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Educational program and Vitamin D Deficiency in Middle-aged Women living in Karaj, Iran

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Background: Vitamin D is a fat-soluble vitamin and is essential nutrient for metabolic and physiological processes in the human body**.** This study aimed to assess the effectiveness of educational program regarding vitamin D deficiency preventive behaviors and vitamin D supplement among middle-aged women living in Karaj, Iran.
Methods and Materials: Two hundred forty middle-aged women (30-60 years old) with vitamin D deficiency were randomly selected from referrers to comprehensive health centers after blood test. The selected individuals were randomly divided into three equal interventional groups of preventive behaviors education, supplemental consumption, combination of preventive behavior education and supplemental vitamin D consumption, and one control group with sample size of 60 individuals in each group. Six months after intervention, the level of vitamin D in serum of all subjects was measured and General Health Questionnaire (GHQ) was used to determine the subjects' general health.
Results: The results showed that the group which were educated to improve preventive behaviors and also were prescribed supplemental vitamin D was significantly better than the other groups regarding vitamin D deficiency improvement and general health score ($P < 0.05$). Combination of complementary and education was more effective than the other methods and significantly improved the general health ($PV < 0.0001$)
Conclusion: This study showed the simultaneous supplementary prescription and preventive behavior education was the most effective to prevent vitamin D deficiency.

Keywords: Vitamin D deficiency, Preventive Behaviors, Vitamin D supplement, General Health

Introduction

Vitamin D is a fat-soluble vitamin and is essential nutrient for metabolic and physiological processes in the human body. Vitamin D is a vitally important substance for the body due to its vitamin and hormonal role (Norman, *et al.,* 2005; Klishadi *et al.,* 2005). Exposure of the sun UVB rays with skin supply more than 90% of vitamin D of body's need (Moghbel, 2009). Reducing of cell proliferation, increasing cellular differentiation, stopping the growth of new blood vessels, and prevention of anti-inflammatory and prevent the formation of cancer cells are affected by vitamin D (Ahn *et al.,* 2008; Anderson *et al.,* 2010).

The supply of vitamin D from skin or biological diet is ineffective and requires two more hydroxyl linkages to become biologically active as vitamin D3 (Moyad, 2010). The high level of vitamin D, increases the absorption of calcium (80%) and phosphorus (30-40%) by intestines (Lips *et al.,* 2006; Lappe *et al.,* 2007; Harvard School, 2010; Chlebowski *et al.,* 2008).

Vitamin D has specific receptors on smooth muscle cells, heart muscle cells and many tissues of the body's organs such as neurons, immune cells, beta-pancreatic cells, vascular endothelial cells and osteoblasts. Vitamin D deficiency is a risk of chronic coronary heart disease, hypertension, diabetes mellitus, metabolic syndrome, left

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ventricular hypertrophy and chronic inflammation of the arteries. Chronic vitamin D deficiency is associated with hyperthyroidism, which, as a defective cycle, increases the incidence of vitamin deficiency (Zittermann, 2007; Holick, 2006; Harvard School, 2010; Chlebowski, *et al.,* 2008).

Vitamin D deficiency closely related to age, sex, body weight, skin color, location and genetics (Blum, *et al*., 2008). Studies on the association of vitamin D deficiency with diabetes type 1 showed that the hormonal system as an environmental agent could contribute to the self-destruction of beta cells and the development of diabetes (Reis *et al*., 2005). Vitamin D deficiency is a major pathogens in type 1 diabetes. Giving the vitamin D supplements at the time of the diagnosis and even at diagnosis of type 1 diabetes promotes the optimal response of the immune system by prevents further degeneration of beta cells. The type 2 diabetes is also effected by vitamin D deficiency.

There is a reverse relationship between vitamin D status and body mass index. Because of high prevalence of obesity, the low levels of vitamin D are expected in type 2 diabetes (Pozzilli *et al.,* 2005). The production of vitamin D in obese peoples comparing to tine ones is 50% lower (Blum *et al.,* 2008). Study on non-diabetic patients with more than 65 years old showed that receiving 700 units of vitamin D (plus calcium) comparing to placebo for more than 3 years reduced fasting blood glucose (Pittas *et al.,* 2007). Study on the effect of vitamin D on non-vertebral and hip fractures showed that vitamin D (with or without calcium supplements) decreased risk of non-vertebral (29%) and hip fractures (15%) in older adults (Holick *et al.,* 2004; Autier *et al.,* 2014). Due to these benefits of vitamin D, this study aimed to assess the effectiveness of educational program regarding vitamin D deficiency preventive behaviors and vitamin D supplement among middle-aged women living in Karaj, Iran.

Materials and Methods

This interventional study was conducted during spring and summer seasons in 2017 in Karaj. Sampling was performed randomly from middle aged women (30-59 years old) referring to comprehensive health centers. The pregnant women under the supervision of physician and those with underlying illness such as kidney and liver disease, endocrine disease, corticosteroid and anticonvulsants therapy were excluded. Demographic factors such as age, height and weight, veil type, characteristics of their house, habitat area, time of exposure to sunlight and the amount of sunblock lotion usage were recorded through a questionnaire. The vitamin D serum level (25 (D) OH) was determined by blood sample testing and people who had normal values of vitamin D were excluded. Finally, two hundred forty middle-aged women were selected and randomly divided into four equal groups. The general health of the subjects was assessed through a general health questionnaire (GHQ). This questionnaire consisted of 28 questions regarding to boredom, medical discomfort and general health status of the person during the last month. Two types of the answer such as 1) more than usual, usual (at all), less than usual, much lower than usual and 2) not at all, usual, more than usual, much higher than usual were included in GHQ-answers' options. The interventional groups are as following:

1) Group 1 as preventive behavior education group for which four sessions were hold (one session a week). The content of education was healthy nutrition method in middle age (based on the Medline Integrated Care Guidelines of the Health and Medical Education Ministry); useful effects of physical activity on the body; beneficial effects of sunshine light due to proper methods, right time usage of sunlight and barriers to use it, training of stretching/strengthen exercise and beneficial effects of vitamin D in the body. In addition, three sessions were held to reminder of previous meetings (one meeting per month). Poster, pamphlet, short messages, along training of sport movements with audio-visual equipment were considered as educational instrument. Review of previous information (15 minutes), education of new information (45 minutes), discussion and one week's performance reports, and self-reporting charts for 30 minutes were considered for each session.

2) Group 2 was as supplemental consumption of one Perl of 50,000 Units vitamin D and sending message once a month to subjects in order to use supplementation.

3) Group 3 was as combination of preventive behavior education and supplemental vitamin D consumption (group 1 & 2).

4) Group 4 was as control group means without education and supplementation.

All questionnaires were completed before intervention and again six months later by all groups. Blood test due to measure vitamin D was done at two time points before intervention and six month after intervention. For laboratory test, in the spring, two cc of blood in fasting form was obtained from samples in the local laboratory close to the place of subjects' residence and were

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transferred to the laboratory of Alborz Kahrizak institute at 4-8 °C temperature. The vitamin D (25 OH) of the serums' levels were measured with Euro-immune kits following to centrifugation.

Statistical analysis was performed using SPSS software (version 21). Normality of variables was confirmed by Kolmogorov-Smirnov test and the mean and standard deviations of variables were calculated. P value less than 0.05 was considered as significant level. As an interventional study, all ethical principals were considered in this study. This study was registered and approved at Ethics committee of Tarbiat Modares University.

Result

The results of Kolmogorov Smirnoff analysis showed that the data of studied variables in each group were normal (Table 1). The demographic data of the samples are presented in Table 2.

Table 1. The results of Kolmogorov-Smirnov test of four groups before and after intervention.

Group	Kolmogorov-Smirnov Before intervention		Kolmogorov-Smirnov After intervention		Kolmogorov-Smirnov Before intervention		Kolmogorov-Smirnov After intervention	
	Vitamin D	Sig.	Vitamin D	Sig.	General health	Sig.	General health	Sig.
Group 1	1.052	0.218	1.428	0.064	1.171	0.129	0.860	0.451
Group 2	1.112	0.165	0.972	0.301	1.117	0.165	1.131	0.155
Group 3	1.131	0.155	1.119	0.163	2.110	0.065	0.928	0.355
Control group	0.870	0.435	0.781	0.575	2.147	0.071	2.237	0.058

Table 2. Frequency of demographic variations at beginning of the study.

Variation	Category	Group 1 (N = 60)		Group 2 (N = 60)		Group 3 (N = 60)		Group 4 (N = 60)	
		No	Percent	No	Percent	No	Percent	No	Percent
Age	30-34	22	36.7	28	46.7	25	41.7	24	40
	35-39	17	28.3	9	15	18	30	11	18.3
	40-44	10	16.7	12	20	8	13	10	16.7
	45-49	3	5	6	10	3	5	8	13.3
	50-54	6	10	3	5	4	6	3	5
	55-59	2	3.3	2	3.3	2	3.3	4	6.7
Weight	40-49	1	1.7	0	0	1	1.7	1	1.7
	50-59	5	8.3	9	15	8	13.3	8	13.3
	60-69	28	43.3	32	53.3	23	38.3	26	43.3
	70-79	21	35	15	25	21	35	19	31.7
	80-89	6	10	4	6.7	5	8.4	5	8.3
	<90	1	0.7	0	0	2	3.3	1	1.7
BMI	>18.5	1	1.7	3	5	1	1.7	0	0
	18.5-24.9	16	26.6	14	23.3	15	25	14	23.3
	25-29.9	37	56.7	36	63.4	33	55	35	58.4
	<30	7	15	5	8.3	11	18.3	11	18.3
House geographically region	North	29	48.3	22	36.7	17	28.3	25	41.7
	South	21	35	25	41.7	33	55	23	38.3
	West-East	10	16.7	13	21.7	10	16.7	12	20
Type of house	House	30	50	25	41.7	33	55	32	53.3
	Flat	30	50	35	58.3	27	45	28	46.7
Type of veil	Chador	45	75	48	80	46	76.7	43	71.7
	Mantou	15	25	12	20	14	23.3	17	28.3
Number of pregnancy	0	3	5	1	1.7	2	3.3	4	6.7
	1	6	10	4	6.7	11	18.3	7	11.7
	2	23	38.3	32	53.3	28	46.7	23	38.3
	3	20	33.3	16	26.7	12	20	17	28.3
	4	5	8.3	3	5	0	0	6	10
	5	1	1.7	1	1.7	2	3.3	2	3.3
	6	1	1.7	2	3.3	3	5	1	1.7
	7	1	1.7	1	1.7	2	3.3	0	0
Number of child	0	3	5	2	3.3	2	3.3	4	6.7
	1	6	10	3	5	11	18.3	7	11.7
	2	23	38.3	32	53.3	28	46.7	24	40
	3	21	35	16	26.7	12	20	17	28.3
	4	4	6.7	3	5	0	0	5	8.3
	5	1	1.7	1	1.7	2	3.3	2	3.3
	6	1	1.7	2	3.3	3	5	1	1.7
	7	1	1.7	1	1.7	2	3.3	0	0
Literacy level	Illiterate	4	6.7	5	8.3	6	10	4	6.7
	Elementary	17	28.3	15	25	11	18.3	19	31.7
	Secondary	27	45	26	43.3	24	40	19	31.7
	Diploma	12	20	13	21.7	18	30	17	28.3
	Upper Diploma	0	0	1	1.7	1	1.7	1	1.7
Height	150-159	18	30	28	46.7	24	40	22	36.7
	160-169	41	65	27	45	33	55	37	61.6
	170 <	3	5	5	8.3	3	5	1	1.7

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Analysis of variance for vitamin D level showed that there is a significant difference between the groups (Table 3). The mean comparison revealed that the mean levels of serum vitamin D in group 1 and group 2 significantly were increased. Increasing of levels of serum vitamin D causing by preventive behavior education and supplementation were shown in Table 4. Combination of supplement and preventive behavior education (group 3) significantly increased the level of vitamin D as 17.71 units that was significantly higher than the other groups. Diversity of average level of vitamin D was negligible for control group during the study.

Table 3. Analysis of variance for Vitamin D.

Source of variation	df	Mean Square	F	Sig.
Between Groups	7	2053.339	38.531	<.0001
Within Groups	472	53.291		
Total	479			

Table 4. The Mean and standard deviation of vitamin D before and after intervention.

Group	Before intervention		After intervention		Sig.
	Mean Vitamin D	SD	Mean Vitamin D	SD	
1	15.71	7.90	21.63	7.07	< .0001
2	15.33	7.94	21.40	7.13	< .0001
3	14.29	6.94	32	5.69	< .0001
4	16.64	8.59	16.54	6.72	1.000

Simultaneous comparison of the vitamin D and general health score showed that varieties in the control group were not significant during the study, but it was positive and significant where educational interventions was applied (Table 5). Combination of complementary and education was more effective than the other methods and significantly reduced the general health score from 63.36 ± 11.25 to 40.88 ± 5.9 (PV < 0.0001).

However, the average level of vitamin D in the first group (preventive behavior) was approximately equal to the second group (supplementation), but increasing of general health in the first group was significantly higher than the second group (P < 0.05). The reduce rate of average general health score was 22.88, 4.38, 25.92 and 0.2 for group 1 to 4, respectively.

Table 5. The Mean and standard deviation of general health score before and after intervention.

Group	Before intervention		After intervention		Sig.
	General Health score (Mean)	SD	General Health score (Mean)	SD	
1	63.36	11.25	40.88	5.9	<.0001
2	60.96	13.26	56.58	12.26	0.813
3	63.28	14.58	37.36	3.91	<.0001
4	64.38	11.14	64.58	10.98	1.000

Discussion

The results of present study showed that intervention was associated with changes in serum levels of vitamin D and general health. The effect of preventive behaviors education on general health was higher than supplementation prescription. It seems that education of preventive behaviors via discussing and expressing the different views among the group, self-reporting of experiments of the subject caused samples to be motivated for doing preventive behaviors. In the current study, the studied groups had behavioral changes as small groups and it increased the mean levels of vitamin D in the intervention groups. presences in the small educational groups (the method used in this research) has been very effective in verifying positive attitudes rather than negative attitudes and increasing general health due to the wider and more comprehensive discussion. Although, various research study showed that vitamin D deficiency reduced general health (Spedding, 2014; Parker *et al.,* 2016) but there is no evidence of the most effective way to compensate. Furthermore, the increase of vitamin D causing by preventive behaviors was

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approximately equal to supplemental intake, but general health due to preventive behaviors was more than the supplementation. Physical activity and exercising in outdoor, using sunlight and proper nutrition as part of the educational program of preventive behaviors seem to increased general health due to induce emotional and joyfulness in people and creating a better mood. Etemad *et al.* (2010) stated that exercise is effective in improving the health of the community and in order to improve the quality and lifestyle, physical activity should be done regularly and with appropriate intensity. Regular and proper physical activity levels cause favorable changes in some cardiovascular risk factors which increase the health of the community (Boule *et al.,* 2001).

In this study the mean level of vitamin D and general health were observed when supplementary completed by behavioral training compared to when each was independently used.

Although, the participants in the current research were in the early stages of thinking and the tendency to change their behavior, but training programs implemented in small groups made a very good subjects' participation and created an appropriate behavior in participant and subsequently improved the general health.

Trust and colleagues (2011) confirmed this obtained results and declared that the presentation of the educational program based on the health promotion model, not only increased effectively the physical activity, but also had a very favorable participation in the participant despite the difficulty of changing. The research results of Taymoori *et al.,* (2008) showed that physical activity behavior constancy was increased by training based on the combination of fitness and health promotion. Krick *et al.,* (2004) stated that individual counseling in diabetic patients increased physical activity and improved cardiovascular fitness in these patients. The results of the cross-analytical researches evaluated the effect of structured training on increasing physical activity in diabetic patients and showed that the education was effective and increased physical activity and cardiopulmonary respiration (Boule *et al.,* 2001; Boule *et al.,* 2001). Despite the strengths points of this study, self-reporting questionnaires may conflict the results of this study. However, these obtained results are supported with many existed evidences.

Conclusion

This study showed the simultaneous supplementary prescription and preventive behavior education was the most effective to prevent vitamin D deficiency. Therefore, designing preventive behaviors educational program as well as vitamin D prescription as a supplement is strongly recommended.

Conflict of interest

No conflict of interest declared.

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Author contribution

ZGR designed the research and conducted all stages of the study and drafted the manuscript.

SST supervised the study and verified the manuscript.

ED visited the participants and confirmed the eligibility and verified the manuscript.

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