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ORIGINAL ARTICLE

# Relationship between 25(OH)D levels and skeletal muscle stiffness in athletes – Preliminary study

*Relation entre les concentrations de 25(OH) vitamine D et la raideur des muscles squelettiques chez le sportif : étude préliminaire*

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## KEYWORDS

Vitamin D;  
Muscle stiffness;  
Muscle damage;  
Athletes;  
Creatine kinase

## Summary

**Objectives.** – The aim of our study was to assess the relationship between 25(OH)D levels and muscle stiffness and elasticity in well-trained football players.

**Material and methods.** – We enrolled 31 Polish first league football players. The mean: age was  $26.3 \pm 5.9$  years, height was  $183.0 \pm 7.6$  cm and body mass was  $78.4 \pm 6.9$  kg, career duration was  $16.7 \pm 5.2$  years. Serum levels of 25(OH)D were measured by electrochemiluminescence (ECLIA). Muscle stiffness and elasticity was tested with MyotonPRO device.

**Results.** – Our study showed decreased serum 25(OH)D levels in 68% of the professional football players. The results also demonstrated a slight statistically significant correlation between vitamin D levels and muscle stiffness in points 12, 22 (located internal hamstrings and gastrocnemius) and elasticity in point 4 (located vastus lateralis). We have found significant positive correlation between muscle stiffness and CK activity.

**Conclusion.** – Based on our study we concluded that in well-trained professional football players, there was slight correlation between serum levels of 25(OH)D and muscle stiffness and elasticity measured immediately after the transition period.

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## MOTS CLÉS

Vitamine D ;  
Raideur musculaire ;  
Lésions musculaires ;  
Athlètes ;  
Créatine kinase

## Résumé

*Objectif.* – Le but de cette étude était d'évaluer la relation entre le niveau de 25(OH) vitamine D et la raideur et l'élasticité musculaire chez des footballeurs professionnels.

*Méthodes.* – Nous avons recruté 31 joueurs de football de ligue 1 polonaise (âge  $26,3 \pm 5,9$  ans, taille  $183,0 \pm 7,6$  cm, poids  $78,4 \pm 6,9$  kg, durée de la carrière professionnelle  $16,7 \pm 5,2$  ans). Les concentrations sériques de 25(OH) vitamine D ont été mesurées par électrochimoluminescence (ECLIA). La raideur et l'élasticité musculaire ont été mesurées avec l'appareil MyotonPRO.

*Résultat.* – Notre investigation a démontré une diminution de la 25(OH) vitamine D chez 68 % des footballeurs professionnels, ainsi qu'une corrélation statistiquement significative entre les niveaux de vitamine D et la raideur musculaire aux points 12 et 22 (ischio-jambiers et gastrocnémien) et l'élasticité musculaire au point 4 (muscle vaste latéral). Nous avons aussi trouvé une corrélation positive entre la raideur musculaire et l'activité créatine kinase.

*Conclusion.* – Ce travail montre donc que chez les footballeurs professionnels la raideur et l'élasticité musculaire mesurées immédiatement après la période de transition sont corrélés aux concentrations de 25(OH) vitamine D.

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## 1. Introduction

Vitamin D plays an important role in the regulation of the calcium and phosphorus balance and bone health. Moreover, many pleiotropic functions have been discovered, such as regulatory function of the kidneys, heart, immune system, anti-inflammatory; anti-apoptotic, antifibrotic, cell differentiation, and proliferation [1,2].

The importance of vitamin D in skeletal muscle function has been demonstrated by the presence of vitamin D receptors (VDR) in both the nucleus and the cell membrane of human skeletal muscle fibres and by defective muscle development [3]. These processes are mediated through genomic and non-genomic mechanisms. [4,5]. Both genomic and non-genomic mechanisms interfere with regulation of metabolic processes, transcription, and gene expression in the skeletal muscles, thereby inducing control of intracellular  $Ca^{2+}$  (regulation of membrane calcium channels), myocyte differentiation, expression of contractile proteins, hypertrophy, and improved mitochondrial function. It may suggest that vitamin D can improve muscle contraction, growth and strength [5,6]. Vitamin D may also participate in muscle tissue regeneration [5]. Vitamin D is related to this process as the secosteroid appears to display an ability to mediate myoblast proliferation and differentiation. Recent literature shows that in deficiency of 25(OH)D, signalling of pathways necessary for growth and survival such as MAPKs, Src and Akt (PKB) is reduced and muscle cell development is impaired [5,7].

Stiffness and elasticity are indirect markers of skeletal muscle damage. The available literature contains reports on the relationship between 25(OH)D levels and muscle strength in athletes, although these relationships are inconclusive [8–10]. Information on the relationship between 25(OH)D levels and muscle stiffness and elasticity is, however, lacking.

The aim of our study was to assess the relationship between 25(OH)D levels and muscle stiffness and elasticity in well-trained football players.

## 2. Material and methods

### 2.1. Subjects

We enrolled 31 Polish first league football players. The mean age, height and body mass, career duration were, respectively:  $26.3 \pm 5.9$  years,  $183.0 \pm 7.6$  cm and  $78.4 \pm 6.9$  kg,  $16.7 \pm 5.2$  years. The study was conducted during a winter season in Wrocław, Poland, which is situated at the latitude of  $51^{\circ}10'N$ . The uniforms covered 80% of the competitors' bodies. All the players were after the transition period and had similar training loads during which the athletes performed exercise at the mean level of 55%  $VO_{2max}$ . None of the subjects used any food supplements containing vitamin D and calcium.

### 2.2. Blood testing

Blood sampling was carried out at 8 am after a 12-hour fast and a 24-hour period without training. Serum was separated and stored at  $-70^{\circ}C$ . Serum levels of 25-hydroxycholecalciferol were measured by electrochemoluminescence (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 of detection was 4 ng/mL (10 nmol/L).

### 2.3. CK activity

Plasma creatine kinase (CK) activity was evaluated using the diagnostic kits for the kinetic enzyme analyser Konelap 60 BioMerieux (France). CK detection limit for the kits was

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