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Effects of a Liquid or Capsule Multivitamin on Vitamin D Status in Active Males and Females

Research Brief

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Abstract

Introduction: The purpose of this study was to compare the effects of liquid and capsule multivitamins on 25(OH) vitamin D status following 10-weeks of supplementation.

Methods: Thirty-four recreationally active men (n=14; 21.7±2.9y; 77.5±10.6 kg;) and women (n=20; 23.2±4.7y; 71.1±14.5kg) participated in this randomized, double-blind, placebo- controlled study. Before and after a 10-week intervention, participants provided a fasted blood sample and were randomly assigned to a liquid multivitamin supplement (LIQ; n=11), multivitamin capsule (CAP; n=11), or placebo group (CON; n=12). Participants took their respective supplement daily for 10 weeks with the LIQ and CAP supplement both containing 268 IU of vitamin D. Plasma samples were assayed for 25(OH) vitamin D concentrations. Data were analyzed using a two-way repeated measures analysis of variance (ANOVA).

Results: A main effect for time (p=0.002) was seen with 25(OH) vitamin D concentrations significantly lower (Δ: -7.8±14.9ng/mL) at post-testing with groups collapsed. Further, there were no significant differences between treatments (p=0.820) in 25(OH) concentrations suggestion no effect of LIQ or CAP compared with CON.

Conclusion: It appears that a chronic low dose of vitamin D in liquid or capsule form is insufficient to maintain or elevate 25(OH)D concentrations in active young adults.

Key Words: Multivitamin, Vitamin D, Micronutrient

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Introduction

Due to a wealth of recent data, vitamin D intake has become especially important for physically active adults as poor vitamin D status has been shown to impair bone health, mental function, mood, and physical performance [1]. Therefore, it is not surprising to find that 40% of US adults report previous vitamin D supplementation either exclusively or as a part of a multivitamin [2]. While convenient, there are wide discrepancies in the quantity of vitamin D contained in multivitamin products with dosages often falling below recommended values [3]. Anecdotally, consumers and manufacturers attest that chronic consumption of micronutrients may offset lower dosages due to a cumulative effect. However, there is a lack of data to support this belief.

In recent years, dietary supplement manufacturers have developed various formulations of vitamin products (e.g. liquid, powder, topical cream) with the aim of either improving micronutrient absorption or increasing daily compliance [4-6]. However, few studies have assessed the efficacy of these new products and compared new vitamin applications to a traditional capsule or tablet. Thus, the purpose of the present study was to determine if a lower dose of vitamin D obtained through either a liquid or a capsule multivitamin maintains or improves 25(OH) vitamin D status in active adults. Additionally, we sought to

compare the efficacy of the liquid multivitamin to determine if it produced any differential effects of 25(OH) vitamin D status compared to a capsule formulation.

Methods

Participants

Thirty-four recreationally active men (n=14; 21.7 ± 2.9y; 174.2 ± 4.7cm; 77.5 ± 10.6 kg; BMI: 25.5 ± 3.3) and women (n=20; 23.2 ± 4.7y; 161.9 ± 5.9cm; 71.1 ± 14.5kg; BMI: 27.1 ± 5.5) participated in this double-blind, randomized, placebo-controlled investigation. The research protocol was approved by the Institutional Review Board of the university prior to participant enrollment and each participant provided their written informed consent prior to participation in this study. Participants were excluded from the study if they were currently taking a multivitamin or had habitually consumed a multivitamin in the past 3 months, were taking other nutritional supplements, suffered from a chronic illness, or were engaged in a restrictive diet.

Protocol

Participants reported to the lab fasted before and after a 10-week intervention and provided a blood sample for analysis of 25(OH) vitamin D status. Following their first visit to the laboratory, participants were randomized to one of three groups: liquid multivitamin (LIQ; n=11), multivitamin capsule (CAP; n=11), or placebo control (CON; n=12). The study was conducted in the fall months (e.g. September-November).

Blood Measurements

All blood samples before and after the 10-week intervention were obtained from an antecubital arm vein into tube treated with K_2EDTA, centrifuged at 3,000×g for 15min, and the resulting plasma was frozen at −80°C for later analysis. Circulating concentrations 25(OH) vitamin D were assessed using a commercial assay kit (Abcam, Cambridge, MA). Each sample was analyzed for 25(OH) vitamin D in duplicate with an average coefficient of variation of 3.7%.

Supplementation Protocol & Dietary Analysis

The liquid multivitamin was a commercially available dietary supplement (CoffeBooster®, CoffeBooster Inc, Ontario, CA) and the capsule multivitamin was custom ordered (JW Nutritional LLC, TX, USA) to match the micronutrient content of the liquid multivitamin suspension (Table 1). All participants were provided with capsules and a liquid product, which were identical in taste and appearance, and participants consumed both daily for 10-weeks to maintain a double blind-design. Thus, all participants were required to consume both 2 teaspoons of their respective liquid supplement (LIQ=Coffee Booster product; CAP & CON=Placebo Liquid) and one pill of their assigned capsule supplement (CAP=active capsule multivitamin; LIQ & CON=placebo capsule). Participants reported to the lab once per week to obtain their supplement for the subsequent week and they returned their empty containers upon their next visit to the lab to ensure compliance. Three-day food logs were completed at weeks 1, 5, and 10 to quantify and analyze (Cronometer, Edmonton, Alberta) macronutrient and vitamin D intake by a registered dietician.

Table 1. Micronutrient Content of Liquid and Capsule Multivitamins

INGREDIENT	MULTIVITAMIN LIQUID (2 TEASPOONS)	MULTIVITAMIN CAPSULE (1 CAPSULE)
Vitamin A	65 mcg (118 IU)	65 mcg (118 IU)
Vitamin C	50 mg	50 mg
Vitamin D3	6.7 mcg (268 IU)	6.7 mcg (268 (IU)
Vitamin E	7 mg (8 IU)	7 mg (8 IU)
Vitamin B1	10 mg	10 mg
Vitamin B3	5 mg	5 mg
Vitamin B12	1 mcg	1 mcg
Vitamin B6	5 mg	5 mg

Vitamin B5	10 mg	10 mg
Folate	86 mcg	86 mcg
Biotin	48 mcg	48 mcg

Statistical Analysis

Statistical evaluation of 25(OH) vitamin D status was accomplished using a 2-way (group x time) repeated measure analysis of variance (ANOVA). Significant main effects were further analyzed using pairwise comparisons with a Bonferroni adjustment. All analyses were performed using SPSS version 24.0 (SPSS, Inc., Chicago, IL) and significance was accepted at an alpha level of $p \leq 0.05$.

Results

No baseline differences ($p>0.05$) were found between groups for any anthropometric variable and no differences were found between groups for supplement compliance ($p=0.143$) (Table 2). Additionally, there was no difference in caloric or macronutrient (all $p>0.05$), or vitamin D ($p=0.477$) intake between groups. There was a main effect for time ($p=0.002$) with 25(OH) vitamin D concentrations significantly lower (Δ: -7.8±14.9 ng/mL) at post-testing with groups collapsed. Further, there were no significant differences between treatments ($p=0.820$) in 25(OH) concentrations suggesting no benefit of LIQ or CAP supplementation over PL.

Table 2. Anthropometric, Micronutrient, and Compliance Values for All Three Supplemental Groups

	LIQUID MULTIVITAMIN (N = 11)	**CAPSULE MULTIVITAMIN (N = 11)**	**PLACEBO (N =12)**
AGE (YRS)	24.1 ± 4.7	22.0 ± 4.1	21.4 ± 3.5
HEIGHT (CM)	166.1 ± 9.0	165.2 ± 7.9	169.3 ± 7.5
WEIGHT (KG)	71.2 ± 12.3	76.8 ± 14.5	70.6 ± 12.2
BMI	25.8 ± 4.1	28.1 ± 5.1	24.7 ± 4.6
VITAMIN D INTAKE (IU)	152.1 ± 85.2	119.1 ± 74.6	150.8 ± 53.4
SUPPLEMENT COMPLIANCE (%)	99.1 ± 1.2	98.6 ± 2.3	96.1 ± 5.9

Data Presented as mean ± SD

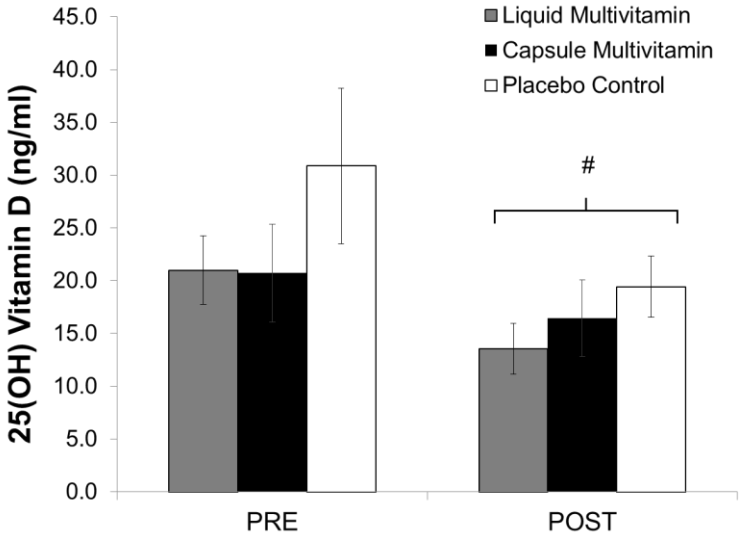

Figure 1. 25(OH) Vitamin D concentrations before and after a 10-week supplemental intervention in active males and females. PRE = baseline measurement. POST = Following 10-weeks of

supplementation. # main effect for time indicating significantly lower concentrations compared to PRE. Data presented as mean ± SD

Discussion

The main finding of this study was that low-dose of vitamin D did not prevent a decline in 25(OH) concentrations following a 10-week multivitamin intervention in the fall months with no differences observed between any of the three supplemental treatments. In partial support of our data, supplementation of 400IU •day^{-1} for 12 weeks did not significantly improve vitamin D status of male and female athletes [7]. However, when supplementation extended to 9 months, a lower dose of vitamin D (400IU) improved serum 25(OH) concentrations in highly-trained athletes with insufficient or deficient vitamin D status [7]. Furthermore, six weeks of vitamin D (600IU) supplementation via a Portobello mushroom power supplement produced a small but significant increase in total 25(OH) concentrations in vitamin D insufficient high school athletes [8]. Thus, low doses of vitamin D may provide a small benefit for athletes with impaired vitamin D status. Nevertheless, a recent meta-analysis suggests that during the winter months, vitamin D supplementation of ≥3000IU•day^{-1} is sufficient to maintain or improve vitamin D status in athletes while lower doses of 2,000IU•day^{-1} are adequate in the spring and summer months [9]. In the present study, it is likely that a much higher dose would have been needed to observe an effect of vitamin D supplementation in the fall months due to the change in sunlight.

Conclusion

In this study, neither a liquid nor a capsule multivitamin were sufficient to prevent a decline in 25(OH) vitamin D status in active adults. These data appear to dispel the idea that chronic low dose vitamin D supplementation (<400IU•day^{-1}) via multivitamin consumption produces noticeable changes in 25(OH) vitamin D status in active young adults.

Media-Friendly Summary

Low doses of vitamin D contained in some commercially-available multivitamins are likely ineffective at maintaining or enhancing 25(OH) vitamin D levels in active young adults. Consumers should pay attention to the quantity of various micronutrients contained in their multivitamins to ensure they consume recommended doses.

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