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THE EFFECTS OF A VITAMIN D
RANDOMISED CONTROLLED TRIAL ON
MUSCLE STRENGTH AND POWER IN
FEMALE ADOLESCENT ATHLETES

A Thesis presented in partial fulfillment of the requirements for the degree of

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Human Nutrition

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Abstract

Background:

Vitamin D deficiency is widespread in the general public and emerging evidence has revealed it is common in athletic populations, particularly those who train indoors. Recent studies suggest that vitamin D deficiency is correlated with impaired skeletal muscle function; however there is limited evidence from randomised controlled trials that vitamin D supplementation can improve muscle strength and power in trained athletes.

Objective:

To investigate the effects of vitamin D₃ supplementation on serum 25(OH)D concentrations and muscle strength and power in female adolescent athletes training predominantly indoors.

Methods:

Female adolescent dancers, gymnasts, and swimmers ($n = 61$) who trained regularly for at least five hours per week participated in this randomised double blind placebo controlled trial. Participants were stratified to receive 50,000 IU vitamin D₃ or placebo every month for six months. Serum 25(OH)D concentrations, muscle strength (handgrip and isokinetic knee extensor and flexor torque), power (vertical jump), and anthropometric measurements were assessed at baseline and endpoint ($n = 54$).

Results:

At baseline, the median 25(OH)D concentration was 77.5 [63.5,92] nmol/L for the vitamin D group and 74 [64.5,88.5] nmol/L for the placebo group. Following six

months of supplementation, serum 25(OH)D concentrations increased significantly in the vitamin D group (16.5 [7,46] nmol/L) ($P = 0.001$), but not the placebo group (-6.25 [-21,44] nmol/L). Peak torque (Nm) of the knee extensors in concentric and eccentric extension increased significantly for both groups ($P < 0.05$), and there was no significant difference in change in peak torque between groups. After controlling for change in 25(OH)D and baseline 25(OH)D separately, supplementation with vitamin D was not associated with any of the strength or power variables.

Conclusions:

Supplementation of 50,000 IU of vitamin D₃ per month improved vitamin D status but did not improve the chosen measures of muscle strength and power in this group of female adolescent athletes. This may be due in part to the small sample size and high baseline serum 25(OH)D concentrations seen in this cohort.

Keywords: skeletal muscle strength, skeletal muscle power, athletes, dancers, gymnasts, vitamin D, 25(OH)D

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List of Abbreviations

1,25(OH) ₂ D	1,25- hydroxyvitamin D
24-OHase	25-hydroxyvitamin D-24-hydroxylase
25(OH)D	25-Hydroxyvitamin D
7-DHC	7-Dehydrocholesterol
AI	Adequate intake
BMD	Bone Mineral Density
BMI	Body Mass Index
Ca ²⁺	Calcium ion
CDPKII	Calmodulin-dependent protein kinase II
CYP27B1	25-hydroxyvitamin D-1 α -hydroxylase
DXA	Dual-energy X-ray absorptiometry
ES	Endocrine Society
IBP	Intracellular binding protein
IGF1	Insulin-like growth factor-1
IGFBP-3	Insulin-like growth factor binding protein-3
IOM	Institute of Medicine

IU	International Units
MED	Minimal Erythematol Dose
MOH	Ministry of Health
nm	nanometer
Nm	Newton metre
nmol/L	nanomoles per liter
ng/ml	nanograms per milliliter
PI3-K	Phosphoinositide 3-kinase
PLA	Placebo (group)
PLC	Phospholipase C
PKA	protein kinase A
PKC	protein kinase C
PTH	Parathyroid Hormone
RXR	Retinoid X receptor
RCT	Randomised controlled trial
SR	Sarcoplasmic reticulum
UV	Ultraviolet
UVB	Ultraviolet B

VD	Vitamin D (group)
VDKO	Vitamin D receptor knockout (mouse)
VDBP	Vitamin D binding protein
VDR	Vitamin D Receptor
VDRE	Vitamin D response element
VO _{2max}	Maximal oxygen consumption