

EXPLORING THE IMPACT OF SUN EXPOSURE, VITAMIN D, AND CARDIORESPIRATORY ENDURANCE ON ATHLETIC PERFORMANCE OF FOOTBALLERS

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Abstract

Vitamin D deficiency carries significant morbidity and is involved in many biological processes including bone metabolism and immunity. The deficiency in athletes has been reported worldwide and hence it was hypothesized that exposure to sun rays may enhance the cardiorespiratory endurance (CRE) of football athletes. local football athletes of district Dir lower, (n=24) with a mean age of 18.3 ± 3.2 years were recruited and equally allocated into experimental group (EG) and control group (CG) randomly. EG was advised to train with minimal clothes in sunlight for 90 minutes daily for 120 days while CG was advised to train indoors. Pre and post-interventional vitamin D levels and cardiorespiratory endurance were measured. The EG showed a significant enhancement in Vit D concentration (17.58 ± 2.91 vs. 43.36 ± 1.92 , $p < 0.003$) which significantly improved their endurance level (9.98 ± 2.96 vs 12.15 ± 2.67 , $p < 0.002$). CG exhibited a significant decrease in Vitamin D (20.85 ± 7.22 vs 10.86 ± 6.53 , $p < 0.036$) and endurance level (11.81 ± 1.98 vs 9.43 ± 1.55 , $p < 0.001$). In addition, a strong positive correlation between Vitamin D levels and CRE for both EG ($R^2 = 0.96$ and $P < 0.001$) and CG ($R^2 = 0.76$ and $P = 0.004$) was determined. The findings of this study suggest that training in sunlight significantly enhances the Vitamin D and endurance levels of athletes. In addition, this study suggests a strong correlation between Vitamin D and CRE.

Keywords: Sun Ray Exposure; Vitamin D; Cardiorespiratory; Endurance.

Introduction

Vitamins are complex organic compounds essential for normal growth and metabolism of the body (McDowell, 2008).

They are categorized as water-soluble (Vitamins B and C) (Olsen *et al.*, 2009) and fat-soluble (vitamins A, D, E, and K) (Varga,

2016). Vitamin D occurs in two forms: Vitamin D₂ (calciferol) and vitamin D₃-Cholecalciferol (Sanders et al., 2018) in humans and is produced in high quantities by the action of sun rays (Japelt, 2011). Sunrays (UVR) activate 7-dehydrocholesterol in the skin and convert it into pre-vitamin D₃ (pre-calciferol) which after passing through the liver and kidney is converted to active form calcitriol (1, 25(OH)₂ or D₃ (Nissen, 2015). A dietary source is another way where Vitamin D is absorbed through the small intestine, carried to the liver (Holick, 2014), and ultimately stored in adipose and muscle tissues (Feingold & Grunfeld, 2018). Vitamin D mainly adds to calcium homeostasis through parathyroid hormone (PTH) and affects kidneys, bones, and intestines (Leaf & Christov, 2019).

Sufficient levels of vitamin D are beneficial for sports performance and levels above 50ng/ml are considered adequate. Vitamin D deficiency is connected with low neuromuscular performance (Heaney, 2008). Research has enormously pointed out low levels of Vitamin D in national and international level athletes (Cannell, et al., 2009), (Willis, et al., 2008), (Shindle, et al., 2011), (Hamilton. et al., 2010). The reasons for low Vitamin D include indoor practice,

high altitudes, black skin, avoiding sun rays, and use of sunscreens (Cannell, et al., 2009).

Research considers sunlight as a better source than supplementation (Shuler, et al., 2012) and encourages maximum skin surface exposure for longer duration in proper UV index for longer durations for larger health benefits (Bartoszewska. et al., 2010).

In this regard, this study was conducted with the objectives of determining base levels of vitamin D and cardiorespiratory endurance in local football players, followed by exposure to sun rays for longer duration (90 minutes daily for 04 months) and later on evaluation again for the same parameters to look for any correlation.

Materials & Methods

Ethical approval for this experimental and quantitative study was granted by the Ethical Review Board of SUIT (Sarhad University of Science and Information Technology) Peshawar. A total of 24 football players with an age range (of 15 to 24 years) were randomly selected after informed written consent from 2 local football clubs and allocated into an experimental group (EG, n=12) treated with sunrays for 4 months (90 minutes daily) and control group (CG, n=12) with no sunrays exposure (using gloves & umbrellas). Participants in both

groups were asked to refrain from vitamin D supplementation and smoking or drug abuse during the experimental period. Rainy and cloudy days during this period were excluded and athletes were advised to sit in the sun using minimal clothing (shorts and vests) during the exercise time. The control group conducted their routine practice indoors or after sunsets.

Age was calculated as per school records. Pre and post-test measurements of vitamin D were conducted in the most reputed private lab in the country, while for Cardio-Respiratory Endurance the athlete's aerobic capacity was determined through the PACER Test (Progressive Aerobic Cardiovascular Endurance Run), interchangeably known as Beep Test. It involves running forth and back between two lines (20 meters apart) where the athlete is supposed to reach the line before the beep. The speed of the participant increases with each lap as the duration between the beeps decreases. The test is terminated if an athlete fails to reach before the beep twice and the number of laps signifies cardiorespiratory fitness (Mayorga-Vega et al., 2015), (Leger & Lambert, 1982).

The data was analyzed using SPSS (Statistical Package for Social Sciences) version 20.0. A paired sample t-test was used for the change in vitamin D levels among the group at pre- and post-intervals and an independent sample t-test was used to compare the mean difference between EG and CG.

Results

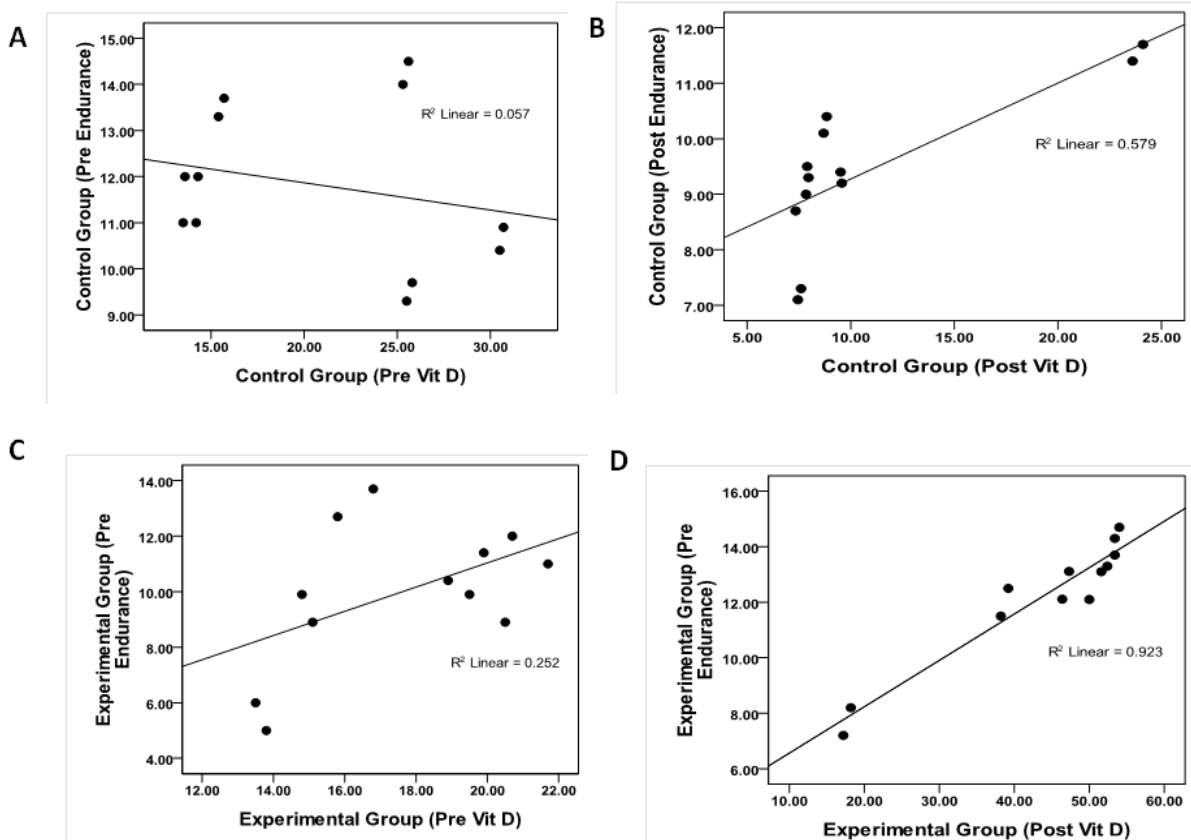
The analysis for the parameters among the group and between the groups are outlined in Table 1, which points towards the fact that the experimental group exhibited a significant increase in Vitamin D levels (P value = 0.003) as well as cardiorespiratory endurance (P value = 0.002) while the control group reported a significant decline in both (P value = 0.036 for Vit D and <0.001 for endurance level) [Table 1].

Further statistics were carried out by looking for a correlation between Vitamin D levels and cardiorespiratory endurance and a strong correlation between the two was found in the experimental group both at the pre-interventional stage ($R^2 = .50$ and $P = 0.047$) and post-interventional stage ($R^2 = .96$ and $P < 0.001$) and in the control group at post-Interventional stage ($R^2 = .76$ and $P = 0.004$) as given in figure 1.

Table 1. Sunrays effect on variables of vitamin D level and Endurance level

Group-wise statistics as determined with independent sample T-test					
Variables		Experimental group (EG)	Control Group (CG)	Mean Difference	P value
Vit D (ng/ml)	Pre	17.58 ± 2.91	20.85 ± 7.22	3.27	0.062
	post	43.36 ± 13.92	10.86 ± 6.53	32.5	<0.001
Endurance Level	Pre	9.98 ± 2.96	11.81 ± 1.98	1.83	0.43
	Post	12.15 ± 2.67	9.43 ± 1.55	2.72	<0.01
Pre and Post interventional statistics as determined through paired sample test					
Group	Variables	Pre-test	Post-test	Mean difference	Values
Experimental group (EG)	Vit D (ng/ml)	17.58 ± 2.91	43.36 ± 13.92	+25.78 ± 11.7	0.003
	Endurance Level	9.98 ± 2.96	12.15 ± 2.67	+2.16	0.002
Control Group (CG)	Vit D (ng/ml)	20.85 ± 7.22	12.15 ± 2.67	-9.98	0.036
	Endurance Level	11.81 ± 1.98	10.86 ± 6.53	-2.38	< 0.001

Figure 1. Correlation of Vitamin D and Endurance levels as determined by Pearson correlation statistics (A) CG at the Pre-interventional stage (B) CG at the interventional stage (C) EG at the Pre-interventional stage and (D) EG at the post-interventional stage



Discussion

The current study aimed to evaluate vitamin D levels and their correlation with cardiorespiratory fitness in football players. Vitamin D insufficiency has been associated with the causation of different diseases such as osteomalacia, rickets, and osteoporosis. It also leads to numerous health conditions such as low bone density, cancer, cardiovascular diseases (CVD), and respiratory infections.

Our study showed baseline vitamin D deficiency (Mean \pm SD 19.215 ng/ml \pm 5.06) both in the control and experimental groups. Athletes are considered active entities in the community and hence this finding is alarming and points towards a huge burden of Vitamin D deficiency in the local population. The findings of the current study are in line with the findings by Shuler et al., 2012, who reported vitamin D insufficiency in 73% of indoor athletic female gymnasts' runners. In addition, they attributed the cold climate as one of the reasons for less sunshine and Vitamin D synthesis. Participants for this study belong to district Dir which has a cold climate and an altitude of 1420 M above sea level. Low basal levels of Vitamin D can be attributed to decreased availability of sun exposure in this part of the country. Vitamin D deficiency is quite common in athletes and impacts the cardio-respiratory fitness of

athletes. Stress fractures, chronic musculoskeletal pain, respiratory tract infections, and several chronic diseases are common due to vitamin D insufficiency (Cannel JJ 2008). Those caring for athletes have a responsibility to promptly diagnose and adequately treat vitamin D deficiency.

It was interesting that athletes with low vitamin D reported less cardiorespiratory endurance. European researchers have highlighted that sunlight enhances sports efficiencies like strength, time trial development, and cardiovascular fitness (Ogan & Pritchett, 2013). Another study suggests that with constant physical conditions, the association between physical performance and the summer season is significant (Bischoff-Ferrari 2004). Similar significant positive associations ($p < 0.01$) were reported between cardiorespiratory fitness measured through maximal oxygen consumption (VO₂ max) and Vitamin D effects (Forney, 2012).

Vitamin D insufficiency affects the bone density of an athlete and the greatest bone density is observed with 25(OH)D concentrations nearing 100 nmol/L (Bischoff-Ferrari et al., 2006). Stress fractures are common in athletes and are serious obstacles to training. Among other factors, increased risk for fractures is

reported to be significantly associated with reduced serum 25(OH)D levels (Ruohola et al., 2006).

Organized exposure to proper sun rays not only enhanced vitamin D levels in athletes but also significantly increased cardiorespiratory endurance as well. Interestingly, a decline in both parameters was observed for the control group. E. L. Carson, 2015 suggests that vitamin D status affects muscle strength and cardiorespiratory fitness in young boys. Their study reported that boys with Vit D levels higher than 51nm/mol had a higher muscle strength ($\beta= 3.90$; $p<0.001$). These findings support our study and hence it can be suggested that adequate serum 25(OH)D levels are beneficial for optimal skeletal and muscular health in later life.

The current study investigated the association between sunrays and vitamin D. The study determines that sunrays have positive effects on vitamin D levels in the Exp group athletes (17.58 ± 2.91 vs 43.36 ± 13.92 , $P= 0.003$). It is concluded that except for sunlight, the human body is not capable of synthesizing vitamin D levels from diets or supplementation. The Control group athletes were only advised to use gloves and umbrellas to avoid sunrays which significantly declined their vitamin D level

(20.85 ± 7.22 vs 10.86 ± 6.53 , $P=0.036$). Therefore, it is arguable that being the major contributor to vitamin D synthesis, outdoor components for sufficient time in the training of the athlete are a must irrespective of the nature of the game (outdoor vs. indoor).

This research augments the previous findings of enhancements in the concentration of vitamins as a result of mere extended exposure to sun rays. In addition, this research also points towards a strong correlation between enhanced cardiorespiratory fitness and endogenous vitamin D concentration. Moreover, a proper training protocol with significant exposure to sunrays is recommended for all types of athletes.

Conclusions

This study was conducted to determine the sun rays' effects on the Cardio-Respiratory Endurance (CRE) of football athletes. The results show that lower Dir football athletes have chronic vitamin D deficiency. We have concluded that athletes engage in outdoor games for 90 minutes in the afternoon to eliminate Vit D deficiency. This research indicated that the experiment group synthesized enough Vit D level and had positive effects on CRE while its level was reduced in the control group. The

exception of sunrays causes low Vit D and CRE levels in the Control group.

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