Weight Loss Induced by Low-Carbohydrate or High-Carbohydrate Diets Does Not Improve Serum 25(OH)D Concentrations

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This study was funded in part by the OHSU Graduate Programs In Human Nutrition and with grants from the National Center for Complimentary and Alternative Medicine (R01 AT001930-01A1) and the National Center for Research Resources (1UL1RR024140).

INTRODUCTION

Vitamin D deficiency is more prevalent in overweight and obese individuals than in normal weight individuals. Reasons for this difference are not well understood but are attributed to reduced sun exposure, and therefore reduced endogenous synthesis of vitamin D, lower intake of dietary vitamin D, and greater sequestration of vitamin D in adipose tissue of individuals who are overweight or obese compared to their normal weight peers.

OBJECTIVE

To determine how serum 25-hydroxy-vitamin D [25(OH)D_{2+3}] concentrations change with weight loss in overweight and obese individuals consuming low-carbohydrate or high-carbohydrate diets.

HYPOTHESES

1. Serum 25(OH)D_{2+3} concentration will be higher after loss of weight and fat mass, than before.
2. Changes in serum 25(OH)D_{2+3} concentrations will be similar between diet groups.
3. Serum 25(OH)D_{2+3} concentration will be inversely related to total body fat mass.

STUDY DESIGN & METHODS

A 6-month, randomized, parallel study design was used to assess the impact of low- and high-carbohydrate weight loss diets on 25(OH)D_{2+3} concentrations in healthy, overweight or obese adults living near Portland, OR.

- Baseline measurements were obtained between July and November; 6-month measurements were obtained between February and May.
- Weight was measured to the nearest 0.01 kg with a digital scale.
- Body composition was measured by dual energy X-ray absorptiometry (DXA).
- Dietary intake was assessed by two, unannounced 24-hour recalls.
- Serum 25(OH)D_2 and D_3 concentrations were measured by liquid-chromatography tandem mass spectrometry in the OHSU Bioanalytical Shared Resource/ Pharmacokinetics Core Lab.
- Multiple linear regression models were used to examine the association between changes in serum 25(OH)D_{2+3} concentration and changes in weight and body composition.

Table 1: Baseline Characteristics

Characteristic	Low-Carbohydrate (n=59)	High-Carbohydrate (n=60)
Age (yr)	51 ± 11	53 ± 11
Weight (kg)	100 ± 16	102 ± 18
BMI (kg/m^2)	34 ± 5	36 ± 6
Gender (% Female)	78%	75%
Race (% White)	95%	82%

Table 2: Classification of Vitamin D Status Before and After the 6-month Low- and High-Carbohydrate Dietary Interventions

Serum 25(OH)D_{2+3} Concentration	Classification	Low-Carbohydrate (n=59)		High-Carbohydrate (n=60)	
		Baseline	6 Month	Baseline	6 Month
< 10 ng/ml	Severe Deficiency	5%	10%	3%	8.5%
< 20 ng/ml	Deficient	37%	45%	29%	36%
20-29 ng/ml	Insufficient	43%	33%	65%	52.5%
30-50 ng/ml	Sufficient	15%	12%	3%	3%
51-149 ng/ml	Optimal	0	0	0	0

Figure 1: Distribution of Serum 25(OH)D_{2+3} Concentrations Before and After the 6-month Low- and High-Carbohydrate Dietary Interventions

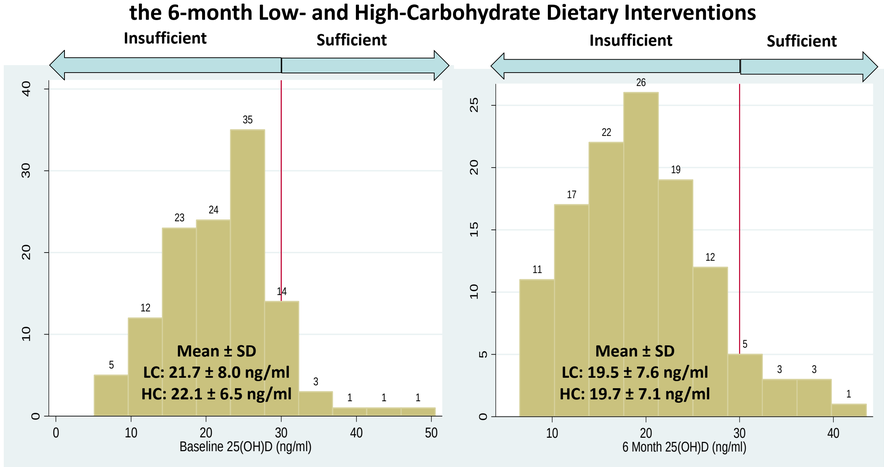

Figure 2: Dietary Vitamin D Intake Before and After the 6-month Low- and High-Carbohydrate Dietary Intervention

Arrows Indicate Recommended Dietary Intake of Vitamin D: 10 mcg/d (400 IU/d)

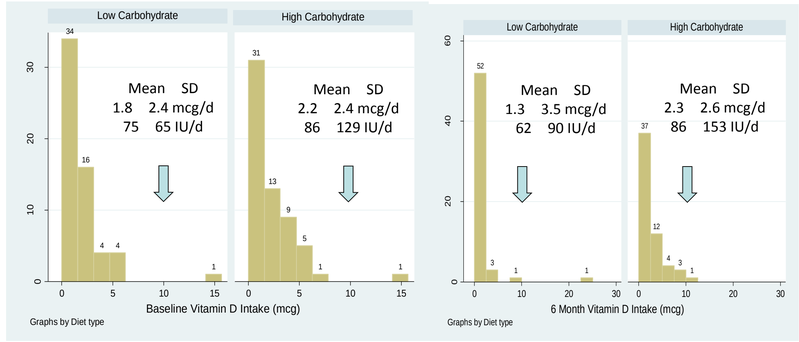

Table 3: Weight, Body Composition & BMI Before and After the 6-month Low- and High-Carbohydrate Dietary Interventions

Variable	Low-Carbohydrate (n=59)			High-Carbohydrate (n=60)		
Time point	Baseline	6 months	Change	Baseline	6 months	change
Weight (kg)	100 ± 16	89 ± 16	-12 ± 6*	102 ± 18	96 ± 17	-6 ± 6
Lean Mass (kg)	59 ± 11	57 ± 11	-3 ± 2	60 ± 8	57 ± 8	-3 ± 2
Fat Mass (kg)	39 ± 9	32.5 ± 10	-6 ± 5	44 ± 12	38 ± 12	-6 ± 5
% Body Fat	41 ± 7	38 ± 8	-3 ± 3	40 ± 6	37 ± 7	-3 ± 3
BMI (kg/m^2)	35 ± 5	32 ± 5	-3 ± 2	37 ± 6	34 ± 6	-3 ± 2

Mean SD; * Significantly different from High Carbohydrate Diet Group (p<0.05)

SUMMARY & CONCLUSIONS

- 92% of participants were vitamin D insufficient or deficient both before and after weight loss.
- Mean serum 25(OH)D_{2+3} concentrations were similar before and after the low- and high-carbohydrate diets despite significant loss of weight and fat mass.
- 98% of participants consumed less than 10 mcg/d of vitamin D and the type of weight loss diet followed did not impact vitamin D status.
- Serum 25(OH)D_{2+3} was not correlated with fat mass (p=0.1).
- Vitamin D supplementation is strongly recommended for overweight and obese individuals living in the Pacific Northwest.
- Additional research is needed to confirm these results and to better understand the mechanisms that contribute to vitamin D deficiency in overweight and obese individuals.

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