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Vitamin D Insufficiency and Atopy in Asthmatic Children at Thammasat University Hospital

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ABSTRACT

This study aimed to assess serum 25-hydroxylase vitamin D level and allergen sensitization among asthmatic children attending the allergy clinic at Thammasat University hospital. The association between vitamin D insufficiency and level of asthma control was also explored. Eighty asthmatic children, aged 6-18 years, attending the allergy clinic at Thammasat University hospital were recruited. Clinical data, level of asthma control, results of skin prick test to allergens and serum 25-hydroxyvitamin D levels were collected. The mean age of pediatric asthma patients in this study was 10.2 years (SD=3.3 years) with 47 boys (58.8%). The mean serum vitamin D level was 34.8 ng/ml (SD=12.8 ng/ml). The prevalence of vitamin D insufficiency was 23.8 percent (95% confidence interval: 14.9%-34.6%). The prevalence of atopy was 82.5 percent. The most prevalent sensitization factor was dust mite (71.3%), followed by cockroach (36.3%). No significant association was found between level of asthma control and patient factors, including vitamin D status. In conclusion, the problem of vitamin D insufficiency among asthmatic children at Thammasat University hospital did exist. The most prevalent sensitization factor was house dust mite, followed by cockroach. However, no significant factors associated with level of asthma control were found.

Keywords: Allergen sensitization; Asthmatic children; Atopy; Vitamin D insufficiency

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1. Introduction

Asthma is a common chronic disease and is a public health problem in Thailand [1-2] and countries around the world [3]. The prevalence of asthma in children is between 10-15% [1-2]. Asthma is a prolonged inflammatory disorder related to hyper-responsiveness of the airways. There is evidence that asthma is caused by an interaction between genetics and environmental exposure to allergens [3]. Several genes can be linked to the pathogenesis of asthma, including those involved in the production of IgE antibodies (atopy) and airway hyper-responsiveness. Vitamin D is of particular interest in asthma due to its immunomodulatory effects [4-5]. Serum 25-hydroxy vitamin D is the best indicator of vitamin D status. Serum 25-hydroxy vitamin D is found to be associated with a wide range of pulmonary diseases including asthma [6]. The relationship between vitamin D deficiency and asthma in children has been reported [7]. Patients with vitamin D deficiency have increased airway hyper-responsiveness and increased corticosteroid requirements. Vitamin D might also increase the response to glucocorticoids in asthmatic patients [8]. A few observational studies have suggested an association between low serum vitamin D levels and poor asthma control with reduced lung function in children [9]. Therefore, this study aimed to determine the prevalence of vitamin D insufficiency and sensitization to allergens in asthmatic children. The association between vitamin D insufficiency and level of asthma control was also explored.

2. Materials and Methods

All asthmatic patients, aged 6-18 years, attending the allergy clinic with asthma at Thammasat University hospital between January 2016 and August 2016 were recruited. Exclusion criteria were patients who had chronic diseases including heart diseases, structured airway diseases, or immunodeficiency diseases. There were 80 asthmatic children eligible for the study. Clinical data and skin prick test reactivity to common allergens including Bermuda grass, cat, dog, rat, house dust mite (*Dermatophagoides Pteronyssinus*), German cockroach, cow's milk and egg white were collected. Serum 25-hydroxy vitamin D levels were measured by enzyme-linked immunosorbent assay (ELISA). Level of asthma control defined by GINA guidelines was also measured in all patients [10].

A positive skin prick test reaction (sensitization) was determined by the presence of a wheal more than 3 millimeters in diameter. Atopy was defined as having at least one allergen sensitivity. Vitamin D insufficiency was defined as having a serum 25-hydroxy vitamin D level of less than 30 ng/ml. This study was approved by the ethics committee of Thammasat University No 1.

Quantitative data are presented as mean and standard deviation. Qualitative data are presented as numbers of subjects and percentages. Prevalence of vitamin D insufficiency was calculated as the proportion of participants with vitamin D insufficiency. The prevalence of sensitization to specific allergens was calculated the same way. All estimated parameters are presented with their 95% confidence intervals. According to GINA guidelines, levels of asthma control are labeled as controlled, partly controlled, and uncontrolled. Clinical characteristics, including vitamin D insufficiency, were compared between patients with and without total asthma control by Fisher's exact tests. Statistical significance was set at the level of $p \leq 0.05$.

3. Results and Discussion

There were 80 asthmatic patients with a mean age of 10.2 years (SD= 3.3 years), 47 of which were boys (58.8%) as detailed in Table 1.

Table 1. Patients' characteristics.

Characteristics	N=80	%
Paternal asthma		
Yes	15	18.7
No	65	81.3
Maternal asthma		
Yes	12	15.0
No	68	85.0
Gender		
Boys	47	58.8
Girl	33	41.2
Allergic rhinitis		
Yes	37	46.3
No	43	53.7
Atopic dermatitis		
Yes	22	27.5
No	58	72.5
Atopy*		
Yes	66	82.5
No	14	17.5
Vitamin D insufficiency**		
Yes	19	23.8
No	61	76.2

* at least one allergen sensitization by positive skin prick test
** serum 25-OH vitamin D levels < 30 ng/ml

The mean serum 25-hydroxy vitamin D concentration was 34.8 ± 12.8 ng/ml (Fig. 1). There was no significant difference (p=0.626) between the mean serum 25 hydroxy-vitamin D levels of boys (33.9 ng/ml) and girls (35.2 ng/ml). The prevalence of vitamin D insufficiency among asthmatic children in this study was 23.8% (95% confidence interval: 14.9%-34.6%). The prevalence of atopy was 82.5% (95% confidence interval: 72.4%- 90.1%).

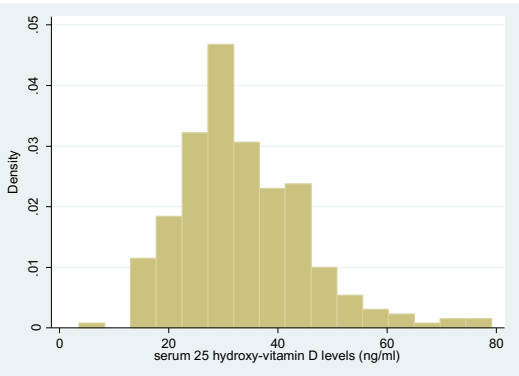

Fig. 1. Distribution of serum 25- hydroxy vitamin D levels.

Concerning positive skin prick test reactions, the most prevalent sensitization was to house dust mite (71.3%), followed by German cockroach (36.3%) as presented in Table 2.

Table 2. Sensitization to common allergens by skin prick test reaction.

Allergens	Positive skin prick test* %
Egg white	13.8
Cow's milk	12.5
Dermatophagoides Pteronyssinus	71.3
Bermuda grass	15.0
German cockroach	36.3
Dog dander	18.8
Cat dander	21.3
Rat	3.8

*Positive skin prick test reaction was based on diameter of wheal size more than 3 millimeters.

According to the level of asthma control classified by GINA guidelines, there were 58 patients (72.5%), 18 patients (22.5%) and 4 patients (5.0%) whose asthma was totally controlled, partly controlled and uncontrolled, respectively. Vitamin D insufficiency was not associated with the level of asthma control, as presented in table 3.

Vitamin D insufficiency was classified as a serum 25-hydroxy vitamin D level of less than 30 ng/ml [11-12]. The prevalence of vitamin D insufficiency was comparable in boys and girls (*p*-value=0.626), concordant with previous studies done in Thailand [11-12]. However, this study found a lower prevalence of vitamin D insufficiency in asthmatic children (23.8%), compared to a reported 44.8% prevalence in Siriraj hospital by Krobtrakulchai W, et al. in 2013 [11]. This two-fold discrepancy in prevalence may be hard to explain by methodological bias. Both studies were done on asthmatic children attending the allergy clinic at tertiary care hospitals located in Bangkok/adjacent district with a similar mean age of 10 years. One possible explanation may be the growing concern of vitamin D deficiency and vitamin D supplementation over the past 10

years. The high prevalence of vitamin D insufficiency/deficiency among the Thai pediatric population has been reported on for more than 10 years [12-13].

Table 3. Comparing characteristics between children with and without total asthma control.

Characteristics	Totally controlled N=58		Partly & Un-controlled N=22		P-value
	N	%	N	%	
Paternal asthma	12	20.7	3	13.6	0.542
Maternal asthma	10	17.2	2	9.1	0.495
Boys	35	60.3	12	54.5	0.800
Allergic rhinitis	28	48.3	9	40.9	0.621
Atopic dermatitis	17	29.3	5	26.3	0.400
Atopy*	47	81.0	19	86.4	0.747
Vitamin D insufficiency**	14	24.1	5	22.7	0.895

* at least one allergen sensitization by positive skin prick test

** serum 25-hydroxy vitamin D levels < 30 ng/ml

The sensitization pattern among asthmatic children in this study was similar to the results of a previous study from 2004 [14]. House dust mite and cockroach were the main allergens found in asthmatic children. However, sensitization prevalence to dog dander (18.8%) and cat dander (21.3%) has increased compared to the reported 9% for each allergen, in the previous report.

Most asthmatic children in this study were classified as asthma totally controlled (72.5%). No significant association was found between the level of asthma control and vitamin D status in this study (p=0.895). The reported correlation between vitamin D insufficiency and poor asthma control has been varied [9, 11, 15-16]. A more robust study or a well-designed randomized control trial should be performed to clarify this correlation.

4. Conclusion

The problem of vitamin D insufficiency among asthmatic children in Thammasat University hospital does exist. The most prevalent sensitization was to house dust mite, followed by cockroach. However, no significant correlation with level of asthma control was found.

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