Original Contribution/Clinical Investigation

Study of the relationship between vitamin D status and basic functional mobility in ambulatory elderly

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ABSTRACT

Background : Associations between physical performance and vitamin D status have been contradicted among studies. Vitamin D deficiency is very common among geriatric patients and is an established risk factor for osteoporosis, falls and fractures.

Aim: to analyse the relation between Vitamin D and basic functional mobility in a sample of ambulatory Egyptian elderly.

Methods: A cross sectional study was conducted on 100 elderly patients aged ≥60 years. Participants were recruited from Geriatric primary health care clinic at Ain Shams University hospital, Cairo, Egypt. All participants underwent comprehensive geriatric assessment, physical performance assessment using timed up and go (TUG) test and Gait speed test at four meters; they also had Serum levels of vitamin D (25OHD) measured by Enzyme- Linked Immunosorbent Assay method.

Results: Of 100 subjects, 52% showed vitamin D insufficiency, 16% were vitamin D deficient and 32% had normal vitamin D levels. Regarding physical performance 64% of subjects had elevated TUG test (as defined by the cut off value 14 seconds), 56% of subjects scored a gait speed < 0.6 m/s. Physical performance was significantly related to vitamin D deficiency when measured by gait speed test but not TUG test.

Conclusion: Vitamin D insufficiency is prevalent among ambulatory elderly and vitamin D status is strongly associated with basic functional mobility when measured by gait speed test.

Key words: Vitamin D; Functional mobility ; Elderly;

Introduction

Functional mobility is the ability to move from one position to another and is extremely important in performing independently daily activities (1). Recent studies have documented the relationship between vitamin D supplementation and functional mobility, muscle strength, sway and the decreased incidence of falls and fractures (2,3).

Vitamin D (calcitriol) is a hormone that consists of vitamin D2 (ergocalcipherol) and vitamin D3 (cholecalcipherol). The main sources of vitamin D are endogenous production of dermal synthesis due to solar or synthetic ultraviolet (UV) B light exposure and also could be obtained through food and supplementation (4,5).
Elderly are prone to develop vitamin D deficiency because of various risk factors including decreased dietary intake, diminished sunlight exposure, reduced skin thickness, impaired intestinal absorption and impaired hydroxylation in the liver and kidneys.(6,7)

Vitamin D deficiency is very common among institutionalized elderly, geriatric patients and patients with hip fractures and it is an established risk factor for osteoporosis, falls and fractures(8). In an international study conducted on women with osteoporosis, the highest proportion of hypovitaminosis D was reported in the Middle East (9).

The Timed Up & Go Test (TUG) is a test of balance that is commonly used to examine functional mobility in community-dwelling, frail older adults (10).

Gait speed is highly recommended as the "sixth vital sign" because of its ability to predict future health status, its ease of administration, ease of grading and interpretation and minimal cost involved (11). Studenski et al reported that gait speed of less than 0.6 m/sec is predictive for future risk of hospitalization and decline in health and function(12).

With a growing elder population, there is an increasing need to identify potentially modifiable risk factors for disability. This study aimed to determine the relation between serum vitamin D concentration and functional mobility in a sample of community dwelling Egyptian elderly.

Subjects and Methods

A cross sectional study was conducted on one hundred elderly; subjects were recruited from Geriatric primary health care clinic at Ain Shams University hospital in Cairo city, Egypt, during the period from (April 2014till November 2014).

Sample size justification: based on previous published literature in Egyptian subjects of 20% prevalence of vitamin D deficiency and a postulated 35% prevalence in the elderly group with a power of study 90% and alpha error 5%, the required sample size is 65 subjects. The program of sample size calculation is STATA 10.

All participants underwent comprehensive geriatric assessment, cognitive assessment, physical performance assessment using (TUG) test and Gait speed test at four meters and had laboratorial measurement of serum vitamin D (25OHD).

Subjects with dementia, clinical cardiopulmonary, neurological and musculoskeletal problems that prevent them from following physical performance test instructions were excluded.

TUG test was used to assess the basic functional mobility by measuring the time required to do subsequent activities: standing up from a 46 centimeter-high chair with back and arm support, walking for 3 meters, turn back to the chair, and sit back. Thus, if a subject scored 14 seconds or longer he or she was classified as high-risk for falling. (13)

Gait speed test at 4 meters was performed. Participants were asked to walk at their usual pace. Walking speed was defined as the best performance of two 4 meter walks at usual pace along a corridor. Time of shortest walk was scored and Gait speed was calculated for each participant using distance in meters and time in seconds. (14)

As regards vitamin D (25OHD), blood samples were collected, centrifuged and stored at -80°C. Serum levels of vitamin D (25OHD) were measured using Enzyme-Linked Immunosorbent Assay (ELISA) method. Vitamin D deficiency was defined as values below 30 nmol/ L and insufficiency values ranged from 30 to75 nmol/ L.

Covariates
Covariates included body mass index (BMI; computed as weight in kg/height in meters squared and classified according to WHO classification, 1997) (15).

Statistical methods:
The collected data were coded, tabulated, revised and statistically analyzed using SPSS program (version 15). The statistical tests used in this study were student t test and ANOVA test for quantitative data and chi-square test for qualitative data. The level of significance was taken at P value < 0.05.

Results

Analysis of baseline socio-demographic characters of subjects showed that mean age of subjects was 72.8 5.1 years, males represented 57% and females represented 43% of sample.

Regarding body mass index, 53% of studied elderly were Overweight (BMI=25-29.9) and obese (BMI ≥30).

Table 1 shows that 52% of subjects had vitamin D insufficiency, 16% had vitamin D deficiency and 32% had normal vitamin D levels.

Table 1: Distribution of vitamin D in whole sample

Vit D (nmol/L)	Whole sample	
	no	%
Normal(>75)	32	32.0
Insufficient(30-75)	52	52.0
Deficient(<30)	16	16.0

Females showed higher rate of vitamin D deficiency compared to males (20.9% versus 12.3%), while males showed higher rate of vitamin D insufficiency compared to females (66.7% versus 32.6%) and that was statistically significant.

Diabetes and hypertension were the highest prevalent co-morbidities among studied subjects, 43% and 47% respectively as shown in Table 2.

Table 2: The Distribution of CO-morbidities among subjects

CO morbidities	Whole sample	
	no	%
Diabetes	43	43.0
Hypertension	47	47.0
ISHD	38	38.0
COPD	37	37.0
Old CVS	9	9.0
CLD	38	38.0

CLD = chronic liver disease
ISHD = ischemic heart disease
CVS = cerebrovascular stroke
COPD = chronic obstructive pulmonary disease

Sixty four percent of subjects scored TUG test >14 seconds as shown in Table 3.

Table 3: Distribution of Timed up and go (TUG) test score among subjects

	No.	%
< 14 seconds	36	36.0
≥14 seconds	64	64.0

As regards gait speed test, subjects were divided into 2 groups; 56% scored a gait speed < 0.6 m/s and 44% scored a speed ≥0.6 m/s.

Table 4 shows higher percentage of elevated TUG among subjects deficient in vitamin D compared to other groups but the difference was not statistically significant.

Table 4: Relation between vitamin D status and TUG test

Vitamin D	TUG< 14sec No. %	TUG ≥14sec No. %	X2	P
Normal N=32	14 43.8	18 56.3		
Insufficient N=52	17 32.7	35 67.3	1.2	0.5
Deficient N=16	5 31.3	11 **68.8**		

Table 5 shows that mean Gait speed test was elevated among vitamin D deficient subjects 5.4 2.4 compared to those with normal vitamin D and the difference was statistically significant.

Table 5: Relation between vitamin D status and mean gait speed

Vitamin D	Mean	SD	F	P
Normal N=32	2.8	1.1		
Insufficient N=52	2.7	1.9	0.9	0.01
Deficient N=16	**5.4**	2.4		

Table 6 shows higher percentage of Vitamin D deficiency (60%) among very obese subjects (BMI >40) compared to other groups and higher percentage of vitamin D insufficiency (65.2%) among obese subjects (BMI >30).

Table 6: Relation between BMI and vitamin D status among participants

BMI	VITAMIN D			X2	P
	Normal N %	Insufficient N %	Deficient N %		
Underweight (<18.5)	2 66.7	1 33.3	0		
Normal(18.5-24.9)	12 27.3	26 59.1	6 13.6		
Overweight(25-29.9)	8 40.0	8 40.0	4 **20.0**	22.8	0.004
Obese (≥30)	8 34.8	15 **65.2**	0		
Very obese(≥40)	2 20.0	2 20.0	6 **60.0**		

BMI (body mass index)

Discussion

The relation between vitamin D status and basic functional mobility has been investigated in this cross sectional study. The mean age of subjects was 72.8 (±5.1) years. TUG test and gait speed test were used as measures for functional mobility among subjects.

In the present study 52% of subjects showed vitamin D insufficiency, 16% showed vitamin D deficiency and 32% had normal vitamin D levels. Vitamin D deficiency was more common among females compared to males while insufficiency was more among males.

Reviewing literature, Aly et al reported that vitamin D insufficiency represented 26% and was more common among males in a study conducted on elderly in Dakhlia governorate in Egypt (16). In the InCHIANTI study Houston et al reported that vitamin D deficiency among females represented 28.8% versus 13.6% among males (17) and in Jakarta, a study conducted on elderly women reported 23.3% vitamin D deficiency rate (18).

Associations between physical performance and vitamin D status have been contradicted among studies. In the current study vitamin D (25- OH) deficiency was inversely associated with gait speed which agreed with results of Houston et al who reported that vitamin D (25- OH) status was inversely associated with poor physical performance. (17) On the contrary, Belfrail population-based study showed no association between gait speed and serum levels of (25-OHD) in elders.(19)

Possible explanation of this contradiction among studies is that researchers have not yet identified the circulating 25-OHD concentrations needed to ensure optimal muscle functioning in elderly people and use a wide range of cut-off levels to define 25-OHD deficiency.

The present study showed that (TUG) test was elevated in 68% of subjects with vitamin D deficiency compared to 52% of subjects with normal vitamin D with no statistical significant difference. This finding comes in agreement with Gschwind et al who didn't find significant difference between cases with the higher quartile of vitamin D and cases with the lowest quartile in performance of TUG test (20). Also Dukas et al reported that TUG was not associated with serum 25-OHD levels in a study conducted on community-dwelling elders (21). This can be explained by presence of factors other than vitamin D which affect TUG test such as nervous system, spine and hip flexibility, range of motion of the joints, muscles, biomechanical relationship between body segments, diseases, medications, and behaviour(22,23).

Regarding BMI, vitamin D deficiency and insufficiency were higher among obese and very obese groups compared to non obese. This comes in agreement with Lagunova et al who reported a significant decrease in serum 25(OH) D3 levels with increasing body mass index in elderly(24). Also Linnebur et al reported that vitamin D deficiency remained present in obese elderly even after taking vitamin D supplementation (25). Obesity-associated low vitamin D levels are likely due to the decreased bioavailability from cutaneous and dietary sources because of its deposition in body fat compartments. (26)

Conclusion

Hypovitaminosis D is common among ambulatory Egyptian elderly and significantly affects gait speed. We recommend further studies with larger sample sizes; also we recommend that researchers should agree on ranges and cutoff values for vitamin D deficiency in elderly.

Ethical considerations
Informed consent was taken from every elder participating in this study; also an approval was taken from the head of Geriatrics and Gerontology Department. The study methodology was reviewed and approved by the Research Review Board of the Geriatrics and Gerontology Department, Faculty of medicine, Ain Shams University.

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