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Nutrition Education and Vitamin D Supplementation Improving Nutrition Intake, Body Composition, and Vitamin D Status of Soccer Athlete

Edukasi Gizi dan Suplemen Vitamin D untuk Perbaikan Asupan Zat Gizi, Komposisi Tubuh, dan Status Vitamin D Atlet Sepak Bola

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ABSTRACT

Background: The success of soccer athletes is influenced by physical, mental, and genetic factors, with nutritional status significantly affects youth soccer performance in Indonesia by 69.8%. Body composition and somatotype are critical components of nutritional status. Biochemical indicators such as creatine kinase (CK) and vitamin D levels provide insights into the impact of training and diet on athletes.
Objectives: To determine the effect of nutritional interventions on improving the intake and body composition of athletes characterized by the value of creatinine kinase levels and vitamin D levels of athletes and an increase in VO_2 Max values as performance indicators.
Methods: This experimental study used a *pre-post control trial design* involving 39 subjects who were divided into treatment (20 athletes) and control (19 athletes) groups for one month. The treatment group received nutrition education (classroom, individual, and nutrition assistance) and vitamin D supplementation of 800 IU per day, while the control group was only monitored. The exercise was adjusted to the coach's program.
Results: Energy, protein, and carbohydrate intakes were deficient among athletes, although fat intake was adequate. CK levels were within normal limits. All athletes in the control group exhibited vitamin D deficiency, compared to 90% in the intervention group, despite supplementation showing modest improvement.
Conclusions: Vitamin D supplementation has a significant effect on increasing blood vitamin D levels. This study reinforces the importance of education and supplementation-based nutrition interventions to improve the nutritional status and performance of soccer athletes.

INTRODUCTION

Vitamin D deficiency in athletes is common and is associated with reduced performance and general health, including risk of injury. Vitamin D plays an essential role in muscle function and bone density, especially for active athletes in intensive training such as soccer[1]. Vitamin D levels in athletes are low, with most concentrations below 20 ng/mL across various sports[2]. A study on soccer players in Ankara showed that about 23.2% of the subjects had vitamin D levels below ten ng/mL, which falls into the deficiency category[3]. In addition, the nutritional status component affects the performance of youth soccer athletes in Indonesia by 69.8%[4]. Soccer athletes still have limited nutritional knowledge and nutrient intake that does not meet recommendations, including vitamin D, which plays an essential role in muscle function, strength, and the immune system[5].

Vitamin D3 supplementation (2000 IU per day) for 4 months in elite ballet dancers training indoors during winter resulted in significant improvements in isometric strength (18.7%) and vertical jump (7.1%) and reduced the incidence of injuries compared to the control group. Vitamin D supplementation can improve overall athletic performance[6]. Vitamin D supplementation is efficacious in improving vitamin D status, muscle function, and physical performance in athletes[7]. Significant improvements in the power leg press and sprint tests in the D-supplemented group of athletes were evident[8]. Vitamin D supplementation has a significant positive effect on muscle strength. Supplementation in vitamin D-deficient people significantly improved compared to those with 25[OH]D levels ≥30 nmol/L. Supplementation in people aged 65 years or older increased considerably muscle strength but was not demonstrated in younger people[9].

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Although many studies have examined nutrition education and vitamin D supplementation in athletes separately, limited studies have combined the two interventions. A comprehensive approach involving nutrition education accompanied by supplementation may provide more optimal results in improving athletes' nutritional status. This study proposes an integrated intervention program that combines nutrition education and vitamin D supplementation to address the problems of nutrient intake, body composition, and vitamin D status in soccer athletes.

While there have been studies on nutrition education and vitamin D supplementation, the combined impact of the two remains unexplored. This study will evaluate the differences in nutritional intake, nutritional status, body composition, blood creatinine kinase levels, blood vitamin D levels and performance (VO_2 Max) of adolescent soccer athletes in the intervention group with nutrition education and vitamin D supplements and the control group. The results of the study are expected to provide scientific evidence of the benefits of a comprehensive nutrition intervention approach, as well as the basis for developing appropriate nutrition programs to optimise the performance of soccer athletes.

METHODS

This research is experimental with a pre-post control trial design method from April to August 2019. Subjects were divided into treatment and control groups. The treatment group received nutrition education intervention and a daily vitamin D capsule supplementation of 800 IU. Nutrition education was provided through counselling (classroom and individual) and meal portion assistance. The training intervention was tailored to the trainer training program. Observations were made on nutritional intake, anthropometric values, body composition, biochemistry (creatinine kinase and Vitamin D), and performance (VO_2 Max). The research location used the Student Training Education Center (PPLP) in Yogyakarta for the intervention group and the Special Sports Class (KKO) in Sleman Yogyakarta for the control group.

The study's inclusion criteria were teenage soccer athletes aged 12-19 years in athlete dormitories, actively practising for the last three months, and getting *informed consent* signed by athletes and coaches or the medical team on duty. In comparison, the research exclusion criteria are athletes injured, so they cannot perform physically during the test. The sample size calculation is based on the assumption of a 95% confidence level (α=0,05), the power is set at 90% (β=0,10), and the intervention effect uses the Lemeshow formula. Based on these calculations, it can be seen that the minimum sample size required for one group is 18 people. However, in the implementation of the study, all athletes were taken as subjects, namely in the intervention and control groups, totalling 20 (twenty) and 19 (nineteen) people, respectively, and no subjects dropped out in the middle of the study. All respondents were male soccer athletes with 6-10 years of experience as athletes.

Vitamin D Supplement Intervention is the provision of vitamin D capsules brand D-Vit FT 400 IU per tablet, giving as many as two tablets per day to fulfill 800 IU per day. Exercise Intervention is an exercise program set by the team coach for one week, recorded in the athlete's exercise log book. Anthropometry is an anthropometric profile that includes body weight and height, nutritional status of body mass index/age (BMI/A), body heiht/age (BH/A), and body weight/age (BW/A). Body weight was measured using the digital scales brand Karada Scan HBF-375, ratio scale, and units of kg. Body height was measured using a microtoise tool, the measurement scale is ratio with units of cm. The nutritional status of BMI/A, BH/A, and BW/A was calculated using WHO-Anthro+ *software* with a ratio scale. Body composition was measured to determine body fat percentage (%), visceral fat, BMR (cal), BMI (kg/m^2), body age (years), segmental subcutaneous fat (%) and segmental skeletal muscle (%) using BIA Karada Scan HBF-375. The data scale is ratio. Nutrient intake is an assessment of the fulfilment of both macro and micro nutritional intake consumed by athletes. The methods used were 24-hour food recall for pre-intervention, food waste analysis during monitoring (2×/week) in the intervention group, and assessment of food intake outside the dormitory using a Semi-Quantitative Food Frequency Questionnaire (SQ-FFQ) (1×week). The data scale was ratio with calorie parameters for energy, grams for protein, fat, and carbohydrate, and some standardised parameters for micronutrients. Creatinine kinase level is an enzyme in large amounts in the cells of striated muscle, heart muscle, and brain, and in small quantities in the tissues of internal organs. A blood sample is taken with a needle from a vein in the arm.

The reference range for men is 5-35 µg/ml, 30-180 IU/l, 55-170 U/l at 37°C (SI units). Athlete performance is a parameter to measure performance by looking at the athlete's aerobic capacity/VO_2 Max using a multi-run (bleep) test. The performance test is done once; the data obtained has a ratio scale and units of ml/kg BB/minute. Vitamin D levels are tests to determine vitamin D levels by looking at the amount of 25-hydroxyvitamin D in the blood. Fasting blood serum is taken from a vein in the arm using a needle. The reference range of total 25(OH)D level is 20-100 ng/mL.

The instruments used are nutrition education media (calculation of nutritional needs, preparation of nutrition profiles, preparation of food etiquette, assistance with meal portioning, nutrition education (classes and individual counseling), body composition data taken using Bioelectrical Impedance Analysis (BIA) equipment, clinical physical data (blood pressure and basal pulse) obtained using an OMRON digital tensimeter, nutrient intake data obtained with a 24-Hour food recall questionnaire, SQ-FFQ for food and beverages, and comstock food waste forms. Other instruments were anthropometric tools, blood collection kits, and reagent kits for vitamin D and creatinine kinase examination. VO_2 Max test equipment using the bleep test requires a track, cones, audio, and recording forms, exercise log books, and Vitamin D 800 IU/day tablets.

The data for each research parameter is shown in the average and difference of all athletes' parameters pre-post nutritional intervention. Statistical analysis of comparative test with paired t-test using 95% confidence level (p-value<0.05). This analysis uses statistical analysis

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software SPSS 20.0 for Windows. This research has received ethical approval from the Health Research Ethics Commission (KEPK) of the Yogyakarta Ministry of Health Health Polytechnic number: e-KEPK/POLKESYO/0263.1/IX/2019 dated September 12th, 2019.

RESULTS AND DISCUSSIONS

Table 1 shows the characteristics of the research respondents. All soccer athletes are male, most of whom have played for 6-10 years, participating in competitions at least 1 time a year. Based on Table 1, it can be seen that the majority of research respondents do not smoke. Most of the athletes involved in this research frequently compete 1-3 times a year. This is similar to research that has been done previously by researchers where soccer athletes in two athlete dormitories have a frequency of competing 1-3 times a year[4]. The exercises carried out by athletes are various, including physical exercises to strengthen endurance and also technical exercises to improve game skills. According to the current analysis, there is a limit to the number of tournaments that powerlifters can participate in and hence improve their performance. More than two events in a calendar year did not result in higher absolute performance for males, but relative performance improved when up to three competitions were participated in. Females who competed 2 or 5 times per year demonstrated the most robust absolute and relative performance throughout the competition[10]. The exercises carried out by athletes are various, including physical exercises to strengthen endurance and technical exercises to improve game skills.

Table 1. Characteristic of respondent

Characteristics	Group	
	Intervention n (%)	Control n (%)
Age (years)		
14	3 (15)	0 (0)
15	6 (30)	3 (15.8)
16	9 (45)	7 (36)
17	2 (10)	8 (42)
18	0 (0)	1 (5.4)
Experience as Athlete (years)		
1-5	5 (25)	1 (5,4)
6-10	14 (70)	16 (83.8)
>10	1 (5)	2 (10.8)
Duration of Competition (times/year)		
0-1	11 (55)	10 (54)
2-3	6 (30)	7 (40.6)
>3	3 (15)	2 (5.4)
Smoking Habit		
Smoking	4 (20)	2 (10.8)
Non Smoking	16 (80)	17 (89.2)

The data were normally distributed using the Shapiro-Wilk test (p-value>0.05). The preliminary data of the study (Table 2) showed that there was no significant difference in energy, protein, and carbohydrates between the two groups (intervention and control), but there was a significant difference in fat intake, namely, the control group had a higher intake than the intervention group. The initial conditions between the two groups are the same, so that different interventions can be given according to the group.

Table 2. Preliminary data on nutrition intake

Nutrition Intake	Group (X±SD)		p-value
	Intervention	Control	
Energy (kkal)	1775.8±821.3	1637.9±506.2	0.534
Protein (g)	59.0±31.9	61.9±21.5	0.743
Fats (g)	59.5±39.5	86.8±41.3	0.042*
Carbohydrates (g)	245.3±137.3	212.0±71.6	0.353

*) significant difference with independent sample t-test

Table 3 shows the results of pre- and post-intervention nutrient intake; all data have a normal distribution (normality test using Shapiro Wilk, p-value>0.05). The analysis of each nutrient intake in each treatment group showed non-significant results, which means there was no significant change in the nutrient intake variable during the intervention. Nutrition education-based interventions often take longer to affect eating habits significantly. Changes in nutritional intake in athletes usually require a sustainable and personalised approach, as athletes tend to maintain long-established eating habits[11]. Short-term nutrition education is not strong enough to change behaviours, especially regarding the intake of energy and macronutrients that have become part of their daily routine.

Athletes' energy and nutrient needs vary greatly depending on the intensity of the exercise, the duration, and the type of exercise. According to Close et al. (2016),

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the adequacy of athletes' nutritional intake is often not by the recommendations because they tend not to change their diet drastically even though there is education about nutritional needs during the intensive training period[12]. In this study, despite being given nutrition education, some athletes did not consider dietary changes to be an urgent need to improve their performance[12].

Table 3. Nutrition intake between group intervention

Nutrition Intake	Intervention Group (X±SD)			Control Group (X±SD)		
	Pre	Post	p-value	Pre	Post	p-value
Energy (kcal)	1775.8± 821.3	1594.0±371.0	0.280	1637.9±506.2	1521.8±390.4	0.376
Protein (g)	59.0±31.9	54.9±15.2	0.530	61.9±21.5	55.8±21.4	0.384
Fats (g)	59.5±39.5	82.5±43.6	0.095	86.8±41.3	81.3±36.3	0.637
Carbohydrates (g)	245.3±137.3	217.1±61.4	0.396	212.0±71.6	196.7±59.3	0.424

The variables of body mass index, percentage of fat in the control group, and percentage of muscle in the treatment group were not normally distributed. The analysis of differences between groups in each variable showed insignificant results, which means that the body composition profile of the two treatment groups did not show a significant difference. Body composition carried out in this study included height, weight, BMI, fat percentage, and body muscle percentage. Based on the research results, it is known that the average rate of body fat in the two groups is <10%. The average body fat percentage of professional soccer athletes in Indonesia is 14.8%[4]. When compared with the reference, it is still relatively low. This can be due to the adequacy of nutrient intake that has not been fulfilled optimally, causing the fat percentage to be lower than the reference.

Table 4. Body composition between group intervention

Body Composition	Intervention Group (X±SD)			Control Group (X±SD)		
	Pre	Post	p-value	Pre	Post	p-value
Height (cm)	169.8±4.17	169.8±0.9	0.330[a]	167.8±4.3	168±4.4	0.42[a]
Weight (kg)	57.7±5.3	59.6±4.8	0.000[a]	57.5±5.0	57.9±4.6	0.058[a]
BMI	20.5±1.9*	20.0±1.7	0.366[b]	20.5±1.8*	20.7±1.5	0.408[b]
Body Fat (%)	9.5±2.4	8.8±2.3	0.033[a]	8.4±2.8*	8.2±2.7*	0.234[b]
Body Muscle (%)	37.7±1.7*	38.5±1.7	0.071[b]	37.7±1.7	37.7±1.6	1.000[a]

*) data not normally distributed (p value<0.05); [a]) independent sample t-test (significant p-value<0.05); [b]) non-parametric Mann-Whitney test (significant p<0.05)

A follow-up analysis of the body composition profile is performed, and each group is compared before and after treatment. Table 4 shows that the weight in the intervention group increased significantly, and the fat percentage decreased significantly. Data in the control group showed a significant increase in the variable height. The research results show that the average percentage of body fat in the two groups is <10%. The average body fat percentage of professional soccer athletes in Indonesia is 14.8%. When compared with the reference, it is still relatively low. This can be due to the adequacy of nutrient intake that has not been fulfilled optimally, causing the fat percentage to be lower than the reference[4].

Table 5. Blood biomarker and performance between group intervention

Variables	Intervention Group (X±SD)			Control Group (X±SD)		
	Pre	Post	Pre	Post	Pre	Post
Creatine Kinase	401.8±265.4	507.2±426.9*	0.191[b]	363.8±215.5*	344.7±156.3*	0.717[b]
Vitamin D	21.21±5.5	24.3±4.7	0.001[a]	22.7±3.3	23.1±3.6	0.400[a]
VO_2 Max	53.0±9.6	51.6±10.8	0.585[a]	47.0±5.8	50.7±4.1	0.009[a]

*) data not normally distributed (p-value<0.05); [a]) paired sample t-test (significant p-value<0.05); [b]) non-parametric Wilcoxon test (significant p-value<0.05)

VO_2 Max in the control group was better in this study because the control group had more experience (6-10 years: 83.8%). Experienced athletes have better adaptation, and training background affects the response to interventions and athletes with competition experience contribute to aerobic performance[13]. In addition, from the characteristic data, it is known that the intervention group is dominantly younger (14-16 years old (90%). Age differences in adolescent athletes can affect biological maturation, adaptation response to exercise, and the capacity to increase VO_2 Max[14]. This study showed that the intervention group experienced a significant increase in body weight (p-value<0.001) from 57.7 kg to 59.6 kg, and body fat decreased significantly (p-value=0.033) from 9.5% to 8.8%. Increasing body weight can affect relative VO_2 Max (mL/kg/min). Although muscle mass increases, total weight gain can decrease VO_2 Max values when expressed per kilogram of body weight[15].

The prevalence of vitamin D deficiency in adults was 30% (95% CI 22-39%), whereas the prevalence in adolescents was 39% (95% CI 25-55%). Elite athletes have

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a high prevalence of vitamin D deficiency (≤ 50 nmol/L), highlighting the need for preventative and treatment efforts[16]. Research conducted by researchers showed that the control group's vitamin D deficiency in soccer athletes was 94%, and the intervention group was 90% (cut off <30 ng/mL). Vitamin D deficiency in athletes has a high prevalence; this can provide a greater risk of injury to athletes because vitamin D plays a role in helping the absorption of calcium minerals for bone mineralisation.

Vitamin D supplementation has been shown to improve athletic performance and recovery. At the same time, doses given to soccer athletes (800 IU per day) may still be too low to increase serum levels of 25(OH)D significantly. Intervention studies in athletes show that higher doses, such as 4000 to 6000 IU per day, improve serum vitamin D levels and athletic performance, especially regarding VO_2 Max and muscle strength production[17]. Low doses are insufficient to address deficiencies, especially in populations with limited sun exposure or higher needs due to exercise intensity.

In addition, it is necessary to pay attention to the duration of supplementation (1 month). Other research suggests that to achieve significant improvements in vitamin D levels, the duration of supplementation needs to be longer, for example, 8 weeks or more, as illustrated in studies in rowing athletes and professional footballers[18]. The individual's response to vitamin D supplementation needs to be considered. Factors such as absorption that differs between individuals, health status, and calcium intake can also affect the effectiveness of supplementation[19].

The effect of vitamin D supplementation in the intervention group was a significant increase in serum vitamin D levels, while the control group also experienced a rise but not significantly. Although there was a substantial increase in serum vitamin D levels, the number of athletes with deficiency was still the same as at the beginning of the intervention, namely 90%. In contrast, in the control group at the end of the study, the number of athletes with deficiency increased to 100%.

The prevalence of vitamin D deficiency, which remains high in athletes, is a phenomenon that is often reported in many studies. Although athletes are more physically active and frequently exposed to the sun, many factors contribute to low vitamin D levels, including the type of exercise, the season, and individual physical characteristics such as skin pigment. One of the main factors is limited sun exposure, especially in athletes who train indoors or during the winter. A meta-analysis found that more than 50% of athletes were deficient in vitamin D. This prevalence was higher in the winter when the UVB rays needed for vitamin D synthesis in the skin were drastically reduced[20,2]. Athletes who train outdoors are also not immune to this problem, especially if they avoid direct sun exposure or use sunscreen, which naturally reduces vitamin D production. In addition, athletes with darker skin have a higher risk of developing vitamin D deficiency, as they need more prolonged exposure to sunlight to produce the same amount of vitamin D compared to light-skinned individuals[2]. Other research shows that vitamin D deficiency remains common in countries with sunny climates, suggesting that other factors, such as diet and supplement use, also play an essential role[20].

The results of the comparative test analysis in each group showed that the athlete group who was given 800 IU daily vitamin D supplementation experienced a significant decrease in body fat percentage. In contrast, the control group that was not given supplementation experienced an insignificant decrease (Table 5). The effect of vitamin D supplementation in the intervention group was a significant increase in serum vitamin D levels, while the control group also experienced a rise but not significantly. Although there was a substantial increase in serum vitamin D levels, the number of athletes with deficiency was still the same as at the beginning of the intervention, namely 90%. In contrast, in the control group at the end of the study, the number of athletes with deficiency increased to 100%.

Vitamin D affects skeletal muscle function and improves athlete performance through mechanisms involving vitamin D receptors (VDRs) in muscles. Vitamin D can also increase the mass of type II muscle fibres, which are essential for muscle strength and endurance. A study showed that vitamin D supplementation improved athlete performance through enhanced muscle function and muscle mass[21]. Vitamin D can increase aerobic metabolism and VO2 max, contributing to increased fat burning during physical activity. In addition, the effect of vitamin D on insulin sensitivity can affect the storage and breakdown of fat in the body, so that body fat loss is more likely to occur in the group receiving the supplementation[18].

Creatine kinase is an enzyme that plays a role in ATP regeneration during intensive physical activity, and the level of creatine kinase in the blood is often used as a marker of muscle damage. However, it is essential to note that creatine kinase levels in the blood do not necessarily reflect muscle mass. A study showed that high levels of CK were more related to exercise intensity and muscle damage rather than directly to muscle mass. Athletes with large muscle mass may not show a significant increase in CK if they are used to a specific training intensity[22]. Muscle mass is a relatively stable parameter, while creatine kinase levels fluctuate, especially after training sessions or matches. Creatine kinase levels can remain high for up to 72 hours after intensive physical activity, so measurement time is essential in assessing the relationship between muscle mass and creatine kinase levels[23].

CONCLUSIONS

The results showed the athlete's nutritional intake for energy, protein, and carbohydrates was included in the inadequate category, while the fulfilment of fat was sufficient. Creatine kinase levels were still within normal limits for soccer athletes. 90% of respondents in the intervention group experienced vitamin D deficiency, and 100% in the control group. Vitamin D supplementation significantly affects the improvement of blood vitamin D levels in the intervention group.

The findings regarding the prevalence of vitamin D deficiency provide a basis for further interventions, especially in designing nutritional strategies for athletic populations with limited sun exposure. Future studies are

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expected to increase vitamin D levels of athletes for more than 1 month. Furthermore, higher sample sizes are required for similar studies on other athlete populations in Indonesia to enhance the generalizability of results and provide more robust insight into vitamin D requirements across different sports disciplines.

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CONFLICT OF INTEREST AND FUNDING DISCLOSURE

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AUTHOR CONTRIBUTIONS

WK: conceptualization, methodology, formal analysis, project administration, supervision, writing-original draft; AW: conceptualization, methodology, data curation, writing-original draft, writing-review and editing; MHP: conceptualization, methodology, investigation, validation.

REFERENCES

1. Holick, M. F. The Vitamin D Deficiency Pandemic: Approaches for Diagnosis, Treatment and Prevention. *Rev Endocr Metab Disord* **18**, 153–165 (2017). https://doi.org/10.1007/s11154-017-9424-1
2. Yagüe, M. de la P., Yurrita, L. C., Cabañas, M. J. C. & Cenzual, M. A. C. Role of Vitamin D in Athletes and Their Performance: Current Concepts and New Trends. *Nutrients 2020, Vol. 12, Page 579* **12**, 579 (2020). https://doi.org/10.3390/nu12020579
3. Dönmez, G. *et al.* Vitamin D Status in Soccer Players with Skeletal Muscle Injury. *Spor Hekimliği Dergisi* **53**, 094–100 (2018). DOI: 10.5152/TJSM.2018.096
4. Penggalih, M. H. S. T., Juffrie, M., Sudargo, T. & Sofro, Z. M. Correlation between nutritional status and lifestyle for youth soccer athlete performance: A cohort study. *Pakistan Journal of Nutrition* **16**, 895–905 (2017). https://doi.org/10.3923/pjn.2017.895.905
5. Baltazar-Martins, G. *et al.* Prevalence and Patterns of Dietary supplement Use in Elite Spanish Athletes. *J Int Soc Sports Nutr* **16**, (2019). https://doi.org/10.1186/s12970-019-0296-5
6. Wyon, M. A., Koutedakis, Y., Wolman, R., Nevill, A. M. & Allen, N. The Influence of Winter Vitamin D Supplementation on Muscle Function and Injury Occurrence in Elite Ballet Dancers: A controlled Study. *J Sci Med Sport* **17**, 8–12 (2014). https://doi.org/10.1016/j.jsams.2013.03.007
7. Chul Jung, H., Seo, M.-W., Lee, S., Woo Kim, S. & Kook Song, J. Vitamin D 3 Supplementation Reduces the Symptoms of Upper Respiratory Tract Infection during Winter Training in Vitamin D-Insufficient Taekwondo Athletes: A Randomized Controlled Trial. doi:10.3390/ijerph15092003. https://doi.org/10.3390/ijerph15092003
8. Alimoradi, K. *et al.* Efficacy of Vitamin D Supplementation in Physical Performance of Iranian Elite Athletes. *Int J Prev Med* **10**, (2019). https://doi.org/10.4103/ijpvm.ijpvm_227_18
9. Beaudart, C. *et al.* The Effects of Vitamin D on Skeletal Muscle Strength, Muscle Mass, and Muscle Power: A Systematic Review and Meta-Analysis of Randomized Controlled Trials. *J Clin Endocrinol Metab* **99**, 4336–4345 (2014). 10.1210/jc.2014-1742. https://doi.org/10.1210/jc.2014-1742
10. Pearson, J. *et al.* Effect of Competition Frequency on Strength Performance of Powerlifting Athletes. *J Strength Cond Res* **34**, 1213–1219 (2020). https://doi.org/10.1519/jsc.0000000000003563
11. Yagüe, M. de la P., Yurrita, L. C., Cabañas, M. J. C. & Cenzual, M. A. C. Role of Vitamin D in Athletes and Their Performance: Current Concepts and New Trends. *Nutrients 2020, Vol. 12, Page 579* **12**, 579 (2020). https://doi.org/10.3390/nu12020579
12. Close, G. L. *et al.* The effects of vitamin D3 supplementation on serum total 25[OH]D concentration and physical performance: A randomised dose-response study. *Br J Sports Med* **47**, 692–696 (2013). https://doi.org/10.1136/bjsports-2012-091735
13. Mujika, I., Halson, S., Burke, L. M., Balagué, G. & Farrow, D. An Integrated, Multifactorial Approach to Periodization for Optimal Performance in Individual and Team Sports. *Int J Sports Physiol Perform* **13**, 538–561 (2018). https://doi.org/10.1123/ijspp.2018-0093
14. Costigan, S. A., Eather, N., Plotnikoff, R. C., Taaffe, D. R. & Lubans, D. R. High-intensity interval training for improving health-related fitness in adolescents: A systematic review and meta-analysis. *British Journal of Sports Medicine* vol. 49 1253–1261 Preprint at https://doi.org/10.1136/bjsports-2014-094490 (2015). https://doi.org/10.1136/bjsports-2014-094490
15. Maciejczyk, M., Wiecek, M., Szymura, J., Szygula, Z. & Cempla, J. Physiological response during running in athletes with similar body mass but different body composition. *Sci Sports* **30**, 204–212 (2015). https://doi.org/10.1016/j.scispo.2015.02.005
16. Harju, T., Gray, B., Mavroedi, A., Farooq, A. & Reilly, J. J. Prevalence and novel risk factors for vitamin D insufficiency in elite athletes: systematic review and meta-analysis. *Eur J Nutr* **61**, 3857–3871 (2022). https://doi.org/10.1007/s00394-022-02967-z
17. Dahlquist, D. T., Dieter, B. P. & Koehle, M. S. Plausible ergogenic effects of vitamin D on athletic performance and recovery. *J Int Soc Sports Nutr* **12**, 1–12 (2015. https://doi.org/10.1186/s12970-015-0093-8

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18. Dahlquist, D. T., Dieter, B. P. & Koehle, M. S. Plausible ergogenic effects of vitamin D on athletic performance and recovery. *J Int Soc Sports Nutr* **12**, 1–12 (2015). https://doi.org/10.1186/s12970-015-0093-8
19. Grant, W. B., Lahore, H. & Rockwell, M. S. The Benefits of Vitamin D Supplementation for Athletes: Better Performance and Reduced Risk of COVID-19. *Nutrients 2020, Vol. 12, Page 3741* **12**, 3741 (2020). https://doi.org/10.3390/nu12123741
20. Yoon, S., Kwon, O. & Kim, J. Vitamin D in athletes: focus on physical performance and musculoskeletal injuries. *Phys Act Nutr* **25**, 20–25 (2021). https://doi.org/10.20463/pan.2021.0011
21. Książek, A., Zagrodna, A. & Słowińska-Lisowska, M. Vitamin D, Skeletal Muscle Function and Athletic Performance in Athletes—A Narrative Review. *Nutrients 2019, Vol. 11, Page 1800* **11**, 1800 (2019). https://doi.org/10.3390/nu11081800
22. Mougios, V. Reference intervals for serum creatine kinase in athletes. *Br J Sports Med* **41**, 674–678 (2007). https://doi.org/10.1136/bjsm.2006.034041
23. Chen, Z. *et al.* Associations of Serum CXCL12α and CK Levels with Skeletal Muscle Mass in Older Adults. *J Clin Med* **12**, 3800 (2023). https://doi.org/10.3390/jcm12113800

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