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Respiratory Infections and Vitamin D Supplement Use among Benghazi Infants

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Abstract:
Several studies link reduced blood 25-hydroxyvitamin D (25(OH) D) levels and high susceptibility to respiratory infection during infancy. Vitamin D has a significant regulatory function in infants' immune system development and respiratory system growth. This study is a cross-sectional study investigates the impact of vitamin D supplement on respiratory infections among infants in Benghazi during winter (2023-2024). 434 subjects have been included in the current study; females and males represent (50.46%) and (49.54%) of the sample respectively. The majority of infants (73.5%) are normal weight, and the majority (70.28%) are normal height. (88.7%) of infants take vitamin D supplements, with the most beginning the supplementation from birth to 4 months (84.3%). The study revealed that 81.8% of the infants were not exposed to the sun directly. The percentage of infants with normal serum vitamin D level is (82.5%). The results of the current study recommend increasing health education and awareness regarding starting vitamin D supplementation as soon as a mother gives birth.

Keywords: Infants, Respiratory infections, Supplementation, Vitamin D.

التهابات الجهاز التنفسي واستخدام مكملات فيتامين د بين الرضع في بنغازي

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الملخص
تربط العديد من الدراسات بين انخفاض مستويات 25-هيدروكسي فيتامين د في الدم وارتفاع قابلية الإصابة بعدوى الجهاز التنفسي بين الرضع. يتمتع فيتامين د بوظيفة تنظيمية مهمة في تطور الجهاز المناعي لدى الرضع ونمو الجهاز التنفسي. هذه الدراسة هي دراسة مقطعية تبحث في تأثير مكملات فيتامين د على التهابات الجهاز التنفسي بين الرضع في بنغازي خلال فصل الشتاء (2023-2024). تم تضمين 434 رضيعا في الدراسة الحالية؛ تمثل الإناث والذكور (50.46٪) و (49.54٪) من العينة على التوالي. غالبية الرضع (73.5٪) لديهم وزن طبيعي، وغالبية الرضع (70.28٪) لديهم طول طبيعي. (88.7٪) من الرضع يتناولون مكملات فيتامين د، مع بدء معظمهم في تناول المكملات من الولادة إلى 4 أشهر (84.3٪). كشفت الدراسة أن 81.8٪ من الرضع لم يتعرضوا لأشعة الشمس مباشرة. النسبة المئوية للرضع الذين لديهم مستوى طبيعي من فيتامين د هي (82.5٪). وتوصي نتائج الدراسة الحالية بزيادة التثقيف الصحي والتوعية بشأن البدء في تناول مكملات فيتامين د بمجرد ولادة الأم.

الكلمات المفتاحية: الرضع، التهابات الجهاز التنفسي، مكملات، فيتامين د.

Introduction

It is revealed that one billion subjects globally have insufficiency or deficiency of Vitamin D. Vitamin D insufficiency and/or deficiency is a significant public health issue that influences people during all life stages. This public health problem is common even in sunny countries. The vitamin D deficiency consequences increase risk of several serious and common disorders, including respiratory tract infections, and low immunity. [1] [2] [3]

Infancy is a critical period in life. [4] during the first early months of infancy, vitamin D status of breastfed infants depends mainly on its intrauterine life placenta-across storages. Breast-fed infants are more vulnerable, because mother milk is a limited source of vitamin D. [5] Worldwide, respiratory tract infections (RTIs) are classified as the leading reason of morbidity, hospitalization, and mortality among under five children. The highest rates of RTIs are occurring during infancy. Infants are 1.3 times more likely to be hospitalized for RTIs compared to the overall child population [6] [7] Vitamin D has a significant regulatory responsibility in infants' immune system development and lung growth. Over the last fifteen years, several publications have related the decreased blood vitamin D levels and raised vulnerability to RTI during early childhood. These studies as mentioned by literature include Binks et al (2016), Lai et al., (2017), and Magnus et al. (2013). [5] [8] [9] Further studies include Al-Shehri, (2012), and (2018); Bouillon et al., (2008); All these publications emphasize the leading role of vitamin D in respiratory system function and health. [10] [11] In further publications, Vitamin D supplements were found to be beneficial in preventing RTIs. These publications include Martineau et al., (2017), Autier et al., (2017); and Grant et al., (2015); [12] [13] [14] However, limited studies found to be on the association between RTIs among infants and vitamin D supplements. Binks MJ et al (2016) indicate that vitamin D insufficiency is more among infants who were subsequently hospitalised with RTIs than those who had not vitamin D insufficiency. [5] Karatekin G, et al, (2009) suggest that newborns with asymptomatic vitamin D deficiency may have a higher risk of suffering from RTIs. [7] Also, Lai et al., (2017) stated that infants with lower cord serum 25(OH) D levels are prone to relatively poor lung function, which may explain the mechanism for the involvement of vitamin D in the susceptibility to RTI episode. [8] Gallo et al (2013) reported that 33% of infants who achieved the optimal 25(OH) D of 75 nmol/L or greater are less susceptible to RTI. [15] Pludowski et al., (2018) reported that 81% of infants are less susceptible to RTI when they received the 800 IU/day of vitamin D. Infants who are given 1,200 IU/day of vitamin D as supplement showed a significant reduction (92%) in susceptibility to RTIs, while those receiving 1,600 IU/day had an even greater reduction, with 100% showing decreased susceptibility to RTIs. [16] Accordingly, a supplement of 800 or 1,000 IU/day as two preventive daily doses against RTIs during early infancy. [15] Recent studies have linked between low blood 25(OH) D levels and a raised susceptibility of RTI among the general population including mother–infant group. However, studies specifically focusing on infants are limited, with only two studies (Grant et al., 2015, and Manaseki-Holland et al., 2012) yielding inconsistent results. [14] [17] In contrast, studies on children have shown that vitamin D supplements can help in preventing RTIs, particularly in those with pre-existing vitamin D insufficiency or deficiency (Camargo et al., 2012, and Loeb et al., 2019). [6] [18] A comprehensive meta-analysis concludes that vitamin D supplement significantly decreesd the risk of (RTIs) among the general population. Notably, daily or weekly supplements regimens showed greater protective effects compared to large bolus doses, particularly in individuals with severe vitamin D deficiency at the initiation of the study. [17] Very limited research covers this area in Arabic countries and Middle East including Libya. Elnady, HG et al (2014) in Egypt revealed an important support for the association between bronchial asthma in children (4- 15 years old) and vitamin D deficiency. [19] Soheila Alyasin (2021) in Iran concluded similar results among asthmatic children. [20] The aim of this study is to determine vitamin D supplement and its relation to respiratory infections among infants in Benghazi.

Methods

Study design and setting

It is a cross-sectional study investigates the impact of vitamin D supplement on respiratory infections among infants in Benghazi during winter (2023-2024). The study followed a random selection of clinics from each area in Benghazi. The included polyclinics are Al-salmani, Khaled bin walid, Al-kiesh, Sidi Younes, Sidi Khalifa, Sidi Hussein, Al-Nawaqia, and Qaryounis. The inclusion criteria are Libyan infants (0-12 months). Based on these criteria, 434 subjects have been included in the study.

Data collection procedure

Data was collected by interview-based questionnaire. Data collection period extended from 13- December-2023 to 1-January-2024. Subjects' guardians gave informed consent, and strict confidentiality measurements were implemented to protect the privacy of collected data. The research was approved by the Faculty of Public Health, University of Benghazi. SPSS version 22 was used for data analysis. A *p*-value of less than 0.05 was considered statistically significant.

Results

Females had a higher percentage (50.46%) than males (49.54%). The age group with the highest participation is 12 months, while the lowest is 8 months. The number of caesarean section births is higher than naturally occurring births (58% versus 42%). (88%) of participants were born in the 36th week.

Table 1. Infant characteristics

Age (Months)	Gender Number (%)		Total (%)
	Males	Females	
1	10(2.3)	13(3)	23(5.3)
2	29(6.68)	24(5.53)	53(12.2)
3	14(2.23)	13(3)	27(6.2)
4	22(5.07)	24(5.53)	46(10.6)
5	25(5.76)	10(2.3)	35(8.1)
6	22(5.07)	23(5.3)	45(10.4)
7	19(4.38)	16(3.69)	35(8.1)
8	9(2.07)	11(2.53)	20(4.6)
9	19(4.38)	13(3)	32(7.4)
10	10(2.3)	14(3.23)	24(5.4)
11	15(3.46)	13(3)	28(6.5)
12	21(4.84)	45(10.37)	66(15.2)
Total	215(49.54)	219(50.46)	434(100)
Birth order			
1-3	289		65.98
4-6	133		30.79
>6	12		2.76
Delivery			
Normal	180		42
Cesarean Section	254		58
Gestational Age			
28 weeks	3		1
32 Weeks	34		8
36 weeks	382		88
40 weeks	15		3

(75%) of the subjects' mothers were between 18–35 years. (90%) of mother's did not have any chronic diseases when they were pregnant. (6%) of mother's have diabetes millets when they were pregnant, (3%) of mother's have hypertension when they were pregnant, and only (1%) of mother's have thyroid dysfunction when they were pregnant,

Table 2. Mothers' characteristics

Family Characteristics	Number	Percentage
Mother Age (Years)		
18-35	324	75.00
36-45	110	25.00
Mother Diseases		
No	389	90
Diabetes millets	27	6
Hypertension	15	3
Thyroids	3	1

The majority of infants (73.5%) have normal weight, (3.46%) suffering from moderate wasting, and the majority (70.28%) were having height, (1.15%) being taller.

Table 3. Infant Anthropometrics

Infant Anthropometrics	Number	Percentage
Weight		
Normal	319	73.5
Mild wasting	34	7.83
Moderate wasting	15	3.46
Sever wasting	30	6.91
Obese	36	8.29
Height ((Stature))		
Normal	305	70.28
Mild stunting	40	9.22
Moderate stunting	29	6.68
Sever stunting	55	12.67
Taller	5	1.15

(88.5%) of infants do not have persistent sore throat, (79.3%) do not have frequent colds, and (90.1%) do not suffer from chronic chest infections. (88.5%) of infant do not use nebulizer. Infants without chest allergies have a higher prevalence (86.9%) compared to those with chest allergies. The percentage of infants do not hospitalize due to chest allergy is (86.4%).

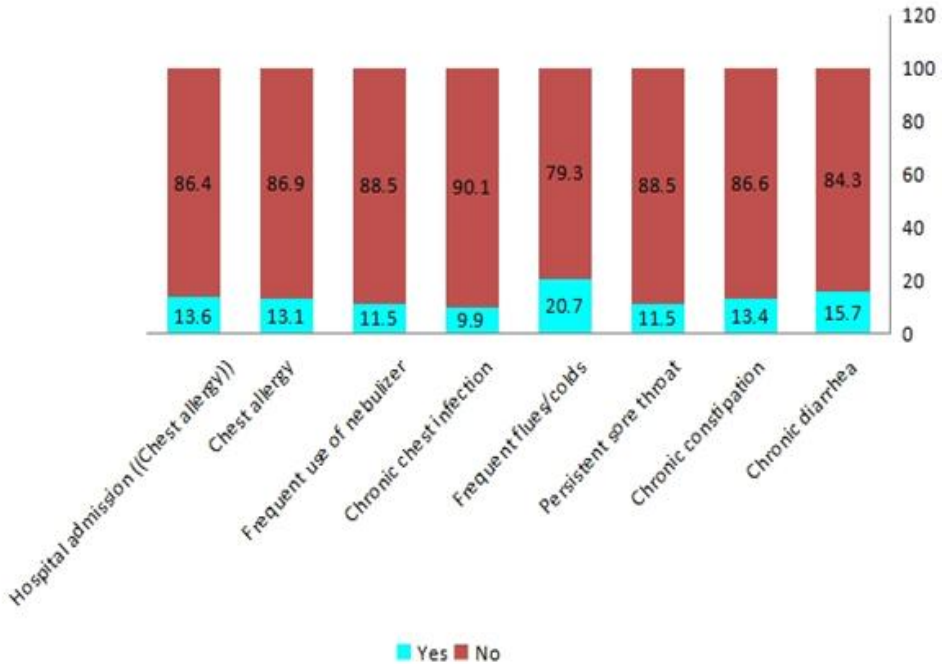

Figure 1. Infants Health Status

(88.7%) of infants take vitamin D supplements, with the most beginning from birth to 4 months (84.3%). The longest duration for continuing vitamin D supplements is one to three months. Infants who use the recommended preventative dose of 400 IU of vitamin D deficiency are the most, accounting for (68.9%). Most infants take one drop daily of vitamin D (63.8%).

Table 4. Vitamin D characteristics

Vitamin D characteristics	Number	Percentage
Vitamin D supplement		
Yes	385	88.7
No	49	11.3
Starting vitamin D supplement		
No intake	49	11.3
Birth – 4 months	370	84.3
5 -8 months	11	2.5
9-12 months	4	0.9
Supplement frequency		
No intake	49	11.3
Daily intake ((not forget))	348	80.2
3-4 times/ week	27	6.2
5-6 times/ week	9	2.1
1-4 times/ month	1	0.2
Supplementation duration ((months))	49	11.3
No intake	80	18.4
< 1	105	24.2
1-3	66	15.2
4-6	88	20.3
7-9	46	10.6
10-12		
Supplementation dosage		
No intake	49	11.3
200 IU	33	7.6
400 IU	299	68.9
Do not know	53	12.2
Daily amount intake		
No intake	49	11.3
1 drop	277	63.8
2 drops	41	9.4
3drops	14	3.2
Not sure	53	12.2
Vitamin D supplement with fatty food		
No intake	49	11.3
Yes	80	18.43
Give it alone	152	35.02
Not always	78	17.97
I do not know	75	17.28
Prescription of vitamin D supplement		
No intake	49	11.3
Physician	359	82.72
Dietitian	7	1.61
Family and friends	17	4.38

As shown in table (5), (81.8%) of the infants were not exposed to the sun directly without a barrier. The exposure of infants for less than 15 minutes was 9.7% higher than that for infants exposed for 31-60 minutes (1.4%).

Table 5. Sun Exposure characteristics

Sun Exposure	Number	Percentage
Direct sun exposure ((No barriers))		
Yes	78	18.2
No	357	81.8
Duration of sun exposure ((minutes))		
No exposure	357	81.8
<15	42	9.7
15-30	29	6.7
31-60	6	1.4

Table (6) shows that infants who do not have vitamin D deficiency are (82.5%).

Table 6. Vitamin D deficiency

Vitamin D deficiency	Number	Percentage
Yes	76	17.5
No	358	82.5

As shown in table (7); the statistical analysis revealed significant correlations between vitamin D deficiency and several health issues, including a positive association with persistent sore throat ($p = 0.004$) and frequent flu/colds ($p = 0.010$). Furthermore, vitamin D deficiency was found to decrease with age ($p < 0.001$), and a negative correlation was observed with chronic diarrhea ($p = 0.006$). Moreover, vitamin D supplementation was linked to reduced persistent sore throat ($p = 0.027$), and longer vitamin D supplementation use was associated with further reduction ($p = 0.042$).

Table 7. Statistical Analysis

Variables		Pearson Correlation"	Sig. (2-tailed)	Notes
Vitamin D Deficiency	Sore throat	0,138** Positive association	0,004	Significant correlation 0.01 level(2-tailed).
	Age	-,276** Negative association	<0.001	
	Diarrhea	-,132** Negative association	0,006	
	Flues/colds	,123* Positive association	0 ,010	* Significant correlation at The 0.05 level (2-tailed).
Use of Vitamin D supplement	Sore throat	-0.106* Negative association	0,027	
Duration of Vitamin D supplement use	Sore throat	-,098* Negative association	0,042	

Discussion

It is a cross-sectional study investigates the association between vitamin D supplement and respiratory infections among Benghazi infants during winter (2023-2024). The current study reveals that infants aged 12 months had the highest participation rate, while those aged 8 months had the lowest participation rate. It is found that significant associations between vitamin D deficiency and several health issues, including persistent sore throat ($p = 0.004$), chronic diarrhea ($p = 0.006$), and frequent flu/colds ($p = 0.010$). Additionally, vitamin D deficiency was linked to age ($p < 0.001$). Notably, vitamin D supplementation was associated with reduced persistent sore throat, both in terms of supplement use ($p = 0.027$) and duration of use ($p = 0.042$). In this study, it has been found that a positive association between vitamin D deficiency and persistent sore throat at *p.* value 0.004. A negative correlation emerges between use of Vitamin D supplement and persistent sore throat at *P* .value (0.027). There is a negative correlation between Duration of Vitamin D supplement use and persistent sore throat at *p* .value (0.042).

A study found that persistent sore throats and vitamin D deficiency as well as usage of vitamin D supplement are related by Raad and Ibrahim (2024). Ibrahim and Raad mentioned how micronutrient deficiencies, such as low vitamin D, have been connected to a higher risk of infection. Vitamin D deficiency was found to be related to tonsillopharyngitis. [21] According to recent research, sore throat and vitamin D deficiency may be related. According to Corsello et al (2023), children with recurring sore throats were more frequent to have insufficient and/ or deficient vitamin D. In the current study, there is a negative association between Vitamin D deficiency and age at *p*. value (<0.001). Older infants have less prevalence of vitamin D deficiency. Two previous studies in South Korea and Africa, found that vitamin D deficiency infants were caused by exclusive breastfeeding. The South Korean study found that a high prevalence of vitamin D deficiency is seen in infants who aged one to six months, especially those who are exclusively breastfed. A Study conducted in South Africa by Stoutjesdijk et al (2017), indicated that, vitamin D deficiency is so common in the first few weeks of life. Strong correlation was found between breastfeeding and the season of birth and the 25 (OH) D concentrations at six to ten weeks. Additionally, children who were breastfed for longer periods of time were more likely to have vitamin D deficiency. [22] [23] A correlation emerges between Vitamin deficiency and frequent flues / colds at *P* .value (0.01). Study in china prepared by Zhou et al (2018) the shows that influenza is more common in the winter when there are less sun exposure and low vitamin D levels. However, the mechanism underlying influenza seasonality is still unclear. One of the many immune-modulatory roles of vitamin D is the up-regulation of antiviral peptides, which are a component of human innate immunity and have the ability to inactivate influenza viruses. [24] Few well-conducted randomized clinical experimental have been established to support vitamin D use to prevent early childhood influenza. The previous studies' participants ranged in age from 6 months to 5 years. However, no prior studies concentrated on infants. Significantly, infants on high dose of vitamin D supplements showed a faster reduction in influenza viral loads than those on low dose. [25] It has been found a negative correlation between vitamin D deficiency and chronic diarrhea at *p*. value (0.006) in the current study. A more normal level of vitamin D associated with less occurrence of diarrhea. A study prepared by Lazarus et al (2024), shows association between vitamin deficiency and diarrhea.[26]

Conclusion

The current study aims evaluate relation between Vitamin D supplement and respiratory infections among infants in Benghazi. The results of the current study recommend that increasing health education and awareness regarding starting if vitamin D supplementation as soon as mother give birth. Study Limitations include that researchers of the current study realize that the observational and cross- sectional design, with single measurement in one season is a limitation of the current study. As well as the shortage in laboratory tests. Anthropometric measurements and other laboratory tests are not within the scope of the current paper. The current results support the following recommendations; increasing early intake of vitamin D supplement after birth directly should be considered essential measurement for having healthier generations. Vitamin D supplement should be increased through health education sessions by government agencies, non-governmental organizations and educational institutions. Support the laboratory of public hospitals and clinics by chemical materials and instrumentations for having more and detailed analysis for vitamin D status. Further studies are needed to assess the nutritional habits, intakes as well as the studies related to vitamin D status among infants in Benghazi. Connections with other bodies such as ministry of health and other agencies are crucial to improve the vitamin D status in Benghazi.

Disclaimer

The article has not been previously presented or published, and is not part of a thesis project.

Conflict of Interest

There are no financial, personal, or professional conflicts of interest to declare.

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