International Journal of Research and Review
Volume 11; Issue: 7; July 2024
Website: www.ijrrjournal.com
Original Research Article *E-ISSN: 2349-9788; P-ISSN: 2454-2237*

Relationship between Consumption of Vitamin D Food Sources, Sun Exposure, and Consumption of Vitamin D Supplements with Intrauterine Growth Restriction at Airlangga University Hospital Surabaya

Thirza Alifia Putri Ariadwianto[1], Widati Fatmaningrum[2], Muhammad Ilham Aldika Akbar[3], Ernawati[4]

[1]Medical Program, Faculty of Medicine, Airlangga University, Surabaya, Indonesia.
[2]Department of Public Health and Preventive Medicine, Faculty of Medicine, Airlangga University, Surabaya, Indonesia.
[3,4]Department of Obstetrics and Gynecology, Faculty of Medicine, Airlangga University – Airlangga University Hospital, Surabaya, Indonesia.

Corresponding Author: Thirza Alifia Putri Ariadwianto

DOI: https://doi.org/10.52403/ijrr.20240752

ABSTRACT

Background: Intrauterine Growth Restriction (IUGR) is defined as a condition when fetus experiences poor growth during the pregnancy due to pathological factors, namely placental dysfunction. One of the causes of several risk factors for IUGR such as maternal diseases, namely diabetes mellitus and preeclampsia, is Vitamin D deficiency.

Objective: To study the relationship between the consumption of Vitamin D food sources, sun exposure, and consumption of Vitamin D supplement in pregnant woman with Intrauterine Growth Restriction (IUGR) at Airlangga University hospital in Surabaya.

Method: This analytic study with case control design was conducted on pregnant woman who delivered baby at the delivery room in Airlangga University hospital in 2021 to 2023, using Food Frequency Questionnaire (FFQ). 44 women were included in case and control group. The data was later analysed with SPSS application. P-value < 0.05 is considered significant.

Results: The result showed in the case group with IUGR, the Vitamin D food sources consumption was higher than the control group without IUGR. Therefore, there is no relationship between Vitamin D food sources consumption with IUGR (P > 0.05). Meanwhile in the control group without IUGR, the sun exposure and Vitamin D supplement consumption were higher than the case group with IUGR. Hence, there is relationship between Sun exposure and Vitamin D supplement consumption with IUGR (P < 0.05).

Conclusion: The result showed that the strategies of collecting the Vitamin D dietary is not effective and not recommended to study the relationship of Vitamin D food sources consumption with IUGR. More study or research need to be conducted.

Keywords: Intrauterine Growth Restriction (IUGR), Pregnancy, Vitamin D food sources consumption, Sun Exposure, Vitamin D supplement consumption

INTRODUCTION

Intrauterine Growth Restriction (IUGR) is defined as a condition where the fetus experiences poor growth during pregnancy due to pathological factors, specifically placental dysfunction[1] · According to The American College of Obstetricians and Gynecologists (ACOG) in 2019[2], IUGR refers to a fetus that does not reach its optimal growth. IUGR is a public health issue and is estimated to occur in approximately 10-15% of pregnant women worldwide. In the postnatal period, IUGR affects 23.8% of newborns, with around 30 million babies affected globally each year[3]. The incidence of IUGR in developing countries is recorded to be 6 times higher compared to developed countries. The prevalence of IUGR is notably high in Asia, constituting for 75% of cases, followed by Africa and Latin America[4].

Some factors contributing to the occurrence of IUGR include maternal health history (hypertension, kidney disease, diabetes mellitus, anemia, autoimmune diseases), socioeconomic status, very low body mass index, maternal age, family history of IUGR or previous IUGR pregnancies, multiple pregnancies, genetic syndromes, placental disorders, villous infarction, and umbilical cord insertion issues[5]. One of the causes of several risk factors for IUGR, such as maternal conditions like diabetes mellitus and preeclampsia, is Vitamin D deficiency[6]. During pregnancy, the Vitamin D status plays a crucial role in the well-being of both the mother and the fetus. Vitamin D is distinct among essential micronutrients because it can be synthesized by the body through exposure to ultraviolet-B (UVB) radiation. Vitamin D receptors are found in various tissues, allowing for numerous hormonal functions of the biologically active form, 1,25-dihydroxyVitamin D (1,25(OH)2D)[7,8]. In several studies it is mentioned that Vitamin D plays a significant role in the early stages of pregnancy, influencing the implantation process and placental development. The placenta is crucial for providing nutrition to the fetus in utero. Furthermore, Vitamin D is essential for placental function, maintaining calcium balance, and promoting bone mineralization, all of which are critical factors influencing fetal growth and development [9,10]. Several studies have shown the relation between Deficiency of Vitamin D and IUGR[8,11,12]. In that regard, this research was aimed to study the relationship between Vitamin D food sources consumption, sun exposure, and Vitamin D supplement consumption during pregnancy with Intrauterine Growth Restriction (IUGR) at Airlangga University Hospital, Surabaya.

MATERIALS & METHODS

This research was conducted at Airlangga University Hospital in Surabaya in December 2023 - May 2024. This research was approved by the Research Ethics Committee of Airlangga University Hospital in Surabaya with ethical approval letter number 195/KEP/2023 on December 29, 2023.The population for this research consisted of pregnant women who gave birth in the Delivery Room of Airlangga University Hospital in Surabaya from 2021 to 2023.

The sample size of this research consisted with patients with medical records of IUGR for the case group and patients without medical records of IUGR for the control group who meet the inclusion and exclusion criteria at Airlangga University Hospital in Surabaya from 2021 to 2023. The minimum sample size required for this study is calculated using the case-control study formula. A statistical formula was used with the help of the Statistic and Sample Size Pro application. The minimum sample size required is 44 individuals with a 1:1 ratio, namely, 22 patients diagnosed with IUGR as case samples and 22 patients without IUGR diagnosis or normal as control samples. The variables studied were age, education, occupation, and parity as well as frequency of Vitamin D food

sources consumption, sun exposure, and Vitamin D supplement consumption on case and control group.

The data were obtained from medical record data from the Maternity Room at Airlangga University Hospital, Surabaya to collect the data and identity of samples who matched with the inclusion criteria. Later the sample was contacted to do an interview using Food Frequency Questionnaire (FFQ) to obtained the Vitamin D food sources dietary, sun exposure, and Vitamin D supplement consumption data. The sample who became the subject of this study is woman who gave birth at Airlangga University age 20 – 35 years old, without metabolic diseases (Preeclampsia, Gestational Diabetes, etc.), and woman without congenital diseases.

STATISTICAL ANALYSIS

Statistical Analysis was conducted using SPSS software version 25.0. The data underwent descriptive statistics and chi-square test. A significance level of less than 0.05 ($P < 0.05$) was used to determine statistical significance.

RESULT

Table 1. Distribution by case and control group

Case Group (IUGR)	Control Group (Normal	Total
22	22	44

The number of samples obtained for this research was 44 individuals. The research samples are pregnant women who gave birth in the Delivery Room of Airlangga University Hospital in Surabaya. There are 22 samples allocated to the case group, which consists of pregnant women diagnosed with IUGR in the Delivery Room of Airlangga University Hospital in Surabaya, and 22 samples allocated to the control group, which consists of pregnant women who delivered in the Delivery Room of Airlangga University Hospital in Surabaya without an IUGR diagnosis. The characteristics of the research samples include age, education, occupation, and parity.

Table 2. Distribution based on characteristics

Characteristics	Case Group	Control Group	Total	Percentage
Age				
20 – 25	9	13	22	50
26 – 30	12	8	20	45,5
31 – 35	1	1	2	4,5
Education History				
Elementary school/equivalent	1	1	2	4,5
Junior high school/equivalent	2	2	4	9,1
Senior high school/equivalent	15	15	30	68,2
Diploma III/equivalent	1	1	2	4,5
Diploma 4/S1/equivalent	3	3	6	13,6
Occupation				
Housewife	13	12	25	56,8
Employee	8	7	15	34,1
Nurse	1	0	1	2,3
Entrepeneur	0	1	1	2,3
Pharmacist	0	1	1	2,3
Trader	0	1	1	2,3
Parity				
Primipara	15	15	30	68,2
Multipara	7	7	14	31,8

The common age of the samples was 20 – 25 years old with the total half of the sample population. Most of the sample had education history in Senior high school/equivalent namely 30 people out of 44. In addition, most of them were

housewife. In total of 68,2% of samples were primipara.

Table 3. Frequency Distribution of Vitamin D Food Sources Consumption on Case and Control Group

No	Vitamin D Food Sources	Case Group n (%)	Control Group n (%)	Total n (%)
1	Beef/Chicken Liver			
	a. More than once a day	1 (4,5)	3 (13,6)	4 (9,1)
	b. Once a day	1 (4,5)	3 (13,6)	4 (9,1)
	c. 4-6 times a week	0 (0)	0 (0)	0 (0)
	d. 1-3 times a week	9 (40,1)	10 (45,5)	19 (43,2)
	e. Once a month	7 (31,8)	3 (13,6)	10 (22,7)
	f. Never	4 (18,2)	3 (13,6)	7 (15,9)
2	Chicken Egg			
	a. More than once a day	2 (9,1)	3 (13,6)	5 (11,4)
	b. Once a day	4 (18,2)	6 (27,3)	10 (22,7)
	c. 4-6 times a week	1 (4,5)	4 (18,2)	5 (11,4)
	d. 1-3 times a week	15 (68,2)	8 (36,3)	23 (52,2)
	e. Once a month	0 (0)	1 (4,5)	1 (2,3)
	f. Never	0 (0)	1 (4,5)	1 (2,3)
3	Fish			
	a. More than once a day	0 (0)	0 (0)	0 (0)
	b. Once a day	0 (0)	0 (0)	0 (0)
	c. 4-6 times a week	0 (0)	0 (0)	0 (0)
	d. 1-3 times a week	5 (22,7)	6 (27,3)	11 (25)
	e. Once a month	7 (31,8)	4 (18,2)	11 (25)
	f. Never	10 (45,5)	12 (54,5)	22 (50)
4	Shrimp			
	a. More than once a day	0 (0)	1 (4,5)	1 (2,3)
	b. Once a day	0 (0)	0 (0)	0 (0)
	c. 4-6 times a week	2 (9,1)	0 (0)	2 (4,5)
	d. 1-3 times a week	10 (45,5)	10 (45,5)	20 (45,5)
	e. Once a month	8 (36,3)	6 (27,3)	14 (31,8)
	f. Never	2 (9,1)	5 (22,7)	7 (15,9)
5	Mushroom			
	a. More than once a day	0 (0)	1 (4,5)	1 (2,3)
	b. Once a day	2 (9,1)	0 (0)	2 (4,5)
	c. 4-6 times a week	1 (4,5)	2 (9,1)	3 (6,8)
	d. 1-3 times a week	7 (31,8)	5 (22,7)	12 (27,3)
	e. Once a month	5 (22,7)	3 (13,6)	8 (18,2)
	f. Never	7 (31,8)	11 (50)	18 (40,9)
6	Cheese			
	a. More than once a day	0 (0)	2 (9,1)	2 (4,5)
	b. Once a day	1 (4,5)	1 (4,5)	2 (4,5)
	c. 4-6 times a week	1 (4,5)	3 (13,6)	4 (9,1)
	d. 1-3 times a week	8 (36,3)	7 (31,8)	15 (34,1)
	e. Once a month	5 (22,7)	4 (18,2)	9 (20,5)
	f. Never	7 (31,8)	5 (22,7)	12 (27,3)
7	Milk			
	a. More than once a day	1 (4,5)	4 (18,2)	5 (11,4)
	b. Once a day	4 (18,2)	4 (18,2)	8 (18,2)
	c. 4-6 times a week	1 (4,5)	1 (4,5)	2 (4,5)
	d. 1-3 times a week	12 (54,5)	6 (27,3)	18 (40,9)
	e. Once a month	1 (4,5)	1 (4,5)	2 (4,5)
	f. Never	3 (13,6)	6 (27,3)	9 (20,5)
8	Soymilk			
	a. More than once a day	1 (4,5)	5 (22,7)	6 (13,6)

	b. Once a day	6 (27,3)	6 (27,3)	12 (27,3)
	c. 4-6 times a week	4 (18,2)	4 (18,2)	8 (18,2)
	d. 1-3 times a week	7 (31,8)	6 (27,3)	13 (29,5)
	e. Once a month	1 (4,5)	0 (0)	1 (2,3)
	f. Never	3 (13,6)	1 (4,5)	4 (9,1)
9	Tofu & Tempeh			
	a. More than once a day	8 (36,36)	5 (22,7)	13 (29,5)
	b. Once a day	8 (36,36)	11 (50)	19 (43,2)
	c. 4-6 times a week	2 (9,09)	0 (0)	2 (4,5)
	d. 1-3 times a week	4 (18,2)	5 (22,7)	9 (20,5)
	e. Once a month	0 (0)	0 (0)	0 (0)
	f. Never	0 (0)	1 (4,5)	1 (2,3)

Most of the samples consumed Vitamin D sources from food 4-6 times a week, with the least frequent consumption occurring more than once a day. Half of the sample (50%) were never consume fish during their pregnancy. While it is obtained that 43,2% of the sample were consuming Tofu and Tempe at least once a day. Foods like egg, shrimp, and beef/chicken liver were consumed at least 1-3 times a week. Milk and its product, cheese, were also consumed by most of the sample at least 1-3 times a week.

Table 4. Chi-square Correlation Analysis between Frequency of Consumption of Food Sources of Vitamin D and Intrauterine Growth Restriction (IUGR)

Frequency of Vitamin D food sources consumption	Case group	Control group	Total (%)	*p-value*
Good	12	10	22 (50)	0.755
Less	10	12	22 (50)	

The table showed that similar numbers of people in both the case and control groups consume Vitamin D-rich foods regularly. This classification was based on each sample's consumption score compared to the average score of the entire sample group. Sample was interviewed about their Vitamin D food sources consumption during their pregnancy with Food Frequency Questionnaire (FFQ). After analyzing the data using a statistical test ($P > 0.05$), we found no strong link between how often people ate these foods and the likelihood of having Intrauterine Growth Restriction (IUGR).

Table 5. Chi-square Correlation Analysis between Frequency of Sun Exposure to Intrauterine Growth Restriction (IUGR)

Frequency of Sun Exposure	Case group	Control group	Total (%)	*p-value*
Regularly	8	20	28 (63,6)	0.000
Never	14	2	16 (36,4)	

The following data is the routine of sunlight exposure during pregnancy of all samples. It was found that 14 people (31.8%) sunbathed every day, and 13 others (29.6%) did so regularly. Meanwhile, 16 people (36.4%) never sunbathed during pregnancy. Overall, 28 people (63.6%) were regularly exposed to sunlight, while 16 people (36.4%) never were. There is a significant link between how often people were exposed to sunlight and the chance of having Intrauterine Growth Restriction (IUGR) ($P < 0.05$).

Table 6. Chi-square Correlation Analysis between Frequency of Vitamin D Supplement Consumption and Intrauterine Growth Restriction (IUGR)

Frequency of Vitamin D supplement consumption	Case group	Control group	Total (%)	*p-value*
Good	6	13	19 (43,2)	0.033
Less	16	9	25 (56,8)	

Out of 44 samples, 10 people in the control group (45.5%) regularly took Vitamin D supplements, compared to only 5 people in the case group (22.7%). Conversely, more people in the case group (63.4%) never consumed Vitamin D supplements, while in the control group, this number was lower at 2 people (9.1%). The frequency of supplement consumption was categorized into good and poor based on FFQ scoring, which compares each sample's consumption frequency against the group's average. This research indicated there is a significant relationship between the frequency of Vitamin D supplement consumption and the occurrence of IUGR ($P < 0.05$).

The average score of the entire sample group. Sample was interviewed about their Vitamin D food sources consumption during their pregnancy with Food Frequency Questionnaire (FFQ). After analyzing the data using a statistical test ($P > 0.05$), we found no strong link between how often people ate these foods and the likelihood of having Intrauterine Growth Restriction (IUGR).

DISCUSSION

This study found that 16 samples consumed Vitamin D-rich foods at a good frequency, while 28 samples were classified as consuming them less frequently. This assessment was based on each sample's consumption score compared to the overall sample mean value of 121. Foods included in the study's list of Vitamin D sources were beef/chicken liver, chicken eggs, fish, shrimp, mushrooms, cheese, milk, soy milk, tofu, and tempeh, all available in Surabaya markets or supermarkets.

The most frequent consumption of Vitamin D sources was chicken eggs, with 23 samples consumed them 1-3 times a week. Eggs are known for their various nutrients, including iron, protein, fat, cholesterol, Vitamin A, and Vitamin D. Consuming eggs, particularly boiled during pregnancy, is efficient in preventing anemia due to its accessibility[13]. Anemia is a risk factor for Intrauterine Growth Restriction (IUGR), which can lead to poor neonatal outcomes and perinatal mortality[14].

Beef/chicken liver more commonly consumed due to its affordability and nutritional richness in folate and iron, crucial during pregnancy[14]. Liver is also a source of Vitamin D, with chicken liver containing 2.7-5.3 mg/kg, contributing to maternal and fetal nutritional requirements[16]. Fish and shrimp are both seafood sources of Vitamin D, the study noted more frequent consumption of freshwater fish and shrimp, with shrimp known for its Vitamin D content. However, seafood consumption can increase exposure to pollutants like mercury, which can negatively impact pregnant women[17]. Sunlight exposure routines was also assessed during pregnancy for each sample. Overall, 28 samples were regularly exposed to sunlight, while 16 samples were not. Sunlight exposure during pregnancy is crucial. Studies highlight that 90% of Vitamin D primarily comes from UVB sunlight exposure, with the remaining 10% from food or supplements[18]. Recommendations suggest daily sunlight exposure without sunscreen for 10-15 minutes can maintain adequate Vitamin D levels in pregnant women[19]. Factors such as geographical location, skin color, and cultural norms influence ideal sunlight exposure levels during pregnancy[20]. Despite Indonesia's ample sunlight, previous research notes Vitamin D deficiency in women due to covered dressing habits influenced by culture and religion, even in tropical climates[21]. Studies from other countries like Saudi Arabia and Malaysia also highlight varying levels of sunlight exposure among pregnant women[21,22]. In this study, obtained that the frequency there were 25 samples never consumed Vitamin D supplement while the 19 others were regularly consumed it during the pregnancy. It is indicated a significant relationship between the frequency of Vitamin D supplement consumption and the occurrence

of IUGR (P < 0.033). Vitamin D supplementation during pregnancy is crucial for reducing the risk of various diseases, including preeclampsia. Adequate Vitamin D intake during pregnancy is recommended by the World Health Organization (2020) [23] and guidelines suggest a daily intake of 600 IU during pregnancy and lactation[24]. Research also suggests that appropriate Vitamin D supplementation may reduce risks such as preeclampsia, gestational diabetes, low birth weight (LBW), and postpartum hemorrhage[25]. Deficiencies in Vitamin D have been linked to several risk factors for IUGR, such as maternal diseases like diabetes mellitus and preeclampsia[6]. However, the direct impact of Vitamin D levels on placental function during pregnancy requires further investigation, despite evidence suggesting benefits for placental development and fetal growth, potentially reducing pregnancy complications like IUGR[26]. A study on Vitamin D supplementation during pregnancy have shown mixed results regarding fetal growth, with some indicating no significant effects[27], while in other studies suggest benefits in improving maternal and fetal Vitamin D status and insulin resistance[28,29]. Cohort studies have indicated increased fetal weight gain in pregnant women with IUGR complications receiving higher doses of Vitamin D supplementation (2000 IU) compared to lower doses [30].

CONCLUSION

In the research conducted on 44 women who delivered their baby at the delivery room of Airlangga University Hospital Surabaya, the following conclusions were achieved:

1. There is no significant relationship between consumption of Vitamin D food sources and IUGR
2. There is a significant relationship between the frequency of sunlight exposure and IUGR
3. There is a significant relationship between the frequency of Vitamin D supplement consumption and IUGR

Declaration by Authors

Ethical Approval: Approved
Acknowledgement: None
Source of Funding: None
Conflict of Interest: The authors declare no conflict of interest.

REFERENCES

1. Melamed N, Baschat A, Yinon Y, Athanasiadis A, Mecacci F, Figueras F, Berghella V, Nazareth A, Tahlak M, McIntyre HD, Da Silva Costa F, Kihara AB, Hadar E, McAuliffe F, Hanson M, Ma RC, Gooden R, Sheiner E, Kapur A, Hod M; FIGO (International Federation of Gynecology and Obstetrics) initiative on fetal growth: best practice advice for screening, diagnosis, and management of fetal growth restriction. Int J Gynaecol Obstet. 2021;152(Suppl 1):3-57. doi:10.1002/ijgo.13522
2. ACOG Practice Bulletin No. 204: Fetal Growth Restriction. Obstet Gynecol. 2019;133(2). Available from: https://journals.lww.com/greenjournal/Fulltext/2019/02000/ACOG_Practice_Bulletin_No__204__Fetal_Growth.39.aspx
3. Tesfa D, Tadege M, Digssie A, Abebaw S. Intrauterine growth restriction and its associated factors in South Gondar zone hospitals, Northwest Ethiopia, 2019. Arch Public Health. 2020;78:89. https://doi.org/10.1186/s13690-020-00475-2
4. Sharma D, Shastri S, Sharma P. Intrauterine growth restriction: antenatal and postnatal aspects. Clin Med Insights Pediatr. 2016;10. https://doi.org/10.4137/cmped.s40070
5. Albu AR, Anca AF, Horhoianu VV, Horhoianu IA. Predictive factors for intrauterine growth restriction. J Med Life. 2014;7(2):165-171.
6. Albu AR, Anca AF, Horhoianu VV, Horhoianu IA. Predictive factors for intrauterine growth restriction. J Med Life. 2014;7(2):165-171.
7. Sari MAP, Islamy N. Suplementasi vitamin D pada ibu hamil. J Med Hutama. 2020;02(01):402-406.
8. Aji A. Vitamin D in Pregnancy. J Arsip Gizi Pangan (ARGIPA). 2016;1:73-90.

9. Gernand A, Cantorna M, Diaz F, Snyder L, Hester J, Vasudevan S, Kamat M, Ott T. Prepregnancy Vitamin D Deficiency and Placental Development in Mice. FASEB J. 2015;29(S1). https://doi.org/10.1096/fasebj.29.1_supplement.lb259
10. Miliku K, Vinkhuyzen A, Blanken LME, McGrath JJ, Eyles DW, Burne TH, Hofman A, Tiemeier H, Steegers EAP, Gaillard R, Jaddoe VWV. Maternal vitamin D concentrations during pregnancy, fetal growth patterns, and risks of adverse birth outcomes. Am J Clin Nutr. 2016;103(6):1514-1522. doi:10.3945/ajcn.115.123752
11. Bodnar LM, Catov JM, Zmuda JM, Cooper ME, Parrott MS, Roberts JM, Marazita ML, Simhan HN. Maternal serum 25-hydroxyvitamin D concentrations are associated with small-for-gestational age births in white women. J Nutr. 2010;140(5):999-1006. doi:10.3945/jn.109.119636
12. Alimohamadi S, Esna-Ashari F, Rooy RSB. Relationship of vitamin D serum level with intrauterine growth retardation in pregnant women. Int J Womens Health Reprod Sci. 2020;8(2):221-226. doi:10.15296/ijwhr.2020.35
13. Purba TJ. Pengaruh Konsumsi Telur Ayam Ras Rebusterhadap Peningkatan Kadar Hb Pada Ibu Hamil Trimester Iii Di Puskesmas Simarmatakabupaten Samosir 2020. J Penelit Kebidanan Kespro. 2020;3(1):57-62. doi:10.36656/jpk2r.v3i1.393
14. Ganju DS. Maternal anaemia, intra uterine growth restriction and neonatal outcomes. Int J Clin Obstet Gynaecol. 2020;4(4):152-155. doi:10.33545/gynae.2020.v4.i4c.638
15. Purwandari A, Korompis MD, Tombokan S, Lontaan A, Lumbu A. Konsumsi hati ayam efektif meningkatkan kadar haemoglobin ibu hamil trimester II dan III. J Poltekkes Kemenkes Manado. 2022;01:128-138.
16. Schmid A, Walther B. Natural vitamin D content in animal products. Adv Nutr. 2013;4(4):453-462. doi:10.3945/an.113.003780.
17. Heppe DHM, Steegers EAP, Timmermans S, Breeijen H Den, Tiemeier H, Hofman A, Jaddoe VWV. Maternal fish consumption, fetal growth and the risks of neonatal complications: The Generation R Study. Br J Nutr. 2011;105(6):938-949. doi:10.1017/S0007114510004460.
18. Hendrawati S, Mardiah W, Febri RA, et al. Pemenuhan Vitamin D Pada Ibu Hamil Untuk Mencegah Stunting: Sebuah Narrative Review. J Ilmu Keperawatan Dan Kebidanan. 2024;15(1):50-67.
19. Dawodu A, Akinbi H. Vitamin D nutrition in pregnancy: Current opinion. Int J Womens Health. 2013;5(1):333-343. doi:10.2147/IJWH.S34032.
20. Dror DK. Vitamin D status during pregnancy: maternal, fetal, and postnatal outcomes. Curr Opin Obstet Gynecol. 2011;23(6):422-426. doi:10.1097/GCO.0b013e32834cb791.
21. Chee WF, Aji AS, Lipoeto NI, Siew CY. Maternal vitamin D status and its associated environmental factors: a cross-sectional study. Ethiop J Health Sci. 2022;32(5):885-894. doi:10.4314/ejhs.v32i5.3.
22. Al-Faris NA. High prevalence of vitamin D deficiency among pregnant Saudi women. Nutrients. 2016;8(2):77. doi:10.3390/nu8020077.
23. World Health Organization. WHO antenatal care recommendations for a positive pregnancy experience Nutritional interventions update: Vitamin D supplements during pregnancy. 2020.
24. ACOG Practice Bulletin No. 204: Fetal Growth Restriction. Obstet Gynecol. 2019;133(2). Available from: https://journals.lww.com/greenjournal/Fulltext/2019/02000/ACOG_Practice_Bulletin_No__204__Fetal_Growth.39.aspx
25. Palacios C, Kostiuk LK, Peña-Rosas JP. Vitamin D supplementation for women during pregnancy. Cochrane Database Syst Rev. 2019 Jul;7(7). doi:10.1002/14651858.CD008873.pub4.
26. Vestergaard AL, Andersen MK, Olesen RV, Bor P, Larsen A. High-dose vitamin D supplementation significantly affects the placental transcriptome. Nutrients. 2023;15(24):5032. doi:10.3390/nu15245032.
27. Roth DE, Leung M, Mesfin E, Qamar H, Watterworth J, Papp E. Vitamin D supplementation during pregnancy: state of the evidence from a systematic review of randomised trials. BMJ. 2017;359. doi:10.1136/bmj.j5237.

28. Hossain N, Kanani FH, Ramzan S, Kausar R, Ayaz S, Khanani R, Pal L. Obstetric and neonatal outcomes of maternal vitamin D supplementation: Results of an open-label, randomized controlled trial of antenatal vitamin D supplementation in Pakistani women. J Clin Endocrinol Metab. 2014;99(7):2448-2455. doi:10.1210/jc.2013-3491.
29. Gallo S, McDermid JM, Al-Nimr RI, Hakeem R, Moreschi JM, Pari-Keener M, Stahnke B, Papoutsakis C, Handu D, Cheng FW. Vitamin D supplementation during pregnancy: An Evidence Analysis Center systematic review and meta-analysis. J Acad Nutr Diet. 2020;120(5):898-924.e4. doi:10.1016/j.jand.2019.07.002.
30. Jakubiec-Wisniewska K, Huras H, Kolak M. Effect of vitamin D supplementation on the fetal growth rate in pregnancy complicated by fetal growth restriction. Children. 2022;9(4):549. doi:10.3390/children9040549.

How to cite this article: Thirza Alifia Putri Ariadwianto, Widati Fatmaningrum, Muhammad Ilham Aldika Akbar, Ernawati. Relationship between consumption of vitamin D food sources, sun exposure, and consumption of vitamin D supplements with intrauterine growth restriction at Airlangga University Hospital Surabaya. *International Journal of Research and Review*. 2024; 11(7): 490-498. DOI: *https://doi.org/10.52403/ijrr.20240752*

******