

## Is there any difference between Vitamin D deficiency among heart failure and non-heart failure elderly with cardiovascular disease?

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### Abstract

Vitamin D deficiency is common among the elderly with and without heart failure (HF). This study was designed to identify the degree of vitamin D deficiency among HF and non- HF elderly with cardiovascular disease. In this study, fifty hospitalized elderly patients with HF (26 women and 24 men, age range 60-90 years) and fifty elderly without HF were randomly selected. The level of serum 25-hydroxy vitamin D was measured using the Eliza method. There were no significantly difference between two groups regarding to the mean age, living location, life style parameters, mean years of disease involvement and disease severity, cardiovascular risk factors and co-morbidities, except for renal problems( $p = 0.039$ ), hemoglobin levels( $p = 0/044$ ), and creatinine levels ( $p = 0.048$ ). In both groups, the majority of patients, were moderately vitamin D deficient and there was no significantly difference between two groups. Considering the high prevalence of vitamin D deficiency among HF and non-HF elderly with cardiovascular disease, its monitoring and correcting seems essential.

**Keywords:** Vitamin D deficiency, elderly, older people, heart failure, cardiovascular disease

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### Introduction

In recent years, the pathophysiologic concept of heart failure (HF) has changed from an isolated hemodynamic view to more complex concept involving neuro-hormonal overactivation and increased concentration of proinflammatory cytokines, such as TNF and interleukin 6 (1,2). Interestingly, experimental studies have shown that the vitamin D can suppress the release of TNF- $\alpha$  (2). Vitamin D deficiency seems to predispose to hypertension, diabetes and metabolic syndrome, left ventricular

hypertrophy, chronic vascular inflammation, pathogenesis of atherogenic dyslipidemia and ischemic heart disease (3-5). Possible causal mechanism that may link vitamin D deficiency to heart failure, may involve the regulatory effect of 1,25 (OH)<sub>2</sub>Vit D on myocardial gene expressions (6). Vitamin D has also been shown to reduce the activation of the systemic and cardiac rennin angiotensin system, which contributes to hypertension and cardiac hypertrophy (4).

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Myocardial calcium homeostasis, which is crucial for the contractility and electrophysiology of the heart, is also partially regulated by  $1,25(\text{OH})_2$  Vit D. This is mediated by its influence on ion channels and enzymatic reactions (7). The results of several studies show that vitamin D supplementation significantly decreases all-cause mortality (6,8). Exposure of arms and legs for about 5 to 30 minutes (depending of time of day, season, latitude, air pollution, the degree of cloud cover, age, the extent of clothing covering, and skin pigmentation) between the hours of 10 am and 3pm, twice a week is often adequate for conversion 7-dehydrocholesterol (existed in the skin) to pre-vitamin D<sub>3</sub> (4). It has been demonstrated that regular exposure to UVB increases circulating  $25(\text{OH})$  Vit D above a level of 10 nmol/l (40 ng/l) and also significantly reduces blood pressure by approximately 6 mm/Hg in hypertensive patients (9). Sunlight exposure and dietary intake of vitamin D may not provide adequate levels of vitamin D. Some studies suggest an intake of at least 800 IU of vitamin D daily among elderly, especially in the winter (10). Consumption of some drugs such as anticonvulsants, steroids, anti-acids, H<sub>2</sub> blockers and proton pump inhibitors, prevent vitamin D absorption (11). According to several studies, 40 to %100 of US and European community dwelling elderly involved in vitamin D deficiency (6). Older people are prone to develop vitamin D deficiency, because of various risk factors including: decreased dietary intake, diminished sun light exposure, reduced skin thickness, impaired intestinal absorption, and

impaired hydroxylation in the liver and kidneys (5,12). Vitamin D deficiency may play a significant role in the pathogenesis of heart failure (6,7,13), though there is insufficient evidence to develop recommendations for strategies that improve vitamin D deficiency for HF patients. In addition, little is known about the degree of vitamin D deficiency among HF and non-HF elderly. The aim of this study was to identify the degree of vitamin D deficiency among HF and non-HF elderly with cardiovascular disease.

### Material and methods

In this cross sectional study, fifty hospitalized elderly patients with HF and the same number elderly patients without HF were randomly selected. This study was conducted between October 2011 and March 2012, at the Sari Heart Center located in Mazandaran province in Iran. All non-HF patients had a diagnosis of ischemic heart disease. Their diagnosis were confirmed by the cardiologist and under angiography. Persons who had history of taking vitamin D during past six months, were excluded. Data gathering tool was a questionnaire that was developed by researchers and its validity and reliability were confirmed by expert panel and test-retest ( $r = 0.79$ ).

In this questionnaire, there were some questions related to demographic characteristics (age, gender, location) and factors affecting vitamin D deficiency such as cardiovascular risk factors (history of diabetes, hyper-lipidemia, hypertension, overweight, anemia, hemoglobin level, ejection fraction < 40%, mean of systolic and diastolic

pressures, body mass index, disease severity (using the NYHA class), biochemical characteristics (fasting blood sugar, cholesterol, creatinine, phosphorus, calcium), the diseases and drugs predisposing vitamin D deficiency (history of hepatic, renal, and gastrointestinal diseases, consumption of sun-block, anticonvulsants, anti-acids, H<sub>2</sub> blockers, steroids), environmental factors (the number of walks per week and its duration, the number of sun exposure per week and its duration, the number of fish consumption per week and the type of fish, the number of dairy product consumption per week). This study was approved by the Research Ethics Committee of the Mazandaran University of Medical Sciences (Number 90-3). After completing of the informed consent by participants, 5 mL of venous blood was taken. Sample centrifuging and serum extraction were done and were immediately frozen. The level of serum 25(OH) Vit D was measured by the Eliza method (IDS ltd kit, UK).

Although a consensus regarding the optimal level of serum 25(OH) Vit D has not yet been established, most experts define vitamin D deficiency as a 25(OH) Vit D level of < 50 nmol/l (19 ng/ml) (14). Based on a randomized clustered sampling from the Tehran population that was designed by Endocrinology and Metabolism Research Center of Tehran University, the cut off point for vitamin D deficiency was considered less than 35 nmol/l (15).

#### *Statistically analysis*

Logistic regression was performed for qualitative variables and T-test was used

for quantitative variables. Values  $p < 0.05$  were considered significant. The results were analyzed by SPSS software version 16.

#### **Results**

Both HF and non-HF groups include 26 women and 24 men. The mean of the age were  $73.2 \pm 7.69$  years and  $70.44 \pm 7.8$  years in HF and non-HF patients, respectively ( $p = 0.078$ ). The majority of the elderly with HF (62%) were rural, while the majority of non-HF elderly (54%) were urban ( $p = 0.16$ ). The mean years of disease involvement were  $5.06 \pm 4.7$  years in HF patients (with CI 95% 3.72-6.4) and  $5.34 \pm 4.96$  years (with CI 95% 3.93-6.75) in non-HF patients ( $p = 0.77$ ). Among HF patients, the number of elderly males with vitamin D deficiency were significantly more than females (83.3 versus 53.8%,  $p = 0.026$ ).

The number of the patients with diabetes, hyperlipidemia, overweight, anemia and ejection fraction (EF) < 40% were more in the elderly with HF compared to those without. There was no significantly difference between two groups, except for EF ( $p < 0.001$ ) (Table 1). Regarding to severity of disease, the majority of HF (48%) and non-HF patients (40%) were class IV ( $p = 0.559$ ).

#### *Diseases and drugs*

HF patients had a more renal, hepatic, and gastrointestinal problems and a more consumption of H<sub>2</sub> blockers and anticonvulsants drugs, compared to non-HF patients. The usage of sun-block, steroids, anti-acids, were more in non-HF patients compared to HF patients. There was no significantly difference between

**Table 1** Cardiovascular characteristics of the elderly with and without HF

Variable	HF group	Non-HF group	sum	P
Diabetes	26 (52%)	22 (44%)	48 (48%)	0.548
HLP	19 (38%)	16 (32%)	35 (35%)	0.675
BMI > 25	24 (48%)	16 (32%)	40 (40%)	0.153
HTN	28 (56%)	35 (70%)	63 (63%)	0.214
Anemia	32 (64%)	28 (56%)	60 (60%)	0.541
EF<40%	34 (68%)	12 (24%)	6 (46%)	< 0.001

HLP:Hyperlipidemia; BMI:Body Mass Index; HTN:Hypertension; EF:Ejection Fraction

two groups, except for renal problems ( $p = 0.039$ ).

#### *Environmental factors*

The number of walks per week, its duration and sun exposure were lower in the elderly with HF compared to those without HF ( $p = 0.172$  and  $p = 0.223$  and  $p = 0.426$  respectively). The amount of milk and fish consumption were more in the elderly with HF compared to those without HF ( $p = 0.420$  and  $p = 0.546$  respectively).

#### *Biochemical characteristics, blood pressure and BMI*

The mean of two times fasting blood sugar, cholesterol, creatinine, and phosphor levels were more in the elderly with HF compared to those without HF. The mean of two times systolic and diastolic blood pressure during 3 days, BMI, hemoglobin, and calcium levels were lower in the elderly with HF compared to those without HF. There was significantly difference between two groups, regarding to hemoglobin and

creatinine levels ( $p = 0.044$  and  $p = 0.048$  respectively).

#### *Vitamin D levels*

The mean vitamin D levels were  $33.76 \pm 2.82$  and  $41.76 \pm 3.06$  nmol/l, in elderly persons with and without HF respectively ( $p = 0.178$ ). In both groups, the majority of patients (38%, 19 persons), were moderately vitamin D deficient (Table 2). The odds ratio of vitamin D deficiency was more in elderly with HF (OR=1.35; 95% CI 0.87-2.21;  $p = 0.151$ ) compared to those without HF.

#### *Vitamin D deficiency group (<35nmol/l)*

The odds ratio of the overweight was significantly more among HF patients compared to those without HF (OR = 1.73; 95% CI 1.22-2.68;  $p = 0.031$ ). In addition, the odds ratio of the gastrointestinal disorders (OR = 1.81; 95%CI 1.23-2.68;  $P=0.022$ ) and renal disorders (OR = 1.74; 95%CI 1.16-2.61;  $p = 0.031$ ) were significantly more among HF patients compared to those without HF (Table 3).

**Table 2** Classification of vitamin D levels among elderly with and without HF.

Vitamin D levels (nmol/l)	< 12.5	12.5-25	25-35	35-50	50-75	> 75
HF	7 (14%)	19 (38%)	8 (16%)	5 (10%)	8 (16%)	3 (6%)
50 (100%)						
Non HF	2 (4%)	19 (38%)	6 (12%)	7 (14%)	10 (20%)	6 (12%)
50(100%)						
Total	9 (9%)	38 (38%)	14 (14%)	12 (12%)	18 (18%)	9 (9%)
100(100%)						

**Table 3** The odds ratio and 95% confidence interval of precipitating factors of vitamin D deficiency , among elderly with HF in vitamin D deficiency group (< 35nmole/l).

Variable	odds ratio (95% CI)	p
Diabetes	1.11 (0.71-1.74)	0.817
HTN	0.86 (0.51-1.25)	0.510
HLP	1.06 (0.67-1.66)	0.997
BMI > 25	1.73 (1.22-2.68)	0.031
Anemia	0.99 (0.63-1.56)	0.821
EF < 40%	2.61 (1.32-3/53)	0.002
Renal problems	1.74 (1.16-2.61)	0.031
Hepatic problems	1.37 (0.74-2.54)	0.436
Intestinal problems	1.81 (1.23-2.68)	0.022
Sunblock	0.43 (0.07-2.39)	0.451
Anticonvulsant	1.84 (1.45-2.33)	0.580
Steroids	0.58 (0.11-2.94)	0.839
Antiacids	1.39 (0.9-2.15)	0.302
H <sub>2</sub> blocker	1.6 (1.07-2.39)	0.101

The number of the elderly with HF who never walks per week, were more than those without HF (41.2% versus 33.3%;  $p = 0.397$ ). The number of the elderly with HF who used sun exposure daily, were lower than those without HF (55.6% versus 44.1%,  $p = 0.856$ ). There were no significantly differences between the number and type of fish usage, and the number of dairy consumption, among the elderly with and without HF ( $P = 0.241$  and  $p = 1$  and  $p = 0.194$  respectively).

### Discussion

The results of this study didn't show significantly correlation between vitamin D levels among the elderly with and without HF. In both groups, there were no statistical relationship between the age and vitamin D deficiency. This finding is contrast with the results of some studies (7,16) and adjusts with other ones (17,18). With increasing of the age, the probability of vitamin D deficiency is increased, because of decreased skin thickness, decreased dietary intake, diminished physical activity out of home, increased prevalence of the kidney, liver and gastrointestinal problems (5). No significantly relationship between the age and vitamin D deficiency may be explained by the relative youth of participants (mean age 72). Among HF patients, the number of men with vitamin D deficiency were significantly more than women. This finding adjusts with the results of one study (19) and is contrast with other ones (18,20). The reason may be a more disease severity among men compared to women. The odds ratio of the overweight was significantly more among HF patients compared to those

without HF. Diminished exposure to UV light, associated with reduced outdoor activities and likely physical inactivity may account, in part, for the lower level of serum vitamin D in overweight participants (21). In addition, the lipid solubility of vitamin D modifies its bioavailability and may contribute to the lower level of serum vitamin D in overweight and obese participants (22,23). Among elderly with HF, there was not significantly relationship between the number of walks per week and vitamin D levels. It may be due to relatively small sample size. The odds ratio of the gastrointestinal and renal disorders were significantly more among the elderly with HF compared to those without HF. Vitamin D deficiency in chronic renal disease, may be due to hyper-phosphatemia. Hyper-phosphatemia increases fibroblast growth factor 23, which decreases 25-hydroxyvitamin D-1 $\alpha$ -hydroxylase activity (24).

### Limitations

A number of limitations exist with respect to the present study. Firstly, this is a cross sectional study and the correlations can not imply the causation relationships between parameters. Secondly, there are different normal vitamin D ranges for winter and summer in different countries. Thirdly, the sample size is relatively small. More ever, the data represent only the subjects who agreed to participate in this study.

### Conclusion

Considering the high prevalence of vitamin D deficiency among the HF and

Non- HF elderly with cardiovascular disease, its monitoring and correcting seems essential.

### Conflict of interest

None of the authors have financial or non-financial competing interests.

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