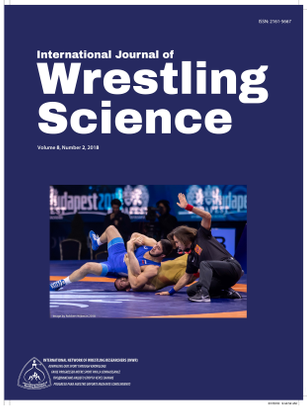

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VITAMIN D LEVEL AMONG ELITE WRESTLERS IN UZBEKISTAN

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Abstract
Purpose. The purpose of the study is to determine vitamin D (VD) levels and acute upper respiratory tract infections (URI) morbidity among elite wrestlers in Uzbekistan as well as possible association with overtraining syndrome (OS). *Methods.* Study participants included 40 elite wrestlers and 60 control individuals. Serum levels of 25(OH) VD and TNF-α, IFN-γ and IL-4 were detected by ELISA technique. Frequency of URI was detected as well as parasitic infections. OS was diagnosed on the basis of typical symptoms and decreased performance. *Results.* Predominance of VD insufficiency was found in both groups of elite athletes and in the control individuals. Prevalence of VD deficiency/insufficiency depends on the season, but in every season the highest values were observed among athletes. The highest level of TNF-α and the lowest of IFN-γ were observed in athletes with VD deficiency. Changes in the level of IL-4 were less expressed. Frequency of episodes of URI depends on VD level and the most number was detected in wrestlers with VD deficiency in winter-spring. OS was diagnosed in wrestlers free of infections, including parasitic ones, but with VD deficiency. *Conclusion*. VD deficiency/insufficiency is widely spread both in elite wrestlers and population in Uzbekistan. Monitoring of VD level in elite athletes with subsequent correction is necessary. VD deficiency/insufficiency in athletes correlates with high morbidity with URI and could be associated with OS.
Keywords: vitamin D, elite wrestlers, cytokines, respiratory infections

INTRODUCTION

Athletes are at risk for injuries and their prevention and rehabilitation are aspects of great importance. Upper respiratory acute infections (URI) are the most common reason for non-injury-related presentation to a sports medicine clinic, accounting for 35-65% of illness presentations. URI can have a negative impact on the health and performance of athletes undertaking high levels of strenuous exercise. The cause of upper respiratory symptoms in athletes can be uncertain, but the majority of cases are related to common respiratory viruses, viral reactivation, allergic responses to aeroallergens and exercise-related trauma to the integrity of respiratory epithelial membranes. Bacterial respiratory infections are less common in athletes (Gleeson & Pyne, 2016). Elite athletes are at a greater risk for injuries and URI; during the Olympic Games in 2016 (Rio de Janeiro), medical staff reported 9,8% injuries and 5,4% illnesses. Of the illnesses, 47% affected the respiratory system and 21% the gastrointestinal system (Smith, 2000). Another important problem in sport is overtraining syndrome (OS). Etiology of OS remains unclear and the term “unexplained underperformance syndrome” adopted in UK (Lewis, 2015) seems to be more justified, because it emphasizes the complexity of the syndrome and its multifactorial etiology.

Above mentioned problems are connected or could be connected with vitamin D (VD) deficiency/insufficiency, which is widespread throughout the world, including countries subtropical and tropical countries (Cashman et al., 2016; Chauhan & Bhimji, 2017; Dhibar et al., 2018). VD deficiency is common in athletes. For athletes presenting with stress fractures, musculoskeletal pain, and frequent illness, one should have a heightened awareness of the additional likely diagnosis of VD deficiency. Correction of the deficiency is completed by standardized and supervised oral supplementation protocols producing significant musculoskeletal sports health benefits (Shuler et al., 2012). VD influences the musculoskeletal health and mineral homeostasis. A serum level ≥30 ng/ml provides sufficient mineralization of non-mineralized bone matrix and positively correlated with an accelerated regeneration of muscular force. Levels above 40 ng/ml provided a protective effect on the development of stress fractures. Levels above 50 ng/ml are required for athletes to achieve maximal physical performance (Butscheidt et al., 2017).

VD deficiency/insufficiency correlated with a high frequency and severe course of URI (Owens et al. 2018). VD supplementation is considered as a safe and inexpensive method for URI prevention (Zitterman et al., 2016; Martineau et al., 2017). This effect can be due to the capacity of VD to increase expression of antimicrobial proteins, in particular cathelicidin in macrophages (Chesdachi et al., 2016).

Evaluation of the VD deficiency/insufficiency prevalence among athletes as well as among population has not been carried out in Uzbekistan previously. The purpose of the study is to determine vitamin D levels and upper respiratory tract infections (URTI) morbidity among elite wrestlers in Uzbekistan as well as the possible association with OS.

METHODS

The prospective diagnostic study was conducted on the basis of the Uzbek State University of Physical Education and Sport and Research Institute of Epidemiology, Microbiology and Infectious Diseases, Tashkent, Uzbekistan during the period from January 2017 till January 2018.

Study participants included 40 elite athletes engaged in freestyle and Greco-Roman wrestling (all males) at the age of 19-24 years. The control group (n=60) for comparison of VD and cytokines level included healthy individuals of the same sex and age without expressed manifestations of diseases. All the participants were residents of Uzbekistan. Participants were required to complete a comprehensive health screening questionnaire and medical examination prior to starting the study. Participants could be included if they were currently healthy (with no health problems or infection symptoms within the previous two weeks), engaged in regular sports training at least six months and at least 3 h of total moderate/high-intensity training time per week.

Immunological tests. Participants were required to abstain from any strenuous physical activity for 24 h before coming to the laboratory. Five milliliters of peripheral venous blood was taken (after 8-12 hours of fasting) from each participant and were collected into Human Tube Serum Gel – C/A for ELISA. All blood samples were collected in August and January. Serum levels of 25(OH) VD and TNF-α, IFN-γ and IL-4 were detected by ELISA technique using a DIAsource kit, Belgium and LLC kit, Vector-Best, Novosibirsk, Russia respectively.

Classification of the level of VD. Serum VD level was classified as reported by Holick et al., (2011). Levels of VD ≤20, 21–29, ≥30–150, and >150 ng/ml were considered as VD deficiency, VD insufficiency, VD sufficiency and VD intoxication, respectively. The performers of immunological tests did not have access to any information about an individual under examination. All information was blinded.

Parasitological analysis. Previously, authors (Kerimov et al., 2014) examining junior wresters showed that intestinal parasites can imitate OS due to the rather high frequency of astenoneurotic syndrome manifesting by the symptoms typical for OS: irritability, mood swings, increased fatigability, performance decrement, sleep disturbances anorexia, etc. All the athletes were examined for intestinal parasites by triple coproscopy, stool samples were taken with 1-3 days interval.

Statistical analysis. Data analysis was performed with the program Origin 6.1 (OriginLab, Northampton, MA). Results are expressed as mean±standard error (SEM) for continuous variables and number (percentage) for categorical data. For numerical variables the independent/paired t test were used. The P value <0.05 was considered as statistically significant.

RESULTS

Table 1 demonstrates that in both groups vitamin D deficiency/insufficiency was prevalent. Frequency of VD deficiency was higher in both groups in winter. The number of individuals with VD sufficiency was higher in control group, but even in summer this index amounted to only 30%, in spite of the abundance of sunny days in the year (>300 days a year), dropping to 10% in winter.

Table 1. The level of serum 25(OH) VD in wrestlers (n=40) and the control individuals (n=60) in August and January

25(OH) VD level in blood serum	The percentage of participants with VD sufficiency/insufficiency/deficiency frequency and (%)			
	Wrestlers (n=40)		Control individuals (n=60)	
	August	January	August.	January.
Sufficiency (>30 ng/ml)	4 (10)	Abs	18 (30)	6(10)
Insufficiency (20-29 ng/ml)	32 (80)	28 (70)	36 (60)	42 (70).
Deficiency (<20 ng/ml)	4 (10)	12 (30)	6 (10)	12 (20)

Table 2 shows a significant elevation of TNF-α in the athletes with VD deficiency, which is a biomarker of inflammation. These data are in agreement with data of Willis et al. (2012) on correlation of VD insufficiency with elevated level of TNF-α. Pathophysiology of the OS has not been determined yet. Cytokine hypothesis seems to be close to reality, because the pro-inflammatory cytokines IL-1b and TNF-α affect the brain, causing a decrease in appetite, sleep disturbance and depression, cytokines can act directly on the central receptors or activate the axis hypothalamus-pituitary-adrenal glands, releasing stress hormones, which leads to the same

effect (Shuler et al. 2012). There is evidence of an increase in the level of these cytokines in patients with depression (Smith, 2000). Thus, VD deficiency can impose OS manifestation.

Changes in the level of proinflammatory cytokine IFN-γ and anti-inflammatory IL-4 were less expressed, but there was a tendency to decrease in INF-γ concentration. Thus, the dynamics of the cytokines level in deficiency/insufficiency and sufficiency of VD indicates the effect of VD on the immune system. In particular, reduction of IFN-γ increases susceptibility to URI. The number of athletes with VD sufficiency was too small, but it is obvious that IFN-γ level is lower than that in healthy individuals, apparently due to significant physical load.

Table 2. The level of serum cytokines in elite wrestlers with various level of serum VD

Cohort under study	TNF-α pg/ml	IFN-γ pg/ml	IL-4 pg/ml
Athletes with VD deficiency (n=5)	31±11.9*	5.9±2.9*	4.3±1.8
Athletes with VD insufficiency (n=10)	22±7.1*	8.1±3.2*	5.1±2.2
Athletes with VD sufficiency (n=3)	9±15	10±18	2±4
Control individuals (n=12)	4.1±2.7	17.9±3.1	3.5±1.9

*- significant difference with the control individuals (P<0.05)

Table 3 shows the frequency of URI during summer-autumn and winter-spring periods among athletes and the control individuals. In both groups, URI were observed more frequently in winter-spring period. However, more than 5 episodes of URI were detected only in elite athletes in winter-spring. 3-4 episodes of URTI regardless of the season were significantly more frequently detected in wrestlers in comparison with the control individuals (P≤0.05). Absence of URI was observed in very low percentage of elite athletes versus the control individuals. It can be explained by several factors, including suppression pf immune system associated with lower VD level and intensive physical load.

Table 3. The frequency of URI during summer-autumn and winter-spring periods among athletes and the control individuals

The number of episodes of URI	The frequency of URI among participants (%) during summer-autumn and winter-spring periods frequency and (%)			
	Wrestlers (n=40)		Control individuals (n=60)	
	summer-autumn	winter-spring	summer-autumn	winter-spring
Absence of URI	15 (37.5)	-	55 (91.6)	24 (41.1)
≤2 episodes	25 (62.5)	5 (12.5)	5 (8.3)	20 (33.3)
3-4 episodes	-	34 (85)		6 (16.6)
≥5 episodes	-	1 (2.5)		

*- significant difference with the control group (P<0.05)

Efficiency of the training process must be ensured by an adequate balance of training load and recovery. OS can be developed through excessive muscle loading and additional stresses. It includes absence of sport enthusiasm, mood swings, problems with concentration, sleep disturbances, increased fatigability, anorexia, reduced performance, increased morbidity, injury frequency etc. (Kreher et al., 2012). The study was performed in January. These symptoms were identified 14 wrestlers. They were examined for infections, including intestinal parasites. Intestinal parasites were found in 8 athletes and after treatment and elimination of parasites symptoms typical for OS disappeared in 6 athletes without any changes in training conditions. VD deficiency was revealed in remaining wrestlers, VD insufficiency was diagnosed in one athlete. We assume that OS can be connected with VD deficiency/insufficiency. This assumption is supported by Sedaghat et al. (2018) who established in experiments on animals subjected to chronic stress that VD (1,25-(OH)2VD3) improved the condition of animals, eliminating the main symptoms of stress, which can be interpreted as an indication the role of VD in the OS development.

CONCLUSIONS

VD deficiency/insufficiency is widely spread both in elite wrestlers and population in Uzbekistan. Monitoring of VD level in elite athletes with subsequent correction is necessary. VD deficiency/insufficiency in athletes correlates with high morbidity with URI. VD deficiency/insufficiency could be associated with OS.

Disclosure of interest

The authors report no conflict of interest. The project was supported by a research grant from the **Ministry of Innovational Development of the Republic of Uzbekistan.**

Ethics approval

The study was approved by the Medical Ethics Committee of the Ministry of Health of the Republic of Uzbekistan in accordance with the Declaration of Helsinki. All participants were fully informed about the rationale for the study. Both informed and written consents were obtained from athletes and the control individuals.

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