Brief Communication

Estimation of vitamin D deficiency prevalence among Saudi children in Armed Forces Hospital and Riyadh Care Hospital in Riyadh, Kingdom of Saudi Arabia and its relation to type 1 diabetes mellitus

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ABSTRACT

Objectives: To evaluate the prevalence of vitamin D deficiency among a group of Saudi children with type 1 diabetes mellitus (T1DM) in Armed Forces Hospital and Riyadh Care Hospital in Riyadh, Kingdom of Saudi Arabia.

Methods: The study was carried out in Riyadh Armed Forces Hospital and Riyadh Care Hospital in Riyadh, Kingdom of Saudi Arabia, from January to June 2017. This study included a total of 100 Saudi (50 males and 50 females) participants with T1DM, aged 2-12 years old. Hemoglobin A1c (HbA1c) levels, serum calcium phosphorous and 25(OH) vitamin D were analyzed.

Results: Seventy percent of the children with T1DM examined showed a reduced level of vitamin D. Vitamin D deficiency was more common in female children compared than male. Serum 25(OH) vitamin D was significantly inversely associated with body mass index as well as HbA1c.

Conclusion: There is a concern that growing children with low vitamin D may be at higher risk for T1DM. It is necessary to further examine the mechanisms underlying vitamin D deficiency in T1DM children.

Diabetes mellitus (DM) is one of the most important public health problem worldwide.[1] The Intern+ational Diabetes Federation (IDF) in 2017 estimated there to be 451 million people with diabetes worldwide in 2017, compared to 108 million in 1980. By 2045, this number is expected to increase to 693 million.[2] Type 1 diabetes mellitus (T1DM) is characterized by hyperglycemia resulting from defects in pancreatic β-cells and represented 5-10% of the total cases of diabetes worldwide. Type 1 diabetes mellitus is the main type of diabetes in youth, representing 90% of diabetes cases in individuals children and adolescents than 20 years of age worldwide.[3]

A reduced risk of developing T1DM due to vitamin D supplementation during the first year of life was reported.[4] The aim of the current study was to evaluate the prevalence of vitamin D deficiency among a group of Saudi children with T1DM attending outpatient clinics at Riyadh Armed Forces Hospital and Riyadh Care Hospital in Riyadh, Kingdom of Saudi Arabia.

Methods. A cross-sectional single-center randomly study was conducted in 100 Saudi (50 males and 50 females) participants with T1DM, aged 2-12 years old between January and June 2017 at Armed Forces Hospital and Riyadh Care Hospital, Riyadh, Kingdom of Saudi Arabia. Ethical approval was obtained from the Ethics Committee of the College of Science Research Center, King Saud University, Riyadh, Kingdom of Saudi Arabia.

Data collection and anthropometric analysis. Data were collected by questionnaire included: age, weight, height, gender, education level, and past and present medical history, sports activity, dietary sources of vitamin D and the frequency of exposure to sunlight. The exclusion criteria included: non-Saudis and those who were suffering from hepatic renal disease, metabolic bone disease, malabsorption, hypercortisolism, malignancy, immobility for more than one-week, or T2DM. The participants' anthropometric characteristics including weight, height and body mass index (BMI) were determined.

Blood collection and biochemical analysis. Approximately 2 ml of venous blood samples were collected from participants who fasted for 8 hours, one with anticoagulant and the other without anticoagulant. The samples without anticoagulant were allowed to rest for 10 minutes, and then were centrifuged and immediately transported to Armed Forces Hospital, Riyadh, Kingdom of Saudi Arabia, and stored at -20°C until analysis. Hemoglobin A1c (HbA1c) levels, serum 25(OH) vitamin D, calcium and phosphorous were analyzed.

Statistical analysis. Categorical data are presented as frequencies and percentages (%). Continuous data are presented as the mean ± standard deviation (SD) for normal variables, and non-Gaussian variables were presented as medians. All continuous variables were checked for normality using the Kolmogorov-Smirnov test. Non-Gaussian variables were log-transformed prior

to parametric analysis. Differences between groups were evaluated using a Student's t-test. Associations between variables were determined using Spearman's correlation. Univariate and multivariate linear regression analysis were performed to identify independent factors affecting 25(OH) vitamin D. A *p*-value of <0.05 was considered significant.

Results. As shown in **Table 1**, there were 100 patients with T1DM, 50 (50%) were males and 50 (50%) were females aged 2-12 years old. Lips classified a level of 25(OH) vitamin D <12.5 nmol/L as a severe deficiency, 12.5-25 nmol/L as moderate deficiency, 25-50 nmol/L as mild deficiency, and >50 nmol/L as normal.[5] According to this classification, 11 (11%) participants with T1DM had severe vitamin D deficiency, 30 (30%) had moderate vitamin D deficiency, 29 (29%) had mild vitamin D deficiency, and 30 (30%) were normal. A

25(OH) vitamin D level of females was significantly (*p*=0.04) lower than males. Moderate vitamin D deficiency was significantly (*p*=0.04) more frequent in females (36%) than males (24%).

As shown in **Table 2**, there was a significant (*p*<0.0001) difference between 25(OH) vitamin D <25 nmol/L and ≥25 nmol/L in regards to gender. A 25(OH) vitamin D level of <25 nmol/L was more frequent in females (50%) than males (32%).

As shown in **Table 3**, serum 25(OH) vitamin D was positively correlated with age (10-12 years) among male and female participants and negatively with BMI (>30 kg/m^2) among male and female participant. Serum 25(OH) vitamin D was also negatively associated with HbA1c in male and female participants.

Discussion. The present study showed that a high prevalence of vitamin D deficiency among T1DM

Table 1 - General characteristics and biochemical parameters of study participants by gender.

Variable	Over all	Gender		*P*-value
		Male	Female	
	100	50 (50)	50 (50)	
Age in years				
2-5	37 (37)	17 (34)	20 (40)	0.09
6-9	35 (35)	20 (40)	15 (30)	0.07
10-12	28 (28)	13 (26)	15 (30)	0.08
BMI (kg/m²)				
18.5-24.9	71 (71)	35 (70)	36 (72)	0.42
25-29.9	17 (17)	10 (20)	7 (14)	0.38
>30	12 (12)	5 (10)	7 (14)	0.35
Serum 25(OH) vitamin D deficiency (%)				
<12.5 nmol/L	11 (11)	4 (8)	7 (14)	0.06
12.5-25 nmol/L	30 (30)	12 (24)	18 (36)	0.04
25-50 nmol/L	29 (29)	14 (28)	15 (30)	1.0
>50 nmol/L	30 (30)	20 (40)	10 (20)	<0.001
Duration of sun exposure				
<10 min/day	60 (60)	20 (40)	40 (80)	<0.001
10-30 min/day	12 (12)	7 (14)	5 (10)	0.19
>30 min/day	28 (28)	23 (46)	5 (10)	<0.001
Dairy products				
Daily intake	53 (53)	28 (56)	25 (50)	0.08
Twice per week	45 (45)	20 (40)	25 (50)	0.09
None	2 (2)	2 (4)	0	0.06
Seafood				
Daily intake	12 (12)	7 (14)	5 (10)	0.08
Twice per week	77 (77)	39 (78)	38 (76)	1.0
None	11 (11)	4 (8)	7 (14)	0.07
Vitamin supplement				
Yes	86 (86)	44 (88)	42 (84)	0.09
No	14 (17)	6 (12)	8 (16)	0.07
Serum 25(OH) vitamin D level nmol/L, Mean±SD	35.1±1.4	34.1±1.8	32.1±2.6	0.04
Serum calcium (2.2-2.6 mmol/L), Mean±SD	1.8±0.5	1.8±0.3	1.9±0.2	0.92
Serum phosphorus (0.8-1.4 mmol/l), Mean±SD	1.4±0.2	1.3±0.3	1.1±0.2	0.85
HbA1c (4-5.6%), Mean±SD	8.6±2.2	8.5±1.4	8.7±1.9	1.0

Values are presented as numbers and percentage (%). BMI - body mass index, HbA1c - hemoglobin A1c, Data are presented as mean±SD with normal laboratory values between brackets.

children. Overall, 70% of participants were vitamin D deficient. In agreement with these findings, in Qatari children under 16 years old, vitamin D deficiency was considerably higher in T1DM children (90.6%) compared with non-diabetic children (85.3%).[6] In a previous study of Saudi children with T1DM, 77%

Table 2 - Differences between vitamin D level groups.

Parameters	25(OH) vitamin D levels (nmol/L)		P-value
	<25	≥25	
	Mean±SD		
N (%)	41 (41)	59 (59)	
Male/female, n (%)	16 (32)/25 (50)	34 (68)/25 (50)	<0.0001
Age (years)	4.5±1.2	6.2±2.5	0.06
BMI (kg/m²)	18.9±2.9	19.8±2.7	0.82
Serum calcium (2.2-2.6 mmol/L)	1.8±0.5	1.9±0.2	0.33
Serum phosphorus (0.8-1.4 mmol/L)	1.3±0.1	1.5±0.3	0.63
HbA1c (4-5.6%)	8.9±2.3	8.2±1.3	0.07

Data are presented as mean±SD with normal laboratory values between brackets.

Table 3 - Bivariate relationship between serum 25(OH) vitamin D as the dependent variable and the anthropometric and biochemical parameters of study participants by gender (N=100).

Variables	Over all	Males (n=50)	Females (n=50)
Age in years			
2-5	0.16	0.29	0.18
6-9	0.22	0.12	0.13
10-12	0.30*	0.16	0.17*
BMI (kg/m2)			
Normal (18.5-24.9	-0.16	-0.18	-0.08
Overweight (25-29.9)	-0.27	-.017	-0.12
Obese (>30)	-0.29*	-0.18*	-0.11*
Duration of sun exposure			
<10 min/day	0.29	0.14	0.21
10-30 min/day	0.18	0.13	0.11
>30 min/day	0.31	0.22	0.15
Dairy products			
Daily intake	0.29	0.13	0.21
Twice per week	0.08	0.03	0.12
None	0.15	0.12	0.11
Seafood			
Daily intake	0.39	0.24	0.11
Twice per week	0.14	0.5	0.7
None	0.31	0.22	0.15
Vitamin supplement			
Yes	0.32*	0.24*	0.21
No	0.13	0.8	0.6
Serum calcium (2.2-2.6 mmol/L)	0.21	0.13	0.12
Serum phosphorus (0.8-1.4 mmol/l)	0.35	0.12	0.14
HbA1c (4-5.6%)	-0.13*	-0.08*	-0.05*

Data presented as coefficient (R). *denotes significance at *p*<0.05 level.

of the children had a low level of 25(OH) vitamin D.[7] Another study showed that 84% of Saudi children with T1DM versus 59% of healthy children were vitamin D deficient.[8]

Preclinical studies described that vitamin D seems to play a regulatory role in insulin secretion and can prevent the death of pancreatic β-cells.[9,10] One study on 10,366 children in Finland over 31 years indicated that 2000 IU of vitamin D3 per day throughout the first year of life can reduce the risk of T1DM by 78%.[11]

In our study, the prevalence of vitamin D deficiency was significantly (*p*=0.04) higher among female than male children with T1DM; furthermore, there was a significant positive correlation between 25(OH) vitamin D and age (10-12 years) with regard to female. These results were consistent with previous studies reported that the frequency of vitamin D deficiency was significantly (*p*<0.0001) higher in females (77%) than in males (37%) with T1DM.[12] A higher incidence of vitamin D deficiency among females in children with T1DM might be related to limited exposure to sunlight, especially during summer, and limited intake of foods and supplements. Vitamin D can be obtained endogenously from sunlight exposure through synthesis.[13] The majority of females with T1DM had only limited exposure to sunlight, because of the cultural practice of wearing protective dress to cover most of the body. These findings are supported by a past study that showed that wearing concealing clothing and restriction of outdoor activities had adverse effects on 25(OH) vitamin D levels among Saudi Arabian adolescents.[14]

Our study indicated that serum 25(OH) vitamin D was significantly inversely associated with BMI in male and female participants. These findings are supported by a past study reported that a significant predictor of vitamin D deficiency in BMI.[15]

Study limitations. The small sample size and cross-sectional-based study cannot suggest any cause of vitamin D deficiency and limits the application of our results to the Saudi population. Enlargements in the size of the groups are needed to investigate the mechanisms underlying vitamin D deficiency in T1DM children.

In conclusion, vitamin D deficiency was common among Saudi children with T1DM. Overall, the level of vitamin D deficiency was found to be 77% with more common in female than those male. There was significant inverse association between serum 25(OH) vitamin D level and BMI as well as HbA1c. There is a concern that growing children with low vitamin D may be at higher risk for T1DM. It is necessary to further examine the mechanisms underlying vitamin D deficiency in T1DM children.

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