INDONESIAN HEALTH JOURNAL
https://ihj.rivierapublishing.id/index.php/rp
Volume 1 Number 1 September 2022
P-ISSN: 2963-3044
E-ISSN: 2963-3036

Description of Total Vitamin D25-OH in Toddlers and Children With Developmental Disorders

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Received: 25-08-2022 Accepted: 24-09-2022 Published: 28-09-2022

ABSTRACT

The age of children is a period in which the process of growth and development takes place. The existence of growth and development disorders in children is a serious problem for both developed and developing countries worldwide. The importance of monitoring growth and development requires adequate nutrition and nutrition, one of which is vitamin D. Vitamin D is a prohormone that plays an important role in the absorption of calcium in the intestine and helps harden bones by regulating the availability of calcium in the blood. This study aims to describe Total Vitamin D 25-OH in toddlers and children with growth and developmental disorders. The research sample was determined by purposive sampling technique based on inclusion and exclusion criteria. The research was conducted at Prodia Kramat Clinical Laboratory in March-April 2021. The D 25-OH level was checked from the patient's serum using the DiaSorin Liaison XL tool. Other variables measured to determine vitamin D status are appetite, eating frequency, nutritional adequacy, consumption of vitamin D supplements, outdoor activity, sunbathing, and genetic and environmental risk factors. Data from the examination of total vitamin D 25-OH levels and vitamin D status of the respondents were analyzed descriptively, then displayed in a table and described. The results showed that most respondents who were examined experienced stunting expected growth and development disorders by 76%, with total vitamin D 25-OH status experiencing insufficiency of 53%.

Keywords: children, toddlers, growth and development disorders, total vitamin D25-OH.

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INTRODUCTION

Children are the nation's next generation who deserve attention (Sugeng et al., 2019). Disruption of growth and development is a serious problem for developed and developing countries. According to (Hanafi, 2018), Human growth begins in the womb, infancy, early childhood, middle childhood and adolescence. Growth and development disorders that often arise in children include physical growth, motor development, language, emotions and behavior (White et al., 2022). In addition, the growth and development disorders of toddlers and children that are often encountered include speech delays (Hartanto, 2018), cerebral palsy (Utomo, 2013), Down syndrome, stunting, autism (Rahayu, 2014), mental retardation (Laily et al., 2020), and attention deficit hyperactivity disorder (DNA Putri et al., 2019). The importance of monitoring the growth and development of children requires adequate nutrition and nutrition as well as stimulation for children. One of the nutrients that must be fulfilled is a useful vitamin to help the body's metabolism and immune processes. According to (Tumiwa et al., 2020), there are several well-known groups of vitamins, namely, A, B, C, D, E and K. Vitamin D is the most often associated with bone growth and health. Therefore, the role of vitamin D is important. It is needed for optimal growth.

Vitamin D is a prohormone that plays an important role in calcium absorption in the intestine (Pusparini, 2018). The important role of vitamin D also helps harden bones by regulating the availability of calcium in the blood (MLP Putri et al., 2018). (Ernawati & Budiman, 2015) It was stated that vitamin D deficiency shows clinical signs such as rickets in children. Meanwhile, excess vitamin D causes

hypercalcemia and hypercalciuria (Ernawati & Budiman, 2015). Deficiency of vitamin 25 - OH D was also seen in 44.6% of children with CSF and 18.5% of healthy children (Toopchizadeh et al., 2018).

The normal level of vitamin D in the body determined by the Endocrine Society is the most widely used value in the medical world, 30 – 100 ng/ml. Vitamin D metabolism in the body is divided into two forms: vitamin D2 (ergosterol) and D3 (cholecalciferol) (Combs Gerald F. & McClung, 2022). Vitamin D in the body is not immediately in an active state, so vitamin D must be chemically modified by being hydrolyzed two times with the help of enzymes into the 25(OH) D form and the active form 1,25$(OH)_2$ D (Calcitrol) (Louisa, 2017). Vitamin D type 1.25$(OH)_2$ D in an active form binds to cell nucleus receptors, namely vitamin D receptors (VDR) in the kidneys, small intestine, and bones. In the Kidney, 1.25 $(OH)_2$ D, together with the parathyroid hormone, stimulates calcium reabsorption in the proximal tubule (Wadhwa et al., 2018). In the small intestine, 1.25$(OH)_2$ D stimulates the absorption of calcium and phosphate. 1.25$(OH)_2$ D and parathyroid hormone mobilize calcium and bone tissue by stimulating osteoclasts. In the bones, this hormone will provide a stimulus to carry out the process of bone destruction (resorption) by osteoclasts, causing levels of phosphate and calcium in the blood to increase. Levels of phosphate and calcium in the bones decrease. In starting the process of bone resorption, this hormone works based on its action target. There are two targets of action, namely against RANK-L (Receptor Activator of Nuclear Factor-Kappaß Ligand) and against OPG (Osteoprotegerin) (Herman, nd).

Measurement of serum 25(OH)D levels is the best indicator of vitamin D status because 25(OH)D reflects the production of skin vitamin D3 and vitamin D2 from food which has a life span in the blood circulation of 3-4 weeks (Dewi, 2017).

The results of previous research (Soesanti et al., 2013) showed that 75.8% of children aged 7-12 years had vitamin D levels in the insufficiency category and 15% in the deficiency category. Compared with previous studies, this study aims to look at the description of Total Vitamin D 25-OH in toddlers and children with characteristics that experience developmental disorders. This research is also to discover vitamin D's important role in children and toddlers, especially those with growth and developmental disorders.

METHOD

This study used a descriptive design with a cross-sectional approach to see an overview of total Vitamin D 25 (OH) conducted at the Prodia Kramat Clinical Laboratory in March-April 2021. The general population of this study was all toddler and child patients who had health checks in the laboratory. Prodia Kramat Clinic. The sample in the study was determined by purposive sampling based on inclusion and exclusion criteria. The procedures carried out were the preparation of tools and materials used for blood sampling, questionnaire forms, sample handling tools, DiaSorin Liaison XL tool for measuring levels of vitamin D 25(OH) Total. Furthermore, data were collected on pediatric patients diagnosed with growth and development disorders at the Prodia Kramat Clinical Laboratory. Blood samples were then taken from the patients to check Total Vitamin D 25-OH levels. After blood sampling, the patient's parents were asked to fill out a questionnaire form. The patient's blood sample was centrifuged at 1800g for 10 minutes and then separated by 300 – 500 µL of serum. The serum obtained is examined using the DiaSorin Liaison XL tool. The results obtained were validated and determined total Vitamin D 25-OH levels. Total Vitamin D 25-OH levels are said to be normal when within the reference value range of 30 – 100 ng/ml.

RESULTS AND DISCUSSION

Based on a study of 45 respondents under five and children with developmental disorders who did a Total Vitamin D 25-OH examination, it was found that the respondents owned most developmental disorders, namely with the characteristics of Stunting, Down Syndrome, Speech Delay

and Autism. As many as 34 respondents (76%) of the four characteristics are known to experience stunting the most (Table 1).

Based on vitamin D status, it was found that 24 respondents (53%) had the most insufficiency (Table 2). Insufficiency in vitamin D status was grouped based on age, sex, nutritional intake, and risk factors. The grouping results obtained were 15 respondents (62%) aged 5-11 years, 16 respondents (67%) were male, 19 respondents (79%) had a good appetite, 17 respondents (71%) ate 3-4x/day, 24 respondents (100%) have adequate nutrition, 22 respondents (92%) do not take vitamin D supplements, 18 respondents (75%) rarely do activities outside the home, 19 respondents (79%) never sunbathe in under the sun, 18 respondents (75%) did not have genetic risk factors, and 24 respondents (100%) did not have environmental risks (Table 3).

Table 1. Percentage of the Number of Respondents to The Characteristics of Growth and Development Disorders

Characteristics of Growth and Development Disorders	∑	%
stunt	34	76
Down Syndrome	4	9
Speech delay	4	9
Autism	3	6
Cerebral Palsy	0	0
Mental Retraction	0	0
Attention Deficit and Hyperactivity Disorder (GPPH)	0	0
TOTAL	45	100

Source: Prodia kramat Clinical Laboratory

Table 2. Percentage of the Number of Respondents to Total Vitamin D25-OH Levels

Vitamin D status	Number of Respondents	%
Sufficiency (normal / enough)	19	42
Insufficiency (not enough)	24	53
Deficiency (lack)	2	5
TOTAL	45	100

Description: -Sufficiency: 30-100 ng/mL; -Insufficiency: 21-29 ng/mL -Deficiency: 0-20 ng/mL
Source: Prodia Kramat Clinical Laboratory

Table 3. Status of Vitamin D on the Distribution of the Characteristics of the Respondents

Characteristics	Category	Sufficiency		Insufficiency		Deficiency	
		∑	%	∑	%	∑	%
Number of Respondents		19	42	24	53	2	5
Age	a. 0-<5 years	12	63	9	38	1	50
	b. 5-11 years	7	37	15	62	1	50
	TOTAL	19	100	24	100	2	100
Gender	a. Man	11	58	16	67	2	100
	b. Woman	8	42	8	33	0	0
	TOTAL	19	100	24	100	2	100
Appetite	a. Well	15	79	19	79	1	50
	b. Not good	4	21	5	21	1	50
	TOTAL	19	100	24	100	2	100
Meal frequency	a. 1-2 x	6	31	5	21	1	50
	b. 3-4 x	11	58	17	71	1	50
	c. >4x	2	11	2	8	0	0
	TOTAL	19	100	24	100	2	100
Adequacy of nutrition	a. enough	18	95	24	100	1	50

Characteristics	Category	Sufficiency		Insufficiency		Deficiency	
		∑	%	∑	%	∑	%
	b. Insufficient	1	5	0	0	1	50
	c. Insufficient	0	0	0	0	0	0
	TOTAL	19	100	24	100	2	100
Take supplements vitamin D	a. Yes	12	63	2	8	1	50
	b. Not	7	37	22	92	1	50
	TOTAL	19	100	24	100	2	100
Activities outside the home	a. Often (daily)	6	31	2	8	0	0
	b. Rarely (1-2 x a week)	11	58	18	75	2	100
	c. Never	2	11	4	17	0	0
	TOTAL	19	100	24	100	2	100
Sunbathe below sunlight	a. Often (at least 2-3 times)	13	68	5	21	0	0
	b. Never	6	32	19	79	2	100
	TOTAL	19	100	24	100	2	100
genetic risk factors	a. Yes	7	37	6	25	1	50
	b. Not	12	63	18	75	1	50
	TOTAL	19	100	24	100	2	100
Risk factor environment	a. Yes	0	0	0	0	0	0
	b. Not	19	100	24	100	2	100
	TOTAL	19	100	24	100	2	100

Based on the results of the study, out of 45 respondents who did a complete Vitamin D 25-OH examination, it was found that 34 respondents (76%) had stunting disorders. Stunting is a growth disorder due to malnutrition characterized by short stature compared to normal children of their age. This causes irreversible disturbances in children's physical development, causing a decrease in cognitive and motor abilities and decreasing work performance (Setiawan et al., 2018).

Maternal factors and poor parenting can also affect child growth and development disorders, especially in feeding behavior in children and mothers who lack nutrition during pregnancy. The importance of monitoring the growth and development of toddlers and children requires adequate nutrition and nutrition to prevent growth and development disorders. One of the vitamin nutrients that must be fulfilled is vitamin D. Total Vitamin D 25-OH levels are said to be normal if they are within the reference value range of 30 – 100 ng/ml.

The prevalence of vitamin D status in toddlers and children with growth and development disorders showed more insufficiency, namely, 24 respondents (53%). This research was previously conducted by (Soesanti et al., 2013), with the results of the study that 75.8% of children aged 7-12 years had vitamin D levels in the insufficiency category and 15% in the deficiency category. Vitamin D insufficiency is when the body does not get enough of this vitamin. It can also be considered mild vitamin D deficiency with 21-29 ng/mL (Dewi, 2017). The occurrence of vitamin D synthesis, according to (Pusparini, 2018), namely the manufacture of vitamin D in the skin, is the main source of prohormone, which begins with the process of exposure to UV B rays, damage to the pro-vitamin D (7-Dehydrocholesterol) B ring by UV light forms pre-vitamin D which then undergoes isomerization to vitamin D and then forwarded to the skin along with D Binding Protein (DBP) to the liver to form 25-OH D and then to the kidneys to form $1.25(OH)_2$ D. Physiologically vitamin D, calcium and phosphorus work together in the growth process. According to (MLP Putri et al., 2018), the function of vitamin D is to regulate that calcium and phosphorus are available in the blood to be deposited in the bone hardening process (Dewi, 2017). Adding Calcitriol increases the absorption of vitamin D by stimulating the synthesis of calcium-binding proteins and binding proteins of phosphorus in the mucosa of the small intestine in the gastrointestinal tract. Calcitriol, together with parathyroid hormone (PTH), stimulates the release of calcium from the surface of the bones into the blood. In the bones and the kidneys, Calcitriol stimulates the reabsorption of calcium and phosphorus. (Chairunnisa et al., 2018) Also added

that during the growth period, bone mineralization processes often occur; calcium deficiency will affect linear growth if the calcium content in the bones is <50% of normal levels, so calcium deficiency in the bones in infants can cause rickets, whereas in children can cause growth retardation. So, in this case, children with low vitamin D status are more likely to experience stunting.

According to the results of the research questionnaire, many children rarely play outside the home, with as many as 18 respondents (75%). All respondents showed a good appetite of 19 respondents (79%) and good eating frequency for 17 respondents (71%), and normal nutritional adequacy for 24 respondents (100%), but respondents experienced insufficiency. This is due to the possibility that the respondent's parents do not know enough about the proper nutrition needed by children; the most important thing is that children eat a lot and gorge themselves, but the nutritional content needed does not vary, especially the content of vitamin D. (Rahmi, 2019) said that children are strongly encouraged to eat foods that contain various nutrients in amounts according to their needs because the nutrients needed by boys and girls are different (Chairunnisa et al., 2018)—stated that a deficiency of micronutrients is proven to be one of the causes of stunted growth in children, especially when there is a deficiency of vitamin A, zinc, iron, iodine, and vitamin D.

Many respondents did not consume vitamin D supplements, as many as 22 respondents (92%). Intake from food alone is not enough to meet the adequacy of vitamin D, especially if macro and micronutrients need to be balanced. According to IDAI (2016), Indonesian children only consume a few foods rich in vitamin D. Eggs are often consumed but contain little vitamin D. Foods high in vitamin D, such as tuna, sardines, mackerel, and cheese, are still rarely consumed by Indonesian children. It also turns out that breast milk contains low levels of vitamin D, so that breastfeeding alone is not sufficient for vitamin D. Vitamin D supplements are recommended for infants 0-12 months, namely a dose of 400 IU/day, children > 12 months 600 IU/day.

Apart from food and supplement intake, vitamin D deficiency can also be prevented with sufficient sun exposure. It is advisable to sunbathe between 10.00-15.00, play a lot, or do activities outside. Meanwhile, respondents rarely do outdoor activities and bask in the sun. Genetic factors such as Down syndrome are also associated with low levels of vitamin D (Gomes et al., 2022). Low levels of vitamin D in the blood occur due to gene polymorphisms that affect vitamin D metabolism. (Setiabudiawan, 2016). Down syndrome is characterized by a total or partial interaction between chromosome 21 triplication and other factors that may play a role in clinical symptoms in sufferers (Meinapuri, 2013). People with Down Syndrome spend less time outside with sun exposure. Moreover, people with Down syndrome are obese with a history of auto-immune disease, which shows low levels of 25-OH D (Graziani et al., 2011). Environmental factors such as low access to health services, sanitation, water, and child care affect children's growth (Geere & Hunter, 2020).

CONCLUSION

Growth and development disorders in children and toddlers are dominated by stunting conditions, and most of them experience vitamin D insufficiency in the body. Suggestions for further research can be carried out further research to see a comparison of total vitamin D 25-OH levels with vitamin D $1,25(OH)_2$, which is the active form of vitamin D.

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