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Original Article

Vitamin-D Level in Children with Bronchiolitis Attending a Selected Tertiary Hospital

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Abstract

Background: *Vitamin D can augment the innate and adaptive immune systems of the human body. Thus vitamin-D (25-hydroxy vitamin D) levels are inversely associated with respiratory infections like bronchiolitis.*

Objective*: To determine the status of Vitamin D-25(OH) D level in children with bronchiolitis.*

Methods: *A case-control study was conducted in ICMH from January to June 2019. Thirty-one children 1 month to < 24 months of age with bronchiolitis as defined by working definition and attending to the inpatient and outpatient departments were enrolled as a case group. Thirty-two children of the same age and sex-matched group without any respiratory illness attending the outpatient and EPI center were taken as a control group. Parents' informed consent was taken before enrolling either the cases or the control group in the study. Data were collected in a pretested structured questionnaire. Venous blood samples were collected from both groups in aseptic conditions and sent to the immunology department to measure their vitamin D level (Vit-D).*

Results: *A total of 63 children were studied; 31cases and 32controls. The mean age of cases was 6.72±4.29 and controls were 8.53±4.99. Vit-D levels were found deficient more in the control group than in the case group, 18(56.2%) vs 14(45.2%) respectively. But the insufficient level was found more in cases than in the control, 11(35.5%) vs 8(25.0%). Only about one-fifth of the study participants had sufficient Vit-D levels, 6(19.3%) and 6(18.7%) in the case and control groups respectively. These differences were not significant statistically. Also, vitamin D levels showed no significant difference in relation to sun exposure in any studied populations.*

Conclusion: *This study showed that there was no significant difference in Vit-D levels between the children with acute bronchiolitis and normal children. Also, the vitamin D level showed no significant difference in any studied populations who were sun-exposed either adequately or inadequately.*

Keywords: *Vitamin D, Bronchiolitis, Sun Light Exposure.*

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Introduction

Nowadays, the harmful effects of pathogens that cause bronchiolitis i.e., RSV, Adeno, Rhino, Influenza & Parainfluenza viruses have been strengthened, possibly due to increasing rates of vitamin D deficiency within infants. Vitamin D has been demonstrated to play roles in both immune system activation and the prevention of infections by killing microorganisms. An increased risk of respiratory system diseases has been demonstrated in the first three months in infants with low vitamin D levels in the cord blood at birth.[1]

Bronchiolitis is the spectrum of lower respiratory tract diseases and is a major cause of illness and hospitalization in infants following a seasonal outbreak. It is common under the age of two years, with most outbreaks seen at 2 to 8 months.[2] Acute bronchiolitis is a viral disease caused by the respiratory syncytial virus (RSV) in more than 50% of cases.[2,3] Acute bronchiolitis is seen more in male, non-breast-fed infants and living in crowded areas. Although the disease often has a good prognosis in most cases, 1-2% of cases need hospitalization.[3]

Vitamin D deficiency causes rickets in children which represents only the tip of the vitamin D deficiency iceberg.[4] There is a high prevalence of vitamin D deficiency among children which is up to 85-98% in several studies.[5,6] One study found that 80% of Bangladeshi children had vitamin D deficiency in relation to sex and socioeconomic condition.[7] The risk factors associated with vitamin D deficiency are inadequate sun exposure, atmospheric pollution, darker skin pigmentation, indoor activities & high-rise buildings.[8-11]

Vitamin D as the sunshine vitamin is a pro-hormone, synthesized in the skin epithelial cells, which is related to the change of 7-dehydrocholesterol to vitamin D3 by the ultraviolet radiation (UVB-ultra violate B) of the sun. Vitamin D is converted by 25- hydroxylase enzyme to 25(OH)D in the liver & then converted to 125- dihydroxy vitamin D in the kidney by 1 alpha-hydroxylase enzyme.[12]

Vitamin D can also be obtained from animal origins such as liver oil, milk, and milk product, egg yolk, fish, and foods that are fortified with vitamin D.[13] In addition to adjusting bone metabolism, vitamin D has antimicrobial and antioxidant properties and modulates the activation and deactivation of the innate and adaptive responses by its effect on B and T lymphocyte function.[14] Some believe that such a deficiency increases the risk of lower respiratory infections[15] while others disagree.[16] An increased risk of respiratory system diseases has been demonstrated in the first 24 months of a child with low vitamin D levels.[17] In this study we assessed the serum Vitamin D levels in children with acute bronchiolitis and also compared that with the healthy children and any relation of sun exposure with Vit-D levels in children with or without bronchiolitis.

Materials and methods

It was a case-control study conducted in ICMH, Dhaka from January to June 2019. Children aged between 1 month to < 24 months with bronchiolitis as defined by working definition and who were attending the inpatient and outpatient department of ICMH were enrolled as a case group. The same age and sex-matched children without any respiratory illness like pneumonia, pleural effusion, pulmonary tuberculosis, cystic fibrosis, cardiac diseases, rickets, having any Vit-D supplements or any drugs that interfere with the absorption and metabolism of Vit-D i.e., anti-epileptic drugs and attending the outpatient and EPI Center of ICMH were taken as a control group. Ethical clearance was taken from the Institutional Review Board (IRB) of ICMH. Parents informed written consent was taken before enrolling both groups of children into the study. Venous blood samples were collected from both groups in aseptic conditions and sent to the immunology department. To get the serum, the patient's sample was centrifuged and then ran on the automated analyzer, 'ADVIA Centaur XP (SN, IRL 81030730)', principle of measurement was chemiluminometric immunoassay (CIA). Results were manually checked, and abnormally high or low result samples were re-assayed. Depending on their 25(OH) D level, children were classified into 3 categories: vitamin D deficiency < 20 ng/ml, vitamin D insufficiency of 21-29 ng/ml, and vitamin D sufficiency > 30 ng/ml. Children's sun exposure time was measured using a pretested structured questionnaire.

Working definition:

Bronchiolitis: This is a clinical diagnosis characterized by runny nose followed by rapid onset of wheezing, fever, tachypnea, chest in drawing, crepitation, and rhonchi with radiographic evidence of hyperinflation in a child below 2 years of age.[18] Radiologically hyperinflation, increased translucency & interstitial markings of the lung fields are the cardinal features.[19]

Vitamin-D level: Sufficient vitamin D level is accepted as >30 ng/mL, insufficiency is between 21-29 ng/mL, deficiency is ≤ 20 ng/mL and toxic level is >100 ng/mL.[20-22]

Sun exposure: Adequate sun exposure is defined as when a child expose to solar noon between 10.00-15.00 hours (ratio of >UVB: UVA light is highest)[23] and

expose to sunlight about 18% of the body surface area for at least 30 minutes.[24]

Data Analysis: Data were analyzed using Statistical Package for Social Science (SPSS version 22). The obtained information was presented in the form of tables and graphs. Descriptive statistics such as mean, SD, frequency, and percentage were used as applicable. The χ^2 tests were applied for testing mean differences between categorical data and the Student's t-test was used for testing mean differences of continuous variables. The statistical tests were considered significant at a level of $p < 0.05$.

Results

A total of 63 children were studied (31 cases and 32 controls). The mean age of cases was 6.72±4.29 and the control was 8.53±4.99. In both cases and controls, males were predominant (22 and 21 respectively). Most parents from both groups were non-consanguineous. The weight of the children in both groups was almost similar. More than half of the children of both groups were exclusively breastfed for up to 6 months. Nearly half of the case group came from higher-income families. Family members living in one room were similar in both groups. Most of the children of both groups came from urban areas. None of the sociodemographic variables showed any significant difference between the two groups (Table-I).

Vit-D levels were found deficient more in the control group than in the case group, 18(56.2%) vs 14(45.2%) respectively. But the insufficient level was found more in cases than in the control, 11(35.5%) vs 8(25.0%). Only about one-fifth of the study participants had sufficient Vit-D levels, 6(19.3%) and 6(18.7%) in the case and control groups respectively. These differences were not significant statistically (Table II).

In the case group, almost half (7, 46.6%) of the children exposed adequately to the sun had insufficient Vit-D levels and almost two-thirds (10, 62.5%) of the children exposed inadequately to the sun had deficient Vit-D levels (Table III).

In the control group, more than half (10, 55.6%) & (8, 57.2%) of the children exposed adequately and inadequately to the sun had deficient Vit-D levels respectively (Table IV).

Table I: Distribution of respondents by socio-demographic characteristics

Socio-demographic characteristics	Case (n=31)	Control (n=32)	P-Value
Age in months (Mean± SD)	6.72±4.29	8.53±4.99	0.130
Sex			
Male	22 (70.9)	21 (65.6)	0.649
Female	9 (29.1)	11 (34.4)	
Weight in kg (Mean± SD)	7.16 ±1.75	7.39 ± 1.42	0.570
Consanguineous parents			
First degree	2 (6.4)	2 (6.3)	
Second degree	2 (6.4)	4 (12.5)	0.873
None	27 (87.2)	26 (81.2)	
Breastfeeding in the first 6 months			
EBF	16 (51.6)	21 (65.6)	
PDF	4 (12.9)	4 (12.5)	0.478
Mixed feeding	11 (35.5)	7 (21.9)	
Monthly family income			
<10,000	8 (25.8)	6 (18.7)	
10,000-20,000	8 (25.8)	17 (53.1)	0.082
>20,000	15 (48.4)	9 (28.2)	
Family members living in one room	4±1.02	4±0.751	0.929
Area of living			
Urban	18 (58.1)	19 (59.4)	0.916
Rural	13 (41.9)	13 (40.6)	

Table II: Comparison of Vit-D level in case and control group

Vit-D Level	Case	Control	P-Value
Deficient	14 (45.16%)	18(56.25%)	
Insufficient	11(35.48%)	8(25.0%)	0.619
Sufficient	6(19.35%)	6(18.75%)	

Table III: Association of sun exposure with vitamin d levels in the case group

Sun Exposure	Vitamin D level			P-Value
	Deficient	Insufficient	Sufficient	
Adequate ≥30min/day	4 (26.7%)	7 (46.6%)	4 (26.7%)	0.136
Inadequate <30min/day	10 (62.5%)	4 (25.0%)	2 (12.5%)	

Table IV: Association of sun exposure with vitamin d levels in the control group

Sun Exposure	Vitamin D level			P-Value
	Deficient	Insufficient	Sufficient	
Adequate ≥30min/day	10 (55.6%)	4 (22.2%)	4 (22.2%)	0.896
Inadequate <30min/day	8 (57.2%)	4 (28.5%)	2 (14.3%)	

Discussion

In this case-control study, any association of vitamin D-25(OH) level with bronchiolitis in children was sought. Vit-D levels were found deficient more in the control group than in the case group, 18(56.2%) vs 14(45.2%) respectively. But the insufficient level was found more in cases than in the control, 11(35.5%) vs 8(25.0%). Only about one-fifth of the study participants had sufficient Vit-D levels, 6(19.3%) and 6(18.7%) in the case and control groups respectively. These differences were not significant statistically. Also, vitamin D levels showed no significant difference in relation to sun exposure in any studied populations.

A case-control study was done by McNally JD et al.[25] at Royal Hospital Canada during the period from Nov 2007 to May 2008, where Vit- D levels were measured in children with bronchiolitis and pneumonia. No significant difference in Vit-D levels was found between cases and controls in this study. Our study was consistent with the above study.

In another case-control study done by Roth DE et al.[16] in Canada, hospitalized children with bronchiolitis aged between 1 to 25 months old were considered as cases, and healthy children of the same age and sex group were matched as control. Vit–D concentration was similar between both groups. Vit-D status was not associated with the risk of bronchiolitis. Our study was consistent with the above study.

In another case-control study, Mahyar A et al.[26] in Qavin University of Medical science, Iran compared children with bronchiolitis with healthy children. Vit-D levels were measured by the ELISA method. The study showed no significant difference between both groups in terms of Vit-D level. Our study was found also consistent with this study.

Beigelman et al.[27] conducted a cohort study at St. Louis Children's Hospital for the period from 2009 to 2012. A total of 145 infants were enrolled in the study. Vit-D levels of the infants hospitalized with bronchiolitis were measured and found no significant association with indicators of acute bronchiolitis severity. Our study was consistent with the above study.

In a study in rural Bangladesh,[15] children aged between 1 and 18 months suffering from lower respiratory tract infections were considered a case group, and the control was matched individually with age and sex. Vit-D

concentrations were measured in both groups and compared by using paired t-test. Vit-D status was found associated with childhood lower respiratory tract infection in this matched case-control study, which was inconsistent with the present study.

Conclusion

This study showed that there was no significant difference between children with acute bronchiolitis and normal children in terms of Vit D levels. Vitamin D levels also showed no significant association with sun exposure either adequately or inadequately in both studied populations.

Limitations

It was a single-centered study & sample size was small. Virus (RSV & other) isolation was not possible.

Recommendation

Further study will be needed with larger sample size.

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