VITAMIN D STATUS AMONG YOUTH SOCCER PLAYERS; ASSOCIATION WITH CHRONOLOGICAL AGE, MATURITY STATUS, JUMPING AND SPRINTING PERFORMANCE

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ABSTRACT

Purpose: Vitamin D is known to have a significant role in numerous body-system processes. Specifically, it has an impact on muscle functioning and, therefore sports performance. Children and adolescents have increased need for vitamin D because of its importance in growth and development, and it is evident that they are more susceptible to have vitamin D deficiency. Consequently, vitamin D status is particularly important issue in youth competitive sport. The aim of this study was to determine the prevalence of vitamin D deficiency/insufficiency (measured as 25(OH)D concentration), and the possible associations between vitamin D, with age, maturity status, sprinting- and jumping-performance among youth soccer players.
Methods: The sample of participants in this research comprised 62 youth soccer players (age: 15.7 ± 2.2 years). They were divided into two categories according to 25(OH)D levels measured at the end of the winter season: group with inadequate levels of 25(OH)D (vitamin D deficiency/insufficiency [< 75 nmol/L]), and group with adequate levels of 25(OH)D (vitamin D sufficiency [> 75 nmol/L]). Biological maturity status (maturity offset) was calculated from participants age and height by the following equation:
Maturity offset = −7.999994 + (0.0036124 × (age(yrs.) × height(cm)). Performance variables were 10 meters sprint test (S10m) and countermovement jump test (CMJ).
Results: Results showed relatively good 25(OH)D concentrations (78.32 ± 23.39 nmol/L), with prevalence of deficiency (< 50 nmol/L) in 8.06%, and insufficiency (50–75 nmol/L) in 46.77% athletes. Significant correlations were evidenced between the CMJ and 25(OH)D level ($R = 0.27$, $p < 0.05$), but chronological age was also correlated with CMJ ($R = 0.64$, $p < 0.05$). Further, higher chronological age was found in participants with sufficient vitamin D levels (15.1 ± 2.4 vs. 16.4 ± 1.6 years; t-test = 2.43, $p < 0.05$). However, no significant association was evidenced between vitamin D and maturity status.
Conclusion: Vitamin D groups significantly differed by chronological age but not by maturity status, which collectively with correlation between CMJ and vitamin D status indicates that both vitamin D status and performance in youth soccer players is actually influenced by chronological age. Meanwhile, biological age doesn't have a significant physiological influence on vitamin D concentration, while some external factors (i.e. time spent outdoors, parental control, sunscreen usage), should be considered important.

Keywords: Vitamin D; age; maturity; jumping; sprinting; soccer

Introduction

Vitamin D is a pro-hormone soluble in fat; it can be synthesized upon skin exposure to ultraviolet B radiation or trough intake of food rich with vitamin D (i.e., fatty fish, eggs, cheese, mushrooms, etc.)

(Holick, 2007). Previously, vitamin D has been recognized mostly only for its beneficial effect on bone development and health as it regulates calcium and phosphate homeostasis, but more recently, vitamin D receptors have been found in many tissues, indicating its importance in regulating numerous body-system functions (Bischoff-Ferrari et al., 2004). Specifically, it might be necessary for optimal muscle function and performance, immune function, and inflammatory modulation. The discovery of vitamin D receptor (VDR) in skeletal muscle tissue provides evidence for the importance of this hormone in muscle metabolism (Hassan-Smith et al., 2017). Changes in protein synthesis, muscle regeneration, myogenesis, mitochondrial activity, and glucose metabolism have been proposed as molecular mechanisms affected by vitamin D, which are considered to make an impact on muscle function, strength and performance (Montenegro, Cruzat, Carlessi, & Newsholme, 2019). Nevertheless, low vitamin D levels in athletes are associated with low bone health, muscle function impairment, and decreased immune function, leading to the reduced regenerative capacity after the exercise session (Dahlquist, Dieter, & Koehle, 2015).

Athletes are more predisposed to have vitamin D deficiency most likely because of the increased active use in many metabolic pathways, therefore they require larger amounts of vitamin D compared to general population (Ogan & Pritchett, 2013). For this reason, it has been hypothesized that vitamin D could impact physical performance in athletes, but there is a limited number of studies which attained supportive results for this theory (Kopeć, Solarz, Majda, Słowińska-Lisowska, & Mędraś, 2013; Koundourakis, Androulakis, Malliaraki, & Margioris, 2014). However, the fact that vitamin D decreases bone fractures and muscle-tissue damage should be considered important for athletes health and, consequently, performance (Ceglia, 2008; DeLuca, 2004). Soccer is a sport which requires large amounts of sprints, jumps, fast changes of direction, and increased aerobic and anaerobic capacities in general. The study conducted on adult professional soccer players suggested that vitamin D is affecting neuromuscular and aerobic performance (Koundourakis et al., 2014). Therefore, it is possible that vitamin D levels could be related to physical performance in soccer players, and this is particularly possible in youth players because of their greater metabolic needs for this pro-hormone (Constantini, Arieli, Chodick, & Dubnov-Raz, 2010). Therefore, the aim of this study was to evaluate the association of vitamin D status with jumping- and sprinting-performances among youth soccer players.

Methods

The sample of participants in this research comprised 62 youth soccer players (age: 15.7 ± 2.2 years). All players were members of the same soccer club in Split, Croatia, and were engaged in systematic soccer training for at least 6 years. All the players have been informed of the purpose, risks, and procedures of the investigation, and were at good health and had no current injuries. Parental consent was obtained as athletes were under 18 years old. The testing was performed during February 2019.

The variables included players maturity status, vitamin D status as measured by 25(OH)D concentration (Bischoff-Ferrari, Giovannucci, Willett, Dietrich, & Dawson-Hughes, 2006), 10 meters sprint test, and countermovement jump test. The biological maturity offset (MO) predicts years from achieving the peak height velocity (PHV) and was calculated by the following equation: $MO = -7.999994 + (0.0036124 \times (age(yrs.) \times height(cm))$; ($R^2 = 0.896$; SEE = 0.542)). A MO of −1.0 suggests that the athlete was measured 1 year before his PHV; a MO of 0 suggests that the player was tested at the point of the PHV; and a MO of + 1.0 indicates that the player was measured 1 year after the PHV (Moore et al., 2015). For the 25(OH)D measurement, the blood samples taken from the athletes were analysed at the accredited laboratory of the University Hospital of Split, Croatia. According to the 25(OH)D levels, players were divided into two categories: group with inadequate levels of 25(OH)D (vitamin D deficiency/insufficiency [< 75 nmol/L]), and group with adequate levels of 25(OH)D (vitamin D sufficiency [> 75 nmol/L]) (Karin et al., 2018). The 25(OH)D levels were measured using an Elecsys Vitamin D total assay with Cobas e601 analyser (Roche Diagnostics International Ltd., Rotkreuz, Switzerland). The 10 meters sprint test (S10m) was used for assessing the running speed. One photoelectronic timing gate (*Powertimer, Newtest*, Finland) was placed

10 meters from a marked starting line, and one gate was placed at the start line. The athlete had preferred foot placed on the marked line 1 meter before the start line, from the standing start, and had to run at maximum speed along the 10-meter field. 3 testing trials have been performed, with 2–3 minutes of rest between the trials (Sekulic, Spasic, Mirkov, Cavar, & Sattler, 2013). For the countermovement jump test (CMJ), players were starting from and upright position with hands placed on the hips. They performed fast downward movement to 90° of knee flexion followed by a maximum-force upward vertical movement. The Optojump system (Microgate, Bolzano, Italy), a dual-beam photoelectric device that measures flight time and ground contact time during a jump or during repeated jumps, has been used for measuring the CMJ (Sattler, Sekulic, Hadzic, Uljevic, & Dervisevic, 2012).

Statistics included frequencies and percentages (for Vitamin D status observed on categorical scales) and means and standard deviations (for continuous variables). The associations between variables was evidenced by calculation of Pearson's correlation coefficients. Additionally, t-test for independent samples between groups based on vitamin D status (vitamin D insufficiency/deficiency vs. vitamin D sufficiency) was calculated for age, maturity offset, CMJ and S10m.

Results

Results showed relatively good 25(OH)D concentrations (78.32 ± 23.39 nmol/L), with prevalence of deficiency (< 50 nmol/L) in 8.06%, and insufficiency (50–75 nmol/L) in 46.77% athletes (Figure 1).

Significant correlations were evidenced between the CMJ and 25(OH)D level ($R = 0.27$, $p < 0.05$), but chronological age was also correlated with CMJ ($R = 0.64$, $p < 0.05$) (Table 1).

The higher chronological age was found in participants with sufficient vitamin D levels (15.1 ± 2.4 vs. 16.4 ± 1.6 years; t-test = 2.43, $p < 0.05$). However, no significant association was evidenced between vitamin D and maturity status (Table 2).

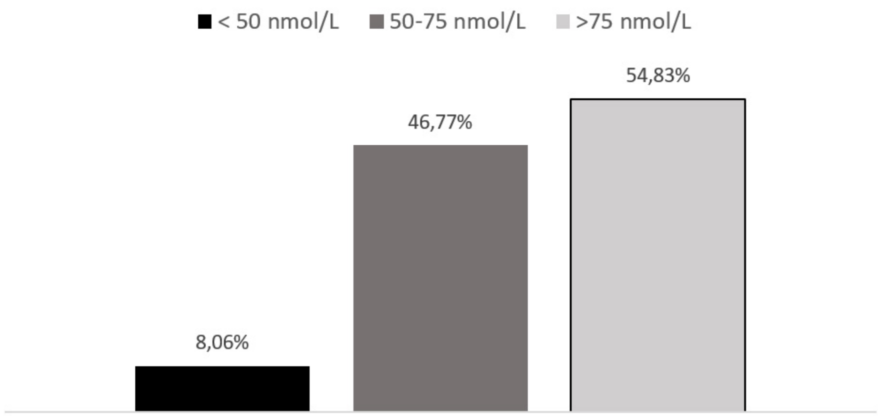

Figure 1 *Vitamin D status in youth soccer players (as measured by 25(OH)D)*

Table 1 *Correlation coefficients between studied variables*

	Age	MO	S10m	CMJ
Age				
MO	0.86*			
S10m	-0.60*	-0.36		
CMJ	0.64*	0.32	-0.68*	
VITAMIN D	0.28*	-0.10	-0.26	0.27*

*Legend: MO – maturity offset, S10m – sprint 10 meters, CMJ – countermovement jump, * denotes statistical significance of p < 0.05*

Table 2 *Descriptive statistics and t-test differences between groups based on vitamin D status*

	Vitamin D insufficiency/deficiency			Vitamin D sufficiency			T test	
	Mean	Std.Dev.		Mean	Std.Dev.		t-value	p
Age (years)	15.11	2.40		16.41	1.63		-2.43	0.02
MO (years)	3.58	0.63		3.35	0.91		0.76	0.45
S10m (s)	1.80	0.11		1.74	0.11		1.95	0.06
CMJ (cm)	31.09	5.71		33.70	6.02		-1.64	0.11

Legend: MO – maturity offset, S10m – sprint 10 meters, CMJ – countermovement jump

Discussion

We have found good results for vitamin D with only 8.06% / 46.77% soccer players with vitamin D deficiency/insufficiency. Meanwhile, recent study of Karin et al., done in the same region as our study, reported 58% / 29% of studied children being vitamin D deficient/insufficient (Karin et al., 2018). Danish study found 45% vitamin D deficiency among youth swimmers (Geiker et al., 2017). However, such differences in results could be explained by differences in the samples of participants. Briefly, Karin et al. investigated pre-schoolers, and it is known that children at this age have different biological and metabolic processes as they are in the phase of intensive growth and development (Rogol, Clark, & Roemmich, 2000). Meanwhile, Danish participants were swimmers and therefore spent most of their training in the indoor facilities, contrary to soccer players who practice outside.

Of all studied performance variables, only CMJ was significantly correlated with 25(OH)D, theoretically supporting the thesis that vitamin D has an impact on muscle functioning as suggested previously (Cannell, Hollis, Sorenson, Taft, & Anderson, 2009). Indeed, the results of the study evaluating vitamin D and exercise performance in professional soccer players suggested that vitamin D level is associated with muscle strength, also expressed by horizontal jumps (CMJ and Squat jump) (Koundourakis et al., 2014). However, our results showed that players with greater CMJ and higher vitamin D levels are also chronologically older, indicating that chronological age is actually a confounding factor of relationship defined between CMJ and vitamin D status (i.e. older children jump higher, and at the same time have higher vitamin D levels).

The finding that chronological age, but not maturity status, is correlated with higher vitamin D levels could lead to the assumption that biological age does not have a significant influence on physiological processes at the studied athletes. Supportively, study done with young hockey players which were divided into vitamin D sufficient-insufficient groups, that also had a low prevalence of vitamin D insufficiency (13.3%), showed that athletes with better vitamin D levels were older (Mehran, Schulz, Neri, Robertson, & Limpisvasti, 2016). Collectively, it is reasonable to conclude that other, external factors are more important concerning vitamin D status. These factors are most likely the amount of time spent outside exposed to sunlight, clothing, sunscreen usage, nutritional habits etc. (Hagenau et al., 2009). Specifically, for children and adolescents who live with their parents, all previously mentioned factors could be highly influenced by parenting style, simply because of the parental influence on their children lifestyle. For example, in the studied region, there is a growing concern about possible negative influence of sunlight radiation on skin health. Therefore, in the recent years parents sometimes (over)protect children from sunlight exposure by reduction of the time the children are exposed to sunlight, extensive usage of the sunscreens with high protective factors, and clothes. Altogether it could result in a lower vitamin D levels in younger children, who are naturally under the stronger parental influence then older ones.

Conclusion

Vitamin D groups significantly differed by chronological age, but not by maturity status. Together, with the correlation between CMJ and vitamin D status indicates that both vitamin D status and performance in youth soccer players are influenced by chronological age. Meanwhile, our results indicated that biological age does not have a significant physiological influence on vitamin D concentration, while some external factors like time spent outdoors, parental control, and sunscreen usage, should be considered important determinants of vitamin D status in studied players.

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