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25(OH)D LEVELS AND SKINFOLDS THICKNESS IN ATHLETES

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ABSTRACT
Purpose. The aim of our study was to assess the relationship between 25(OH)D levels and skinfold thickness in Poland's premier league (Ekstraklasa) football players. **Methods.** We enrolled 43 Poland's premier league football players. The mean age was 22.7 ± 5.3 years. Serum levels of 25(OH)D were measured by electrochemiluminescence (ECLIA) using the Elecsys system (Roche, Switzerland). Skinfold measurements were taken with a Harpenden-type skinfold calliper body fat tester, characterised by a constant pressure of 10 g/mm^2. **Results.** Our study showed decreased serum 25(OH)D levels in 74.4% of the professional football players. We did show a statistically significant negative correlation between the 25(OH)D levels and the biceps skinfold thickness ($r = -0.33$), iliac crest skinfold thickness ($r = -0.43$), the sum of all the studied parameters ($r = -0.5$) and percentage of body fat ($r = -0.49$). **Conclusions.** Our results suggest that athletes with higher content of the adipose tissue may be at a higher risk of vitamin D deficiency, and that 25(OH)D levels need to be monitored in professional athletes, particularly during the winter season.

Key words: fat mass, skinfold, vitamin D, athletes

Introduction

Vitamin D is a lipophilic prohormone, which may derive from the diet, but its main source is endogenous synthesis during exposure to sunlight. As a result of exposure of keratinocytes to ultraviolet B (UVB) radiation, 7-dehydrocholesterol is converted to cholecalciferol, or vitamin D_3. The resulting compound is not biologically active and is further converted in the liver and kidneys. The end product of this conversion is the biologically active 1,25$(OH)_2D_3$ (calcitriol) [1]. Receptors for the active form of vitamin D are found in many tissues and organs [2].

The two principal roles of vitamin D in the body are: regulation of calcium and phosphate metabolism, and bone mineralisation [3]. It has been suggested, in the literature, that low levels of vitamin D in athletes may lead to reduced muscle strength, and may significantly increase the risk of bone injuries [3–5]. There is strong evidence that vitamin D is capable of regulating both innate and adaptive immune processes via binding of active vitamin D to its complementary receptor [6].

While the available literature abounds in data on the relationship between vitamin D levels and the amount of body fat in overweight or obese individuals [7–9], reports on similar studies investigating individuals with normal weight, high levels of physical activity and low levels of adipose tissue are scarce. Heller et al. [10] suggest that athletes with a large body size and/or excess adiposity may be at a higher risk for vitamin D insufficiency and deficiency. In our previous study, we showed significant correlation between 25$(OH)D_3$ levels and body mass, body cell mass, total body water, fat – free mass and muscle mass. Body composition was assessed by bioelectric impedance analysis (BIA) [11].

The aim of our study was to assess the relationship between 25(OH)D levels and skinfold thickness in professional football players.

Material and methods

We enrolled 43 Polish premier league (Ekstraklasa) football players. The mean age, height, body mass, percentage of body fat were respectively: 22.7 ± 5.3 years, 182.0 ± 6.7 cm, 76.3 ± 7.4 kg, 8.1 ± 1.1%, and the mean career duration was 14.7 ± 4.5 years. The study was conducted in December 2013. All the footballers were in the competitive period and had similar exercise loads. None of the subjects used any food supplements containing vitamin D and calcium.

Training sessions took place in Wroclaw, in Poland, which is situated at latitude of 51°10' N. They were performed twice a day and they lasted for 2–3 hours each. In winter, the uniform covered 80% of the body of the studied athletes.

To assess subcutaneous adiposity, skinfold thickness was measured on the biceps under the inferior angle of the subscapular, and over the iliac crest. Skinfold measurements were taken with a Harpenden-type skinfold calliper body fat tester characterised by a constant pressure of 10 g/mm^2.

We used the following formulas to estimate the percentage of body fat.

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An equation here in below was used to compute body density (D), which included the skinfolds thickness [12]:

$$D = 1.0982 - 0.000815(3SF) - 0.000000(3SF)^2,$$

where 3SF stands for a sum of triceps, subscapular and abdomen skinfolds. Brozek et al. [13], equation was applied to compute the percentage of fat:

$$\%F = 100*(\frac{4,57}{D} - 4,142).$$

Blood sampling was carried out at 8.00am, after a 12-hour fast, and a 24-hour period without training, in December 2013. Serum was separated and stored at –70°C. Serum levels of 25(OH)D were measured by electrochemiluminescence (ECLIA) using the Elecsys system (Roche, Switzerland). The intra- and interassay coefficients of variation (CV) for 25(OH)D were 5.6% and 8.0%, respectively, and the limit detection was 4 ng/ml (10 nmol/l).

The study was approved by the Bioethics Committee of the University School of Physical Education, Wrocław, Poland, No. 18/2013.

The relationship between serum 25(OH)D levels and skinfold thickness and percentage of body fat was assessed using the Pearson correlation coefficient and the statistical analysis was performed using Statistica 10.

Results

The results of our study are presented in Figure 1–2.

The mean serum 25(OH)D level was 16.9 ± 8.4 ng/ml. Assuming the levels of serum 25(OH)D of 30–50 ng/ml as the physiological norm [14], we found that 74.4% of the subjects had levels consistent with vitamin D deficiency.

We found significant negative correlation between 25(OH)D levels and the biceps skinfold thickness, iliac crest skinfold thickness, the sum of all the studied parameters and percentage of body fat.

Figure 1 and 2 present the Pearson correlation coefficients (*r* and *p* – values).

Discussion

Many studies suggest that vitamin D deficiency is highly prevalent among athletes, particularly during the winter season [11, 15–18], and this has also been demonstrated in our study: we found decreased serum 25(OH)D levels as the physiological norm [14] in 74.4% of the professional football players during the winter season.

In our study, we assessed the relationship between 25(OH)D levels and skinfold thickness in professional football players and found significant negative correlation between the biceps skinfold thickness, iliac crest skinfold thickness, the sum of studied parameters and percentage of body fat. Similar results were obtained by Koundourakis et al. [19], while Peeling et al. [20] showed a significant positive correlation between 25(OH)D levels and the sum of skinfold thicknesses in athletes. It should, however, be noted that these authors evaluated representatives of various sport disciplines. Athletes with lower skinfold thicknesses represented disciplines whose training units occurred in an indoor venue for prolonged periods of time, where the skin is not exposed to sunlight. These factors may have indirectly affected the resulting serum levels of 25(OH)D.

Using radioactive labelling, Mawer et al. [21] proved that vitamin D is stored in the adipose tissue. Due to its lipophilic character and the mechanisms of sequestration, vitamin D is cumulated in the subcutaneous tissue. This process has not been yet fully elucidated [22]. Pramyothin et al. [23] assessed the concentration of vitamin D in the adipose tissue excised during bariatric operations (HPLC). The concentration of vitamin D in the specimens was high (297 ± 727.7 ng/g fat tissue) [23]. Cheng et al. [24] suggested that increased amount of the adipose tissue that facilitates storage may lead to a diminished transport of vitamin D into the bloodstream. It has been well-documented that blood concentration of 25(OH)D is negatively correlated with the amount of adipose tissue [24].

Notably, skinfold thickness measurements are a recognised method of measuring adipose tissue content in the body with skinfold thickness being accepted as a body fatness predictor for two reasons: about 60% of total body fat is in the subcutaneous region of the body, and skinfold thickness can be directly measured using a well-calibrated calliper [25]. The method is also non-invasive and easily accessible. It should also be pointed out that anthropometric measurements do not require any particular conditions to be met by the examinee, in contrast to the BIA method (appropriate level of hydration, lack of strenuous exercise for 12 hours before the examination). The measurement is therefore independent of the so-called external factors. Adipose tissue content estimation, based on skinfold thickness measurements, seems to be a good method to assess the level of adiposity, particularly in athletes with similar levels of exercise load [26]. Reilly et al. [27] have suggested that skinfold thickness measurement of various parts of the body may be a good indicator of obesity in athletes, especially in football players.

Our results have revealed a considerable vitamin D deficiency in athletes, particularly during the winter season, as players with higher levels of 25(OH)D were characterised by lower values of skinfold thickness in all the sites, which we analysed. Based on our results, it may therefore be suggested that athletes with higher adipose tissue content may be at a higher risk of vitamin D deficiency, particularly during the autumn and winter seasons.

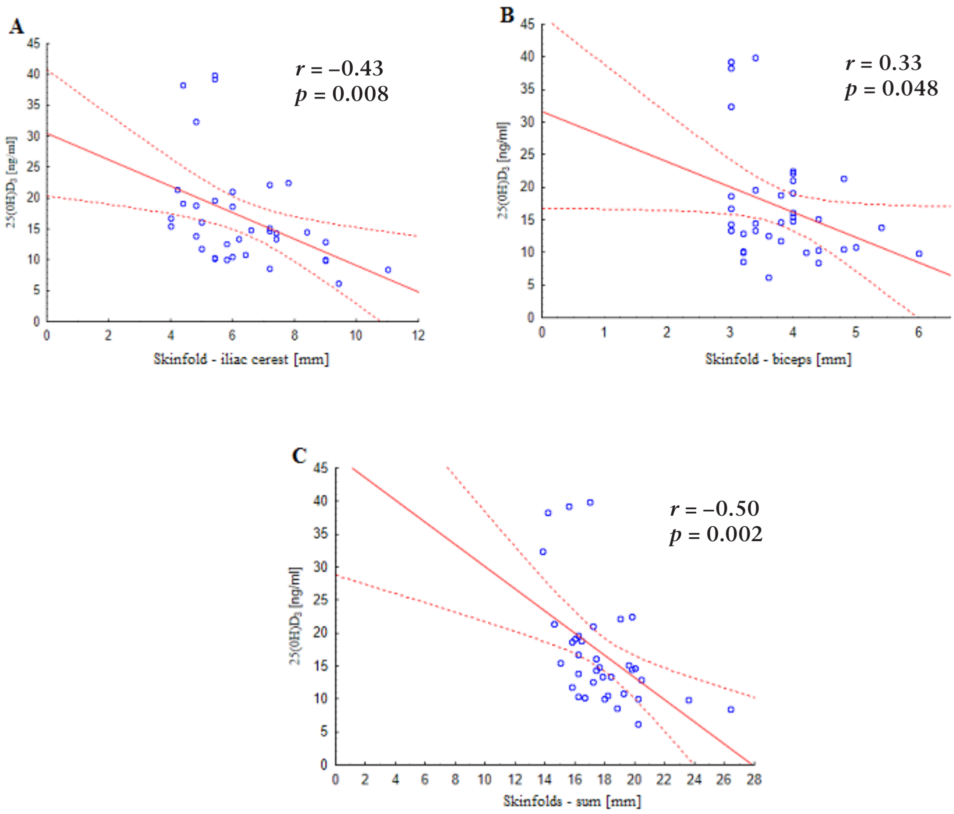

Figure 1. Correlations between 25(OH)D levels and the iliac crest skinfold thickness (A), the biceps skinfold thickness (B), and the sum of all the studied skinfolds thickness (C)

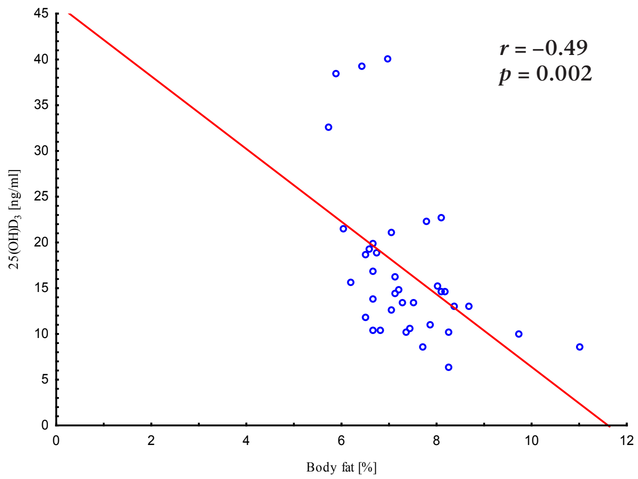

Figure 2. Correlations between 25(OH)D levels and percentage of body fat

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