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## **VITAMIN D STATUS AND SOME BONE TUNOVER MARKERS IN SCHOOL-AGE CHILDREN IN CAN THO CITY**

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### **ABSTRACT**

*Vitamin D is a hormone that has an important function. Vitamin D insufficiency is adversely associated with health problems: osteoporosis, diabetes mellitus, asthma. **Objective:** To determine the value of vitamin D, some bone turnover markers and evaluate the effectiveness of the supplement of calcium and vitamin D in children of vitamin D decrease or deficiency aged 6-14 years old in schools located in Can Tho city from October, 2012 to April, 2016. **Method:***

cross-sectional, follow up study. **The results:** The percentage of children with vitamin D insufficiency and deficiency was 30.6%. This figure was higher in the urban (50%) than in the rural areas (17.8%). The average concentration of PINP, beta-CTX of the stunted children was less than that of normal children and obese ones. The corresponding figure increased to 15 ng/mL in girls and to 7.19 ng / mL in boys. The percentage of the group with insufficiency vitamin D levels dropped from 31.79% to 5.3%, while that of the group with normal vitamin D levels climbed from 47.68% to 94.7%. The concentration of PINP in children after intervention reduced significantly compared to before intervention in normal children and obese ones. The concentration of  $\beta$ -CTX after intervention in girls was higher than in boys. **Conclusion:** The boys had concentration of vitamin D higher than the girls. It also proved the effectiveness of calcium and vitamin D supplements for the group children with vitamin D insufficiency/deficiency.

**Keywords:** Vitamin D, bone turnover makers PINP, beta-CTX in children

## **I. INTRODUCTION**

Since 2009, Vietnam has appeared two extremes: obesity and malnutrition at a rate of 10.7%, and 9.3%, respectively [1]. Both of them reduce bone density and influence adults' height. Genetics and environment affect the growth and development of children's bodies. Predominance of osteoblasts compared to osteoclasts, so the markers of children biosynthesis are difference with the adults [2]. Measurement of bone turnover markers is very important to evaluate the state of bone health.

### **Study objectives**

1- To determine the value of vitamin D, some bone turnover markers (PINP, Beta-CTX) in 6-to-14-year-old children who have normal nutritional status and stunted or obese children in Can Tho city.

2- To evaluate the effectiveness of supplement with calcium and vitamin D in children with vitamin D decrease or deficiency.

## **II. OBJECTS AND METHODS**

The study was implemented in 794 children, including 499 normal, 207 stunted and 88 obese children at the age from 6 to 14 in schools located in Can Tho city from October, 2012 to April, 2016.

### **1. riteria for selecting objects**

The subjects were divided into 3 groups: group of stunted children, overweight – obese and normal healthy children.

### **2. Methodology**

*Stage 1:* Cross - sectional

*Stage 2:* Uncontrolled intervention.

*The variables, methods of measuring the value of variables*

Age, height, weight, BMI, stunting, obesity is excess passive drag by age, gender WHO standards in 2007, by WHO Anthro Plus software.

Vitamin D concentrations were quantified by means of high pressure liquid chromatography and mass spectroscopy. We accepted the criteria for determining the status of vitamin D in children and adolescents: vitamin D levels  $\geq 20$ ng / mL are called enough; vitamin D levels between 15 and 20ng / mL insufficiency and vitamin D  $\leq 15$ ng / mL deficiency.

Bone-P1NP marker is quantified using the Roche Elecsys 2010 COBA system. The normal value in the range of 17 to 71ng / ml, called P1NP reduce concentrations <17ng / ml.

B-CTX bone resorption marker is quantified using the Roche Elecsys 2010 COBA system. From 0.07 to 0.68 normal ng / ml, increasing the concentration called  $\beta$ -CTX> 0.69 ng / ml.

The drug intervention for 6 months: drug manufactured by the Hau Giang Pharmaceutical Joint Stock Company - DHG Pharma: effervescent tablets Davitabone label content: 300 mg calcium, 200 IU of vitamin D3, ...; Tablets label type Calvit D content: 750 mg of calcium and 60 IU of Vitamin D3.

Due to calcium and vitamin D needs not much difference between the ages, should choose as recommended by the National Institute of Nutrition.

### III. RESULTS

The study was implemented in 794 children including 499 normal, 207 stunted and 88 obese children at the age from 6 to 14 in schools located in Can Tho city from October, 2012 to April, 2016.

#### 3.1 General features

The result: among 794 children with the proportion of 393 boys (49.5%), 401 girls (50.5%) there were 207 stunted children (26.07%), 72 overweight children, 16 obese children (11.08%) and 499 normal children (62.85%).

Table 1: Distribution of nutritional status by sex

Sex Nutrition	Boys n (%)	Girls n (%)	Total n (%)	$\chi^2, p$
Stunted	81 (20.6)	126 (31.4)	207 (26.1)	$\chi^2=12.0354$ $p < 0,001$
Normal	249 (63.4)	250 (62.3)	499 (62.8)	
Overweight, Obese	63 (16.0)	25 (6.3)	88 (11.1)	
Total	393 (100)	401 (100)	794 (100)	

The rate of stunting is higher in girls. Overweight/ obese children in boys are more than in girls.

#### 3.2 Vitamin D and the value of some markers of bone turnover in children.

Table 2: Distribution of Vitamin D concentrations according to nutritional status

Nutrition Vit D	Normal		Stunted		Overweight. Obese		Total	
	n	%	n	%	n	%	n	%
Insufficiency	63	12.63	29	14.01	30	34.09	122	15.4
Deficiency	80	16.03	34	16.43	7	7.95	121	15.2
Adequate	356	71.34	144	69.57	51	57.95	551	69.4
Tổng	499	100	207	100	88	100	749	100
$\chi^2, p$	$\chi^2=28.1628; p<0.0001$							

In the groups of overweight – obese children, the rate of vitamin D deficiency was highest 34.09%. The group of children with vitamin D levels of 30.6% is not sufficient.

Table 3: Percentage of children with a lack of vitamin D levels, reduced vitamin D levels, normal vitamin D levels according to place

Vit D	Place	Urban n (%)	Rural n (%)	Total n (%)
Adequate		158 (50.0)	393 (82.2)	551 (69.4)
Deficiency		57 (18.0)	64 (13.4)	121 (15.2)
insufficiency		101 (32.0)	21 (4.4)	122 (15.4)
Tổng số		316 (100)	478 (100)	794 (100)
$\chi^2$ . P		$\chi^2= 8.0200$ p < 0.05		

Children living in urban areas have ratio decreased vitamin D children was higher in rural areas.

Table 4: Concentration P1NP (ng / ml) by age group

Age	Sex	Normal			Stunted			Overweight/Obese		
		Med	Low	Hight	Med	Low	Hight	Med	Low	Hight
6		480	371.7	563.3	225	163.4	300.4	391.7	238.4	851.3
7		490.3	355.2	618.4	272	230.1	338.2	474.8	358.2	528.5
8		486.6	367.8	637.8	390.5	239.4	541.1	451.3	302.8	502.1
9		531.5	422	665.2	409.6	277	440.5	510.7	495.9	537.2
10		457.2	365.9	614.5	384	299.8	411.6	603.8	468.1	616.5
11		520.1	387.4	682.5	393.8	305.3	558.3	495.8	425.6	770.9
12		574.9	421.7	825.5	445.3	331.6	578.4	625.8	475	781.1
13		539.6	362.7	767.4	520.4	375	729.2	503.7	240.4	706.6
14		323.5	174.9	590.3	305.6	142.7	532.3	115.3		
P		p=0.0001			p=0.0001			p> 0.05		

P1NP concentration increased in age, and 14 years P1NP lower back. Stunted children had lower concentrations of P1NP than normal children and overweight children.

Table 5: Average concentration of P1NP by nutritional status

P1NP	Nutrition	Normal	Stunted	Overweight. Obese
$\bar{x}$ ng/ml		526.7	421.4	508.4
$\pm \sigma$ ng/ml		258.6	246.9	216.6
$\chi^2$ . P		$\chi^2=5.0304$ ; p<0.0001		

P1NP average concentrations at higher normal children group of overweight children, obese children and stunting higher.

Table 3.6: Concentration of  $\beta$ -CTX (pg / ml) by age group

Age	Sex	Normal			Stunted			Overweight/ Obese		
		Med	Low	Hight	Med	Low	Hight	Med	Low	Hight
6		952.5	843.4	1049	510.9	477.7	609.2	1038	841.1	1346
7		957.9	671.2	1070	581	410.2	707.7	763.3	554.1	998.9
8		1102	885.1	1234	706.2	535.7	832.6	868.3	624	1274
9		952.1	796.9	1105	700.1	471.6	887.9	788.3	684.5	910.1
10		929.9	653.9	1189	826.8	716.1	933.7	963.7	804.4	1004
11		1050	829.1	1401	823.7	700	1134	1047	854.4	1331
12		1308	999.9	1703	995.8	717.7	1234	1248	1207	1332

Age	Sex	Normal			Stunted			Overweight/ Obese		
		Med	Low	Hight	Med	Low	Hight	Med	Low	Hight
13		1231	812.7	1568.5	884.3	591.2	1334	863.8	450.1	1226.7
14		669.1	368	963.9	683.4	371	1332	432.9		
p		p<0.0001			p=0.0001			p=0.0170		

$\beta$ -CTX concentration increases with age, and 12  $\beta$ -CTX peaked and started 13  $\beta$ -CTX lower back. Stunted children with  $\beta$ -CTX levels lower than normal children and overweight obese children.

Table 7: Concentration of average  $\beta$ -CTX by nutritional status

$\beta$ -CTX	Nutrition	Normal	Stunted	Overweight, Obese
	$\bar{x}$ pg/ml		1022	838
$\pm \sigma$ pg/ml		424	409	396
$\chi^2, p$		$\chi^2=2.0520; p=<0.0001$		

$\beta$ -CTX averaged concentrations above normal young group of overweight children, obese children and stunting higher.

### 3.3. Evaluate the effectiveness of supplement with calcium and vitamin D in children who have decreased or insufficient vitamin D.

Table 8: Change in average levels of vitamin D by nutritional status

Vitamin D	Before ( $\bar{x}$ ng/mL $\pm\sigma$ ng/mL)	After ( $\bar{x}$ ng/mL $\pm\sigma$ ng/mL)	$\Delta$ (Af-Be) (ng/mL)	T test
Normal (n=87)	26.84 $\pm$ 9.0	35.48 $\pm$ 8.9	8.64	t=-6.3377 p<0.0001
Stunting (n=50)	27.95 $\pm$ 11.7	31.11 $\pm$ 9.9	3.16	t=-4.6865 p<0.0001
Overweight. Obese (n=14)	20.19 $\pm$ 6.8	31.16 $\pm$ 8.6	10.97	t=-3.7463 p<0.001

After intervention, vitamin D levels vary considerably, not young concentration levels of vitamin D deficiency, the ratio of the concentration of vitamin D group fell from 31,79% to 5,3%.

Table 9: Change P1NP average levels by gender

P1NP	Before ( $\bar{x}$ ng/ml $\pm\sigma$ ng/ml)	After ( $\bar{x}$ ng/ml $\pm\sigma$ ng/ml)	$\Delta$ Af- Be (ng/ml)	T test
Boys (n=64)	462.07 $\pm$ 216.75	352.19 $\pm$ 196.16	-109.85	t= 3.006 p=0.003
Girls (n=87)	441.98 $\pm$ 213	368.58 $\pm$ 131	-73.4	t= 2.731 p=0.007

The P1NP average concentration of children after the interference was reduced more than before the intervention in both groups of boys and girls. The concentration of normal children, overweight/ obese children was decreased significantly compared to the group of stunted children.

Table 10: Change of  $\beta$ -CTX levels by gender

$\beta$ -CTX	Before ( $\bar{x}$ pg/ml $\pm\sigma$ pg/ml)	After ( $\bar{x}$ pg/ml $\pm\sigma$ pg/ml)	$\Delta$ Af- Be (pg/ml)	T test
Boys (n=64)	837.67 $\pm$ 341.42	875.81 $\pm$ 368.18	38.14	t=-0.607 p=0.5445
Girls (n=87)	835.15 $\pm$ 333.17	943.47 $\pm$ 262.1	108.32	t=-2.383 p=0.0182

B-CTX average concentrations were increased in children after the intervention more than before the intervention, in girls more than in boys.

#### IV. DISCUSSION

##### 4.1. Vitamin D, the value of some markers of bone turnover in children

Our data showed better results compared to that of research on nutritional status of children aged 6 months to 12 years in four Southeast Asian countries from 2010 to 2012. To the domestic researches in recent years, our study shows stronger. Hyppönen found exactly the same result as us. The average concentration of 25-OH-D in the serum of boy was higher than that of girls. The rate of vitamin D deficiency was 20% in boys and 46% in adult girls. Although there were differences of time and locations, overall average concentration of vitamin D in boys was higher than in girls. The similar results to other cohort studies of the parents and children in southwest England in 7560 children with a mean age of 9.9 years suggested that vitamin D deficiency (<20ng / ml) was 29 Parikh% and obese children had a concentration of 25 (OH) D lower than people with normal body weight [4], [5], [6].

P1NP level of children in the Can Tho was the same as that of the Finnish authors (Riitta K Tahtela). P1NP in healthy population by age and gender was higher in boys to girls, higher in the younger. Gwang Suk Kim's research told the same record of low bone formation markers in obese children and M.Bayer impressed the fluctuation of P1NP in the first years of life. Our  $\beta$ -CTX decreased in age the same as L.Gracia Marco,  $\beta$ -CTX higher in boys [3], [7], [9].

##### 4.2. Evaluate the effectiveness of supplement with calcium and vitamin D in infants who have decreased or insufficiency vitamin D.

The average vitamin D levels increased markedly after intervention. Especially, after the intervention, the vitamin D levels of girls gained much more than that of boys, girls increase up to 15 ng / mL, boys at 7.19 ng / mL. In all groups of children: overweight and obesity get more benefits than rickettsia and normal children. After 6 months of intervention, bone density and vitamin D levels strengthen as the authors talked by exercise, and calcium supplementation via food, medicine [5]

P1NP titration decreased after the intervention in both groups of gender. Normal children and children of overweight-obesity significantly reduced compared to group of rickettsia. Solarz and A. Kopec confirmed that: 25 (OH) D, P1NP and CTX in group of professional football players higher in the least active group. B-CTX concentrations of young girls is better than group of boys. Rickettsia gets small profit than children of overweight, obese or healthy [10].

After 6 months of intervention with calcium and vitamin D, marker P1NP reduced and beta CTX increased from our study is a little bit different than that of Rantalainen: Both beta CTX and P1NP increased after the exercise.

Although the correlation between BMD and markers of bone remodeling has statistical significance, but the value of the markers can not be used to predict the orientation of osteoporosis as an additional risk factor for treatment decisions.

## **V. CONCLUSIONS**

The study was implemented in 794 children including 499 normal, 207 stunted and 88 obese children at the age from 6 to 14 in schools located in Can Tho city from October, 2012 to April, 2016.

### *Vitamin D status, some bone turnover markers (P1NP, Beta-CTX) in children*

The boys had concentration of vitamin D higher than the girls. The percentage of children with vitamin D insufficiency and deficiency was 30.6%. This figure was higher in the urban (50%) than in the rural areas (17.8%).

P1NP concentration increased with ages and decreased when being older than 14. The concentration of CTX beta also increased with ages, then reducing at the age of 13. The average concentration P1NP, CTX beta of the stunted children was less than that of normal children and obese ones.

### *The effectiveness of supplementation with calcium and vitamin D in children with vitamin D insufficiency and deficiency*

The average vitamin D concentration in children increased significantly after intervention. The corresponding figure increased to 15 ng/mL in girls and to 7.19 ng / mL in boys. The percentage of the group with vitamin D insufficiency levels dropped from 31.79% to 5.3%, while that of the group with normal vitamin D levels climbed from 47.68% to 94.7%.

The concentration of P1NP in children after intervention reduced significantly compared to before intervention in normal children and obese ones.

The concentration of  $\beta$ -CTX after intervention in girls was higher than in boys.

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## **PROCEDURES OF CONVERSION FROM PRIMARY EXTERNAL FIXATION TO SECONDARY INTRAMEDULLARY NAILING IN THE TREATMENT OF OPEN TIBIAL FRACTURES**

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### **ABSTRACT**

**Background:** *There are a lot of methods of treatment for open tibial fractures, such as casts, traction, internal fixation. Each method has its own advantages and disadvantages. Secondary nailing after external fixation is applied in treatment for open tibial fractures by surgeons around the world. Objectives:* *Establishing procedures of conversion from primary external fixation to secondary intramedullary nailing in the treatment of open tibial fractures and assessing treatment outcomes. Method:* *63 open tibial fractures (including type II, type IIIA, type IIIB) were done secondary nailing after external fixation at CanTho Central General Hospital from 11/2006 to 12/2011. Results:* *The overall final results were excellent in 52 (82.54%) cases, good in 11(17.46%) cases. Conclusion:* *The primary results showed that this is a potential method for treatment of the complicated open fractures of the tibial shaft.*

**Keywords:** *open tibial fracture, primary external fixation, secondary intramedullary nailing.*

### **I. INTRODUCTION**

The management of open tibial fractures remains controversial. The rates of infection and nonunion are higher in Gustilo type IIIB than in types I, II, and IIIA open fractures. There are a lot of methods of treatment for open tibial fractures, such as casts, traction, internal fixation. Each method has its own advantages and disadvantages. Collaborating, promoting the advantages of each method to have an optimal treatment has always been studied. Secondary nailing after external fixation is applied in treatment for open tibial fractures by surgeons around the world. In Vietnam, it is still new method. This is the main reason for this study. This study plans to solve two objectives:

1. Establishing procedures of conversion from primary external fixation to secondary intramedullary nailing in the treatment of open tibial fractures.
2. Assessing treatment outcomes.