Original Article

The Prevalence of Vitamin D and Calcium Supplement use and Association with Serum 25-Hydroxy-vitamin D (25(OH)D) and Demographic and Socioeconomic Variables in Iranian Elderly

Abstract

Aims: The objective of this study was to determine the prevalence of vitamin D and calcium supplement use, and association with serum 25-hydroxy-vitamin D(25(OH)D) and demographic and socioeconomic variables in Iranian elderly. **Settings and Design:** This cross-sectional study was conducted in health centers of Tehran, capital of Iran. **Methods:** A total of 600 men and women were recruited using a two-stage cluster sampling method from 60 health centers. Participant's inclusion criteria included enrolling older adults over 60 years old who able to answer questions. We used valid and reliable questionnaires to record dietary intake of vitamin D and calcium. Any dietary supplements which included vitamin D/calcium were recorded. 25(OH)D level was measured. Participants were categorized as supplement users if they had taken supplements during last month. **Results:** The mean age of participants was 67.16 ± 6.07 years. Vitamin D supplements were used more often by females (OR = 11.89, 95% confidence interval (CI): 4.82–29.34), high educated subjects (OR = 3.49, 95% CI: 1.45–8.44), participants who did more physical activities (OR = 2.75, 95% CI: 1.52–5.00), and subjects who took antiosteoporosis medications (OR = 6.90, 95% CI: 2.84-16.78). Calcium supplements were used more often by females (OR = 13.05, 95% CI: 5.19–32.81), more physical activities participants (OR = 2.17, 95% CI: 1.20–3.92), and antiosteoporosis users (OR = 8.31, 95% CI: 3.43–20.14). Significant positive associations were seen between 25(OH) D levels and osteoporosis ($P = 0.020$), vitamin D supplement use ($P < 0.0001$), and sun exposure ($P = 0.093$). **Conclusion:** In this population of Tehranian adults, the prevalence of vitamin D and calcium supplement use may be attributed to educational level and underlying disease. Vitamin D supplementation, osteoporosis, and sun exposure were the strong predictors of vitamin D status.

Keywords: *Calcium supplements, elderly, Iran, serum vitamin D, vitamin D supplements*

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Introduction

Vitamin D deficiency is widespread among all populations, especially in the elderly.[1,2] It may be due to several factors, including the reduced capacity of older skin for UV-mediated vitamin D synthesis, lack of food intake, lack of sun exposure, and limited awareness of the benefits of vitamin D supplementation.[3] Adequate vitamin D and calcium intake is necessary to prevent osteoporosis and fractures, especially in the elderly.[4] In a review of more than 180 studies, Gaugris *et al.* found that people who took vitamin D and calcium supplements were less likely to bone loss and fall-related fractures than those who did not use these supplements.[5] Several studies have indicated that vitamin D and calcium supplementation may improve bone health and prevent fractures among older population.[6,7] As there are very few food sources of vitamin D, it is difficult to reach recommended doses.[8] Therefore, a daily dose of 800 IU is recommended by National Osteoporosis Foundation to produce adequate serum 25(OH)D and prevent bone loss in older adults. Likewise, guidelines recommend a daily intake of at least 1200 mg calcium to maintain bone health in the elderly.[9] Although studies have shown that old people take more supplements than do younger people, Ervin and Kennedy-Stephenson found that less than

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60% of this population took vitamin D and calcium supplements constantly.[10] The third National Health and Nutrition Examination Survey (NHANES III) determined that among the elderly >60 years, only 42% of men and 54% of women took calcium supplements.[11]

It has been shown that supplement users may have different sociodemographic characteristics from nonsupplement users. They may have healthier diet and more physical activities.[12] Most studies indicated that women are more likely to take supplements than men.[10,11,13] Results from NHANES showed that older people, former smokers, and more highly educated individuals were more likely to take supplements.[11] In Ervin and Kennedy-Stephenson study, supplement users had better dietary intakes than nonsupplement users.[10] Espino *et al*. survey indicated that increasing comorbidity and usage of antiosteoporosis medications were associated with calcium and vitamin D supplement use.[13]

Based on a literature search, there is no data on vitamin D and calcium supplement use in Iranian elderly. Only Maddah and Sharami examined the usage of vitamin D and calcium supplements in postmenopausal women in Guilan, north of Iran. Intake of vitamin D and calcium supplements was only 18.8% in this population.[14] Study of postmenopausal women in Guilan showed that urban and high educated women were more likely to use vitamin D and calcium supplement than rural and less educated subjects.[14]

Although vitamin D/calcium supplement use increases with aging, the determinants of utilization vitamin D/calcium supplement, which have an influence on vitamin D status, remain unclear. Therefore, the objective of this study was to determine the prevalence of vitamin D and calcium supplement use, and association with serum (25(OH)D) and demographic and socioeconomic variables in Iranian elderly.

Subjects and Methods

Participants

This cross-sectional study was conducted between October 2015 and January 2016 in health centers ($n = 60$) of North, South, East, West and center of Tehran, capital of Iran. Using a two-stage cluster sampling, we selected health centers and within each health centers, we used a convenience sampling to recruit people in the study. A total of 600 men and women 60 year of age and older who attended health centers participated in this survey. Elderly individuals attended health centers for regular measurements of blood pressure and fasting blood sugar. Some of them also participated in special classes for the elderly held by the centers. All 600 subjects entered our study consecutively in 4 months. Participant's inclusion criteria included enrolling older adults over 60 years old who able to answer questions. Participants were excluded

if they had type 1 diabetes, dialysis, or had clinical symptoms of any other disease like cancer and those with any disease that affects vitamin D metabolism. We also excluded those with reported energy intakes <500 and >3500 kcal/day. All participants were asked to sign an informed consent form which included a short description of the study and participant's confidentiality and rights. The study was approved by the ethics committee of the Tehran University of Medical Sciences (Ethics No. 27810).

Use of vitamin D and calcium supplements

We asked participants to bring all medications and supplements. According to the use of calcium and/or vitamin D supplements or any dietary supplements which included vitamin D/calcium, within last month, subjects were assigned to one the following groups: a) calcium supplement only, b) calcium/vitamin D supplement, and c) vitamin D supplement. We recorded all product's names and dosages. If they took any vitamin D and calcium or any dietary supplements which included vitamin D/calcium, they were asked for additional information. We asked participants "how often do you take vitamin D and calcium supplements?" and "how long have you been taking the supplements?"

Sociodemographic characteristics

Participant's age, level of education, job, marital status, and living arrangements (living alone or with someone) were based on self-reported data.

Dietary intakes

A validated 147-item food frequency questionnaire was used to assess usual food intake.[15] Nutritional information was collected by experienced and trained nutritionist through interviews. Participants reported their intake frequency for each food item during the past year on a daily, weekly, monthly or yearly basis. Portion sizes of consumed foods that were reported in household measures were converted to grams. The food items were analyzed for their energy content using the Nutritionist 4 software modified for Iranian foods.

Comorbidities

Subjects were asked about their history of illnesses such as hypertension, dyslipidemia, heart disease, diabetes mellitus, osteoporosis, cancer, pulmonary disease, and prostate disease. Participants who said that a physician informed them that they had the illnesses were considered as having the illnesses. Then, we measured the number of comorbidities which was ranged from 0 to 3 the same scale that was used in previous studies.[13]

Physical activity level

We used a valid and reliable short form of the International Physical Activity Questionnaire (IPAQ) to assess the level

of physical activity. Vigorous physical activity, moderate physical activity, walking, and sitting in the past 7 days were recorded using this questionnaire.[16] Then, the Metabolic Equivalents (METs) was calculated to estimate total physical activity per week for each participant. Finally, METs were classified as weak (<600 MET-minutes/week), moderate (600–3000 MET-minutes/week), and vigorous (>3000 MET-minutes/week). Activities of daily living

We assessed subject's ability to perform activities of daily living using the Katz questionnaire. The reliability and validity of the self-report ADL-Katz among institutionalized elderly have been reported previously.[17] Subjects who did not need any assistance with their activities were considered independent.

Sun exposure level

We asked participants "On average, how many hours per day do you spend outside?" and "how often do you use sun protection agents?" We categorized sun exposure level as none, 10 min to 1 h, more than 1 h up to 2 h, and more than 2 h.

Smoking status

We categorized subjects as nonsmoker and current/former smoker based on self-reports.

Anthropometric measures

Patient's height was measured without shoes by a wall stadiometer with sensitivity of 0.1 cm (Seca, Germany) and weight by digital scale (Seca 808, Germany) with an accuracy of 0.1 kg with light clothes (without a coat and raincoat). Body mass index (BMI) was calculated by dividing weight in kilograms by the square of height in meters. Waist circumference was measured with a measurement tape between the iliac crest and the lowest rib on the exhale.

Serum 25(OH)D

Of these 600 subjects, a subgroup of 180 individuals (90 supplement users and 90 nonsupplement users) was randomly selected to measure their serum 25(OH) D levels with ELISA kits (Biosource, Brussels, Belgium) and inter- and intra-assay coefficients of variation of serum 25(OH) D were 7.9% and 8.5% respectively. It took 2 months to collect 180 participant's serums and all measurements were performed in autumn. Therefore, the total participant's enrollment period was 6 months.

Statistical analysis

Mean dietary intake of vitamin D and calcium was computed in this population. Then, one-sample t-tests were performed to compare the daily intake of vitamin D and calcium with recommended doses of 800 IU and 1200 mg, respectively. Subjects were divided into two groups of supplement/nonsupplement users. Then, logistic regression analysis was used to assess factors associated with the intake of vitamin D and calcium supplements. We also conducted univariate linear regression to examine which variables were significantly associated with serum 25(OH)D and parathormone (PTH) levels. Then, we used factors with $P < 0.05$ for multiple linear regression models to assess the concurrent effects of associated factors. We considered $P < 0.10$ as significant in multiple linear regression models. Analyses were conducted using SPSS version 18.

Results

Participant's characteristics

A total of 600 elderly (138 men and 462 women; mean age 67.16 ± 6.07 years) participated in this study. Most of the subjects (75.2%) were 60–70 years of age and 77% were women. Participant's demographic characteristics are shown in Table 1.

Vitamin D and calcium intakes

Mean daily dietary intake of vitamin D was 73.38 ± 64.07 IU which was significantly lower than the recommended dose of 800 IU for the elderly ($P < 0.001$). Likewise, mean daily intake of calcium from food was 1124.41 ± 398.6 mg that was significantly lower than recommended dose of 1200 mg for this age group ($P < 0.001$).[9] The overall prevalence of vitamin D and calcium supplement use among this population was 32.2% and 30%, respectively. All supplement users took vitamin D as cholecalciferol [Table 1].

Factors associated with intake of vitamin D supplement

After adjusting for other variables, significant associations were seen between vitamin D supplement use and female sex (OR = 11.89, CI: 4.82–29.34), education (diploma vs. uneducated: OR = 2.40, 1.15–5.03 CI and university educated vs. uneducated: OR = 3.49, CI: 1.45–8.44), physical activity level (OR = 2.75, 1.52–5.00 CI), and antiosteoporosis medication use (OR = 6.90, CI: 2.84–16.78). Odds ratios and 95% confidence intervals of factors associated with vitamin D use are shown in Table 2.

Factors associated with intake of calcium supplement

When adjusted for other variables, significant associations were seen between calcium supplement use and female sex (OR = 13.05, CI: 5.19–32.81), physical activity level (OR = 2.17, CI: 1.20–3.92), and antiosteoporosis medication use (OR = 8.31, CI: 3.43–20.14). Odds ratios and 95% confidence intervals of factors associated with calcium use are shown in Table 3.

Factors associated with serum 25(OH)D levels

Mean serum 25(OH)D and PTH concentrations in this subgroup of elderly were 44.4 ± 27.3 nmol/L and 0.51 ± 0.27. Mean serum 25(OH)D concentration was different between supplement users and nonsupplement users ($P < 0.001$). Prevalence of vitamin D deficiency (25(OH)D <50 nmol/L) in

Table 1: Participant's characteristics of supplement users and nonusers

Characteristics	Vitamin D users	Vitamin D nonusers	Calcium users	Calcium nonusers	Total *n* (%)
Number (%)					
Sex					
Male	11 (5.7)	127 (31.2)	10 (5.6)	128 (30.5)	138 (23)
Female	182 (94.3)	280 (68.8)	170 (94.4)	292 (69.5)	462 (77)
Age (years)					
69-60	58 (30.1)	100 (24.6)	53 (29.4)	105 (25)	158 (26.4)
79-70	100 (51.8)	193 (47.4)	92 (51.1)	201 (47.9)	293 (48.8)
89-80	35 (18.1)	114 (28)	35 (19.4)	114 (27.1)	149 (24.8)
Education					
Uneducated	35 (18.2)	106 (26)	36 (20.1)	105 (25)	141 (23.5)
Under diploma	81 (42.2)	215 (52.8)	80 (44.7)	216 (51.4)	296 (49.4)
Diploma	39 (20.3)	50 (12.3)	31 (17.3)	58 (13.8)	89 (14.9)
University educated	37 (19.3)	36 (8.8)	32 (17.9)	41 (9.8)	73 (12.2)
Job					
Employed	6 (3.1)	22 (5.4)	3 (1.7)	25 (6)	28 (4.7)
Housewife	139 (72)	242 (59.5)	131 (72.8)	250 (59.5)	381 (63.5)
Retired	48 (24.9)	139 (34.2)	46 (25.6)	141 (33.6)	187 (31.2)
unemployed	0	4 (1)	0	4 (1)	4 (7)
Marital status					
Single	4 (2.1)	5 (1.2)	2 (1.1)	7 (1.7)	9 (1.5)
Married	113 (58.5)	272 (66.8)	112 (62.2)	273 (65)	385 (64.2)
Divorced	4 (2.1)	5 (1.2)	2 (1.1)	7 (1.7)	9 (1.5)
Widow/widower	72 (37.3)	125 (30.7)	64 (35.6)	133 (31.7)	197 (32.8)
Life arrangement					
Alone	40 (20.7)	74 (18.2)	35 (19.4)	79 (18.8)	114 (19)
Note alone	153 (79.3)	333 (81.8)	145 (80.6)	341 (81.2)	486 (81)
Smoking					
Nonsmoker	176 (91.2)	351 (86.2)	165 (91.7)	362 (86.2)	527 (87.8)
Former smoker	14 (7.3)	37 (9.1)	13 (7.2)	38 (9)	51 (8.5)
Current smoker	3 (1.6)	19 (4.7)	2 (1.1)	20 (4.8)	22 (3.7)
Physical activity level					
Very low	72 (37.3)	199 (48.9)	74 (41.1)	197 (46.9)	271 (45.2)
Weak	79 (40.9)	160 (39.3)	67 (37.2)	172 (41)	239 (39.8)
Moderate	36 (18.7)	42 (10.3)	33 (18.3)	45 (10.7)	78 (13)
Vigorous	6 (3.1)	6 (1.5)	6 (3.3)	6 (1.4)	12 (1.7)
Activities of daily living (Katz)					
Partial independent	10 (5.2)	16 (3.9)	8 (4.4)	18 (4.3)	26 (4.3)
independent	183 (94.8)	391 (96.1)	172 (95.6)	402 (95.7)	574 (95.7)
Sun exposure level/day					
None	39 (20.2)	81 (19.9)	42 (23.3)	78 (18.6)	120 (20)
10 min-1 h	137 (71)	276 (67.8)	122 (67.8)	291 (69.3)	413 (68.8)
1-2 h	14 (7.3)	41 (10.1)	13 (7.2)	42 (10)	55 (9.2)
>2 h	3 (1.6)	9 (2.2)	3 (1.7)	9 (2.1)	12 (2)
Mean±SD					
Energy, Kcal/d	2734±756	2232. ± 487	2716±59	3263±833	2648±671
Total fat, g/d	78.0±38.1	55.7±15.6	72.1±18.2	106.6±49.7	79.0±38.6
Protein, g/d	82.3±30.2	59.6±12.3	78.7±14.8	109.0±34.0	85.3±33.6
Carbohydrate, g/d	362±128	265±58	340±62	484±133	378±99
Ca dietary intake (mg/day)	1163±446.8	1115±394.4	1142±429.3	1132±410	1124.41±398.6
Vitamin D dietary intake (IU/day)	84.1±78.8	68.8±60.0	82.8±71.8	72.5±64.2	73.38±64.07
Serum 25 (OH) D (nmol/L)	56.6±25.4	32.1±23.5	39.1±27.6	53.0±24.8	44.4±27.3
Serum PTH (pg/ml)	0.49±0.21	0.51±0.30	0.48±0.19	0.51±0.30	0.50±0.27

METs were classified as weak (<600 MET-min/week), moderate (600-3000 MET-min/week), and vigorous (>3000 MET-min/week)

Table 2: Odds ratios and 95% confidence intervals of demographic and lifestyle characteristics associated with vitamin D supplement use by elderly

		Crude			Adjusted*			P-trend
		OR	95% CI	P	OR	95% CI	P	
Sex	Male	1			1			-
	Female	7.50	3.94-14.28	<0.001	11.89	4.82-29.34	<0.001	
Age (years)	69-60	1			1			0.83
	79-70	0.89	0.59-1.34	0.584	1.26	0.78-2.03	0.343	
	89-80	0.53	0.32-0.87	0.012	1.29	0.70-2.37	0.416	
Education	Uneducated	1			1			0.33
	Under diploma	1.14	0.72-1.80	0.574	1.10	0.65-1.86	0.711	
	Diploma	2.36	1.34-4.16	0.003	2.40	1.15-5.03	0.020	
	University educated	3.11	1.71-5.65	<0.001	3.49	1.45-8.44	0.005	
Job	Employed	1			1			0.83
	Housewife	2.10	0.83-5.31	0.115	1.23	0.38-4.02	0.729	
	Retired	1.26	0.48-3.30	0.630	1.16	0.35-3.80	0.805	
Marital status	Single/divorced/widow	1			1			-
	married	0.70	0.49-0.99	0.049	0.95	0.57-1.57	0.830	
Life arrangement	Alone	1			1			-
	Not alone	0.85	0.55-1.30	0.458	1.28	0.70-2.32	0.412	
Smoking	Nonsmoker	1			1			-
	Current/former smoker	0.60	0.34-1.07	0.086	1.56	0.71-3.41	0.264	
BMI (kg/m²)	Underweight	1			1			0.57
	Normal	0.68	0.40-1.13	0.139	0.68	0.37-1.25	0.217	
	Overweight/obese	0.70	0.42-1.17	0.178	0.57	0.31-1.06	0.078	
WHR	Good	1			1			0.13
	Average	0.46	0.31-0.71	<0.001	0.76	0.47-1.23	0.259	
	At risk	0.37	0.23-0.59	<0.001	0.66	0.38-1.15	0.142	
Number of comorbidities	None	1			1			0.52
	1	1.11	0.67-1.85	0.674	1.03	0.57-1.85	0.923	
	2	0.77	0.45-1.32	0.339	0.84	0.45-1.56	0.586	
	3 and more	0.59	0.35-1.01	0.055	0.95	0.51-1.77	0.868	
Activity level	Weak	1			1			0.074
	Low	1.36	0.93-1.99	0.110	1.31	0.84-2.04	0.233	
	Vigorous	2.42	1.47-3.96	<0.001	2.75	1.52-5.00	0.001	
Antiosteoporosis medication	No	1			1			-
	yes	5.36	2.58-11.14	<0.001	6.90	2.84-16.78	<0.001	

*For each variable, in adjusted model, other variables were covariates. METs were classified as weak (<600 MET-min/week), moderate (600-3000 MET-min/week), and vigorous (>3000 MET-min/week)

this elderly subgroup was 21.1% (26.1% and 19.4% in men and women, respectively). Vitamin D insufficiency (50 ≤25(OH) D <75 nmol/L) was seen in 17.2% of participants (23.9% and 14.9% in men and women, respectively). There was no association between the type of supplement intake (tablet or injection) and serum 25(OH)D levels (*P* = 0.149), but mean serum 25(OH)D was significantly higher in subjects who took the supplements monthly compared with those who took the supplement daily and weekly (*P* = 0.05). Furthermore, serum 25(OH)D was higher in participants who had been taking vitamin D supplements for more than 1 year (*P* = 0.013). There was a significant association between vitamin D supplement dosage and serum 25(OH)D (*P* < 0.001). The significant factors from the nonparametric analysis that were entered in multiple regression model are shown in Table 4. Significant associations were seen between 25(OH)

D levels and osteoporosis (*P* = 0.020), vitamin D supplement use (*P* < 0.001), and sun exposure (*P* = 0.093) after adjusting for other variables.

Discussion

The results of this cross-sectional study indicated that the overall prevalence of vitamin D and calcium supplement use among this population was 32.2% and 30%, respectively. Vitamin D supplements were used more often by females, high educated subjects, participants who did more physical activities, and subjects who took antiosteoporosis medications. Calcium supplements were used more often by females, more physical activities participants, and antiosteoporosis users. Significant positive associations were seen between 25(OH) D levels and osteoporosis, vitamin D supplement use, and sun exposure.

Table 3: Odds ratios and 95% confidence intervals of demographic and lifestyle characteristics associated with calcium supplement use by elderly

		Crude			Adjusted			P trend
		OR	95% CI	P	OR	95% CI	P	
Sex	Male	1			1			
	Female	7.45	3.81-14.57	<0.001	13.05	5.19-32.81	<0.001	
Age (years)	69-60	1			1			
	79-70	0.90	0.60-1.37	0.642	1.19	0.74-1.93	0.464	0.74
	89-80	0.61	0.37-1.00	0.052	1.43	0.78-2.63	0.251	
Education	Uneducated	1			1			0.20
	Under diploma	1.08	0.68-1.70	0.741	1.05	0.62-1.77	0.857	
	Diploma	1.56	0.87-2.78	0.132	1.43	0.68-3.03	0.346	
	University educated	2.28	1.25-4.14	0.007	2.08	0.87-4.99	0.099	
Job	Employed	1			1			0.39
	Housewife	4.37	1.29-14.73	0.018	2.89	0.71-11.75	0.138	
	Retired	2.72	0.78-9.42	0.115	3.79	0.91-15.75	0.066	
Marital status	Single/divorced/widow	1			1			-
	married	0.88	0.62-1.27	0.516	1.37	0.82-2.29	0.223	
Life arrangement	Alone	1			1			-
	Not alone	0.96	0.62-1.49	0.856	1.22	0.67-2.25	0.512	
Smoking	Nonsmoker	1			1			-
	Current/former smoker	0.57	0.31-1.03	0.063	1.47	0.67-3.22	0.334	
BMI (kg/m²)	Underweight	1			1			0.30
	Normal	0.81	0.47-1.38	0.430	0.84	0.45-1.55	0.569	
	Overweight/obese	0.87	0.51-1.48	0.599	0.72	0.39-1.34	0.300	
WHR	Good	1			1			0.085
	Average	0.50	0.33-0.77	0.001	0.75	0.46-1.22	0.241	
	At risk	0.43	0.27-0.69	<0.001	0.69	0.39-1.20	0.185	
Number of comorbidities	None	1			1			0.28
	1	0.94	0.56-1.57	0.819	0.81	0.45-1.44	0.470	
	2	0.79	0.46-1.36	0.399	0.79	0.43-1.44	0.443	
	3 and more	0.47	0.27-0.81	0.007	0.62	0.33-1.17	0.141	
Activity level	Weak	1			1			0.018
	Low	1.04	0.70-1.53	0.855	0.98	0.62-1.53	0.927	
	Vigorous	2.04	1.24-3.34	0.005	2.17	1.20-3.92	0.010	
Antiosteoporosis medication	No	1			1			-
	Yes	5.99	2.88-12.48	<0.001	8.31	3.43-20.14	<0.001	

*For each variable, in adjusted model, other variables were covariates. METs were classified as weak (<600 MET-min/week), moderate (600-3000 MET-min/week), and vigorous (>3000 MET-min/week)

Table 4: Factors associated with serum 25(OH) D levels

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
Smoking	−18.45	12.80	−.097	−1.596	0.15
Osteoporosis	22.17	9.41	0.161	2.727	0.020
Vitamin D supplement use	52.10	9.32	0.382	1.614	<0.001
Sun exposure/day 1*	10.59	19.00	0.059	0.249	0.578
Sun exposure/day 2**	27.89	16.51	0.179	1.394	0.093

For each variable, other variables were covariates. Smoking: current/former smokers vs. nonsmokers. Osteoporosis: yes vs. no. Vitamin D supplement use: users vs. nonusers. *Sun exposure/day 1:<10 min. **Sun exposure/day 2: 10 min-1 h vs. more than 1 h

Maddah and Sharami found that vitamin D and calcium supplement use was 18.8% among postmenopausal women in Guilan.[14] Espino *et al*. reported that 10.6% of 2069 older Mexican Americans used calcium supplements.[13] Similarly, data from NHANES III demonstrated that 18.4% of 1825 subjects more than 60 years of age used calcium supplement.[11] Therefore, older individuals may be at high risk for bone loss and fall-related fractures due to inadequate intake of vitamin D and calcium.

Results of our study showed that the mean dietary intakes of both vitamin D and calcium were noticeably lower than recommended doses for the elderly. On the other hand, the mean intake of vitamin D and calcium supplements were significantly higher among women compared with men. In Espino *et al*. study, 13% of women and 7.2% of men took vitamin D and calcium supplements.[13] Likewise, supplements were more often used by females in NHANES III.[11] These results suggest that there should be a lot of attention to increase the awareness of older individuals of the necessity of these supplements use, particularly men.

Participants aged 71–89 years were less likely to take vitamin D and calcium supplement in comparison with those aged 60–62 but no significant association was seen after adjusting for other variables. However, supplement use was notably higher in older adults of NHANES III.[10] We found that a high proportion of vitamin D supplement users were in under diploma subgroup. In this regard, in contrast to our result, Maddah and Sharami reported that educated subjects were more likely to take supplements in comparison with those who were less educated.[14]

Our results demonstrated that participants in the lowest quartile of WHR were more likely to be supplement users compared with those in the highest quartile, which was consistent with data from NHANES 2003–2006.[18] and Rozga *et al*. study[19] which reported a positive association between normal weight and supplement use. But adjusted odds ratios showed no significant association between supplement use and WHR. In addition, our results showed that mean intake of vitamin D and calcium supplements was higher among participants who practiced moderate-to-high physical activities compared with those who had none or low physical activity which remained significant after adjustment. It has been indicated that individuals who practice healthier lifestyle are more likely to use dietary supplements.[20]

In the current study, nonsmokers were more likely to take vitamin D and calcium supplements, but not statistically significant. In Radimer *et al.* study, supplements were more often used by former smokers.[11] Participants who had diagnosed osteoporosis and those who took antiosteoporotic medications used more vitamin D and calcium supplements, as expected. Similarly, significant associations have been reported between supplement use and antiosteoporosis medications use in several cross-sectional studies.[13,21,22] It can be concluded that vitamin D and calcium supplements are prescribed by physicians to decrease bone loss in subjects with osteoporosis. Furthermore, our results indicated that an increasing number of comorbid illnesses was associated with decreased use of vitamin D and calcium supplements in this older population but no significant association was seen after adjustment. Espino *et al*. reported a direct association between supplement use and the number of comorbidities.[13] It can be concluded that increasing number of comorbidities might be associated with increased intake of multivitamin supplements but not vitamin D and calcium. This might be due to the adverse effects of calcium supplements on cardiovascular diseases which cause the elderly avoid calcium-D supplement use.

Mean serum 25(OH)D level in this subgroup of elderly was 44.4 nmol/L. Serum 25(OH)D levels have been categorized as low (<50 nmol/L), intermediate (50–80 nmol/L), and high (>80 nmol/L).[23] Serum 25(OH)D level was significantly higher in nonsmokers, subjects with osteoporosis and who took antiosteoporotic medications, participants who reported vitamin D supplement use, and those who had 10 min to 1 h sun exposure per day. But when analyzed in multiple linear regression model, only osteoporosis, supplement use, and total vitamin D intake were significant predictors of vitamin D status. Among 90 supplement users, serum 25(OH)D level was higher in subjects who took vitamin D supplements monthly and those who had been taking the supplement for more than 1 year. Results of the current study were consistent with several similar studies which investigated the predictors of vitamin D status in the elderly. Miettinen *et al*. reported that low physical activity, smoking, and high BMI were factors associated with low 25(OH)D concentration.[24] Results from a cross-sectional study in China demonstrated that serum 25(OH)D was higher in nonsmokers, subjects who practiced more physical activity, and those who took vitamin D and calcium supplements,[25] which was similar to Soteriades *et al*. study.[26] In Hintzpeter *et al*. study, after adjusting for covariates, vitamin D intake, being married or living with someone, and being physically active were positively associated with serum 25(OH)D.[27] Burgaz *et al*. and Brot *et al*. reported that regular vitamin D supplement use and taking a sun vacation were significantly associated with vitamin D status.[28,29] Millen *et al*. confirmed that serum 25(OH)D increased with increasing vitamin D intake, education, time spent outside, and physical activity.[30] Vitamin D status was influenced by body composition, economic factors, lifestyle, and supplement use in Jungert and Neuhäuser-Berthold's study.[31]

Strengths and Limitations

There might be several strengths and limitations to our results. This is the first population-based study covering the six geographical regions of Tehran. We measured all possible and major known potential confounders. However, we had some limitations. First, elderly adults who attend health centers may live a healthier life compared with general population. They may pay more attention to their health needs and represent a healthier population. Second, dietary intakes and frequency of supplement use are based on participants self-report, which is influenced by subject's memory and other subjective factors. Third, participant's illnesses were recorded based on their recall and were not confirmed.

Finally, we did not examine bone mineral density to compare with supplement use.

Conclusion

Vitamin D and calcium supplement use was low among this sample of Iranian elderly. Men and also lower educated subjects are particularly at high risk for osteoporosis and fall-related fractures. This study provides valuable data about risk factors that might be associated with vitamin D deficiency among women living in Tehran.

Therefore, more attention should be paid to increase the awareness of this population regarding the necessity of vitamin D and calcium use in order to prevent bone loss.

Conflicts of interest

There are no conflicts of interest.

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