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ASSOCIATION BETWEEN VITAMIN D AND URIC ACID AMONG NORTH CYPRUS ADULTS: FIRST PRELIMINARY REPORT

KUZEY KIBRIS YETİŞKİNLERİNDE D VİTAMİNİ VE ÜRİK ASİT ARASINDAKİ İLİŞKİ: BİRİNCİ ÖN HAZIRLIK RAPORU

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ABSTRACT

Objective: The aim of the study is to evaluate the association between serum uric acid (SUA) and 25-OH Vitamin D (25-OH-VIT D). There is no data about the association between hyperuricemia and 25-OH-VIT D deficiency for North Cyprus.

Material and Methods: A cross-sectional study was performed on 356 adults aged between 18-75 years in the North Cyprus. Patients socio-demographic information, clinical and biochemical characteristics, eating habits, and lifestyle choices were recorded. Biochemical parameters were evaluated in all patients. Data were analysed by Chi-square test, Student's t test, and ANOVA, as appropriate. Also, the Gamma correlation coefficient was calculated for the relationship between 25-OH Vitamin D groups and the other variables.

Results: The prevalence of 25-OH-VIT D deficiency was 55.9% among the patients (12.86±4.63 ng/mL), the prevalence of 25-OH-VIT D insufficiency (23.44±2.38 ng/mL) was 27%, and 25-OH-VIT D levels were sufficient in only 17.1% of the patients (36.01±5.83 ng/mL). The ANOVA results indicated statistically significant differences SUA for both male and female patients between the 25-OH-VIT D groups. According to the Gamma correlation coefficient values, 25-OH Vitamin D levels were significantly negatively correlated with SUA.

Conclusion: In our study indicated a high prevalence of 25-OH-VIT D deficiency and insufficiency in North Cyprus adults and we have found a significant association between SUA levels and 25-OH-VIT D. As a result, both vitamin D supplementation and uric acid-lowering therapies are important in protecting patients against future atherosclerotic diseases.

Keywords: North Cyprus, Vitamin D, uric acid, prevalence, atherosclerosis

ÖZET

Amaç: Kuzey Kıbrıs için hiperürisemi ile 25-OH-VIT D eksikliği arasındaki ilişki hakkında veri yoktur. Bu çalışmanın amacı serum ürik asit (SUA) ile 25-OH-VIT D arasındaki ilişkiyi değerlendirmektir.

Gereç ve Yöntem: Kuzey Kıbrıs'ta yaşları 18-75 arasında değişen 356 yetişkin üzerinde kesitsel bir çalışma yapılmıştır. Hastaların sosyodemografik bilgileri, klinik ve biyokimyasal özellikleri, beslenme alışkanlıkları ve yaşam tarzı tercihleri kaydedildi. Tüm hastalarda biyokimyasal parametreler değerlendirildi. Veriler Ki-kare testi, Student t testi ve uygun şekilde ANOVA ile analiz edildi. Ayrıca 25-OH Vitamin D grupları ile diğer değişkenler arasındaki ilişki için Gama korelasyon katsayısı hesaplandı.

Bulgular: Hastalar arasında 25-OH-VIT D eksikliği prevalansı %55,9 (12,86±4,63 ng/mL), 25-OH-VIT D yetmezliği prevalansı (23,44±2,38 ng/mL) %27 idi ve 25-OH-VIT D düzeyleri hastaların sadece %17,1'inde yeterliydi (36,01±5,83 ng/mL). ANOVA sonuçları, 25-OH-VIT D grupları arasında hem erkek hem de kadın hastalar için istatistiksel olarak anlamlı SUA farklılıkları gösterdi. Gama korelasyon katsayısı değerlerine göre, 25-OH Vitamin D düzeyleri SUA ile anlamlı olarak negatif korelasyon gösterdi.

Sonuç: Çalışmamızda Kuzey Kıbrıs erişkinlerinde 25-OH-VIT D eksikliği ve yetersizliği prevalansının yüksek olduğu gösterildi ve SUA düzeyleri ile 25-OH-VIT D arasında anlamlı bir ilişki bulundu. Sonuç olarak, hem D vitamini takviyesi hem de ürikasit düşürücü tedaviler, hastaları gelecekteki aterosklerotik hastalıklara karşı korumada önemlidir.

Anahtar Kelimeler: Kuzey Kıbrıs, Vitamin D, ürik asit, prevalans, ateroskleroz

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INTRODUCTION

Hyperuricemia is an important marker increasing the risk of cardiovascular disease (CVD) and is a common health problem in all societies. As it is known, uric acid is the end product of purine metabolism, and produced in the intestines, liver, muscles and is excreted by the kidney. Elevated serum uric acid (SUA) level was found associated with diabetes mellitus (DM), hypertension (HT), low-grade inflammation, metabolic syndrome (MS), insulin resistance, stroke and significant cardiovascular events (1, 2). Additionally, hyperuricemia can lead to gouty arthritis, nephrolithiasis, and chronic renal disease if it is constant (3).

Vitamin D (VIT D) deficiency is now recognized as a worldwide epidemic and an increasingly important public health issue. It has many significant functions in extraskeletal tissues as well as the musculoskeletal system (4). Although VIT D has been defined a fat soluble vitamin in bone mineralization, it is rather a hormone since it can be synthesized in the body. It is a secosteroid which is widely known as the sun hormone (5, 6). It is estimated that more than one billion people in the world have VIT D deficiency (7). There are many studies supporting the relationship between hyperuricemia and VIT D deficiency, as well as unclear literature data (7-12). It is thought that SUA can reduce the conversion of 25-hydroxyvitamin D (25-OHD) to 1,25-di hydroxyvitamin D (1,25-$(OH)_2$D) active VIT D form by suppressing the 1-alpha-hydroxylase enzyme (3, 13).

Therefore, the study aims to determine the possible relationship between 25-OH-VIT D insufficiency-deficienc and hyperuricemia, and to evaluate clinical-biochemical characteristics in adults aged 18-75 years inNorth Cyprus.

MATERIAL AND METHODS

Subjects and design

This research was a cross-sectional study that was conducted in the Near East University Hospital. The records of 356 patients who presented to the Near University Hospital Internal Medicine Outpatient Clinic between the dates of June 2020 to June 2021 were retrospectively reviewed after obtaining the approval of the Near East University Hospital Ethics Committee (Date: 29.04.2021, No: YDU/2021/90-1327). Exclusion criteria included being under 18 years of age, pregnant, breastfeeding, having psychiatric disease, receiving calcium and/or VIT D supplements, use of uric acid-lowering medication, skeletal musculoskeletal disease, gastrointestinal system disease, chronic renal disease, and individuals using drugs that interact with the VIT D metabolism (such as anticonvulsants, antibiotics, glucocorticoids, and bile acid binding).

In this study, we used the Turkey Endocrinology and Metabolism Society for Metabolic Bone Diseases Diagnosis and Treatment 2020 guidelines as reference values for 25-OH-VIT D levels: >30 ng/mL sufficient, 20-30 ng/mL VIT D insufficiency, <20 ng/mL VIT D deficiency (14). According to the 25-OH vitamin D levels, patients were divided into three groups as the deficient vitamin D group D1 (25-OH vitamin D<=20 ng/mL), insufficient vitamin D group D2 "20 ng/mL<25-OH vitamin D<30 ng/mL" (D2) and sufficient vitamin D group D3 "25-OH vitamin D>=30 ng/mL".

Laboratory studies and calculation

Venous blood samples were collected in the morning under fasting conditions at the time of admission. Waist circumference (WC), Systolic blood pressure, Diastolic blood pressure, body mass index (BMI), fasting blood sugar, total cholesterol level (TCL), High density lipoprotein (HDL)-cholesterol, Low density lipoprotein (LDL)-cholesterol, triglycerides, uric acid, hs-CRP (high sensitivity C-reactive protein), homeostatic model assessment–insulin resistance (HOMA-IR) and 25-OH-VIT D vitamin levels of the patients were recorded. Also, the individuals participating in our study were asked whether they used VIT D, their age, gender, height, weight measurements, smoking and alcohol use, skin color, sunscreen use, sun exposure, nutritional status, supplemental vitamins or minerals use, and fish oil use.

Homeostasis Model Assessment-Insulin Resistance (HOMA-IR) values of 2.5 and above were considered as "insulin resistance exists". Low density lipoprotein (LDL) values of 130 mg/dL and above were considered as "high LDL". Patients with total cholesterol (TC) levels of 200 mg/dL and above were considered as "high cholesterol". Fasting SUA levels were measured by uricase-based commercial kit (Architect i2000, Abbott, USA). In addition, individuals with SUA levels of 6 mg/dL and above in women and SUA 7mg/dL and above in men were considered as "high uric acid". High-sensitivity C-reactive protein (hs-CRP) values of 0.5 mg/dL and above were accepted as "hs-CRP high". In addition, individuals with a body mass index (BMI) of 30 kg/cm^2 and above were classified as obese.

Statistical analysis

The IBM Statistical Package for Social Sciences (SPSS) for Windows version 23.0 was used to perform statistical analysis. Continuous variables obtained were presented with mean±standard deviation and median (min, max) values. In addition, the chi-square (test was used to determine statistical significance for the categorical variables. The degree and direction of the relationship between 25-OH-VIT D groups and other variables were evaluated with the Gamma correlation coefficient (G). The One-way ANOVA test was applied to investigate whether significant differences between the mean levels of clinical and biochemical characteristics existed with-

in Vitamin D groups in cases where the homogeneity of variances was met according to the Levene test results. For the post hoc test, the Scheffe test was used if the variances were equal. According to the Levene test results, in cases where the homogeneity of variances was not met, Welch's Anova test was applied to investigate whether there were significant differences between the mean levels of clinical and biochemical characteristics within Vitamin D groups. For the post hoc test, the Games-Howell test was used because the variances were not equal. Also, the Student's t test was used to assess the significance of differences between the mean value of 25-OH-VIT D levels within two groups. A level of 5% was set as the level for statistical significance for all two tailed statistical tests.

RESULTS

A total of 356 patients, comprising 265 women (74.4%) and 91 men (25.6%), were included in the study. The mean age of the patients was 50.89±18.45 years. The mean age of the male patients (54.03±18.19 years) was statistically higher than the female patients (49.83±18.45 years) (p=0.000). In addition, 40.7% of the patients in the research group had obesity, while 59.3% of them did not have obesity.

The mean serum 25-OH-VIT D level of the study group was found to be 19.68±9.73 ng/mL. The serum 25-OH-VIT D levels of the female patients were significantly lower than the male patients (18.96±9.08 ng/mL; 21.79±11.23 ng/mL; p=0.017). The prevalence of VIT D deficiency was 55.9% (12.86±4.63), the prevalence of VIT D insufficiency (23.44±2.38) was 27%, and VIT D levels were sufficient in only 17.1% of the patients (36.01±5.83).

Table 1 presents the descriptive statistics of the clinical parameters and biochemical characteristics; age, BMI, WC, Systolic blood pressure, Diastolic blood pressure, fasting glucose, TCL, HDL-cholesterol, LDL-cholesterol, triglycerides, uric acid, hs-CRP, HOMA-IR and 25-OH Vitamin D levels of the patients according to the VIT D groups (Table 1). Table 2 and Table 3 present the ANOVA results of the patients' biochemical and clinical characteristics levels according to the 25-OH-VIT D groups. The results of the Welch's ANOVA test showed that there was a statistically significant difference for the mean value of SUA between the 25-OH-VIT D groups for both male and female patients, respectively.

The Games-Howell post hoc test for significance revealed that the mean value of SUA for the male patients with 25-OH-VIT D deficiency (9.144.45) was significantly greater than the mean value of SUA for the male patients with 25-OH-VIT D insufficiency (6.02 and with sufficient 25-OH-VIT D (4.611.68)), respectively. The mean value of SUA for the 25-OH-VIT D insufficient group was also

Table 1: Descriptive statistics of clinical and biochemical characteristics

		Mean	Median
Age (years)	D1	47.58	46.00
	D2	54.10	56.50
	D3	56.40	56.00
BMI (kg/m²)	D1	30.12	30.11
	D2	27.85	27.00
	D3	25.17	25.00
WC (cm)	D1	105.67 (male) 94.48 (female)	106.00 93.55
	D2	99.81 (male) 90.94 female)	98 92
	D3	90.65 (male) 81.75 (female)	90 80
Systolic blood pressure (mmHg)	D1	121.99	120.00
	D2	122.48	120.00
	D3	122.36	120.00
Diastolic blood pressure (mmHg)	D1	72.70	70.00
	D2	71.60	70.00
	D3	72.10	70.00
Fasting blood sugar	D1	110,17	98.00
	D2	104,15	97.00
	D3	104.27	95.00
HOMA-IR	D1	2.91	2.15
	D2	2.61	2.07
	D3	2.74	1.94
hs-CRP (mg/dL)	D1	1.04	0.65
	D2	0.50	0.20
	D3	0.30	0.10
Uric acid (mg/dL)	D1	9.14 (male) 6.17 (female)	7.8 5.5
	D2	6.02 (male) 4.61 (female)	5.85 4.3
	D3	4.61 (male) 4.02 (female)	3.70 3.8
Total Cholesterol (mg/dL)	D1	208.89	192.30
	D2	204.48	203.40
	D3	194.93	196.60
HDL	D1	38.83 (male) 45.65 (female)	37.00 46
(mg/dL)	D2	40.86 (male) 50.91 (female)	40.50 51
	D3	47.35 (male) 53.04 (female)	47 54

Table 1: Continue

		Mean	Median
LDL (mg/dL)	D1	128.90	126.00
	D2	130.81	126.50
	D3	120.66	117.00
Triglycerides (mg/dL)	D1	144.67	136.00
	D2	127.07	112.00
	D3	110.63	102
25-OH Vitamin-D (ng/mL)	D1	12.86	13.10
	D2	23.44	23.40
	D3	36.01	34.00

BMI: Body Mass Index, WC: Waist circumference, HOMA-IR: Homeostatic model assessment for insülin resistance, hs-CRP: High-sensitive C-reactive protein, HDL: high density lipoprotein, LDL: Low density lipoprotein

Table 2: Welch's ANOVA results according to vitamin D groups

	Statistic	df1	df2	Sig.	Significant difference
Uric acid (male)	11.769	2	55.994	**0.000**	D1-D2 D1-D3 D2-D3
Uric acid (female)	13.708	2	146.707	**0.000**	D1-D2 D1-D3
BMI	34.068	2	186.344	**0.000**	D1-D2 D1-D3 D2-D3
hs-CRP	12.802	2	216.497	**0.000**	D1-D2 D1-D3
Triglyceride	11.168	2	184.955	**0.000**	D1-D3
WC (male)	21.201	2	49.804	**0.000**	D1-D3 D2-D3
WC (female)	24.842	2	126.630	**0.000**	D1-D3 D2-D3

BMI: Body Mass Index, WC: Waist circumference, hs-CRP; High-sensitive C-reactive protein

significantly greater than the 25-OH-VIT D -sufficient group. For female patients, the mean value of SUA for the 25-OH-VIT D -deficient group (6.17 4.36) was significantly greater than the mean value of SUA for the male patients with insufficient 25-OH-VIT D (4.61 and with sufficient 25-OHVIT D (4.021.19)), respectively.

25-OH-VIT D levels were not significantly related with systolic blood pressure, diastolic blood pressure, fasting blood sugar, LDL, total cholesterol level, HOMA-IR, gender, smoking, alcohol use, use of sun cream and use of milk products. VIT D levels were significantly negatively correlated with BMI, WC, hs-CRP, USA and triglycerides.

25-OH-VIT D levels were significantly positively correlated with HDL, use of fish oil, use of vitamin and mineral supplements, use of salmon, use of tuna fish, use of egg yolk and sun benefit status. There was a significant relationship between 25-OH-VIT D deficiency or insufficiency accompanying high SUA levels. Patients with a SUA value of 6 mg/dL and above in women, SUA value 7 mg/dL and above in men and also 25-OH-VIT D deficiency or insufficiency comprised 25% (89/356) of all patients. A total of 69 people with high SUA levels along with 25-OH-VIT D deficiency were observed.

DISCUSSION

The strength of our current study is that it was planned to include all of the patients' metabolic status in a well characterized cohort of patients whose 25-OH-VIT D levels were measured. This is the first reported study to determine the 25-OH-VIT D status in the adult population of North Cyprus.

The relationship between 25-OH-VIT D and SUA levels has been extensively investigated in the literature. Important results have been reported showing that 25-OH-VIT D deficiency can increase the cardiovascular mortality (14-16). Also, according to previous estimates, the frequency of metabolic syndrome is significantly high in North Cyprus due to sedentary lifestyles and eating habits. In a study which was done among the adult health check-up subjects in the Near East University in North Cyprus, considering the NCEP ATP-III criteria for determining metabolic syndrome, the prevalence of Met S was found at 37.0 % generally, 22.4 % for women and 51.5 % for men respectively (17,18). The prevalence of 25-OH-VIT D deficiency was found to be 55.9%, the prevalence of 25-OH-VIT D insufficiency was 27%, and 25-OH-VIT D levels were sufficient in only 17.1% of the patients in our study. In addition, we have observed that 25-OH-VIT D deficiency was quite common in North Cyprus due to possible inaccuracies in lifestyle perceptions in the society. We found low 25-OH-VIT D levels in both genders; however 25-OH-VIT D levels were lower in females than males. Patients with a SUA value of 6 mg/dL and above in women, SUA 7 mg/dL and above in men and also 25-OH-VIT D deficiency or insufficiency comprised 25% (89/356) of all patients. A total of 69 people with high SUA levels along with 25-OH-VIT D deficiency were observed. There was a significant relationship between 25-OH-VIT D D deficiency or insufficiency accompanying high SUA levels in this study.

Low circulating 25-OH-VIT D levels have been associated with a wide variety of disease states and physiological

Table 3: Chi-square analysis results between VIT D groups and clinical-biochemical characteristics, skin color, sunscreen use, sun exposure, nutritional status and habits

n		D1		D2		D3		p
		%	n	%	n	%		
Gender	**Female**	150	75.4%	74	77.1%	41	67.2%	0.347
	Male	49	24.6%	22	22.9%	20	32.80%	
BMI	**<30 (kg/m²)**	95	47.7%	59	61.5%	57	93.4%	**0.000**
	(kg/m²)	104	52.3%	37	38.5%	4	6.6%	
WC	**<88 cm (female) <102 cm (male)**	80	40.2%	40	41.7%	49	80.3%	**0.000**
	88 cm (female) 102 cm (male)	119	59.8%	56	58.3%	12	19.7%	
Systolic blood pressure	**<130 mmHg**	114	57.9%	56	58.3%	36	59.0%	0.987
	mmHg	83	42.1%	40	41.7%	25	41.0%	
Diastolic blood pressure	**<85 mmHg**	164	82.4%	87	90.6%	48	78.7%	0.091
	mmHg	35	17.6%	9	9.4%	13	21.3%%	
Fasting blood sugar	**<100 mg/dL**	108	54.3%	57	59.4%	30	49.2%	0.447
	mg/dL	91	45.7%	39	40.6%	31	50.8%	
HOMA-IR	**<2.5**	130	65.3%	67	69.8%	40	65.6%	0.736
	2.5	69	34.7%	29	30.2%	21	34.4%	
hs-CRP	**<0.5 mg/dL**	113	56.8%	74	77.1%	51	83.6%	**0.000**
	0.5mg/dL	86	43.2%	22	22.9%	10	16.4%	
Uric acid	**<7 mg/dL (male) <6 mg/dL (female)**	130	65.3%	76	79.2%	55	90.2%	**0.000**
	7 mg/dL (male) 6 mg/dL (female)	69	34.7%	20	20.8%	6	9.8%	
Total cholesterol	**<200 mg/dL**	117	58.8%	43	44.8%	34	55.7%	0.076
	200 mg/dL	82	41.2%	53	55.2%	27	44.3%	
LDL-C	**<130 mg/dL**	130	65.3%	54	56.3%	36	59.0%	0.286
	130 mg/dL	69	34.7%	42	43.8%	25	41.0%	
HDL-C	**<40 mg/dL (male) <50 mg/dL (female)**	125	62.8%	38	39.6%	19	31.1%	**0.000**
	40 mg/dL (male) 50 mg/dL (female)	74	37.2%	58	60.4%	42	68.9%	
Triglycerides	**<150 mg/dL**	103	51.8%	63	65.6%	48	78.7%	**0.000**
	150 mg/dL	96	48.2%	33	34.4%	13	21.3%	
Metabolic syndrome	**No**	94	47.2%	68	70.8%	57	93.4%	**0.000**
	Yes	105	52.8%	28	29.2%	4	6.6%	
Smoking	**No**	148	74.4%	72	75.0%	49	80.3%	0.448
	Yes	39	19.6%	14	14.6%	9	14.8%	
	Previously used	12	6.0%	10	10.4%	3	7.0%	
Alcohol	**No**	172	86.4%	87	90.6%	49	80.3%	0.183
	Yes	27	13.6%	9	9.4%	12	19.7%	

Table 3: Continue

n		D1		D2		D3		p
		%	n	%	n	%		
Skin colour	**Light**	110	55.3%	63	65.6%	53	86.9%	**0.000**
	Dark	89	44.7%	33	34.4%	8	13.1%	
Use of sun-cream	**No**	137	68.8%	66	68.8%	48	78.7%	0.306
	Yes	62	31.2%	30	31.3%	13	21.3%	
Use of fish oil	**No**	196	98.5%	87	90.6%	52	85.2%	**0.000**
	Yes	3	1.5%	9	9.4%	9	14.8%	
Use of vitamin and mineral supplements	**No**	180	90.5%	72	75.0%	41	67.2%	**0.000**
	Yes	19	9.5%	24	25.0%	20	32.8%	
Use of milk products	**No**	11	5.5%	7	7.3%	5	8.2%	0.704
	Yes	188	94.5%	89	92.7%	56	91.9%	
Use of salmon	**No**	192	96.5%	86	89.6%	52	85.2%	**0.001**
	Yes	7	3.5%	10	10.4%	9	14.8%	
Use of tuna fish	**No**	136	68.3%	63	65.6%	11	18.0%	**0.000**
	Yes	63	31.7%	33	34.4%	50	82.0%	
Use of egg yolk	**No**	28	14.1%	13	13.7%	1	1.6%	**0.025**
	Yes	171	21.1%	82	20.0%	60	14.8%	
Sun benefit status	**Not direct exposure to the sun**	170	14.1%	78	13.7%	38	1.6%	**0.000**
	Direct exposure to the sun	29	21.1%	18	20.0%	23	14.8%	

BMI: Body Mass Index; WC: Waist circumference, HOMA-IR: Homeostatic model assessment for insülin resistance, hs-CRP: High-sensitive C-reactive protein, HDL-C: high density lipoprotein chlosterol, LDL-C: Low density lipoprotein chlosterol

disorders. In observational studies, lower 25-OH-VIT D levels have been associated with higher blood pressure levels, type 2 diabetes, stroke, myocardial infarction, and heart failure (19,20). When relationship between 25-OH-VIT D and the metabolic syndrome components were examined, a statistically significant difference was found between high TG, WC and BMI, and between low HDL and low 25-OH-VIT D levels. It has been suggested that SUA levels are associated with metabolic syndrome risk factors. Our previous study indicated that the mean concentration of SUA in patients with Met S was higher than that in non-affected people (19). Additionally, Abbasian et al. showed that SUA levels were significantly higher in Met S patients (20). In our study, SUA levels were found to be high in people with low 25-OH-VIT D. Also, a statistically significant difference was found between the groups with both deficiency and insufficiency of 25-OH-VIT D and hyperuricemia. Although the relationship between low 25-OH-VIT D D and hyperuricemia can be explained indirectly by the presence of metabolic syndrome, larger case-control studies with more patients are needed to explain the direct relationship in the pathogenesis. Due to the fact that hyperuricemia is a factor that increases the risk of metabolic syndrome, it is recommended that it should be included in routine tests (21).

Observational data suggest that low 25-OH-VIT D levels are associated with an increased risk of hypertension, but randomized controlled trials have shown minimal support for the beneficial effect of 25-OH-VIT D supplementation on blood pressure (22, 23). In other words, conflicting results were found in various meta-analyses examining observational and randomized controlled studies. However, another meta-analysis that included individual data suggested that 25-OH-VIT D supplementation can be considered in the blood, and even individuals with low baseline 25-OH-VIT D levels or high baseline blood pressure reported no significant effect on their blood pressure. Similarly, limited effects of VIT D supplementation on glycaemic control were observed in participants with type 2 diabetes (23). No significant relationship was found between patients with low 25-OH-VIT D and HT, DM, impaired fasting glucose or insulin resistance in our study. There was also no significant relationship between low 25-OH-VIT D and

LDL cholesterol. However, a statistically significant relationship was observed between patients with low 25-OH-VIT D levels and low HDL and high TG in our study.

Many studies have shown that poor 25-OH-VIT D status is associated with obesity (24). Although the reason for this relationship is not known exactly, it seems that extra body fat may decrease its bioavailability with 25-OH-VIT D sequestration (25). In our study, individuals with low 25-OH-VIT D levels had a BMI >30, and we found a statistically significant relationship between increased waist circumference and those with a 25-OH-VIT D level of <20 ng/mL, which is consistent with the literature.

The amount of exposure to sunlight through the skin, the type and style of clothing, the use of sunscreen, latitude, institutionalization (pollution), condition and skin colour can all alter the levels of 25-OH-VIT D in the blood. Therefore, diet, lifestyle, working environment, cultural habits, and demographics all play a role and these should be taken into account when planning food supplement programs and public health policies (26). Despite the fact that the sun generally shines for 11 months of the year in North Cyprus, people avoid sun exposure due to the scorching heat. This may explain some of the reasons for VIT D deficiency due to the lack of exposure.

In our study, 25-OH-VIT D levels of those who regularly consumed fish oil, salmon, tuna fish and egg yolks were better than of those who did not consume these sources in their diet. A statistically significant negative relationship was found between those with 25-OH-VIT D deficiency and fish oil, fish and egg consumption. In other combined vitamin-mineral supplement areas, vitamin D levels were within normal limits (>30). Valer-Martinez et al. reported that 25-OH-VIT D status showed a strong inverse association with subcutaneous adipose tissue and visceral adiposity, measured in different ways with other body measurements (i.e., body mass index) (27). Studies have shown that hypovitaminosis D has a potential inverse association with insulin resistance and cardiovascular risk factors (28).

The main limitations of this study were the limited number of participants and lifestyle characteristics. The population of the study was not comprised of randomly selected individuals, but patients who were admitted to the hospital. Genetic analysis could not be performed to determine possible genetic risk factors for VIT D deficiency due to the high cost. Another limitation of this study is that it is not known whether SUA levels will change positively with VIT D supplementation. Therefore, further research is needed with a larger cohort.

CONCLUSION

Our study results are the principal data for North Cyprus and our study showed that there is a significant inverse relationship between 25-OH-VIT D deficiency and SUA in North Cyprus. The significant relationship between 25-OH-VIT D and the metabolic status components such as HDL, triglyceride levels, SUA and WC should also be emphasized. Attention should be paid to the importance of 25-OH-VIT D in providing metabolic control in primary care. As a result, it is possible to find a solution to the problem with treatment protocols in accordance with the recommended guidelines. Improvement of both 25-OH-VIT D levels and hyperuricemia may reduce the risk of possible DM, coronary artery disease, and HT in the future. For this purpose, VIT D supplementation is as important as changing the lifestyle and eating habits.

Ethics Committee Approval: This study was approved by Near East University Scientific Research Ethics Evaluation Board (Date: 29.04.2021, No: YDU/2021/90-1327).

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