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Vitamin D status of athletes with high UV-exposure during exercise training[1]

Anja Carlsohn, Friederike Scharhag-Rosenberger, Juliane Heydenreich, Frank Mayer, Potsdam

Summary

The summer vitamin D status was measured of 35 professional and recreational athletes. Professional and recreational athletes consumed 3.5 ± 5.9 g/d and 3.9 ± 5.1 g/d vitamin D, respectively (p = 0.82). However, the serum values (90 ± 14 nmol/L and 74 ± 2 nmol/L; p = 0.03) were within the normal range. It is possible that UV exposure during training makes a major contribution towards meeting requirements.

Keywords: Vitamin D status, nutrition, sports, excercise

Introduction

The fat soluble vitamin D is essential for intra- and extracellular potassium and phosphate homeostasis, as well as for bone mineralisation. The recognised consequences of vitamin D deficiency are therefore mostly skeletal diseases, e. g. rickets or osteomalacia [1].

The current "estimate of appropriate supply of vitamin D in the lack of endogenous synthesis" (referred to below as "estimate") of the German Nutrition Society (DGE) is 20 µg/d for adults. However, vitamin D can also be synthesised endogenously. Under normal living conditions in Germany, endogenous synthesis is indeed the most important factor, corresponding to 80–90 % of vitamin D supply [1, 2].

A deficient vitamin D status is reflected by the serum concentration of 25-(OH)-cholecalciferol, as 25-(OH)-cholecalciferol reflects vitamin D supply in food and from endogenous synthesis [3]. For serum concentrations of 25-(OH)-cholecalciferol < 50 nmol/L, it is assumed that vitamin D supplies are inadequate [3]. In spite of the great importance of endogenous synthesis for vitamin D balance and thus the relative independence from nutritional supply, inadequate vitamin D supply is very common in the general population [4].

Recording vitamin D status is not only interesting for the general population or for groups at risk of osteoporosis, but also increasingly for healthy athletes. Aside from its function in bone metabolism [5] and the resulting potential effect on fatigue fractures in athletes [6], vitamin D also acts through the intramuscular vitamin D receptor to influence muscle protein synthesis and neuromuscular control [7–9]. It has therefore been suggested that vitamin D status and physical performance may be linked and this has been supported by some studies [1, 10, 11]. However, recent investigations have shown that young athletes – particularly in indoor sports – may exhibit inadequate or low serum concentrations of 25-(OH)-cholecalciferol [13, 14].

Objective

The objective of this study was to record vitamin D intake and the serum concentration of 25-(OH)-cholecalciferol as parameters of vitamin D supply of recreational and professional athletes and to compare this with published data.

Methods

During the summer months (15 July to 15 September), venous blood samples were taken from 16 athletes in the national teams for rowing and racing canoes (8f, 8m; 23 ± 4 years, 80.5 ± 15.3 kg; 183 ± 12 cm), as well as 19 recreational athletes (11f, 8m; 25 ± 2 years, 73.3 ± 11.2 kg; 178 ± 8 cm), in order to determine the 25–(OH)-cholecalciferol serum concentration as marker of vitamin D supply. Before analysis, the blood samples were stored at –20 °C. The analysis was performed by immunochemistry, with a commercial ELISA test kit (IDS Germany, Frankfurt/Main).

During the same period in which the blood samples were taken, nutrition (including intake of food supplements) was documented in a stan-

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[1]The present data have already been presented as a poster at the 43th Congress of Sports Medicine of the German Association of Sports Medicine in 2012 [Deutscher Sportärztekongress] in Berlin.

dardised 3-day consumption record and the vitamin D supply was recorded on the basis of the German Food Database II.3 (Prodi Nutri-Science 5.7 expert, Hausach, Germany). A standardised 7-day activity protocol was used to record physical activity during the period of examination.

The data were evaluated descriptively (mean ± standard deviation [SD]). In addition, the hypothesis was tested that there were differences between professional and recreational athletes (t test for independent samples, level of significance $\alpha = 0.05$). Finally, the Pearson correlation coefficient was calculated, in order to evaluate the correlation between the daily duration of exercise training and 25-(OH)-cholecalciferol serum concentrations.

Results

The professional athletes trained for a mean period of 138 ± 56 min/d, whereas the recreational athletes engaged in sport or were physically active for 72 ± 36 min/d ($p = 0.004$). One reason for the high physical activity of the recreational athletes in this group is that they frequently used the bicycle as transportation means.

There was no significant difference between the two groups with respect to vitamin D supply, which was 3.5 ± 5.9 g/d for the professional athletes, and 3.9 ± 5.1 g/d for the recreational athletes ($p = 0.82$) (◆Figure 1). The serum concentrations of 25-(OH)-cholecalciferol were significantly higher for the professional athletes (90.1 ± 14.3 nmol/L) than for the recreational athletes (73.5 ± 25.7 nmol/L, $p = 0.03$). Nevertheless, the values in both groups were greater than 50 nmol/L, which is regarded as the lower limit for the prevention of falls, fractures and premature death in older men and women (◆Figure 2) [4].

No professional athlete, but 21 % of recreational athletes (n = 4), exhibited serum concentrations below the reference range (< 50 nmol/L). Serum concentrations < 30 nmol/L were not observed.

The correlation coefficient between the mean 25-(OH)-cholecalciferol serum concentration and the duration of exercise training was calculated to be r = 0.10 for the recreational athletes, r = 0.41 for the professional athletes and r = 0.24 for the two groups combined.

Discussion

The German Nutrition Society estimates that the vitamin D requirement for adults is 20 g/d, in the lack of endogenous synthesis [1]. Both recreational and professional athletes lay well under this figure, with just 4 g/d. Similarly low intakes of vitamin D have been found with professional basketball players, with only 3.5 ± 2.0 g/d vitamin D [15]. Athletes consumed similarly low levels of vitamin D compared to the general German population [16].

In spite of the low consumption of vitamin D in food, professional and recreational athletes exhibited vitamin D concentrations of > 50 nmol/L during the summer months – indicating adequate endogenous synthesis. Thus, the levels found in German athletes appear to be better than the levels in the rather sparse data in the international literature. On the other hand, the latter include

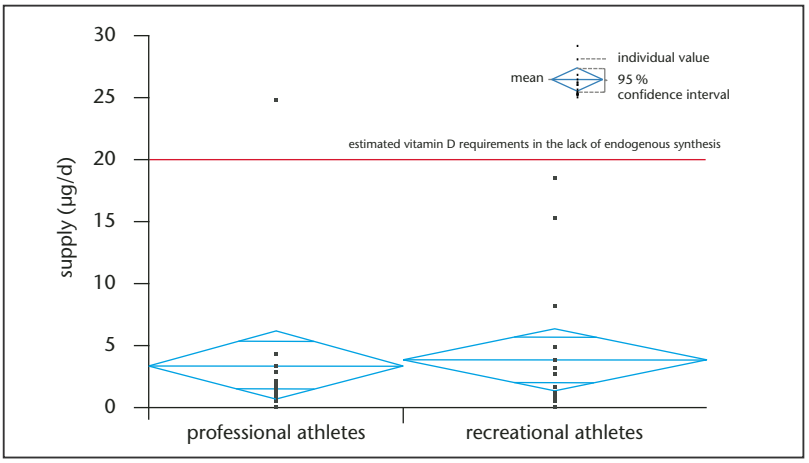

Fig. 1: **Supply of vitamin D to professional and recreational athletes compared with the estimated values for appropriate vitamin D supply in the absence of endogenous synthesis (——)**

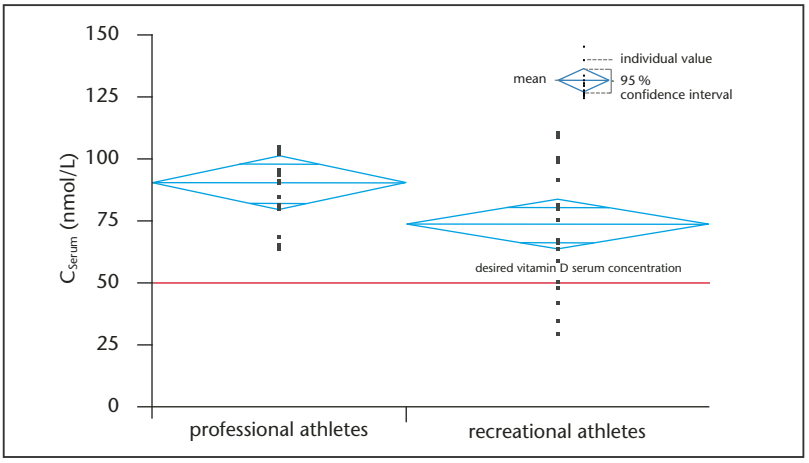

Fig. 2: **25-(OH)-cholecalciferol concentration in the serum (C_{Serum}) of professional and recreational athletes**

data from athletes involved in indoor sports, so that direct comparison is difficult. For example, the serum concentrations of 25-(OH)-cholecalciferol in ballet dancers were 37.3 nmol/L in winter and 59.8 nmol/L in summer [14]. Serum concentrations of 63.3 ± 20.8 nmol/L 25-(OH)-cholecalciferol were observed in a group of 98 athletes practising various types of indoor and outdoor sport [17].

In the present study, it is striking that the recreational athletes (72 ± 36 min/d sport) exhibited significantly lower vitamin D concentrations than the professional athletes, who were active for almost twice the time (138 ± 56 min/d). As there was no difference between the two groups with respect to vitamin D supply, it can be assumed that the high UV exposure of professional athletes during exercise training plays a decisive role in covering their vitamin D requirements. On the other hand, in both groups (recreational and professional athletes) and in the overall sample, there was only a slight or moderate combination between the daily duration of exercise training and 25-(OH)-cholecalciferol serum concentration. In general, it can be concluded that vitamin D supply in the summer months is adequate for athletes who frequently train outside.

Study limitations

The study limitations include the low number of volunteers and the lack of information about vitamin D supply and 25-(OH)-cholecalciferol serum concentrations of the same volunteers in winter or spring. In addition, the recreational athletes practised different types of sport (mainly fitness training, football and jogging), so that it is unclear how much time was spent outdoors during exercise training. Thus, UV exposure during exercise training and other leisure activities remains unknown.

Conclusion

During the summer months, endogenous vitamin D synthesis can easily compensate for low nutritional intake in athletes. In future studies, it would be interesting to study the supply and serum concentrations of vitamin D in athletes in the winter months and in indoor sports.

Jun.-Prof. Dr. rer. nat. Anja Carlsohn[1, 2]
Dr. phil. Friederike Scharhag-Rosenberger[2, 3, 4]
Dipl.-Sportwiss. Juliane Heydenreich[2]
Prof. Dr. med. Frank Mayer[2]

[1]**Korrespondenzadresse:**
Pädagogische Hochschule Schwäbisch Gmünd
Oberbettringer Str. 200
73525 Schwäbisch Gmünd
E-Mail: anja.carlsohn@ph-gmuend.de
[2]Hochschulambulanz der Universität Potsdam
Am Neuen Palais 10, 14469 Potsdam
[3]Deutsche Hochschule für Prävention und Gesundheitsmanagement Saarbrücken
[4]Nationales Centrum für Tumorerkrankungen (NCT) Heidelberg
Medizinische Onkologie

Conflict of Interest
The authors declare no conflict of interest according to the guidelines of the International Committee of Medical Journal Editors.

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