufficient vitamin D supplementation during pregnancy, and unfavorable health insurance. In an academic manner of expression, the foremost determinants for neonatal vitamin D deficiency (OR=7. 5) are identified as regrettable insurance coverage and inadequate vitamin D provision during pregnancy (Wang et al, 2019) in an academic manner of expression. This study was reinforced by a survey by Khalessi et al., who also said there was no relationship between maternal education level and vitamin D status (p=0.43 or p>0.05) (Khalessi et al., 2015). Although no significant difference was found between the mother's education level and the mother's vitamin D status, this finding contradicts research conducted by van den Berg et al., and this study states that women with low education have lower intakes of vitamin D than women with high education Vitamin D is a modifiable contributor to the relationship between low-educated mothers and low-birth-weight offspring. Therefore, increasing vitamin D intake in pregnant women dietary adaptations or through supplementation to meet the recommendations is very beneficial (van den Berg et al., 2013; Kamaruddin M, Triananinsi N., Sampara N & RA, AM, 2020).

The outcome of the analysis revealed a non-significant association (p = 0. 135) between the maternal age at the time of pregnancy and the neonate's birth weight. Based on the present study's respondents aged 20-35 years, it can be inferred that the maternal age during pregnancy does not have a significant impact on the baby's birth weight. The results of this study are the same as those Fajriana & Buanasita's study, which also said that there was no relationship (p = 0.052) between maternal age during pregnancy and birth weight (Fajriana & Buanasita, 2018). Increased risk of low birth weight (LBW) among adolescent mothers (commonly defined as women <20 years old. Increased perinatal risk of adverse events has also been found in older mothers (women aged 35 years and over) in both high- and middle-income countries (Restrepo-Méndez et al., 2015). Based on gestational age, most mothers deliver babies when the fetus is <40 weeks old. The analysis revealed that there is no statistically significant association (p=0. 771) between gestational age and birth weight. The present findings are disparate from those reported by Fajriana and Buanasita. The observed disparity in outcomes can be attributable to the fact that the majority of newborns are delivered at full gestational maturity. The findings of the study indicated a noteworthy correlation (p = 0. 006) between gestational age and the prevalence of low birth weight (LBW) in Semampir District, Surabaya, with an odds ratio (OR) of 6. 198 This suggests that mothers who deliver preterm infants are 6.2 times more susceptible to LBW. (Fajriana & Buanasita, 2018; Kamaruddin M & Sari NA, 2019). This study also found that most respondents had 1-3 children, and statistical analysis showed no relationship (p=0.958) between parity and birth weight. The results of this study are the same as research by Hanifah, who also said that there was no relationship (p = 0.433) between the number of parities and birth weight (Hanifah, 2009). Strengthened by research by Salawati, who said there was no relationship (p = 0.085) between the number of parities and birth weight (Salawati, 2012). The analysis results also showed no relationship between the sex of the baby and the birth weight (p=0.448). The results of this study are the same as those of Anggrenisa's research conducted by Medan Tembung, which said that there was no relationship (p = 0.502) between the sex of the baby and the birth weight of the baby (Anggrenisa Rika, 2018).

Based on pregnant women's vitamin D intake status, most respondents to have adequate vitamin D intake status. The results of this study differ from Pratiwi's, which stated that most respondents had insufficient vitamin D intake (Novita Sari Pratiwi et al., 2017). Differences in research locations can influence the difference in these results. According to a study conducted by Rahman et al. (2020), the average level of 25[OH]D in mothers of infants with normal birth weight (n = 58; 77. 33%) was significantly greater (50. 41 ± 500 ng/mL) when compared to the level observed in mothers of infants with low birth weight (28. 24 ± 687 ng/mL), revealing a statistically significant difference (p

< 0. 0001) The statistical analysis conducted in this study aimed to investigate the potential association between maternal vitamin D intake during pregnancy and birth weight. The obtained results revealed a statistically significant finding (p=0. 031 or p<005), indicating that a relationship exists between maternal vitamin D intake during pregnancy and birth weight. The outcome revealed a PR of 1. 5, thus denoting that mothers who were found to have sufficient vitamin D intake were 1. 5 times more probable to bear offspring of average or greater weight when compared to those mothers who had inadequate vitamin D intake. The present investigation yielded congruent outcomes with Suganda's (2021) research, which posits a constructive association between the vitamin D concentration in expectant mothers and neonatal weight (r=0. 463, p<005).

CONCLUSION

This study found that there is a correlation between the consumption of Vitamin D by pregnant women and the mass of their newborn child.

LIMITATION OF THE STUDY

This study has some limitations. Firstly, the 96 incidents sample represents a small number of the total number of serious incidents that occurs every year. Our lack of epidemiological knowledge about maternal nutritional deficiency incidents and maternal nutritional status, however, means that determining an appropriate sample size continues to be difficult.

CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

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