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Research Article

The effect of vitamin D supplementation on body composition parameters in patients with non-alcoholic fatty liver disease (NAFLD)

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Abstract

Background: In several studies, nonalcoholic fatty liver disease associated with obesity. In recent years, in clinical trials demonstrated that vitamin D supplementation may be reduced weight. So, in this study, effect of Vitamin D supplementation was surveyed on body composition parameters in patients with NAFLD.

Methods: This randomized controlled clinical trial was conducted on 60 patients with fatty liver. Patients received capsules containing 50,000 IU vitamin D and placebo capsules weekly.

Results: After 10 weeks supplementation vitamin D, (Weight, body mass index, percent body fat (PBF), lean body mass (LBM), soft lean mass (SLM), mean body fat (MBF), waist circumference (W.C) and waist hip ratio (W.H.R)) in patients in intervention group decreased none significantly in compared with patients in placebo group. But total body water (TBW) in patients in intervention group increased significantly in compared with patients in placebo group. Data were analyzed using SPSS software.

Conclusion: TBW in patients in intervention group increased significantly in compared with patients in placebo group. However, vitamin D supplementation had not significant effect on other variables.

Keywords: vitamin D; body composition; non-alcoholic fatty liver disease

Introduction

Several evidences have showed that obesity is a predisposing agent for progress fatty liver [1-3]. Exert of the phrase obesity is too wide. General obesity is obviously in relationship with fatty liver, body fat mass play a key role in fatty liver. In special, abdominal obesity may have an important role in this disorder, through both powerful relationships with insulin resistance and probably as a producer of free fatty acids [4]. So, abdominal obesity has been directly associated with fatty liver [5-6] and insulin resistance in adults [7]. So, in abdominal obesity, particularly reposition of visceral fat is a more serious predisposing agent for metabolic syndrome than skin-fold fat mass that can encompass steatosis and the manufacture of several cytokines [8-9]. Several studies have demonstrated that serum triglycerides level and free fatty acid from adipose tissue in splanchnic fat take part in the progress of metabolic syndrome and fatty liver [10-11].

Vitamin D is determined as major regulate of phosphorous and calcium balance. Several studies demonstrated that vitamin D is associated with visceral fat [12-14]. Negative association has been presented between visceral body fat mass and circulating 25 (OH) D levels [13]. Reduced level vitamin D was relationship with elevated body mass index and fat percent, in both genders [14]. However, other studies showed that effect of vitamin D on BMI and central obesity is not clear. One of the outcomes of a reduced vitamin D concentration is increasing PTH [15], and individuals

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with central obesity have elevated PTH concentration [16]. In derivative cell fat, it has been showed that PTH augment cyclonic calcium concentration [17] that can prevent the lipolysis and it can lead to progress of fatty acid synthase [18]. This can resulted in reposition of fat and it has been assumed that PTH and vitamin D can be important in progress of fatness [19].

So, the aim of this study was investigated effect vitamin D supplementation on body composition in patients with non-alcoholic fatty liver disease (NAFLD).

Methods

A randomized placebo-controlled clinical trial was conducted on 60 patients with non-alcoholic fatty liver. This study was conducted in Metabolic Liver Disease Research Center in Isfahan University of Medical Sciences. Study was performed with the approval of Isfahan University of Medical Sciences Local Ethics Committee (code 391214). The consent was obtained from participants. Participant's non-alcoholic fatty liver disease was confirmed by ultrasound test. Exclusion criteria in our study were defined acute illness, hepatitis C, B, Wilson diseases, history of chronic liver disease, or disease that affects the gallbladder and bile ducts, lack of pregnancy or history of taking any drugs affecting levels of Alanin amino transferase (ALT) (valproic acid, tamoxifen, HMG-COA reductase inhibitors, metformin, ACE 1 and ACER 1). Also, they do not follow any diet.

Participants were randomly assigned to one of the two groups: a) 30 patients in vitamin D group (50,000 IU capsules vitamin D b) 30 patients in placebo group. The placebo capsules were in the same color, odor and taste. The intervention period followed for 10 weeks and patients receive vitamin D supplements or placebo every week. To evaluate the acceptability of vitamin D supplementation, serum 25-hydroxy vitamin D level was measured at the beginning and end of the study. Dietary records were collected every two weeks and intakes were determined based on estimated values in household measurements. To obtain nutrient intakes of participants on the basis of these 5-d food diaries, NUTRITIONIST IV Software (Version 7.0; N-squared Computing, Salam, OR, USA) this was modified for Iranian food items. 5-days physical activity records were taken of patients (one per two week). Physical activity level was estimated as metabolic equivalent minutes per week (MET-min/wk). In order to calculate MET-min/wk, we calculate the MET-min/wk for each exercise (Days per week × Minutes of exercise each time × MET equivalent of exercise) and summed all MET-min/wk values to estimate total MET-min/wk for each person.

Anthropometric measurements

Height and body weight were measured while the subjects were in standing position at baseline and 10th weeks. Waist circumference was measured by a tape around the mid-distance between the last rib margin and the iliac crest. Hip circumference was measured at the level of the largest circumference around the hip. BMI was measured by formula (weight (kg)/height2 (meter)). Body composition parameters were measured by the bio impedance analyzer machine (In Body 3.0 body composition analyzer; Bio space, Seoul, Korea).

Biochemical measurements

Fasting blood samples were taken at the beginning and end of the study. 25-hydroxy vitamin D was assessed by direct competitive immune assay kit (Diasercine Italian Company) at beginning and the end of study. Serum calcium was measured by UV test method.

Degree of fat accumulation in liver

Level of liver esteatosis was assessed by using ultrasonography with Esaote Medical ultrasound machine (convex 3.5 MHz) at beginning and the end of the study. Hepatic ultrasonography was conducted by someone who is unaware of the objectives of the study.. Patients for ultrasound should be fasting for 8 hours. Ultrasonography is performed in supine position. Right and left lobes of the upper and lower surface are studied. Echogenicity the liver, the presence or absence of bulky tumors cystic or solid and calcification was assessed. Intrahepatic bile ducts, portal vein and hepatic artery were evaluated. Liver esteatosis is scored semi-quantitatively: 0: absent, 1: mildgrade, 2: moderate grade and 3: severe grade.

Statistical analysis

Normality of studied variables was evaluated using Kolmogorov–Smirnovtest or P P plot. For nonnormal variables, log transformation was used. Independent samples student's t test was used to detect differences in general characteristics and dietary intakes between two groups. In this analysis, Vitamin D and placebo treatment was regarded as between subject's factor. Further analyses were conducted to investigate between group comparisons by using analysis of covariance. Paired t test used to assess the within group comparison of quantitative variables. $P < 0.05$ was considered to be significant level. All statistical analyses conducted using Statistical Package for the Social Sciences (SPSS), version 16 (SPSS Inc., Chicago, USA).

Results

In this study 29 men and 31 women participated. Mean age of participants was 48.5 year.. Compliance with the treatments was good in both groups and no side effects were presented. On the basis of 5-days dietary intake and physical activity records, no significant differences were seen between 2 groups (Table 1).

When the analyses were adjusted for baseline values Cholecalciferol supplementation result in increase of serum 25 (OH) D concentrations compared with placebo (+68±12 compared with -1.9±2.44ng/mL; P: 0.001; Table 2).After 10 weeks supplementation vitamin D, (Weight, BMI, PBF, LBM, SLM, MBF, W.C and W.H.R) in patients in intervention group

Table 1: Dietary intakes and physical activity of NAFLD of intervention and control group1

[1]All values are means (SD).

[2]Obtained from independent-samples t test.

	Intervention group(n=30)	control group (n=30)	P value[2]
	Mean(SD)	Mean(SD)	
Energy(kcal/d)	2217.2(461)	2045.1(461)	0.76
Carbohydrate (% Cal/day)	61	58	0.52
Protein (% Cal/day)	12	12	0.91
Fat (% Cal/day)	27	30	0.65
Cholesterol (mg/day)	225(57)	236(111)	0.44
Dietary fiber (g/day)	19(7)	24(5)	0.34
Vitamin D (mg/day)	3(.4)	4(.3)	0.18
Physical activity score (MET-hour/week)	32.3(1.44)	33.2(1.22)	0.54

decreased none significantly in compared with patients in placebo group. But TBW in patients in intervention group increased significantly in compared with patients in placebo group (TBW (kg)1.03±3 in compared with -3.8±1, P value:.001) (Table 2).

Discussion

This study was the first clinical trial that was investigated the effect of vitamin D supplementation on body composition parameters in patients with nonalcoholic fatty liver. In this study, vitamin D supplementation led to increase significantly total body water in intervention group in compared with placebo group. Weight, BMI, PBF and LBM in patients in intervention group decreased none significantly in compared with patients in placebo group.

With the epidemic of obesity prevalence, rate of chronic diseases such as diabetes and cardiovascular disease has increased in worldwide (4). Nonalcoholic fatty liver disease is directly associated with obesity. Weight loss is one of the treatment strategies for fatty liver [7].

In several studies demonstrated inverse association between obesity and 25 (OH) vitamins D. The Framingham Heart Study presented that obesity was correlated with vitamin D deficiency [20]. In addition, several evidences presented negative association between 25(OH) D level and body fat mass in overweight adolescents [21] and with percent body fat in young women [22].

Several studies presented the effect of vitamin D supplementation on BMI, and the results are controversial. In the clinical trial that conducted by Bette C and et al, 36 282 postmenopausal women randomized intake vitamin D supplementation or placebo for 7 years, After duration study, women in intervention group had more weight loss in compared with placebo group [23]. In a study

Table 2: Laboratorycharacteristics in intervention and control groups[1]

[1]All values are means ±SD. 2Obtained from independent sample t test. 3Paired test.

Significant levels at <0.05. *: before and after intervention

Characteristic	intervention group (n=30)	Control group (n=30)	P[2]
	Mean±SD	Mean±SD	
BMI (mg/dL)			
Before*	29.33±.33	30± .44	0.07
After*	28.91± .11	29.83± .22	0.067
P[3]	0.059	0.077	
weight (mIU/mL)			
Before*	83.3±.12	84.32±.34	. 8
After*	82.81± .22	84.3± 1.3	0.45
p[3]	0.064	0.087	
waist circumference (cm)Before*			
After*	91.7±10.5	94.1±.34	0.07
p[3]	88.3±3.65	92.3±.32	0.057
	0.067	0.099	
waist to hip ratio(W.H.R) Before*			
After*	1.3±.3	1.32±.4	0.75
p[3]	1± .2	1.22± .2	0.084
	0.067	0.097	
Calcium(mg/dl)			
Before*	9.5(3)	12.9(2)	0.76
After*	13(1)	9.7(1)	0.032
p[3]	0.03	0.055	
Vitamin D serum (nmol/l)			
Before*	49±1	47±2	0.32
After*	117±13	45.8±.44	0.001
p[3]	0.001	0.65	
Percent body fat%			
Before*	36.1±1	37.3±2	0.088
After*	35.12±1.14	35.5±.44	0.091
p[3]	0.068	0.075	
Mean body fat (kg)			
Before*	30.89±1	30.23±2.3	0.32
After*	31.14±1.3	30.28±1.44	0.098
p3	0.081	0.085	
Lean body mass (kg)			
Before*	52.8±1	52.6±2.3	0.55
After*	51.68±1.3	51.88±1.44	. 98
p3	0.091	0.095	
Lean body mass (kg)			
Before*	52.8±1	52.6±2.3	0.55
After*	51.68±1.3	51.88±1.44	. 98
p3	0.091	0.095	
Soft lean mass (kg)			
Before*	48.06±1.9	49.34±2.3	0.087
After*	47.43±1.3	48.71±1.44	. 098
p3	0.091	0.095	
Total body water (kg)			
Before*	41.06±1.9	42.34±2.3	0.077
After*	42.09±1.3	38.54±1.44	. 058
p3	0.081	0.065	

Table 3: adjusted changes in metabolic variables in NAFLD who received either vitamin D supplements or placebo[1]

[1] All values are means ±SEs adjusted for baseline values.BMI: body mass index, PBF: percent body fat, MBF: mean body fat, LBM: lean body mass, SLM: soft lean mass, TBW: total body water

[2]Obtained from ANCOVA (adjusted for age and sex

	Vitamin D group (n = 30)	Placebo group (n = 30)	P value[2]
Weight (kg)	-.49±.2	-.29±.21	0.49
BMI (kg/m^2)	-.42±.14	-.17±.22	0.65
Vitamin D (ng/mL)	68±12	-1.9±2.44	0.001
Calcium (mg/dL)	4±.4	-3.2±1	0.032
waist circumference (W.C) (cm)	-3.4±1.33	-1.8±2.21	0.53
waist to hip ratio (W.H.R)	-.3±.04	-.1±.02	0.44
PBF%	-.98±.42	.43±.32	0.55
MBF (kg)	.89±.71	.25±.44	0.34
LBM (kg)	-1.12±.81	-.72±.52	0.62
SLM (kg)	-.63±.56	-.63±.54	0.54
TBW(kg)	1.03±3	-3.8±1	0.001

conducted by Ljunghall et al on 65 men, after 12 weeks vitamin D supplementation, there was a significant mild weight loss in intervention group compared with the placebo group [24]. In another study, vitamin D supplementations lead a significant mild weight loss in a group of 14 middle-aged men [25]. However, in a study had conducted by Nilas, vitamin D supplementation had no effect on percent body fat and total body fat in compared with placebo group [26]. In addition, in another study that included 238 subjects, after 4 month vitamin D supplementation, there is no significant different between body weight and BMI in intervention and placebo groups (Table 3) [27].

Inadequate vitamin D may also promote greater adiposity through other metabolic effects, such as regulation of PTH and modulation of adipogenesis. Moderate to severe vitamin D deficiency leads to increased PTH, which may promote an increase in free intracellular calcium into adipocytes and, thereby, enhance lipogenesis [15–18].

In this study, we had several limitations. The first limitation was the use of ultrasound for the diagnosis of fatty liver disease, while for accurate diagnosis of fatty liver, liver biopsy should be used. The second limitation of small sample size of participants. More studies must conduct to demonstrate the effect of vitamin D supplementation on body composition parameters.

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Conflict of Interest

"The authors declare that there is no conflict of interest regarding the publication of this paper

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