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THE STUNTING SITUATION AND PREVENTIVE EFFICACY IN CHILDREN AGED FROM 12 TO 36 MONTHS AT KIMDONG, HUNGYEN IN 2017

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INTRODUCTION

Malnutrition in general, stunting in particular is still an interessted public health problem. The stunting is a delayed high developmentof children compared with their age, only attaining less than 90% comparing with reference population, realising a chronic malnutrition. According to WHO and UNICEF, although the stunting reduced in global level, its mortality is really high, 29.5% to 22.9% in the middle of year 2005 and year 2016, and it at least influenced the mortality in children under 5.

The stunting was a disease that can be intervened to reduced its morbidity and its consequence. In Vietnam, the stunting has already reduced but it was still in high leve; from 29.3% in 2010 to 24.6% in 2015. In Hung Yen, the stunting rate was high that ranged from 23.7% to 31.8%. According to the report of Nation Nutritional Institute in 2017, Viet Nam belonged to 20 countries in which people' s height was the lowest, particularly, mean height of adult increased least comparing to the world's. In Viet Nam, some studies about Vitamin D showed that the Vitamin D deficiency and efficiency incidence ranged from 21% to 60%. The intervention in the community improved malnutrition status in children under 5. However, the stunting reduced but it was still high. Is there some factors else that impact on the stunting still unsolved.

The intervention by supplying Vitamin D for children has already proved to have high preventive efficacy and high results in the treatment of Vitamin D deficiency. The supplementation of Vitamin D combining with adequate diet, all-round care helped children improve their height and bone density. An issue to be studied is why the stunting is prevalenct in children aged from 12 to

36 months. This question need to have scientific evidences that lead us to carry out this study name "The situation of stunting and the preventive efficacy in children aged from 12 to 36 months at Kim Dong, Hung Yen in 2017" with the following objectives:

1. To determine the stunting incidence, the Vitamin D concentration and some risk factors in children aged from 12 to 36 months in Kim Dong, Hung Yen in 2017.

2. To evaluate the preventive efficacy by supplying Vitamin D and all-round child care to improve the stunting situation in chldren aged under 36 months.

Thesis significance:

- The study evaluated the situation of deficient and insufficient Vitamin D in 12-36 months group in Kim Dong, Hung Yen in 2017, determined the nutritional status in this age group that was golden chance to catch up the normal height development.

- The community intervention such as Vitamin D supplementation and all round care for children less than 36 months old helped them develop their height and improve the stunting status.

-Thesis results were the scientific evedences to take the intervention solutions, demonstrated their preventive efficacy, and reality values in the prevention and fight against the stunting in Vietnam.

Thesis struture: The thesis with 119 pages (not including references and appendices), included the following parts: Introduction (2 pages), Overview (32 pages), Subjects and Method (22 pages), Results(31 pages), Discussion (33 pages), Conclusions (2 pages), Recommendation (1 page). The thesis has 42 tables, 03 chart, dia04 figures, 158 references and appendices.

CHAPTER 1
OVERVIEW

1.1. Some concepts about stunting malnutrition

1.1.1. Malnutrition definition

Malnutrition is a condition that results from the lack of protein – engergy and micronutrient dificiency. Malnutrition frequently encountered in children under 5, manifested by delayed growth and accampanied by bacterial infections. Nowaday, Malnutrition is considered a condition that lacks more micronutrients than simple protein-energy deficiency.

1.1.2. Classification of malnutrition

The stunting is a malnutrition having Zscore height for age less than - 2 SD compared with reference population. A low height for age showed malnutrition in the past.

Zscore <-2SD was chosen to be a cutoff. A child who has Zscore < - 2 SD is malnourished. The more a child has low Zscore, the more he/she malnourishes. In 2006, WHO declared the new Child Growth Standards that called WHO 2006 standards.

1.2. The situation of stunting in Viet Nam

Viet Nam is one of 36 countries that has the highest incicdence of malnutrition in global level. According to the statistics in 2010, in Viet Nam, among about 7.6 millions of children under 5 years, 2.1 millions suffered from the stunting, meaning every 3 children under 5 one having the stunting. In general, malnutrition is still an issue of public health in Viet Nam. Beside, the stunting condition has a big difference between regions and lands.

The distribution according to age group and gender:

The stunting incidence in children under 12 months was not high, particularly in children under 6 months; from 12 months, the stunting incidence gradually increased maintained high incidence to 59 months in both sexes. In the majority of age group, the stunting incidence in boys was higher than that of girls but the difference was not statistically significant.

In general, compared to the WHO's criteria, the stunting in children of our country was still in high level. So, the Ministry of Health has launched a Program fighting against malnutrtion in children with the objective to reduce the stunting incidence to 23% in year 2020.

1.3. The role of Vitamin D for child growth

1.3.1. Biosynthesis of Vitamin D in the body

Vitamin D is an oilment soluble Vitamin D, exsisting under 2 main forms that are Vitamin D_2 and Vitamin D_3. In this study, Vitamin D_3, the most common form used in the market and in medicine was administered instead of Vitamin D_3.

1.3.2. The role of Vitamin D for the child growth

1.3.2.1. The role of Vitamin D for the child growth

Vitamin D has an important role for the skeleton, helping it develop and grow. Vitamin D has an important role in the development and in the differenciation of the cartilage cells and osteoblasts,. Its biological functions impact on osteoblasts and their differenciation. The lack of Vitamin D or their receptors are demaged ìnluencing the height growth.

1.3.2.2. The need of Vitamin D and calcium for the body

In Viet Nam, accordintg to the recommendation of the Ministry of Health, the need of Vitamin D for children from 1 to 3 years old was 10 mcg (corresponding to 400 IU) per day, the need of calcium for children from 1 to 2 years is 500 mg, from 3 to 600mg per day.

1.3.2.3. Side effects and toxic dose of Vitamin D

According to the international consensus about the prevention and the treatment of nutritional ricket in 2016 of Muns CF et al, the toxic dose of Vitamin D is defined as the concentration of calcium and 25OHD >250 nmol/L together with increased calciuria signs and reduced PTH. The evidence for the toxication that children have administered the Vitamin D dose of 240.000 to 4.500.000 IU. In the toxication, calciuria and blood calcium increase for longtime that lead to renal stone.

1.3.3. Situation of Vitamin D deficiency and insufficiency and intervention study by supplying Vitamin D

Many studies in the world showed that Vitamin D deficiency and insufficiency was very prevalent and that affected bone health and other disseases but in Vietnam, a little of such studies were done. According to Vu Thi Thu Hien (2014) in small children the Vitamin D deficiency and insufficiency incidence at the cutoff less than 50 nmol/l was 23.6% and less than 75 nmol/l was 40.7%.

The study of Abrams A Steven showed that the elective dose of 1000 IU per day was recommended for all age group and after 8 weeks of Vitamin D supplementation, the statistically significant relationship between the 1,25 $(OH)_2$ Vitamin D concentration and the calcium absorption. In Canada, an author estimated that the Vitamin

D supplementation for the need, each day, infants must be supplied 400 to 1000 IU and for toddlers to 18 years old must be supplied from 600 to 1000 IU.

In 2017, Tran Thi Nguyet intervened by supplying high dose of Vitamin D3 combining with the died rich in calcium for stunted children and showed that the Vitamin D deficiency and insufficiency was 49.0%. After of 6 months of the intervention, the Vitamin D concentration increased to 83.95 ± 55.32 nmol/l (attained 133.01± 55.83 nmol/l), the Vitamin D deficiency and insufficiency reducded to 97.37% compared with before the intervention. In the intervention group, the difference mean height 5.7± 1.2 cm higher than that of the control 4.8 ± 1.4 cm with p <0.001. The stunting incidence reduced to 15.8 % compared with the control with p <0.05.

Chapter 2
SUBJECTS AND METHOD

2.1. Subjects, time and studied place

The study was done in children aged from 12 to 36 months and their mother/main care-giver (main care-giver is a person who feeds the child daily), studied time was from 10/2017-12/2018 at Kim Dong, Hung Yen.

2.2. Method

2.2.1. Type of study

- The study was divided into 2 stages.

Stage 1

The cross-sectional study was done to estimate the incidence of stunting, deficiency/effeciency of Vitamin D according to age

group and gender and describe some risk factors related to the stunting and deficiency/effeciency of Vitamin D. These factors were the scientific basis to start the intervention solutions to improve the stunting status in children aged from 12 to 36 months at Kim Dong, Hung Yen in 2017.

Stage 2

The study was the community in in children aged from 0 to 24 months during 12 months, intervention done in 02 communes, 1 commune for intervention and 1 for control, compared before (*stage 1 population*) and after (*the population at the 12th of stage 2*) with control group.

Intervention solutions included: Taking one dose of Vitamin D 200.000UI having the effect in 12 months, combining with all-round care such as couseling maternal feeding, child diet, and preventing some bacterial infections like acute respiratory infections and acute diarrhea.

2.2.2. Sample zise and sampling process

2.2.2.1. Sample size for the cross-sectional study

The sample size was calculated based on the national incidence of stunting that was 24,6%. The least number of subjects for the study was 327 aged from 12 to 36 months and their main care-givers.

Sample zise was chosen by a multistage Sampling Process.

2.2.2.2. Sample zise to assess after the control

After the community intervention (Intervened commune: Vinh Xa, controlled commune: Hiep Cuong), we randomly chose 73 subjects in the intervened commune and 69 subjects in the controlled communed according to systematic method (similar to that of the

first stage). Among them, 60 subjects for each commune were determinded the Vitamin D concentration. This sample was used to compare the Vitamin D concentration after the intervention.

2.3. The studied content

2.3.1. Indices and variables

2.3.1.1. Some informations about studied subjects: Gender, child age, maternal age, maternal profession, maternal income, and maternal education level.

2.3.1.2 Stunting incidence

- The common incidence of stunting and according to age group and gender.
- Stunting severity according to age group and gender.

2.3.1.3. Vitamin D defficiency and efficiency incidence

Common incidence and incidence according to age group and gender.

2.3.1.4. Some risk factors

- Child side: Gender, age group, gestational age, birth weight, full maternal feeding in the first 6 months, adequate vacination according to the schedule, micronutrient supplementation according to the schedule, weaning time, already sufferd from bacterial infections, anemia, number of hours to sun exposure/week.
- Maternal side: Maternal age, maternal profession, income, maternal education level, maternal height, gaining weight during pregnancy, maternal nutrient supplementation during pregnancy.

2.3.1.5. Informations after the intervention

- Age, gender, child height, Vitamin D amount.

- Incidence of deficiency and efficiency of Vitamin D after the intervention (Intervention and control): common, according to age group and gender and preventive efficacy.

- Incidence of the stunting after the intervention (Intervention, control): Common, according to age group and gender and preventive efficacy.

2.3.2. Collecting informations

Stage 1

- Anthropometry of children aged from 12 to 36 months to determine the mean height, the incidence of stunting of studied subjects.

- Interviewing care-givers about some risk factors related to the stunting and Vitamin D deficiency and efficiency.

- Blood taking to determine Vitamin D amount and the incidence of deficiency and efficiency of Vitamin D.

Stage 2

- Anthropometry to determine the improvement of height and the incidence of the stunting

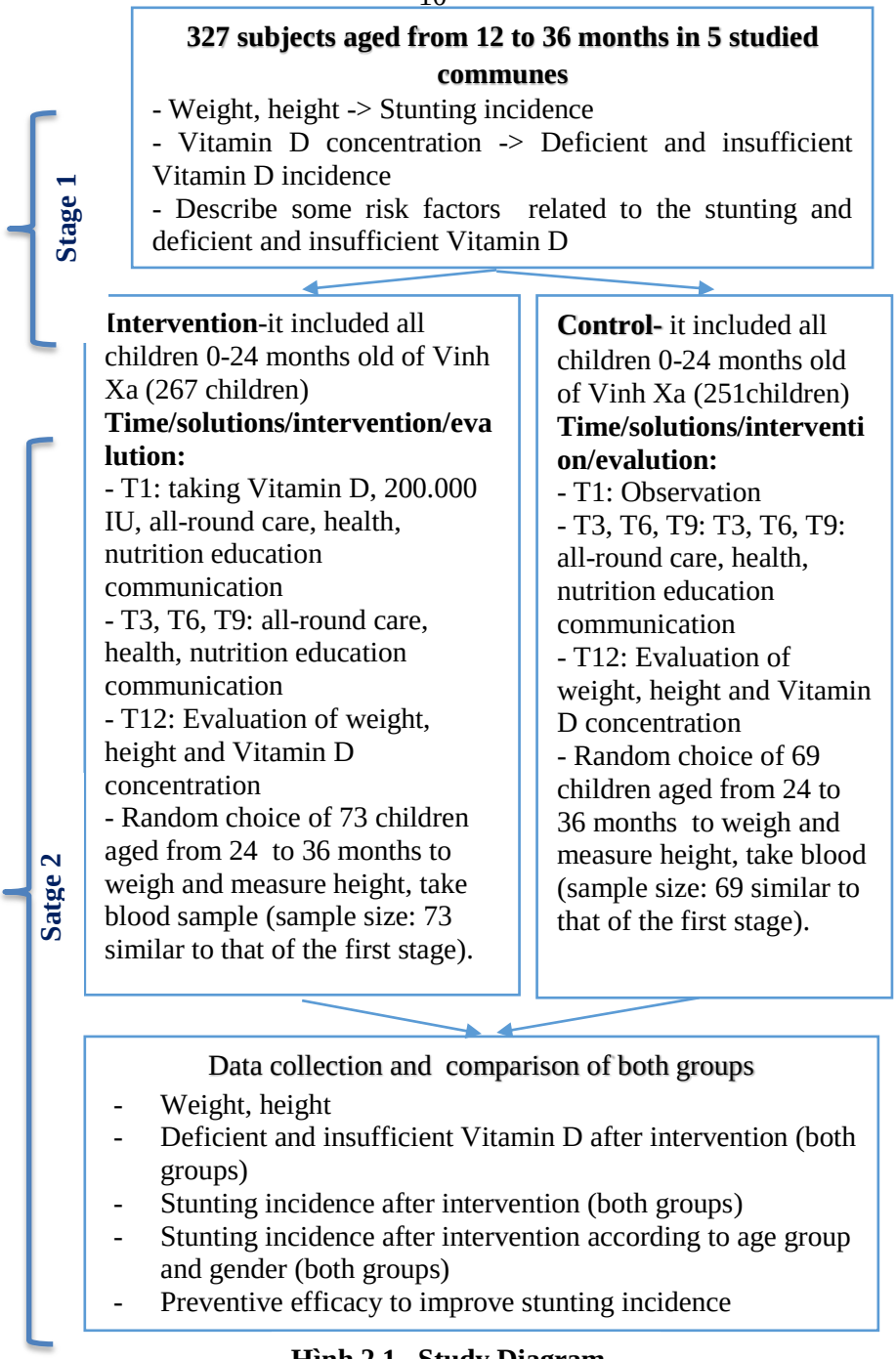
- Blood taking to determine the Vitamin D amount and the change of the stunting incidence

2.3.3. Observation and evaluation during the intervention

Intervention time: 12 months. During the intervention, the observation and assessment were done in the 3^{rd} month, the 6^{th} month, the 9^{th} month and final assessment on the 12^{th} month (T12).

2.4. Data analysis

Data analysis were done by using Anthro - WHO 2006 and SPSS 20.0 sotfware packages.



Hình 2.1. Study Diagram

Chapter 3
STUDIED RESULTS

3.1. The situation of stunting and Vitamin D concentration and some risk factors

Table 3.5: Mean height (cm) according to age group and gender

		n	Mean (cm)	SD(cm)	p
Age (Months)	12 - <24	167	79.03	4.97	>0.05
	24 - 36	160	88.47	4.97	
Gender	Boys	173	84.05	6.55	>0.05
	Girls	154	83.19	7.18	
	Common	**327**	**83.65**	**6.85**	

T - test was used to compare 2 means

Mean height of 12 - <24 months group was 79.03 cm lower than that of 24 - 36 months group 88.47 cm. Mean height of boys was 84.05 cm higher than that of girls 83.19 cm. However, the difference was not statistically significant in both groups with p>0.05.

Table 3.7: The stunting incidence according to the age group and gender

		Number of studied subjects (n)	**Number of stunted subjects (n)**	**Incidence (%)**	**p**
Age (month)	12 - <24	167	42	25.1	>0.05
	24 - 36	160	35	21.9	
Gender	Boys	173	45	26.0	>0.05
	Girls	154	32	20.8	
	Common	**327**	**77**	**23.5**	

χ^2 test was uswd to compare 2 incidences

There were 77/327 subjects who were suffered from the stunting accounnted for ***23.5%***. The stunting incidence in the 12 - <24 monhts group was 25.1% higher than that of the 24 - 36 age group 21.9% but the difference was not significant (p>0.05). The stunting incidence of boys was icantly higher than that of girls 26.0% and 20.8% respectively p>0.05).

Table 3.11: The Vitanmin D deficiency and insufficiency incidence according to the age group and gender (<30 ng/ml)

		Number of studied subjects (n)	Number of stunted subjects (n)	Incidence (%)	p
Age (month)	12 - <24	167	71	42.5	>0.05
	24 - 36	160	85	53.1	
Gender	**Boys**	173	81	46.8	>0.05
	Girls	154	75	48.7	
	Comon	**327**	**156**	**47.7**	

χ^2-test was used to compare 2 incidences

The common Vitamin D deficiency and insufficiency incidence was 47.7%; The Vitamin D deficiency and insufficiency incidence in the 12 - <24 months group was lower the 24-36 months group (45,2% and 53,1% respectively). Similarly, which boys was lower to that of girls (48.7% and 46.8% respectively with p>0.05).

Table 3.15: The association of stunting with some risk factors (Multinomial regression)

Risk factors		Stunting		OR, 95%CI variate regression	OR, 95%CI Multinomi-nal regression
		Yes	No		
Birth weight	<2500g	9	5	6.48 2.10– 19.99	5.57 1.63-18.95
	≥2500g	68	245		
Deficient and insufficient Vitamin D	Yes	48	108	2.18 1.29 – 3.68	2.28 1.3-4.01
	No	29	142		
Totally maternal breasfeeding in the first 6 monhts	Yes	44	109	1.72 1.03 - 2,89	1.76 1.009-3.09
	No	33	141		
Maternal breastfeeding weaning before 12 months	Yes	33	70	1.93 1.34 – 3.27	2.37 1.33-4.22
	No	44	180		
Having already suffered from bacterial infections	Yes	47	103	2.12 1.26 – 3.56	1.83 1.04-3.2
	No	30	147		

When analyzing multinomial regression, the final model remained 5 variables the were statistically significant with the stunting. They were low birth weight, deficient and insufficient Vitamin D, not totally maternal breasetfeeding in the first 6 months, breastfeeding wean before 12 months, having already suffered from bacterial infections.

Table 3.20: The relation of stunting with some maternal risk factors (Multinomial Regression)

Risk factor		Stunting		OR, 95%CI Variate analysis	OR, 95%CI Multinomial regression
		Yes	No		
Maternal height	<150 cm	12	15	2.89 1.29 – 6.48	2.69 1.17-6.16
	≥150 cm	65	235		
Maternal gain weight during pregnancy	<12 kg	45	102	2.04 1.22 – 3.43	1.98 1.17-3.36
	≥ 12 kg	32	148		
Nutrient supplementation during pregnancy	No	15	22	2.51 1.23 – 5.12	2,33 1.12-4.86
	Yes	62	228		

When analyzing multinomial regression, the stunting were significantly associated with maternal height less than 150 cm, maternal gain weight less than 12 kg during pregnancy, mother not supplemented nutrients during her pregnancy with OR 2.69, 1.98 and 2.33 respectively ($p<0.05$). No variable was eliminated from the final model.

3.2. Preventive efficacy to reduce the stunting incidence after 12 months of intervention

Table 3.28: The preventive efficacy to improve the Vitamin D defficency and efficiency rate (%) (Stage 1 and T12 – stage 2)

Studied place	Before inter-vention (%)	After interven-tion (%)	Improved incidence (%)	Preven-tive Efficacy (%)	p
Innterven -tion group	38.9 (n=73)	18.2 (n=60)	20.7	53.21	<0.01
Control group	46.4 (n=69)	44,2 (n=60)	2.2	4.74	>0.05
p	>0.05 (0.368)	<0.01			

χ^2 used to compare 2 incidences

In the intervention group, the deficient and insufficient Vitamin D incidence reduced 20.7% after the intervention and the difference was statistically significant with p<0,05. The preventive efficacy was 53.21%. In the control, the deficient and insufficient Vitamin D incidence reduced 2.2% and the preventive efficacy was 4.74% and the difference was not significant with p>0,05. When comparing the deficient and insufficient Vitamin D in 2 groups, we did not find any differnce but we found the difference between groups after the intervention (p<0.01).

Table 3.30. The change of mean height (cm), HAZ, and the stunting incidence (%) after the intervention (T12 –stage 2)

Indices	Control group (n = 69)	Intervention group (n = 73)	p0
Mean height (cm)			d
T0 (0-24 months)	69.76 ± 9.28	71.97 ± 8.38	>0.05
T12 (12-36 months)	82.38 ± 6.55^{*c}	85.79 ± 6.51^{*c}	<0.05
Difference T12-T0	12.62 ± 2.73	13.82 ± 1.2	<0.01
HAZ-score			d
T0 (0-24 months)	-1.33 ± 0.93	- 0.94 ± 1.15	<0.05
T12 (12-36 months)	-0.95 ± 1.40$^{\#c}$	-0.22 ± 1.06^{*c}	<0.05
Difference T12-T0	-0.38 ± 0.96	-0.72 ± 0.09	<0.01
Stunting incidence (%)			b
T0 (0-24 months)	20 (29.0%)	15 (21.7%)	>0.05
T12 (trẻ 12-36 months)	16 (21.9%)$^{\#b}$	7 (9.6%) $^{\#b}$	<0.05
Difference T12 – T0	4 (7.1%)	8 (12.1%)	<0.05

Data was presented in mean ± SD, n (%). b: χ^2 test, comparison of 2 means; c: paired -t test d: Man-Whitney test, comparison of mean. p0: comparison with the control; *: p <0.05, $^{\#}$: p>0.05 comparison with T0 in group.

Mean height of the intervention and control increased significantly compared with T0 but in the intervention the mean height increased more (1.2cm). In T12, mean height in the intervention improved more than that in the control (85.79 cm vs 82.38 cm respectively p<0.05).

In the intervention, in T12, HAZscore reduced -0.72 compared with T0 (p<0.05), the control reduced only -0,38 compared with T0 (p>0.05).

The change of the stunting in both groups after and before the intervention were not significant but the improvement of the intervention was better than that of the control (12.1% vs 7.1% and p<0.05).

Table 3.33: The comparison of mean height (cm) of intervention and control groups before and after intrervention (Stage 1 and T12 of stage 2)

Studied place	Before intervention	After intervention	Improved mean height (cm)	p
Intervention group	(n=73) 83.14±6.81	(n=73) 85.79 ± 6.51	2.65 ±0,3	<0.05
Control group	(n=69) 82.37 ± 6.55	(n=69) 83.61 ± 6.59	1.24 ± 0.04	>0.05
p	>0.05	<0.05		

The mean height in the intervention increased 2.65 ±0.3 cm (p<0,05) while the mean height in the control improved only 1,24 ±0.04 cm that was not significant different compared with before the intervention with p>0,05.

The mean height of both groups before the intervention was similar (p>0.05) but after the intervention, the mean height of the intervention was higher than that of the control with p<0.05 (85.79 ± 6.51 cm vs 83,61 ± 6,59 cm respectively).

Table 3.36: The Preventive Efficacy to reduce the stunting incidence after intervention (%) (Stage 1 and T12 of stage 2)

Studied place	Before interven -tion (%)	After interven -tion (%)	Difference before/ after interven- tion (%)	Preven -tive effficacy (%)	p
Interven- tion group	(n=73) 24.7	(n=73) 9.6	15.1	***61.1***	<0.05
Control group	(n=69) 23.2	(n=69) 21.7	1,5	6.5	>0.05
p	>0.05 (0.837)	<0.05			

χ^2 used to compare 2incidences

In the intervention group, after the intervention, the stunting incidence was 9.6% lower than that of before the intervention 24.7% with p<0.05. The incidence improved 15.1% compared with before the intervention and the preventive efficacy was 61.1%.

In the control group, after the intervention, the stunting incidence was 21.7% lower than that of before the intervention 23.2% that improved 1.5% and the preventive efficacy was 6.5%. The difference of stunting incidence before and after the intervention was not significantly different with p>0.05.

The preventie efficacy of the intervention was 61.1% while in the control it was 6.5%.

Chapter 4
DISCUSSION

4.1. The stunting incidence, Vitamin D amount and some risk factors in children aged from 12 to 36 months in Kim Dong, Hung Yen in 2017

4.1.1. The situation of the stunting in Kim Dong

Among 327 studied subjects, 77 children were malnourished accounting for 23.5%. Our stunting incidence was corresponding to that of Tran Thi Nguyet Nga in 2017 (23.5% vs 25.9%) and lower than that of National Institute of Nutrition in 2015 (24.6%). According to Nguyen Anh Vu when interviewing to improve the stunting in children aged from 12 - 23 months group at Tien Lu, Hung Yen showed that the stunting incidence was rather high (29.4%, vs 23.5% respectively). According to Dinh Dao the stunting incidence in children under 5 in Bac Tra My, Quang Nam in 2014 was 62.8% much higher than that of ours.

4.1.2. The situation of Vitamin D insufficiency and deficiency

Among 327 studied subjects, 156 children were in Vitamin D deficiency and insufficiency that accounted for 47.7% . There was not difference between sexes in Vitamin D deficieny and insufficiency (46.8% and 48.7% respectively and $p>0.05$). The deficient and insufficient Vitamin D incidence in the 24 - 36 months group (46.9%) was not significantly higher than that of the 12 - <24 months group (42.5%) with $p>0.05$.

When comparing to results in Viet Nam in 2013 in children from 6 months to 6 years old in 19 provinces in the whole country we fount that the deficient and insufficient Vitamin D incidence with the cutoff less than <50 nmol/l was 50% . This incidence was a little

bit higher than that of ours 47.7%. The difference can be explained by enfluencing the studied time, the age group, and sample zise.

4.1.3. Some risk factors related to the stunting

Our research showed some risk factors from child and from mother while variate and multinomial analysis. In child side, multinomial analysis showed that birth weight less than 2500g (OR=6.48), deficient and insufficient Vitamin D (OR=2.18), not totally breastfeeding in the first 6 months (OR=1.72), weaning before 12 months (OR=1.93), having alreasy suffered from bacterial infections (OR=2.11) were related to the stunting. In mother, the final model showed that maternal height less than 150 cm (OR=2.89) and maternal gain weight less than 12 kg during pregnancy (OR=2.04) and maternal nutrients supplementation during pregnancy (OR=2.51) were strongly associated with the stunting. Similarly, when analyzing some risk factors relating to the stunting, Tran Thi Nguyet Nga found that birth weight less than 2500 g (OR=2.2), having already suffered from acute diarrhea (OR=2.1) were associated with the stunting in the multinomial model, maternal age, profession, and child gender were not associated with the stunting.

4.1.4. Some risk factors related to deficient and insufficient Vitamin D

In the table 3.5 was results of the association of deficient and insufficient Vitamin D with risk factors. In the final model of multinomial analysis, some significant risk factors remained were not having totally breasfed in the first 6 months (OR=2.34), weaning before 12 months (OR=2.22), not adequately vacinated (OR=4.05), sun exposure less than 6 hours per week (OR=2.34). So the mecanism of deficient and insufficient Vitamin D was not adequately

supplied by breastfeeding and early weaning. Moreover, the synthesis of Vitamin D through the skin was limited due to less sun exposure. Finally, I found that children who were not adequately vacinated frequently suffered from infections increasing the comsuption of Vitamin D. This discovery was the basis for some intervention solutions to improve the deficient and insufficient Vitamin D.

To prevent the deficient and insufficient Vitamin D in our subjects, firstly mother must change the concept of maternal breastfeeding and time to breastfeed, and let children to sun exposure and adequately being vacinated.

The study found that children have not totally breastfed in the first 6 months and early weaned were related to the deficient and insufficient Vitamin D and the stunting. This was a reality because mother has to quit her job in the field for new job in the company and in the factory far from her home so she has to wean early. According to Le Nam Tra, maternal milk is an important source of Vitamin D for children. So, a child is in deficient and insufficient Vitamin D leading to malnutrition.

Tran Thi Nguyet Nga showed that birth weight less than 2500 g (OR=3.2), early weaning (OR=4.3) were related to deficient and insufficient Vitamin D. Maternal nutritent supplementation, sun exposure $\geq$ 30 minutes/day, acute diarrhea, acute respiratory infections, lipid diet, Vitamin A, Zn, Magnesium were not significantly associated with deficient and insufficient Vitamin.

In our study, birth weight less than 2500 g was strongly associated with deficient and insufficient Vitamin D. A child with birth weight less than 2500g suffered from deficient and insufficient

Vitamin D 2.5 times higher than that of a child ≥2500g with p<0.05. A child with early weaning less than 12 months suffered from deficient and insufficient Vitamin D higher than that of a child with weaning more than 12 months with p<0.05. The Vitamin D source for the body was mainly sun exposure so mother need to be aware of the role of sun exposure to prevent a child from deficient and insufficient Vitamin D.

4.2. The preventive efficacy to reduce the deficient and insufficient Vitamin D incidence

***4.2.1.* The change of deficient and insufficient Vitamin D**

The result showed the preventive efficacy to reduced the deficient and insufficient Vitamin D incidence in the intervention and the control group in the T12 -the second stage and the first stage. While comparing the change of Vitamin D concentration in the intervention and the control group, we found that the incidence reduced 20.7%, sự khác biệt tỷ lệ trước can thiệp (38,9%) và sau can thiệp (18,2%) có ý nghĩa thống kê with p<0.05. We did not find the change in the control group (p>0.05).

The preventive efficacy was 53.21% (p<0.05) in the intervention but in the control, the improvement before and after the intervention was not significantly difference (46.4% vs 44.2% respectively with p>0.05). The comparison of the defficient and insufficient Vitamin D incidence before the intervention in both groups, we did not find any difference with p>0.05 (0.368) but the differerence was found after the intervention in both groups (18.2% in the intervention and 44.2% in the control and p<0.01).

Our results were similar to that of Tran Thi Nguyet Nga in Hai Duong. According to the author, the deficient and insufficient

Vitamin D was improved after 6 months intervention. In the intervention group, the Vitamin D concentration at the T6 was significantly higher than that of the T0 with $p < 0.05$ while the author did not find the change significantly in the control.

4.2.2. The change of stunting incidence

When we compared the mean height between groups after the intervention. The intervention group improved 2.65 cm compared with that of before the intervention ($p<0.05$) while the control improved only 1.24 cm but it was not different from that before the intervention ($p>0.05$). Meanwhile, in the control group the mean height increased only 0.77 cm, and this difference was not significant ($p>0.05$). The mean height in the intervention group did not differed from that of the control group ($p>0.05$) but the mean height of the intervention group (85.79 ± 6.51 cm) was statistically higher than the control group (83,61 ± 6,59 cm).

In our study, the stunting incidecence in the intervention group reduced from 24.7% to 9.6%, improved 15.1% and the preventive efficacy was 61.1%, the difference was significant compared with that of before the intervention, $p<0.05$. In the control group, the stunting incidence before and after the intervention was unchanged (23.2% and 21.7%, respectively), just reduced 1,5% and the preventive efficacy was 6.5%.

According to Tran Thi Nguyet Nga, the difference between groups at the T6 was statistically significant, $p < 0.001$, the intervention was higher than that of the control 0.92 cm. When comparing the mean height at the T6 and T0 in group, the mean height was higher in both groups $p<0.05$.

CONCLUSION

1. Stunting and deficient and insufficient Vitamin D situation, and some risk factors

- Stunting incidence was 23.5%. More boys (26.0%) were stunted than girls (20.8%). More children in the 12 - <24 months group (25.1%) were stunted than that of the 24 - 36 months group (21.9%). There was not severe stunting, moderate stunting met the most in the 12 - <24 months group and in boys.

- The deficient and insufficient Vitamin D incidence was 47.7% in which children in the 12 - <24 months group accounted for 42.5% and children in the 24 - 36 months group presented 53.1%, and the stunting affected more boys 46.8% than girls 48.7%.

- Some risk factors included birth weight less than 2500g (OR=5.57), deficient and insufficient Vitamin D (OR=2.28), not having totally breastfed in the first 6 months (OR=1.76), early weaning less than 12 months (OR=2.37), having already suffered from infections (OR=1.83) in multinomial analysis.

Maternal risk factors included height less than 50cm (OR=2.69), gain weight less than 12 kg during pregnancy (OR=1.98) that were strongly associated with the stunting in multinomial analysis.

Children having not totally breastfeed in the first 6 months (OR=2.21), being weaned before 12 months (OR=1.97), not being adequately vacinated (OR=3.55), sun exposure<6 hours/week (OR=2.22) were associated with deficient and insufficient Vitamin D.

2. Preventive efficacy of Vitamin D supplementation and all-round care taking

After 12 months of the intervention, the Vitamin D concentration increased from 32.39 ± 9.06 ng/mL to 35.31 ± 6.52

ng/mL. The deficient and insufficient Vitamin D incidence reduced from 38.9% to 18.2%, the improved incidence was 20.7% and the preventive efficacy was 53.21%.

In the intervention group, the mean height improved 2.65 ± 0.3 cm compared with before the intervention ($p<0.05$). In the control, the mean height increased 1.24 ± 0.04 cm. The improved mean height was not significantly different compared with before the intervention with $p>0.05$.

The stunting incidence reduced 15.6% in the intervention, the incidence difference after and before the intervention was statistically significant with $p<0.05$ and the preventive efficacy was 61.1% while in the contrel, the stunting incidence reduced 1.5% and the preventive efficacy was 6.5%. No difference was found before and after the intervention in the control group ($p>0.05$).

RECOMMENDATION

From studied results, some recommendations can be given as followed:

1. It need to have an early Vitamin D supplementation program for children combining with the conceling about maternal feeding benefits: total maternal feeding in the first 6 months of the life, not weaning before 12 months, adequate vacination, treatment in time of common childhood infections. Let children expose to the sun light in early morning to strengthen the synthesis of Vitamin D, helping increassing children's height and reducing stunting.

2. More studies about Vitamin D supplementation for children in different age group by oral supply can be done to improve the stunting malnutriton.

THE LIST OF THE AUTHOR'S STUDIES PUBLISHED RELATED TO THE PhD THESIS

1. Nguyen Xuan Hung, Dặng Van Chuc (2018), "The nutritional status of children aged 12 - 36 months at Kim Dong, Hung Yen in 2017", Medicine Practice Journal, *Number 8* (1077), Pages. 318 - 324.
2. Nguyen Xuan Hung, Dang Van Chuc, Vuong Thi Trang (2018), "The Vitamin D concentration in children aged 12 - 36 months at Kim Dong, Hung Yen in 2017", Medicine Practice Journal, *Number 8* (1077), Pages. 324 - 330.
3. Nguyen Xuan Hung, Dặng Van Chuc, Vu Thanh Liem, Vuong Thi Trang, Dang Viet Linh (2018), "The incidence of anemia and some risk factors in children aged 12 - 36 months at Kim Dong, Hung Yen in 2017", Medicine Practice Journal, *number 8* (1077), pages. 330 - 336.
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