ASEMPTOMATİK REKREASYONEL SPORCULARDA YÜKSEK D VİTAMİNİ EKSİKLİĞİ PREVALANSI

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ÖZ

D vitamini eksikliğine küresel bir pandemic olarak değerlendirilmektedir. Sporcuların D vitamini takviyesinden gördükleri fayda düşük serum D vitamini düzeyleri ile ilişkili çok sayıda hastalıktan korunmakla sınırlı olmayıp, aynı zamanda performansta iyileşme, egzersize daha iyi uyum gösterme ve kemikte stres kırıkları riskinin azalması gibi etkilerden de faydalanırlar. Elit sporcuların D vitamini düzeyleri ile ilgili araştırmalar mevcuttur. Bununla birlikte, rekreasyonel sporcularda D vitamini eksikliğinin yaygınlığı hakkında çok az şey bilinmektedir. Bu retrospektif çalışmada, bir yıl içinde kliniğimize başvuran 12 farklı spor branşından asemptomatik rekreasyonal sporcuların serum D vitamini konsantrasyonlarını (n = 165) analiz ettik. Sporcuların% 11.51'inde yetersiz D vitamini konsantrasyonu (20-30 ng / mL) bulunurken, sporcuların % 84.24'ünde D vitamini eksikliği (<20 ng / mL) izlendi. Bununla birlikte, 73.1 ng / dL gibi önerilenden daha yüksek D vitamini seviyeleri de gözlenmiştir. D vitamini düzeyleri, mevsimler arasında anlamlı farklılık göstermiştir (p <.01), ancak sporun iç / dış mekan karakteristiği önemli bir etkiye sahip değildir (p> .05). Erkek ve kadınların D vitamini düzeyleri arasındaki fark istatistiksel anlam taşımamaktaydı (p> .05). Sonuç olarak, kliniğimize başvuran rekreasyonal sporcular arasında D vitamini eksikliği prevalansı çok yüksektir.

Anahtar Kelimeler: D Vitamini, Spor Beslenmesi, Spor Hekimliği, Sporcu Sağlığı

HIGH PREVALENCE OF VITAMIN D DEFICIENCY IN ASYMPTOMATIC RECREATIONAL ATHLETES

ABSTRACT

Vitamin D deficiency is referred to as a global pandemic. Athletes benefit from vitamin D supplementation not only by prevention of a wide range of diseases that are associated with low serum vitamin D concentrations but also by improved performance, better adaptive responses to exercise and reduced risk of bone stress fractures. Research on vitamin D status of elite athletes are present. However, very little is known on vitamin D deficiency prevalence in recreational athletes. In this retrospective study we have analysed the vitamin D concentrations of asymptomatic recreational athletes (n=165) from 12 different sports branches who presented to our clinic in the time course of a year. 11.51% of athletes had insufficient vitamin D concentrations (20-30 ng/mL), whereas 84.24% of athletes were vitamin D deficient (<20 ng/mL). However, vitamin D levels higher than recommended, such as 73.1 ng/dL, were also observed. Medians of vitamin D levels showed significant difference among seasons (p<.01), however indoor/outdoor characteristic of the sport did not have a significant effect (p>.05). Difference between vitamin D levels of men and women were insignificant (p>.05). In conclusion, prevalence of vitamin D deficiency was very high among recreational athletes who presented to our clinic.

Keywords: Vitamin D, Sports Nutrition, Sports Medicine, Sports Health

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INTRODUCTION

For maximum musculoskeletal health benefits, sufficient levels of 25(OH) D is defined as higher than 30ng/ml, insufficiency as 21-29ng/ml and deficiency as <20 ng/ml in Endocrine Society's Practice Guidelines on Vitamin D in 2011[8]. Certain populations are under higher risk of vitamin D deficiency, such as people with increased skin pigmentation, pregnant women, obese people and ones that abstain from direct sun exposure[9]. Low levels of vitamin D increases the risk of various conditions throughout life, such as respiratory infections, Rickets disease and hypocalcaemia in infancy; wheezing, asthma, type 1 diabetes, food allergies and autism in childhood; hypertension, obesity, metabolic syndrome, cardiovascular disease, type II diabetes, polycystic ovary syndrome in adulthood; and osteoporosis, myopathy, falls, fractures, cognitive impairment and cancer in elderly[9]. Studies also report low vitamin D levels' association with higher overall mortality[15].

On the other hand, athletes benefit from having sufficient vitamin D concentrations in more aspects than only prevention of abovementioned diseases. International Olympic Committee (IOC) has listed vitamin D as "Supplements that may assist with training capacity, recovery, muscle soreness and injury management" and suggests that adequate vitamin D plays a role in the adaptive process to stressful exercise[12]. One of the key benefits of vitamin D supplementation in athletes is decreased risk of stress fractures. In Finnish military recruits low vitamin D levels were associated with 3.6 times higher risk of stress fracture[17]. In accordance with this correlation, supplementation of 800IU/day of vitamin D3 and 2000 mg calcium in female navy recruits resulted in 20% reduction of stress fracture incidence[10].

Due to very high prevalence of vitamin D deficiency, the problem is now referred to as a global pandemic[9]. Daily recommended dietary intakes of vitamin D for patients at risk for vitamin D deficiency varies according to targeted population. Infants, children, healthy adults, pregnant and lactating women, adults above 50 and adults on specific medication (anticonvulsant medications, glucocorticoids, antifungals such as ketoconazole, and medications for AIDS) are recommended different amounts of supplementation regarding their needs[8]. Recommended supplementation regime for vitamin D deficient athletes according to IOC guidelines is as such: short-term, high-dose supplementation which includes 50000IU/week for 8-16 weeks or 10000IU/day for several weeks[7,11,12]. Nevertheless, authors of the guideline have stated that more data is needed in order to make optimum recommendations to address athletes' needs.

Vitamin D requirements of athletes may be different than general population considering the musculoskeletal benefits, such as performance enhancement and decreased risk of bone stress fractures. Recommendations in today's guidelines are based on estimations instead of adequate and detailed data. For example, whether athletes from different sports branches would benefit vitamin D supplementation similarly is a question yet to be answered. Also, research is mainly focused on elite athletes, however vitamin D status and requirements of recreational athletes may be different than elites. Recreational athletes are a heterogeneous group that stands somewhere between elite athletes and adults that only meet the recommended physical activity levels. Recreational athletes constitute a "grey zone" by means of athletic demands, dedication, medical attention that is received and risk of injury. As difficult as it is to define this heterogenous group, the challenging task of making the proper recommendations to recreational athletes stands in front of us. Effects of

vitamin D status on recreational athletes' performances is investigated in one recent study and it was demonstrated that in male recreational athletes vitamin D concentrations are associated with physical performance measured by treadmill ergometer [20]. However, no study in the literature has presented vitamin D status of recreational athletes with no musculoskeletal symptoms. Such information is necessary in order to decide whether scanning or blind supplementation would be more reasonable and in fact whether supplementation is needed at all. This study aims to demonstrate vitamin D status of asymptomatic recreational athletes' vitamin D status throughout a year.

MATERIALS AND METHODS

Ethics approval was obtained for this study from Necmettin Erbakan University Ethics Committee. Athletes who present to our sports medicine clinic in request for a yearly preparticipation examination are routinely checked for their vitamin D status. Serum 25-OH-vitamin D concentrations of athletes are analysed in our hospital biochemistry laboratory in a Modular Analytics Cobas C 702/8000 (Roche Diagnostics, Mannheim, Germany) by an electrochemiluminescent assay.

Athlete's age, gender, sports branch, level of participation (elite/recreational), use of medication/supplements and time of measurement were retrieved from hospital records between 01.10.2017 – 01.10.2018. Only recreational athletes were included in the study. Athletes who had a diagnosis of a chronic disease and/or are on regular medication were excluded. Supplementation use was not an exclusion criterion unless it consisted of vitamin D. 25-OH vitamin D levels of asymptomatic recreational athletes were analysed with respect to season of sampling, gender of the athlete and indoor/outdoor characteristic of the sports branch. Football(soccer), cycling, track & field, running and running are categorized as outdoor sports, whereas volleyball, basketball, fitness, swimming, taekwondo, wing-chun, judo and gymnastics are categorized as indoor sports. This retrospective study was conducted in Konya, Turkey with coordinates: 37° 52' 22.1"N - 32° 29' 30.9"E.

According to literature, vitamin D levels below 20 ng/ml is defined as deficiency, and a vitamin D level under 30 ng/ml is defined as vitamin D insufficiency[8,18].

Distribution of the data was analysed via density plots, histograms and Shapiro test. Descriptive statistics were performed to analyse the demographics of the participants. Kruskal-Wallis rank sum test, Student's t test and Wilcoxon rank-sum test were performed for inferential analysis. The level of statistical significance was 0.05. Statistical analysis was performed using software R (version 3.5.1) (R Core Team, 2018).

FINDINGS

Among athletes who presented to our sports medicine clinic between 01.10.2017 – 01.10.2018 in request for a yearly preparticipation examination, patients with chronic diseases and patients on regular medication and/or supplement use which consists of vitamin D and elite level athletes were excluded. Remaining 165 recreational athletes were included in the analysis. 140 (84.8%) of athletes were male and 25 (15.15%) were female. Distribution of the athletes according to the sport they practise is shown

in Table 1. When sports branches are categorized as indoor and outdoor according to the description in Methods section, it was observed that 111 (67.27%) of athletes were doing outdoor sports, whereas 54 (32.72%) were doing indoor sports.

Table 1. Number and percentage of athletes according to sports discipline

Sports discipline	n	%
Football	81	49.09
Running	17	10.30
Volleyball	16	9.70
Cycling	14	8.48
Basketball	12	7.27
Track & Field	9	5.45
Fitness	9	5.45
Swimming	2	1.21
Taekwondo	2	1.21
Wing-chun	1	0.61
Judo	1	0.61
Gymnastics	1	0.61

Median age of all participants was 21 (minimum:10, maximum:68). Median 25(OH)D3 levels of all participants were 9.97 ng/ml (minimum: 4.2 ng/ml, maximum: 73.09 ng/ml).

A Kruskal-Wallis test was conducted to evaluate the differences among seasons (winter, spring, summer, autumn) on median vitamin D levels after results were grouped according to the month of blood sampling. The test, which was corrected for tied ranks, was significant χ 2 (3, N = 165) = 44.98, p < .001. Table 2 shows a detailed summary of 25(OH)D levels of recreational athletes in different seasons. Follow-up tests were conducted to evaluate pairwise differences among four seasons. No significant difference was observed between summer and autumn (p>.05), whereas all other comparisons between seasons showed statistically significant differences (p<.01) (Figure 1).

Table 2. Summary of 25(OH)D3 Levels of Recreational Athletes in Different Seasons.

Season	n	Mean	SD
Winter	29	14.8	6.69
Spring	113	10.3	7.33
Summer	7	23.7	10.7
Autumn	16	24.8	12.3

SD: Standard deviation. Mean and SD values are given in ng/ml.

When vitamin D status of participants are analysed without any consideration of time of blood sampling, 84.24% of all results were below 20ng/ml (Table 3).

Table 3. Vitamin D Status of Recreational Athletes

	n	%
Sufficient (>30 ng/mL)	7	4.24
Insufficient (20-30 ng/mL)	19	11.51
Deficient (<20 ng/mL)	139	84.24

Median 25(OH)D levels of athletes who practised an indoor sport was 11.8 ng/ml (IQR:14.1), whereas it was 9.74 ng/ml in athletes who practised outdoor sports (IQR:6.42). There was no significant difference between the 25(OH)D3 levels of participants who practised indoor and outdoor sports (p>.05). Vitamin D concentrations of men and women also did not show any significant difference (p>.05). Median 25(OH)D3 levels were 10.1ng/ml (IQR: 8.16) in male and 9.34 ng/ml (IQR: 9.99) in female participants. Vitamin D concentrations and age of athletes showed no correlation (p>.05).

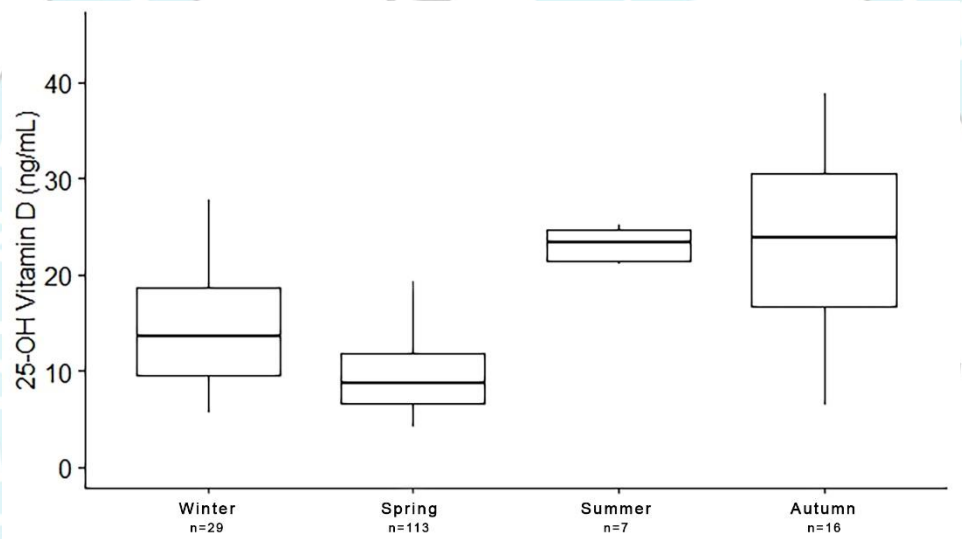

Figure 1. Vitamin D levels of asymptomatic recreational athletes in four seasons.

DISCUSSION

Effects of vitamin D on overall health is known to be beyond providing serum calcium and phosphate homeostasis. In terms of bone health, vitamin D is a modulator of bone-muscle cross-talk together with growth hormone – insulin like growth factor 1 axis and sex hormones[13]. Therefore, vitamin D has its effects on muscle tissue as well. After vitamin D supplementation, improved muscle strength and improved physical performance was documented among various populations[16]. Importance of vitamin D levels stems from its relevance to a wide range of diseases, such as infectious, autoimmune and cardiovascular diseases, type 1 and type 2 diabetes mellitus, several types of cancer, neurocognitive dysfunction, musculoskeletal disorders and mental illness. Epidemiologic studies have suggested that sufficient concentrations of vitamin D play a critical role in prevention of prostate, breast, ovary and colon tumours. In fact, a meta-analysis concluded that each 4-ng/ml increase in blood 25 (OH)D levels was associated with a 6% reduced risk of colorectal cancer[1]. Vitamin D deficiency is associated with all-cause mortality[16]. However, the relationship is observed to be J-shaped, suggesting that highest levels of vitamin D are not with best health outcomes

and keeping vitamin D concentration in the correct range is vital[5]. Therefore, the aim in supplementation of athletes with vitamin D should not be increasing levels of vitamin D as high as possible, but maintaining the optimum concentration. Optimum concentrations of vitamin D is different among various populations and there is no exact recommendation for athletic population either. And moreover, the recommendations that are available are limited to elite athletes.
Prevalence of vitamin D deficiency vary among studies but general recommendations are that both elite and recreational athletes need to be evaluated regarding vitamin D status. Some researchers have suggested that it should be targeted that athletes maintain a level of 25(OH)D higher than 40ng/ml, considering its effects on electrolyte metabolism regulation, protein synthesis, gene expression and immune function[14]. Studies have shown that vitamin D levels above 40ng/ml are associated with higher muscle performance. When 25(OH)D levels of athletes and healthy controls were increased from (mean ± SD) 11.62 ± 10.02 ng/ml to 41.27 ± 10.02 ng/ml after vitamin D supplementation, significant improvements ($p<.01$) were observed in 10-meter sprint times and vertical jump compared to placebo [2]. Other authors suggest, based on the literature, that vitamin D levels between 30-40ng/ml increase skeletal muscle function, decrease recovery time after training, increase force and power production, and increase testosterone levels, each of which potentiate athletic performance[3].

We report in this study that 84.24% of all recreational athletes that presented to our sports medicine clinic were indeed vitamin D deficient (<20ng/ml) and only 4.24% had sufficient concentration of 25(OH) D3. Although we report very high ratios of vitamin D deficiency, even among this population, some vitamin D levels were higher than recommended, such as 73.1 ng/ml. Therefore, it is noteworthy that blind supplementation of vitamin D should be avoided. Outdoor and indoor athletes did not differ by means of vitamin D levels in our study. A study from Denmark also reported that indoor and outdoor workers' vitamin D concentrations did not show any significant difference, however night workers had significantly lower results[4]. This indifference between outdoor and indoor workers and recreational athletes can be explained by the time spent under direct sun light besides work and training. Also, recreational athletes are not as dedicated as elites and some of them may be training as little as 2-3 times a week, which wouldn't have a big impact on total sun exposure of a person. However, a study conducted with urban Asian Indians showed that outdoor workers had significantly higher levels of serum 25(OH)D (29.0 ± 8.61 in outdoor workers, 19.1 ± 5.73 in mixed workers and 10.9 ± 4.19 ng/ml in indoor workers, $p<.001$), bioavailable 25(OH)D and free 25(OH)D index compared to mixed and indoor workers[6]. Discrepancies in these findings can also be attributable to geographical coordinates of countries in which the studies were conducted, also working hours may be different among these countries and it would have an impact on the study outcomes. Latter study also measured vitamin D binding protein levels of participants and concluded that it did not change the interpretation of the vitamin D status.

There are several limitations to this study. First of all, both sexes are not equally represented. However, authors did not have a chance to recruit equal number of athletes from both sexes, since the study design is retrospective. This gap between female and male athletes that presented to our clinic is most probably due to low levels of sports participation of women in this geographical region. Besides, samples taken in summer are very low in number, because overall number of hospital visits decline in summer and according to our observation, patients prefer having a yearly

preparticipation examination, which has no urgency, not in summer time. Another important limitation of the study is the lack of some other relevant parameters such as parathormone levels or bone mineral density counts. Unfortunately, we don't measure these parameters in healthy, asymptomatic athletes.

CONCLUSION

Information regarding vitamin D levels of recreational athletes are limited in the literature. In this study we reported the results of a vitamin D level measurements of 165 healthy recreational athletes from 12 different sports branches throughout a year. We observed very high prevalence of vitamin D deficiency (84.24%) and insufficiency (11.51%). However, even among this population, we observed vitamin D levels higher than recommended. According to the results of our study it is reasonable to recommend to evaluate recreational athletes' vitamin D levels on a regular basis and to recommend supplementing only after insufficiency/deficiency is proven.

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