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Evaluation of relation between vitamin D serum level and community acquired pneumonia in children between 1 to 60 months

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ABSTRACT

Background: Community-acquired pneumonia is the leading cause of hospitalization and death in children under five, particularly in developing countries. Low UV B exposure during winter can decrease serum vitamin D levels, which is a defense factor against microbial agents. This study aims to investigate the relationship between serum vitamin D levels and community-acquired pneumonia in children at Motahari Hospital in Urmia, despite the limited number of studies in this field. The findings could help improve the management of pneumonia in children.

Methods: In the present study, 45 children admitted to Motahhari Hospital in Urmia with a diagnosis of pneumonia and 45 children without respiratory symptoms referred to health centers have been performed as evidence.

Results: The mean of vitamin D in the case group was 31.28 ± 24.28 and less than the control group (34.43 ± 25.65), but no statistically significant difference was observed. Vitamin D deficiency is common in both groups. Community-based interventions for vitamin D deficiency appear necessary.

Conclusion: Various studies have shown several effects of vitamin D on health. The results of this study showed that vitamin D deficiency is common in both groups under study and of course in the case group this deficiency is more than it is recommended to take preventive interventions.

Keywords: Community-acquired pneumonia, serum vitamin D levels, children, case-Control

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1. Introduction

Community-acquired pneumonia (CAP) is a most common cause of hospitalization and the primary cause of death in children under five years of age (1). Pneumonia is more common and severe in developing countries than in European and North American countries, and is the most important cause of death in children (2). About 30% of children's deaths in developing countries are for CAP (4 million deaths per year), and about two-thirds of these deaths occur in infancy (3). 151 million recent cases of pneumonia occur every year, and 7-13% (20 million) of these cases are life-threatening and lead to hospitalization (1). The annual incidence of pneumonia in developed countries is about 33 children per 10,000 people in children under 5 years old and 5.14 people per 10,000 people in children 0 to 16 years old (4).

Pneumonia is inflammation of the lung parenchyma, consolidation in the affected areas and filling of the alveoli with pus and inflammatory cells. Pneumonia occurs under the influence of viral, bacterial, fungal and mycoplasma factors, which are in relation to the physical and immunological characteristics of the child. Symptoms and signs of pneumonia include fever, tachypnea and respiratory distress. A physical examination shows a reduction of lung sounds, crackle, tactile fremitus and dullness in the lungs, which are consistent with the consolidation caused by pneumonia. An infiltration in a plain chest X-ray confirms the diagnosis of pneumonia (3). Predisposing factors for pneumonia are nutrition, low socio-economic level, ethnicity, incomplete vaccination, being exposed to tobacco and underlying diseases such as congenital heart failure and prematurity (5). Other risk factors for pneumonia are air pollution at home because of cooking with wood, increasing the probability of pathogen transmission because of overcrowding, poor home ventilation and malnutrition such as lack of calories, protein, nutrients and vitamins (6). The more probable incidence of pneumonia is during winter, and seasonal factors influence this condition (7).

Although seasonal factors are attributed to crowding, some recent hypotheses explain that the serum level of vitamin D decreases during the winter because of the low intake of ultraviolet B rays, which is a predisposing factor for pneumonia (8-10). Vitamin D is a defense factor against microbial agents. Williams et al. found that vitamin D levels are low in children with tuberculosis (11). Vitamin D deficiency is the most common nutritional deficiency and remains undiagnosed all over the world (12). Nowadays, vitamin D is associated with many diseases such as fractures, diabetes, autoimmune diseases, cardiovascular diseases, kidney diseases, depression, tuberculosis, neurodegenerative diseases and cancer (13). Sunlight effect on the skin provides about 80% of the vitamin D for the human body, and the rest is provided through food and supplements (14). It plays a role in regulating bone health and has many effects on the functioning of the immune system and possibly the health of the airways (15). It is a potential moderator of gained and innate immune system responses (16).

Vitamin D operates through receptors that are present in almost many immune cells, such as the active form of CD4+CD8+ T lymphocytes, B lymphocytes, neutrophils, macrophages and dendritic cells. Vitamin D deficiency affects the function of the immune system by reducing defense strength against infections in children. Children with poverty or lack of vitamin D are more exposed to respiratory infections (17-25). Observations have shown a relationship between low levels of vitamin D and increased likelihood of involvement of the upper and lower airways in children (18).

Hashemian et al. (2017) conducted a case-control study to investigate the relationship between vitamin D serum level and the progression of pneumonia in children. They studied forty children with pneumonia between the ages of 3 months and 5 years as the case group, and 40 children of the same age as the control group. They found that the serum level of vitamin D and pneumonia only in children between ages 24 to 60 months had a

significant relationship with each other in pneumonia afflicted children referred to 17 Shahrivar Hospital in Rasht (p=0.015) (19). The research team, because of the different results in different studies and the limited studies in Iran, conducted this study to investigate the relationship between the serum level of vitamin D and pneumonia in children referred to Ayatollah Motahari hospital in Urmia.

2. Material and methods

The research, after achieving the permits from the ethical committee of the Urmia University of Medical Sciences in Iran and informed consent from the patient's parent, studied the children aged 1 to 60 months referred to Ayatollah Motahari Hospital in Urmia between December 2018 and December 2019 who have been hospitalized because of pneumonia. Diagnosis of community-acquired pneumonia was based on cough, fever above 38 degrees Celsius, respiratory distress (tachypnea: RR>60 for children 0 to two months, RR>50 for children 3 to 12 months, RR>40 for children 13 to 60 months) and consolidation in the chest radiograph and the confirmation of a pediatric infectious diseases specialist. Pneumonia fell also under two groups, typical "LoBAL" and atypical, based on the pattern of lung involvement. The control group was selected from children aged 1 to 60 months without respiratory symptoms who were hospitalized in Motahari Hospital or referred to hospital clinics. The exclusion criteria included asthma, croup, acute thoracic disease other than pneumonia, chronic diarrhea, congenital heart disease, and disease affecting vitamin D level. Then the serum level of vitamin D in both groups was measured from venous blood samples in the laboratory of the Ayatollah Motahari Center. Information of patients such as age, gender, and place of residence was extracted from patients' files.

3. Results

The present study is going to determine the relationship between the average serum level of vitamin D and community-acquired pneumonia in children from one month to five years admitted to Shahid Motahari Hospital in Urmia. It, therefore, examined 45 hospitalized children diagnosed with community-acquired pneumonia and 45 healthy children without respiratory symptoms referred to health-treatment centers in Urmia. According to the results from the table above, the frequency distribution of four qualitative variables between the two groups of case and control is homogeneous.

As the results show, the average age in the case group was 27.13±21.95 months and in the control group 26.04±15.58 months. There is no significant difference between the two groups according to the results of the statistical test (P = 0.80). The average level of vitamin D was 31.28±24.28 in the case group, and it was 34.43±25.65 in the control group. There is no significant difference between the two groups according to the results of the test (P=0.55). The average duration of hospitalization was 6.60 ± 1.85 days in the case group. As the results show in the case group, the average level of vitamin D in city residents is 34.47±28.95 and in village residents 26.93±15.58. There is no significant difference between the two groups (p=0.31). The average level of vitamin D in city residents was 35.76±26.89 in the control group, and 32.61±24.45 in village residents. There is no significant difference between the two groups (p=0.69). As the results show in the case group, the average level of vitamin D in boys is 30.20±25.43 and in girls 32.41±23.57. There is no significant difference between the two groups (p=0.76). The average level of vitamin D in boys was 37.54±34.49 and in girls 31.94±15.81 in the control group. There is no significant difference between the two groups (p=0.47). As for the results in the case group, the average level of vitamin D in the 1-12 month group was 42.62±32.17, in the 13-36 month age group it was 27.73±15 and was 22.24±14.63 in the 37-60 age group. The results of the statistical test did not show any significant difference between the two groups (p=0.04). We used Bonferroni's Post Hoc method to make a pairwise comparison, and the results showed only the average of the 1-12 month group differed from the 37-60 month group (p=0.04). The average vitamin D level in the 1-12 month group was 38.68±27.21 in the control group, 38.79±30.82 in the 13-36 month age group, and 25.83±16.08 in the 37-60 month age group.

Table 1. Distribution of the frequency of demographic variables by case and control Groups.

Variable		Group				P-value
		case		control		
		Frequency	Percent	Frequency	Percent	
Place of residence	City	26	57.8	26	57.8	0.999
	Village	19	42.2	19	42.2	
Gender	Man	23	51.1	20	44.4	0.401
	Women	22	48.9	25	55.6	
Smoking	Yes	32	71.1	23	51.1	0.051
	No	13	28.9	22	48.9	
Ages(m)	1-12	17	37.8	15	33.3	0.65
	13-36	11	24.4	15	33.3	
	36-70	17	37.8	15	33.3	

Table 2. Comparison of the average level of vitamin D according to the type of pneumonia in the case group

		Type of pneumonia	N	Mean	Standard deviation	p-value
Case	Vitamin D levels	Typical	16	26.88	16.66	0.37
		Antitypical	29	33.71	27.58	

Table 3. Comparison of the frequency of vitamin D sufficiency level according to the groups under investigation.

Variable		Group				P-value
		case		control		
		Frequency	Percent	Frequency	Percent	
Vitamin D levels	deficient	23	51.1	21	46.7	0.673
	Sufficiency	22	48.9	24	53.3	
Vitamin D levels	<20	17	37.8	12	26.7	0.55
	20-30	10	22.2	12	26.7	
	>30	18	40	21	46.6	

Table 4. Comparison of the average level of vitamin D in children with pneumonia and healthy children in different studies

study	Country	N	Mean age	ALRI group	Control group
Wayse 2004 (50)	India	150	9.23	8.22	4.38
Karatekin 2009 (51)	Türkiye	40	3	8.22	8.4
Roth 2009 (52)	Canada	129	3.13	2.77	77
McNally 2009 (53)	Canada	175	6.13	81	83
Roth 2009(54)	Bangladesh	50	2.4	2.29	2.39

* Summary of published case–control studies on the association between vitamin D status and acute lower respiratory infection in early childhood.

The results of the statistical test showed no significant difference between the two groups (p=0.29). As the results of the above table show in the group of cases, the average level of vitamin D in the typical type is equal to 26.88±16.66 and 33.71±27.58 in the atypical type. The results of the statistical test showed no significant difference between the two groups (p=0.37). Pearson's correlation coefficient was used to investigate the relationship between the duration of hospitalization and the level of vitamin D. The results showed an inverse relationship between the two, so that an increase in the average level of vitamin D was associated with a decrease in the duration of hospitalization; but this relationship was not statistically significant (r= -.074, p=.628).

4. Discussion

Vitamin D deficiency is common in many parts of the world (27-35). Diagnosis of vitamin D deficiency occurs when serum OHD 25 is less than 27.5 nmol/l, and it appears, depending on age, with clinical manifestations such as rickets or osteomalacia (36). However, vitamin D deficiency, i.e. HD 25 less than 70 nmol/L, has ambiguous clinical manifestations and usually its effect on health is not completely known (36). Although the effect of vitamin D deficiency in adults has been noticeable (37, 38), but this was not the case in children (39). Vitamin D affects health beside bones (40-42). Many studies have found the relationship between vitamin D deficiency and pneumonia, tuberculosis, diabetes, cancer (prostate and breast), multiple sclerosis and high blood pressure (41-46).

The average level of serum vitamin D in children with pneumonia was 31.28±24.28 ng/ml in the present study, and it was 34.43±25.65 ng/ml in the control group. There was no significant statistical difference between the two groups (p>0.05). Previous studies have also been investigated this rate. For example, a study conducted in Tehran by Hosseininejad et al. (2014) on 50 children aged 2 to 59 months reported an average of 31.78 ± 1.75 ng/ml (20), which is like the recent study. Javadinia et al. achieved the average serum level of vitamin D in children with acute respiratory infection to be 37.3 ± 4.3 ng/ml (47), which is similar to the recent study. The serum level of vitamin D in pneumonia patients in Ardabil was 25.5 ng/ml (48). This level in a study in Germany was 11.3±9 in the viral pneumonia group and 9.3±7.4 in the bacterial pneumonia group (49).

The results showed that 51.1% in the case group and 46.7% in the control group had vitamin D deficiency (less than 27.5), although this difference was not significant. As the results showed, the two groups had no statistically significant differences in the variables of residence, gender, mother and father's literacy, and age groups, but there was a significant statistical difference in the number of smokers in the family between the two groups, so that it was in the case group equal to 71.1%, but it was in the control group equal to 51.1%. The results also showed that the level of vitamin D in the two groups was not statistically significant in the variables of residence, gender, mother and father's literacy, but it was different by the age groups, so that as the age increased in the group of cases decreased the level of vitamin D. This relationship has been significant. There was no significant correlation in Hosseininejad's study between vitamin D level and age, gender, severity of pneumonia, type of pneumonia, and length of hospitalization (20), which is similar to the finding of the current study.

5. Conclusion

Various studies have shown several effects of vitamin D on the health. The findings demonstrated that vitamin D insufficiency is widespread in both groups under study. Of course, this deficiency was more in the case group, so it is recommendable to take preventive interventions for overcoming it.

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