

Association Between Asthma Control Status and Lung Function with Vitamin D Level in Children with Bronchial Asthma

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Abstract: Bronchial asthma is one of the most common chronic diseases in childhood. Pooled vitD levels were positively correlated with pooled ACT scores, Treg counts, FEV1% values and VDBP levels. Vitamin D supplementation reduced the rate of asthma exacerbation, especially in patients with vitamin D insufficiency. The 25-OH vitamin D levels were lower in pediatric asthma patients with worse spirometry results. Lower vitamin D levels in children with STRA were associated with increased ASM mass and worse asthma control and lung function. Materials and methods: The study was performed in children aged 6 -15 years old, including patients with asthma (n=50), who referred to Sachkhere medical center for a visit. The status of asthma control in the basic group was classified as controlled (n=31) and uncontrolled (n=19). The children underwent serum vitamin D and IgE level, spirometry and skin prick tests for the study. Results: Using the multivariate logistic regression analysis, the presence of asthma was associated with the reduced level of vitamin D (OR=1.35, 95% CI (1,14-1.58) P=0.011; X²=6.78; F=0.022) in children with uncontrolled bronchial asthma. 48% of the patients in the group- controlled asthma (n=15) had vitamin D deficit, and in 52% of the cases (n=16) was confirmed with vitamin D insufficient. In the group – uncontrolled asthma - 5% of the patients (n=1) had Vitamin D insufficiency in blood serum. In 95% (n=18) of the patients vitamin D level was significantly low < 20 ng/ml. According the results, decreased pulmonary function (p=0.039; x²=3.12) is strongly associated with low level of vitamin D; but neither serum IgE level (p=0.54; x²=10.9), nor skin prick test result on dust mite (p=0.50, x²=5.12) was correlations with serum vitamin D low level. Conclusion: The presence of vitamin D deficiency effectively predict increased risk of uncontrolled bronchial asthma in children. Serum vitamin D level is related to lung function too. Therefore, by normalize vitamin D level in blood serum maybe improve lung function and control status in children with bronchial asthma.

Keywords: Vitamin D, Children, Uncontrolled Asthma, Prick-test, Spirometry, IgE

1. Introduction

Bronchial asthma is one of the most common chronic diseases in childhood. Pooled vitD levels were positively correlated with pooled ACT scores, Treg counts, FEV1% values and VDBP levels. [1] The forced expiratory volume in 1 sec (FEV1), peak expiratory flow (PEF) and the ratio of FEV1 to forced vital capacity (FVC) in children with bronchial asthma in the observation group were higher after vit. D treatment than those before treatment (P<0.05) [2]; Serum vitamin A and 25OHD3 levels were positively correlated with pulmonary function and ADL score in

children with stable asthma, while serum vitamin A and 25OHD3 levels were negatively correlated with MRC score (all P<.05). [3]; Oxidative stress correlates with the serum vitamin D concentrations. Clinical trials are required to confirm that increasing serum 25OHD may improve asthma control, as measured by clinical and oxidative stress markers. [4]; The inconsistent results from studies assessing vitamin D either in blood or intake may be explained by previously reported non-linear association between blood vitamin D3 and childhood asthma.[5]; On the other hands, Vitamin D levels are not associated with pulmonary function test outcomes. However, low vitamin D levels are associated with

atopy. [6] Vitamin D supplementation reduced the rate of asthma exacerbation, especially in patients with vitamin D insufficiency. [7]; Children whose mothers had sufficient vitamin D status (25Hydroxyvitamin D ≥ 30 ng/mL) at early and late pregnancy and had cord blood vitamin D sufficiency demonstrated a lower risk of asthma/recurrent wheeze than children who had insufficient cord blood vitamin D status at birth [8]; The assessment of circulating 25(OH)D concentration and the optimisation of vitamin D status to prevent acute respiratory tract infections [9]; Serum 25(OH)D was significantly lower in the wheezing group, and its decrease was a risk factor for wheezing.[10]; Lower vitamin D levels in children with STRA were associated with increased ASM mass and worse asthma control and lung function. [11]; Vitamin D deficiency is common among UK adults with ICS-treated asthma, and classical environmental determinants of serum 25(OH)D operate in this population. [12]; There was no effect of maternal vitamin D supplementation on asthma and recurrent wheeze in either an intention-to-treat analysis or an analysis with stratification according to the maternal 25-hydroxyvitamin D level during pregnancy. [13]; Conclusions The 25-OH vitamin D levels were lower in pediatric asthma patients with worse spirometry results.[14]; Vitamin D₃ deficiency is associated with exacerbation severity and serum IgE levels in patients with pediatric asthma; [15]; Genetic variants in the vitamin D pathway affect vitamin D serum levels and, thus, atopy and asthma. [16].

The aim of the study - to establish the correlation between asthma control status, lung function and vitamin D level in blood serum.

2. Material and Methods

One centric clinical trial was performed on the base of Sachkhere Medical Center. The main group was formed. Fifty patients with bronchial asthma, were involved in the main group. Patients were given long-term control and/or quick-relief medicines, (which is provided by GINA guidelines) according to the asthma control status.

Inclusion criteria: Confirmation consent of a parent or a guardian about the participation in the research. age from 6 to 15 years; confirmed Bronchial asthma by using clinical-instrumental examines.

Exclusion criteria: Severe chronic infections. Vitamin D intake within one month prior to research; associated somatic disease;

The study was performed at Sachkhere Medical Center.

According to clinical characteristics (GINA defined asthma control), that include: daytime symptoms, limitation of activity, nocturnal symptoms/awakening, lung function (PEF or FEV1), and need for reliever/rescue treatment, asthma patients were classified as controlled and uncontrolled.

The persons were given the following types of tests: The quantitative determination of vitamin D in blood serum; define the IgE serum blood level; spirometry exam- (using

Spirolab II) and skin prick test using Allergopharma allergens.

The quantitative determination of vitamin D in blood serum. (Chemiluminescensational analysis). were performed in the laboratories – “Enmedici” and “Vistamedi”.

The results were evaluated by the following criteria.

Vitamin D normal level- (30-100 ng/ml); Vitamin D insufficiency (20-30 ng/ml); And vitamin D deficiency (<20 ng/ml).

Individual study map was created for each patients, which included questions as a debut of the disease, symptoms and comorbid conditions. The genetically predisposition of patients, allergic anamnesis and risk factors were also assessed.

The data was processed by the methods of variation statistics. We studied median and median squared deviation. The difference between groups was stated by the student's coefficient (t) for independent selection and for quality coefficient – by F Fisher criterion; The chances of the odds (OR) and the 95% reliability interval (95% CI) were determined. x2 value has been defined by the p-value. Analysis was performed using the program packet SPSS/v 20.

3. Study Results

Children, involved in the study are divided according to the quality of age, sex and asthma as follows:

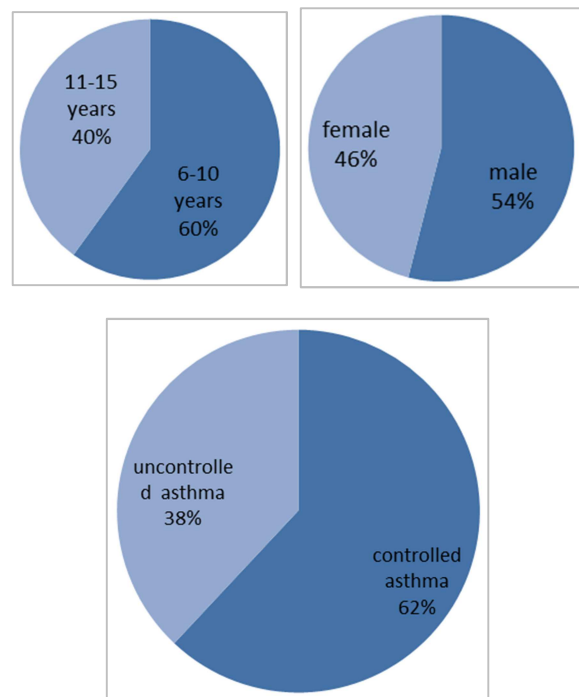


Figure 1. Demographic information about patients.

The patients involved in the main group prevail in the male sex population (n=27; p=0.000), female gender was represented by 23 persons. (n=23; p=0.00).

The most patients (60%) were between 6 and 10 years old (n=30; p=0.01), and only 40% was between 11-15 years (n=20; p=0.002).

According to the quality of asthma control, the individuals are divided into two subgroups:

Controlled bronchial asthma 62% (n-31; p-0.00),

Uncontrolled bronchial asthma 38% (n-19; p-0.039).

The information about exams is given in the table.

Table 1. Statistical data of diagnostic studies.

Studies	Mean	%	F	t	P
Lung function reduction –mild obstruction	0.56	56%	24.09	5.73	0.001
Lung function reduction –Moderate obstruction	0.44	44%	18.90	5.12	0.00
skin prick test on ambrosia	0.04	4%	16.3	1.79	0.078
Skin prick test on dust mite	0.84	84%	36.2	12.04	0.000
Skin prick test on milk protein	0.10	10%	37.8	4.09	0.00
Serum IgE high level	1.00	100%	24.09	3.73	0.001

Table 2. Serum IgE level in basic group.

	N	Mean	Std. Deviation	Std. Error Mean
IgE blood serum level	50	564.26	568.68	103.82

Table 3. Vitamin D serum blood level in basic (controlled and uncontrolled asthma) group.

		N	Mean	Std. Deviation	Std. Error Mean
Serum vitamin D level	1 basic group	50	18.78610	6.044547	1.103578
	Controlled asthma	31	20.72498	5.624890	1.023454
	uncontrolled asthma	19	15.04238	5.345128	1.024537

As a result of statistical processing of the results, we have received the following data. According to the results of the spirometer exams, the patients had mild (n-28; p-0.001) and moderate (n-22; p-0.00) obstruction.

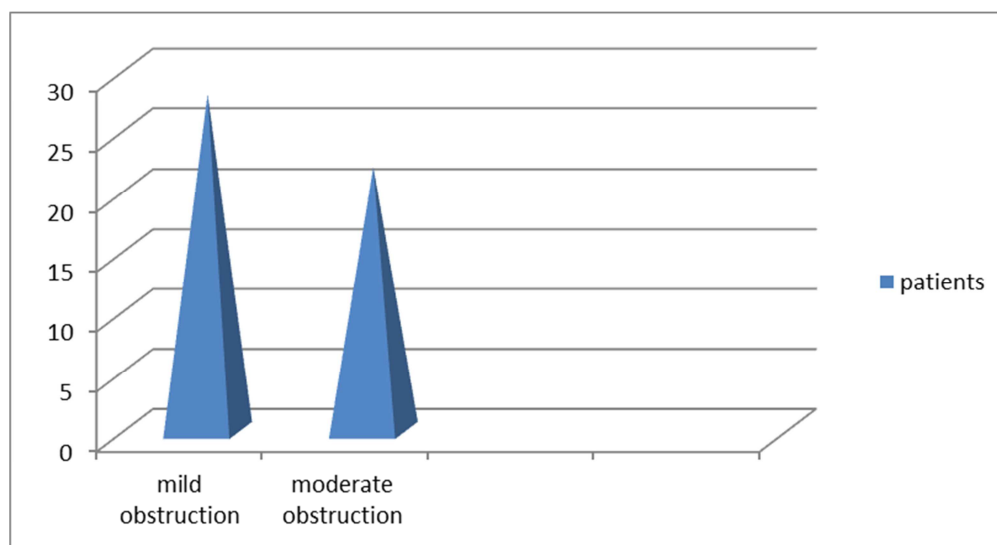


Figure 2. Lung function indicators by spirometry test.

Within the study, the patients were determined serum immunoglobulin E level. High level of immunoglobulin E has been detected in all patients' blood serum. mean- 564.26 kU/l.

The patients were performed skin prick tests, using "Allergopharma"- allergens. The highest frequency allergy was revealed on dust mite- "Dermatophagoides farinae" in 84% (n-42; p-0.001). 10% of persons were allergic to ambrosia (n-5; p-0.00), and only 6% of the patients were allergic to milk protein (n-3; p-0.078) according skin prick test result.

In the main stage of the study, the patients were tested in quantitative analysis of Vitamin D in blood serum. Different cases also have been identified as sufficiency and deficiency.

We concluded, that serum vitamin D level was

significantly decreased (18.78 ± 6.04 ng/ml).

In addition, 48% of patients in the controlled bronchial asthma group (n-15), has been found with vitamin D insufficiency in blood serum, when 52% of cases (n-16) - vitamin D deficiency was revealed.

In group of uncontrolled bronchial asthma, 5% of patients (n-1) had vitamin D insufficiency, and 95% of them revealed vitamin D deficiency (n-18).

Mean level of serum vitamin D level in group of controlled asthma was: mean-20.72 ng/ml. As for serum vitamin D level in uncontrolled asthma group, it was significantly low: mean-15.04 ng/ml.

Using the multivariate logistic regression analysis, the presence of asthma was associated with reduced level of

vitamin D in patients with uncontrolled bronchial asthma. (OR=1.35, 95% CI (1,14-1.58) P=0.011; $X^2=6.78$; F-0.022).

Also, by statistical analysis, serum vitamin D level is strongly associated with decreased lung function (p-0.039; $x^2=3.12$); Exactly, in group of controlled asthma, presence of insufficiency and deficiency was almost equal, while in uncontrolled asthma group 95% of patients were found with vitamin D deficiency in blood serum.

Based on the statistical analysis of the results, there was not found correlations between serum vitamin D deficiency and IgE high level (P-0.54; $x^2=10.9$). Also there has not been proved any association skin prick test results and vitamin D serum level (P-0.50; $x^2=5.12$).

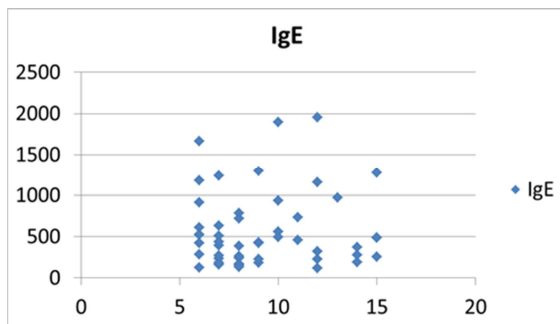


Figure 3. IgE quantitative division by age.

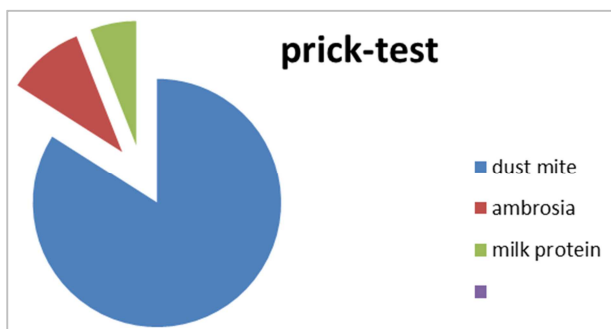


Figure 4. Skin prick test results using "Allergopharma"-s allergens.

Table 4. Evaluation of the x^2 and p-value indicators in the conditions of vitamin D deficiency.

	Chi-square - x^2	Sig. (2-tailed)- p
Controlled bronchial Asthma	2.11	0.01
Uncontrolled bronchial Asthma	6.78	0.01
Blood serum IgE level	10.90	0.54
Decreased lung function	3.12	0.039
Skin prick test on dust mite	5.12	0.50

4. Conclusion

By using multivariable logistical regression analysis, bronchial asthma is strongly associated with low level of vitamin D in blood serum in children with uncontrolled bronchial asthma.(OR=1.35, 95% CI (1,14-1.58) P=0.011; $X^2=6.78$; F-0.022).

Also, decreased pulmonary function (p-0.039; $x^2=3.12$) is strongly associated with low level of vitamin D; but neither serum IgE level (p-0.54; $x^2=10.9$) nor skin prick test result on

dust mite (p-0.50, $x^2=5.12$) was in correlations with serum vitamin D low level.

The presence of vitamin D deficiency effectively predict increased risk of uncontrolled bronchial asthma in children. Serum vitamin D level is related to lung function, Therefore, the normalization of the serum levels of Vitamin D may have beneficial effect on improvement of asthma control in the complex of asthma management and preventive measures.

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