Original Article

Vitamin D Status among Bangladeshi Adult Muslim Females Having Diabetes and Using Hijab

Shefin SM[a], Qureshi NK[b], Nessa A[c], Latif ZA[d]

Abstract

Background: *This study was done to evaluate vitamin D level and status among Bangladeshi muslim women and to see association between vitamin D level and residence status, sunlight exposure, glycemic status, using hijab with exposed face and hands.*

Methods: *This cross-section observational study was conducted during January 2015 to July 2017 among 353 Bangladeshi non-pregnant muslim female subjects aged e" 18 years who attended an urban endocrine clinic with complaints of myalgia, fatigability, muscle cramp etc. Subjects who were on vitamin D supplement/ treatment, suffering from mal-absorption syndrome, hepatic impairment, renal impairments, severe co-morbid conditions were excluded. Diabetic subjects were selected as per clinical history, HbA1c%, OGTT (oral glucose tolerance test) criteria or who already were receiving treatment for diabetes. Data were collected by face-to-face interview and medical documents review and vitamin D level was tested with standard laboratory procedure. Subjects were enquired about using hijab with exposed face and hands with duration of years. Vitamin D status was defined as "deficient" with level of serum 25 (OH) vit D d"20 ng/ml, "insufficient" with level from 20.01 to 29.9 ng/ml and "sufficient" with level from 30 to 100 ng/ml. Data were analyzed with IBM SPSS for Windows version 20. The significance was tested by using un-paired T test and Chi-square test.*

Results: *A total of 353 Bangladeshi muslim female were studied. Among them 332 (94.1%) were urban dwellers. Mean age was 40.66 ±13.80 years, mean vitamin D level was 17.27±7.47 ng/ml, while 71.67% subjects were vitamin D deficient and 22.66% subjects were insufficient. Residence status (urban and rural) showed no significant association with vitamin D level and status [p 0.074 and p 0.28 respectively]. Vitamin D insufficient subjects were more aged than deficient subjects [p 0.01]. Vitamin D level was not significantly different in regard to difference in sunlight exposure [p 0.70]. Diabetic (46.2%) and non-diabetic (53.8%) subjects had similar residence status [p 0.824]. Diabetic subjects were more aged than non-diabetic subjects [p 0.001] and vitamin D level was not significantly different among them [p 0.126 and p 0.28 respectively]. Among studied subjects 32.9% (n=116), mostly urban dwellers, never used hijab and they had mean vitamin D level as 17.04±7.77 ng/ml, while 30.3% (n=107) subjects used hijab more than 15 years with exposed face and hands and they had mean vitamin D level as 18.52±8.07 ng/ml. Difference of vitamin D levels and vitamin D were not significant among hijab users and non-users [p 0.16 and p 0.13 respectively].*

Conclusion: *The study revealed that most of the studied Bangladeshi muslim female urban dwellers had vitamin D deficiency and insufficiency which was not significantly influenced by glycemic status, residence status, level of sunlight exposure and using hijab. Large scale population based study is needed to elucidate findings of the current study.*

Key Words: *Vitamin D, Diabetes, Hijab.*

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Author Information

a. Dr. Sultana Marufa Shefin, Assistant Professor, Department of Endocrinology, Ibrahim Medical College & BIRDEM General Hospital, Dhaka, Bangladesh.

b. Dr. Nazmul Kabir Qureshi, Consultant, Dept. of Endocrinology & Medicine, National Healthcare Network, Dhaka, Bangladesh.

c. Dr. Azimun Nessa, Senior Medical Officer, Department of Endocrinology, BIRDEM General Hospital, Dhaka, Bangladesh.

d. Prof. Zafar Ahmed Latif, MBBS, FCPS, FACE, Professor, Department of Endocrinology, Ibrahim Medical College & BIRDEM General Hospital, Dhaka, Bangladesh.

Address of Correspondence: Dr. Sultana Marufa Shefin, MBBS, MD, FACE. Assistant Professor (Endocrinology), Ibrahim Medical College & BIRDEM General Hospital, 122 Kazi Nazrul Islam Avenue, Shahbagh, Dhaka 1000, Bangladesh. Email: shefin_neon@yahoo.com

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Introduction

Vitamin D is a fat- soluble substance which becomes a hormone after activation[1]. It is found in two forms; vitamin D2 or ergocalciferol that is manufactured by plants or fungus and vitamin D3 or cholecalciferol which is the most effective form in human body[2]. The most important source of vitamin D3 is exposure of skin to sunlight (ultra violet A rays and ultra violet B rays) and under normal conditions the skin is able to supply the body 80-100% of the vitamin D requirement[3]. Rest of required vitamin D3 can also be obtained through consuming animal products such as salmon, tuna, sardines, fish liver oils, beef liver, cheese, egg yolks

and dietary supplements[4]. Major biologic function of vitamin D3 in humans is to maintain serum calcium and phosphorus concentrations within the normal range by enhancing the efficiency of the small intestine to absorb these minerals from the diet.[1,2] Serum concentration of 25(OH)D is the best indicator of vitamin D3 status.[2,5]

Human body needs vitamin D for growth and development as well as to reduce risk of osteoporosis and osteomalacia in adults and to prevent rickets among children[2]. According to the National Osteoporosis Foundation (NOF), vitamin D requirement for adults under the age of 50 is 400 - 800 IU per day and age 50 and above is 800 - 1,000 IU per day.[2]

A recent study has shown that rickets among teenagers in Saudi Arabia are undiagnosed and are associated with deficiencies in vitamin D[6] .Another study done in Morocco demonstrated that low levels of vitamin D increases risk for osteoporosis.[7]

In many studies, it has been found that vitamin D insufficiency is associated with increase in risk of colon, breast and prostate cancer, type 1 diabetes mellitus, Crohn's disease, multiple sclerosis, hypertension, and cardiovascular disease.[8,9] Its deficiency may also be associated with hypertension, secondary hyperthyroidism, myopathy and fibromyalgia.[10] Low serum levels of serum 25 (OH) vit D are related to increased cardiovascular mortality in a national U.S. sample, particularly among dark skinned people.[11]

Limited exposure to sunlight, that results from decreased ambient light and living in countries located at northern latitudes, seasonal variation, time of day when exposed to sunlight, usage of sunscreen, may lead to vitamin D insufficiency or deficiency. Lowered production of vitamin D may also result due to being a dark skinned individual.[1,8,9,12]

Covering entire body surface for religious or cultural reasons when outdoors (muslim religious dresses e.g.; hijab, niqb, burkha) which is practiced by many muslim women[1.8.9.12] may result into limited exposure to sunlight. Among muslim women, the degree of covering the skin also varies. Hence, several studies have been conducted among muslim women regarding this issue and many found significant level of insufficiency or deficiency of D vitamin among them.[10,11,12]

This study was done to evaluate vitamin D level and status among Bangladesh muslim women and to see association between vitamin D level and residence status, sunlight exposure, glycemic status, using muslim religious dress hijab that covers whole body with exposure of face and hands only.

Methods

This cross-section observational study was conducted during the period of January 2015 – July 2017. Studied subjects were randomly selected among Bangladeshi non-pregnant muslim female aged ≥18 years who attended an urban endocrine clinic with complaints of myalgia, fatigability, muscle cramp etc.

Diabetic subjects were selected as per clinical history, HbA1c%, OGTT (oral glucose tolerance test) criteria or who were receiving treatment for diabetes. Subjects were enquired about using hijab that covers whole body with exposure of face and hands only with duration of years of its use. History of sun-exposure was taken. Usually 10–15 min outdoors sun exposure in summer environment, two to three times in a week, is considered to be adequate/sufficient sun exposure for effective vitamin D production in the skin.[13]

Subjects who were on vitamin D supplement/treatment, pregnant, on lactation, suffering from mal-absorption syndrome, hepatic impairment, renal impairments, and severe co-morbid conditions were excluded from the study.

After selection, data were collected in a pre-formed standard printed data collection form by face-to-face interview and medical documents review after explaining the study purpose, procedure and taking informed consent. Studied subjects were tested for vitamin D level with standard laboratory procedure. Vitamin D status was defined as "Deficient" with level of serum 25 (OH) vit D was ≤20 ng/ml, "Insufficient" with level from 20.01 to 29.9 ng/ml and "Sufficient" with level from 30 to100 ng/ml.[14] All co-researcher involved in data collection were briefed and trained before commencement of the study. Primary outcomes of this study were vitamin D level in ng/ml and vitamin D status as deficiency, insufficiency, sufficient among diabetic, non-diabetic muslim women and among women using hijab with exposed face and hands and not using so.

Statistical analysis

Data were collected in pre-formed record form and were analyzed with IBM SPSS (Statistical Package for Social

Science) for Windows version 20 (IBM SPSS Statistics for Windows, Version 20.0. IBM Corp. Armonk, NY, USA). The means and standard deviations were used to describe continuous data. For categorical data, frequencies and percentages were estimated. The significance of differences was tested by using the un-paired T test and Chi-square test. Statistical significance was set at $P < 0.05$.

Results

A total of 353 Muslim women were studied. Among them, 332 (94.1%) were urban dwellers. As mean ± SD, subjects had age as 40.66 ±13.80 years and of serum 25 (OH) vit D level as 17.27±7.47 ng/ml.

According to vitamin D status, 253 (71.67%) subjects had vitamin D deficiency and 80 (22.66%) subjects were insufficient. Mean age was more of subjects having vitamin D insufficiency [44.57±15.98 vs 39.23±12.86 years, p 0.01] than that of subjects having deficiency (Table I). Residence status (urban and rural) was not different among them [p 0.074 and p 0.28 respectively].

Among studied subjects, 277 (78.5%) had adequate exposure to sunlight and rest (21.5%) had less exposure to sunlight. Mean age was more of subjects who had inadequate sunlight exposure than that of who had adequate sunlight exposure [43.46±16.29 vs 39.89±12.97 years, p 0.05]. Mean of vitamin D levels were similar among subjects having adequate and inadequate sunlight exposure [17.33±7.37 vs 17.08±7.87 ng/ml, p 0.70]. (Table II)

According to glycemic status, subjects were grouped as diabetic (n=163, 46.2%) and non-diabetic (n=190, 53.8%). Residence status (urban vs rural) was not different among groups [p 0.824]. Mean age of diabetic subjects were more than that of non-diabetic

Table I Vitamin D Level and Status among 353 Muslim Bangladeshi Females

Vit D status(ng/ml)	Urban		Rural		Age (years)	Vitamin D level (ng/ml)	DM	Non-DM
	N	%	N	n	Mean ± SD	Mean ± SD	N	n
Deficient (d"20)	253	71.67	242	11	39.23±12.86	13.53±3.82	111	142
Insufficient (20.01-29.9)	80	22.66	71	9	44.57±15.98	24.41±2.87	40	40
Sufficient (30-100)	20	5.67	19	1	43.00±13.36	36.09±5.65	12	8
	Total=353	100%	332	21				
			P 0.074		P 0.01	P 0.001	P 0.28	

N.B.: Among 353 Muslim women, 332 (94.1%) were urban dwellers. Mean age was more of vitamin D insufficient subjects [44.57±15.98 vs 39.23±12.86 years, p.01] than that of deficient subjects.**DM:** Diabetes Mellitus.

Table II Association of Vitamin Status with Sunlight Exposure

Sunlight Exposure	Urban(n)		Rural(n)		Age (years)	Vitamin D(ng/ml)
	N	%	n	n	Mean ± SD	Mean ± SD
Adequate	277	78.5	257	20	39.89±12.97	17.33±7.37
Inadequate	76	21.5	75	1	43.46±16.29	17.08±7.87
	Total=353	100.0	332	21	P 0.05	P 0.70

N.B.: 78.5% subjects had adequate exposure to sunlight. Mean age was more of subjects who had inadequate sunlight exposure. Mean of vitamin D levels were similar among subjects having adequate and inadequate sunlight exposure. Usually 10–15 min outdoors sun exposure in summer environment, two to three times in a week, is considered to be adequate/sufficient sun exposure for effective vitamin D production in the skin.

subjects [47.06±11.76 vs 35.19±13.08 years, p 0.001]. Mean of vitamin D level were not significantly different among the groups [17.93±8.13 vs 16.71±6.82 ng/ml p 0.126] and vitamin D status was similar among groups [deficiency as 111 vs 142 subjects, Insufficiency as 40 vs 40 subjects respectively, p 0.28].(Table III)

Among studied subjects, 32.9% (n=116) never used Hijab and they were mostly urban dwellers (n=111). They had mean age of 39.80±13.67 years and mean vitamin D level as 17.04±7.77 ng/ml while 30.3% (n=107) subjects used Hijab with exposed face and hands more than 15 years and they had mean age of 49.79±11.52 years and mean vitamin D level as 18.52±8.07 ng/ml. Among these two groups, mean age was more in subjects who used Hijab [p 0.001] but difference of vitamin D levels and vitamin D status were not significant [p 0 0.16 and p.13 respectively]. (Table IV)

Table III Vitamin D level and status among diabetic and non-diabetic Muslim female subjects

T2DM group	Urban		Rural			Age (years)	Vitamin D		Vit D Status
	N	%	n	n	Mean ± SD	Mean ± SD	Deficient	Insufficient	Sufficient
Total	353	100%	332 (94.1%)	21 (5.9%)	40.66 ±13.80	17.27±7.47	253(71.67%)	80(22.66%)	20(5.67%)
DM	163	46.2%	154	9	47.06±11.76	17.93±8.13	111	40	12
Non-DM	190	53.8%	178	12	35.19±13.08	16.71±6.82	142	40	8
			P 0.824	P 0.001	P 0.126	P 0.28			

N.B.: Residence status was not different among groups. Mean age of diabetic subjects were more than that of non-diabetic subjects. Mean of vitamin D level was not significantly different and vitamin D status was similar. **DM**: Diabetes Mellitus, **SD**: Standard Deviation.

Table IV Association between vitamin D level and using Hijab with exposed face and hands

Hijab with exposed face and hands	Urban		Rural		Age (years)	Vitamin D	Deficient (up to 20ng/ml)	Insufficient (20.01-29.99 ng/ml)	Sufficient (30-100 ng/ml)
	N	%	n	n	Mean ± SD	Mean ± SD	n	n	N
Never used	116	32.9	111	5	39.80±13.67	17.04±7.77	83	26	7
Up to 5 y	46	13.0	43	3	31.40±13.00	15.67±6.52	40	4	2
6-10 y	48	13.6	45	3	34.91±10.66	17.63±7.55	34	11	3
11-15 y	36	10.2	33	3	35.97±10.01	15.90±4.86	29	7	0
>15 y	107	30.3	100	7	49.79±11.52	18.52±8.07	67	32	8
Total Subjects	353	100.0	332	21	40.66±13.80	17.27±7.47	253	80	20
			P 0.90	P 0.001	P 0.16	P 0.13			

N.B.: 32.9% (n=116) female never used Hijab who were mostly urban dwellers (n=111) while 30.3% (n=107) subjects used Hijab with exposed face and hands more than 15 years. **SD:** Standard Deviation.

Discussion

This cross-section observational study evaluated vitamin D level and status among diabetic and non-diabetic, 353 adult muslim female Bangladeshi subjects using or not using hijab with exposed face and hands.

Most of the subjects (94.1%) were urban dwellers with mean age of 40.66 ±13.80 years and mean vitamin D level of 17.27±7.47 ng/ml. Among study subjects 71.67% were vitamin D deficient and 22.66% subjects were insufficient and residence status (urban and rural) showed no significant association with vitamin D level and status. Vitamin D insufficient subjects were more aged than deficient subjects. Vitamin D level was not significantly different in regard to difference in sunlight exposure.

In this study, diabetic and non-diabetic subjects had similar residence status. Diabetic subjects were more aged than non-diabetic subjects. Vitamin D level was not significantly different among the groups and vitamin D status was not significantly different as well.

Several studied have been conducted previously among Bangladeshi women to find out vitamin D status and to find factors influencing level of this vitamin. A study conducted upon premenopausal Bangladeshi women investigated influence of socio-economic -residence status (urban versus rural) and physiological status (pregnant versus non-pregnant) on serum 25 (OH) vit D concentration (P 0.038, P 0.015, respectively). The distribution of serum 25 (OH) vit D concentrations in both groups was shifted overall toward the lower limit of the normal range. Seventeen percent of women in low socioeconomic and 12% of women in high socioeconomic group had serum 25 (OH) vit D concentrations < 25 nmol/l. Hypovitaminosis D (serum 25-OHD concentration 37.5 nmol/l) was observed in 50% of subjects in low socioeconomic and 38% of subjects in high economic group, respectively. The prevalence of hypovitaminosis was higher in lactating subjects of both low and high socioeconomic groups (63% and 46%, respectively) suggesting that lactation was an additional risk factor for vitamin D deficiency.[15]

Another cross-sectional study evaluated vitamin D status in three groups of women in Bangladesh aged 18-60 years. Study subjects included non-veiled young women (N = 36, mean+/- SD age 22.3 +/- 1.9 years), veiled women (N = 30, mean+/- SD age 47.7+/- 9.4 years) and non-veiled diabetic women (N = 55, mean +/- SD age 50.2 +/- 5.9 years). The mean value of serum 25 (OH) vit D was not significantly different in the groups (P > 0.05). The distribution of serum 25 (OH) vit D concentrations in all groups was shifted overall toward the lower limit of the normal range. Vitamin D deficiency [serum 25 (OH) vit D level <25 nmol/l] was detected in 39% of young women, 30% in veiled women and 38% in diabetic women, respectively. Vitamin D insufficiency [serum 25 (OH) vit D level <40 nmol/l] was detected as 78%, 83% and 76% in corresponding groups, respectively.[16]

A recent cross sectional observational study conducted among 212 subjects (female 73.6% and rest male) aged 18 years and above presented with generalized body aches and pains found that prevalence of vitamin D deficiency was 100% in all age groups. Mean vitamin D level among male was 14.29 (SD 4.68) and among female was 12.64 (SD 4.74). The factors associated with severely deficient vitamin D level were female sex, urban population, & obesity.[17]

Studied conducted upon muslim women in other regions of the world showed similar status of vitamin D. A study conducted in Morocco among 415 adult women between the ages of 24 and 77 showed that 91% of women had low levels of vitamin D.[10] Study among Danish Muslim women who had a moderate vitamin D intake, vitamin D deficiency were still found.[3] In a study undertaken among Arab-American Muslim women who lived in a traditional Islamic cultural pattern were shown to have severe vitamin D deficiency as well.[6] While examining Muslim women who immigrated to western regions, 25 (OH) vit D deficiency was found very common.[6] Some studies have also shown that veiled women who have immigrated to the West appear to have hypovitaminosis D prior to and after immigration.[18]

This study revealed that 32.9% study female, mostly urban dwellers, never used hijab and they had mean vitamin D level as 17.04±7.77 ng/ml while 30.3% subjects used hijab with exposed face and hands more than 15 years and they had mean vitamin D level as 18.52±8.07 ng/ml. However, difference of vitamin D levels and vitamin D status were not significant among hijab users and non-users.

There were few limitations of the study. It was a small-scale clinic-based study. Rural representation in the

studied subjects was less which lacks uniformity of studied population. Sample size was small and was selected from a single center with particular health care facilities that cannot be generalized over the whole population. Age-grouped analysis was not done. Despite limitations, the study points towards that while considering current recommended cut-off levels, vitamin D may not be found optimum among most of the Bangladeshi women which was not influenced by glycemic status, level of sun-light exposure and using hijab.

There may be many confounding factors that are able to influence vitamin D concentration which has not been properly considered yet. Other than exposure to sunlight, use of sunscreen, naturally dark skin tone, season, geographic latitude, clothing and institutionalization, the increase in air pollution might have an effect on the quality of sunlight and may reduce the production of 25 (OH) vit D in the body.[18] Other physiological factors like age, body mass index, extracellular volume and vitamin D binding globulin concentration and affinity can also influence the concentration of vitamin D in the body.[18,19] The racial difference in vitamin D metabolism is also an important factor and need to be considered as the mean levels of total serum 25 (OH) vit D are usually lower in blacks than in whites with a low level of vitamin D binding globulin, which makes the overall bio-available 25 (OH) vit D more or less similar in both races.[20]

Dietary and social cultural activities are also heterogeneous in this region. Hence, current recommended reference levels of vitamin D may not be representative for Asian or South East Asian population. A large scale multinational population base study has to be conducted to find out find answers to these issues and to formulate normal vitamin D reference levels for this region.

Conclusion

The study revealed that according to current recommended reference levels, most of the studied Bangladeshi muslim female urban dwellers had vitamin D deficiency and insufficiency. In this study, it has also been found that vitamin D level was not significantly influenced by glycemic status, residence status, level of sunlight exposure and using hijab. Large scale population-based study is needed to evaluate magnitude of the problem and elucidate findings of the current study.

Conflicts of interest: Nothing to declare.

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