Knowledge, Attitude and Perceptions of the population towards Vitamin D in Jeddah, Saudi Arabia

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Abstract

Background: There is a significant presence of Vitamin D deficiency in the Middle East, and among school children, and university students, in Saudi Arabia.

Objectives: to explore the Knowledge, Attitude and Perceptions of the population towards Vitamin D in Jeddah, Saudi Arabia

Method: It was a cross-sectional study of 880 subjects, who gave their responses through an online Google form. A standardized questionnaire on assessment of Awareness, Knowledge, Attitude, and the Practice of Vitamin D consumption among the General population was used. In addition the Fitzpatrick scale of skin types IV – V, was used. The software SPSS (IBM compatible version 23), was used to analyze the data. Chi square test was used. The level of significance for the present study was 0.05.

Results: 373 subjects (42.4%) consumed Vit. D supplements; the majority of them were females (70.8%). There is no relationship between Vit-D consumption and level of education. It was significantly related to light or pale white-type of skin; and associated with hearing about Vit. D from media or friends and family or health professionals. Use was associated with significantly more knowledge about availability of Vit-D in fortified food, nuts and dairy products. They also knew that exposure to sunlight was important for source of Vit. D. They had reasonable knowledge about the importance of Vit. D. They think that dietary sources of Vit. . D are not sufficient to maintain Vit. . D levels, and knew that Vit. D prevents rickets, and is important for hair growth. There was a lack of knowledge about the RDA for Vit. D. There was significant association between taking Vit. D supplements and wearing sunscreen.

Conclusions: The majority of participants possessed good knowledge about Vitamin D and they identified sun exposure as the main source of vitamin D. However, there is a lack of consistency between knowledge and attitude towards improving vitamin D levels in their sera. This indicates the need to improve awareness among the Saudi population by providing specific guidelines about the frequency, duration, optimum season and amount of exposure to sunlight required, as well as the importance of fortification of food.

Key words: KAP of Vit. D, Determinants, Saudi Arabia

Introduction

The ultraviolet (UVB type) sunlight activates 7-dehydrocholesterol in the skin to produce the fat soluble cholecalciferol (or Vitamin D). It is metabolized in the liver to form 25-hydroxy vitamin D and then the kidneys convert it into 1,25 (OH) D, which is considered the most active metabolite of vitamin D (1, 2).

Vitamin D levels are reduced in younger adults and in men when compared to women, and inversely related to BMI (1). Those who are not exposed to sunlight are unlikely to obtain adequate vitamin D from sunlight. Knowledge and concern about vitamin D were the main determinants of vitamin D supplement use. The basic knowledge about vitamin D has been observed in previous studies among Saudi school girls, and female Saudi university students, and Saudi women. There is a significant presence of Vitamin D deficiency in the Middle East. It is significantly related to education level. People are exposed to a lot of information from several sources (3). The media was often used for getting the information about Vit. D by men, and a distinction was observed between television (more cited by younger individuals and those with lower education or income), and newspapers and radio (more cited by older subjects and those with higher income). School/university was more frequently quoted by younger, better-educated subjects and those with higher income (3,4). Black skinned people absorb more UVB in the melanin of their skin than do white people and, therefore, require more sun exposure to produce the same amount of vitamin D (5).

Few foods naturally contain vitamin D. The flesh of fatty fish (such as trout, salmon, tuna, and mackerel) and fish liver oils are among the best sources. An animal's diet affects the amount of vitamin D in its tissues. Beef liver, egg yolks, and cheese have small amounts of vitamin D, primarily in the form of vitamin D3 and its metabolite 25(OH) D3. Mushrooms provide variable amounts of vitamin D2 (6, 7). In addition, most steps in the metabolism and actions of vitamins D2 and D3 are identical. However, most evidence indicates that vitamin D3 increases serum 25(OH) D levels to a greater extent and maintains these higher levels longer than vitamin D2, even though both forms are well absorbed in the gut (8-10). Certain malabsorption syndromes such as celiac disease, short bowel syndrome, gastric bypass, inflammatory bowel disease, chronic pancreatic insufficiency, and cystic fibrosis may lead to vitamin D deficiency. Lower vitamin D intake orally is more prevalent in the elderly population (11). About 50% to 90% of vitamin D is absorbed through the skin via sunlight while the rest comes from the diet. Twenty minutes of sunshine daily with over 40% of skin exposed is required to prevent vitamin deficiency (4). Cutaneous synthesis of vitamin D declines with aging. Dark-skinned people have less cutaneous vitamin D synthesis. Decreased exposure to the sun is seen in individuals who are institutionalized, or have prolonged hospitalization can also lead to vitamin D deficiency. Medications such as phenobarbital, carbamazepine, dexamethasone, nifedipine, spironolactone, clotrimazole, and rifampin induce hepatic p450 enzymes which activate degradation of vitamin D. End organ resistance to vitamin D can be seen in hereditary vitamin D resistant rickets (11).

Vitamin D3 (VitD3) is known to play a role in the skin barrier function, as it modulates structural proteins of the cornified dermis layer, regulating the glycoseramides essential for the hydrating protective lipid barrier which keeps the skin moisturized. It modulates innate immunity via the production of the anti-microbial peptides (AMPs) cathelicidin and defensin which can help reduce skin infection risk. In addition, Amon et al. (2018) discussed how vitamin D has inhibitory effects on monocyte production (via Toll-like receptors) as well as inhibiting dendritic cell activity and increasing mast cell release of IL10. They also discussed how vitamin D reduces the release of pro-inflammatory cytokines from Th1 cells and inhibits the release of IgE by reducing B cell function (12).

There is consensus that daily intake of 400 IU of vitamin D can prevent nutritional rickets in infants and children. Many observational studies suggest a link between low vitamin D status and T2DM (13). Clearly daily intake >400 IU/day is necessary to reduce the reported rates of deficiency in the UK (14). Homebound individuals; people who wear long robes, dresses, or head coverings for religious reasons; and people with occupations that limit sun exposure are among the groups that are unlikely to obtain adequate amounts of vitamin D from sunlight (15). Similarly, critically ill patients have a very high prevalence of vitamin D deficiency and low vitamin D levels are clearly associated with greater illness severity, morbidity, and mortality in both adult and pediatric intensive care unit (ICU) patients, as well as medical and surgical ICUs (16). When do we get sufficient Vitamin D synthesis from sunlight exposure in the KSA? Despite numerous research studies on the status of vitamin D, there is a conspicuous lack of data in infants and children worldwide, together with countries in the middle-eastern region (17, 18). Some expert bodies and vitamin D researchers suggest, for example, that approximately 5–30 minutes of sun exposure, particularly between 10 a.m. and 4 p.m., either daily or at least twice a week to the face, arms, hands and legs without sunscreen, usually leads to sufficient vitamin D synthesis (19, 20). Constructs related to individual dispositions, a general attitude towards food fortification and perceived personal benefit of vitamin D fortification, as well as perception of cultural norms and problem awareness, are important in consumers' decision-making. The findings are relevant for public health as they demonstrate paths to heighten the intake of vitamin D (21). Both oral and IM routes are effective for the treatment of Vitamin D deficiency. 25-hydroxyvitamin D levels in the IM cholecalciferol group show a sustained increase from baseline (22). The production of vitamin D3 from sun exposure vs. oral supplementation has been evaluated in several studies. Data from Australia and New Zealand, has demonstrated that whole body exposure of mid-day sun in summer for 10–15 min is comparable to taking vitamin D3 orally. Based on this, exposure of hands, face and arms (around 15% of body surface) should produce about 1000 IU of vitamin D3. The optimum time to get sun exposure for vitamin D3 production during summer is from 9:00 AM and before 10:30 AM, as well as after 2:00 PM until

3:00 PM, while during winter it is from 10:00 AM until 2:00 PM (23-25). Messages on skin cancer prevention and benefits of sun exposure on 25-OH-D status should be clear and integrated (26-27). The present study aimed at exploring Knowledge, Attitude and perceptions towards Vitamin D of the general public of Jeddah, Saudi Arabia.

Methodology

A cross-sectional study was carried out, and the sampling method was a non-probability convenient one where data were collected through online Google forms, on adults, in Jeddah, Saudi Arabia. Sample size was determined using G*power software, where α = 0.05, Power = 0.95 effect size = 0.3, and degree of freedom= 5. The minimal sample size required was 277 subjects; thus, 880 subjects were enrolled in the present study. Data were collected using structured questionnaire which provided information on socio-demographic characteristics, and clinical aspects. A standardized questionnaire on assessment of Awareness, Knowledge, Attitude, and the Practice of Vitamin D among the General population was used (4). In addition the Fitzpatrick scale of skin types IV – V, was used (5). The software SPSS (IBM compatible version 23), was used and Chi square test and multiple linear regression were used to analyze the data. The level of significance for the present study was 0.05%.

Availability of the data:
The row data is available at the research center of ISNC and all results of the data are included in the paper.

Results

Table 1 reveals distribution of studied subjects by consumption of vitamin D supplements, and personal and sociodemographic characteristics. Out of the 880 respondents, 373 subjects (42.4%) consumed Vit-D supplements; the majority of them were females (70.8%) compared to males. This difference was statistically significant ($p < 0.000$). Nationality and living areas were not significant with consumption of Vit-D supplements ($p >0.05$). There is no relationship between Vit-D and level of education (p-value < 0.777). A greater proportion of those who consume Vit. – D supplements were of skin type light or pale white. This difference was statistically significant where $x2 =11.184$, and $p < 0.048$. A greater proportion of those who consume Vit. D supplements had previously heard of vitamin D supplements (98.9%) compared to those who hadn't. This difference was statistically significant where $x2 =5.413$, and $p < 0.020$. A greater proportion of those who consume Vit-D supplements did not get information from the media($p < 0.022$). A greater proportion of those who consume Vit. D heard about it from friends or families. ($p <0.05$) A greater proportion of those who consume Vit. D heard about it from Health professionals (doctor, nurse, dietitian, nutritionist). This difference was statistically significant where $x2 = 14.602$ and $p < 0.000$.

Table 2 shows the distribution of studied subjects by consumption of vitamin D supplements and knowledge about sources of Vit. D

Subjects who consumed Vit. D supplement had significantly more knowledge about availability of Vit. D in fortified food, nuts and dairy products compared to those who do not consume Vit. D supplements ($p<0.05$).

Table 3 shows the distribution of studied subjects by consumption of Vit. D supplements and knowledge about importance of Vit. D. A majority of participants who use vitamin D supplements think that dietary sources of Vit. D are not sufficient to maintain Vit. D levels compared to those who did not ($p <0.05$). Those who consumed Vit. D supplements knew that Vit. D prevents rickets, and is important for hair growth ($p <0.05$).

A greater proportion of those who consume vitamin D supplements did not know the RDA of Vit. D ($p <0.05$).

A greater proportion of those who consume vitamin D supplements knew that exposure to sunlight was important for any subject to get Vit. D where $p< 0.05$ (Table 4).

Table 5 displays the distribution of Vit. D supplement intake and practice towards acquiring Vit. D. There was a significant association between taking Vit. D supplements and wearing sunscreen ($p< 0.05$). A greater proportion of those who consume vitamin D supplements were people concerned with low vitamin D levels (77.5%) compared to those who said no or who were unsure. A greater proportion people who were concerned =their vitamin D level was too low (58.8%) was encountered among those who did not consume vitamin D. This difference was statistically significant where $x2 = 34.316$ $p< 0.000$. Those who consumed Vit. D supplements were more likely to have their Vit. D tested, and were eager to know about Vit. D ($p <0.05$).

A greater proportion of those who consumed vitamin D supplements were people willing to purchase/consume fortified foods ($p<0.05$).

Table 1: Distribution of the studied subjects by consumption of vitamin D supplements and personal and sociodemographic characteristics.

Variable	Categories	Have Vit. D supplement				Total		X^2 (p-value)
		No		Yes		N	%	
		N	%	N	%			
Gender	Male	237	46.7%	109	29.7%	346	39.3 %	27.657 (.000)
	Female	270	53.3%	264	70.8%	534	60.7 %	
Living area	Jeddah	398	78.5%	285	76.4%	683	77.6 %	.542 (.462)
	Other	109	21.5%	88	23.6%	197	22.4 %	
Nationality	Saudi	278	55.0%	216	85.5%	494	56.5 %	1.055 (.304)
	Non Saudi	227	45.0%	153	41.5%	380	43.5 %	
Level of education	Didn't finish high school	33	6.5%	26	7.0%	59	6.7 %	4.027 (.777)
	High school	178	35.1%	138	37.0%	316	35.9 %	
	Trade School	13	2.6%	5	1.3%	18	2.0 %	
	Undergraduate/ Bachelor's degree	223	44.0%	157	42.1%	380	43.2 %	
	Postgraduate degree (PGDip)	11	2.2%	8	2.1%	19	2.2 %	
	Master's degree	16	3.2%	11	2.9%	27	3.1%	
	Doctorate (PhD)	5	1.0%	8	2.1%	13	1.5 %	
	Other	28	5.5%	20	5.4%	48	5.5 %	
Fitzpatrick Scale, which skin type best describes yours?	Light or pale white- Always burns, never tans	41	8.1%	56	15.0%	97	11.0 %	11.184 (.048)
	White, Fair- Usually burns, tans with difficulty	173	34.1%	119	31.9%	292	33.2 %	
	Medium, between white to moderate brown- Moderately burns, moderately tans	196	38.1%	134	35.9%	330	37.5 %	
	Moderate brown- Rarely burns, tans more than average	61	12.0%	44	11.8%	105	11.9 %	
	Brown, dark brown- Rarely burns, tans very easily	28	5.5%	15	4.0%	43	4.9 %	
	Very dark brown to black, black- Never burns, tans very easily, deeply pigmented	8	1.6%	5	1.3%	13	1.5 %	

(continued next page)

Have you previously heard of vitamin D?	YES	489 96.4%	369 98.9%	858 97.5 %	5.413 (.020)
	NO	18 3.6%	4 1.1%	22 2.5 %	
Media	YES	257 50.7	160 42.9%	417 47.4 %	5.237 (.022)
	NO	250 49.3%	213 57.1%	463 52.6 %	
Book	YES	118 23.3%	93 24.9%	211 24.0 %	.324 (.569)
	NO	389 76.7%	280 75.1%	669 76.0 %	
Leaflets/ Posters	YES	75 14.8%	42 11.3%	117 13.3 %	2.327 (.127)
	NO	432 85.2%	331 88.7%	763 86.7 %	
Family/ Friends	YES	243 47.9%	152 40.8%	395 44.9 %	4.476 (.034)
	NO	264 52.1%	221 59.2%	485 55.1 %	
Health professionals (doctor, nurse, dietitian, nutritionist)	YES	218 43.3 %	210 56.3%	428 48.8 %	14.602 (.000)
	NO	286 56.7 %	163 43.7 %	449 51.2 %	

Table 2: Distribution of the studied subjects by consumption of vitamin D supplements and knowledge about source of Vit. D.

Variable	Categories	Do you take Vit. D supplement?				Total		χ^2 (p-value)
		No		Yes				
		N	%	N	%	N	%	
Food	Yes	259	51.1%	183	49.1%	442	50.2%	.352 (.553)
	I do not know	248	48.9%	190	50.9%	438	49.8%	
Sunlight	Yes	457	90.1%	333	89.3%	790	89.8%	.174 (.677)
	I do not know	50	9.9%	40	10.7%	90	10.2%	
Water	Yes	9	1.8%	7	1.9%	16	1.8%	.012 (.911)
	I do not know	498	98.2%	366	98.1%	864	98.2%	
Air	Yes	4	0.8%	4	1.1%	8	0.9%	.192 (.662)
	I do not know	503	99.2%	369	98.9%	872	99.1%	
Exercise	Yes	15	3.0%	15	4.0%	30	3.4%	.737 (.391)
	I do not know	492	97.0%	358	96.0%	850	96.6%	
	No	391	77.1%	306	82.0%	697	79.2%	
Oily fish	Yes	232	46.4%	192	52.3%	424	48.9%	2.965 (.085)
	I do not know	268	53.6%	175	47.7%	443	51.1%	
Egg yolks	Yes	138	27.2%	115	30.8%	253	28.7%	1.369 (.242)
	I do not know	369	72.8%	258	69.2%	627	71.3%	
Fortified foods	Yes	53	10.5%	56	15.0%	109	12.4%	4.117 (.042)
	I do not know	454	89.5%	317	85.0%	771	87.6%	
Red meat	Yes	74	14.6%	54	14.5%	128	14.5%	.002 (.961)
	I do not know	433	85.4%	319	85.5%	752	85.5%	
Dairy products	Yes	83	16.4%	59	15.8%	142	16.1%	.049 (.826)
	I do not know	424	83.6%	314	84.2%	738	83.9%	
Fruit	Yes	118	23.3%	74	19.8%	192	21.8%	1.487 (.223)
	I do not know	389	76.7%	299	80.2%	688	78.2%	
Vegetables	Yes	82	16.2%	80	21.4%	162	18.4%	3.980* (.046)
	I do not know	425	83.8%	293	78.6%	718	81.6%	
Chicken	Yes	20	3.9%	15	4.0%	35	4.0%	.003* (.954)
	I do not know	487	96.1%	358	96.0%	845	96.0%	
Nuts	Yes	52	10.3%	59	15.8%	111	12.6%	6.030* (.014)
	I do not know	455	89.7%	314	84.2%	769	87.4%	

Table 3: Distribution of the studied subjects by consumption of vitamin D supplements and knowledge about Vit. D sources and benefits to the body.

Variable	categories	Have Vit D supplement				Total		X^2 (p-value)
		No		Yes				
		N	%	N	%	N	%	
Do you think dietary sources are sufficient to maintain vitamin D levels?	Yes	96	18.9%	48	12.9%	144	16.4%	21.925 (.000)
	No	236	46.5%	233	62.5%	469	53.3%	
	Unsure	175	34.5%	92	24.7%	267	30.3%	
Factors affect vitamin D production / I don't know	Yes	262	51.7%	189	50.7%	451	51.2%	.087 (.768)
	No	245	48.3%	184	49.3%	429	48.8%	
Skin pigmentation	Yes	119	23.5%	85	22.8%	204	23.2%	.056 (.812)
	I do not know	388	76.5%	288	77.2%	676	76.8%	
Cloud cover	Yes	31	6.1%	24	6.4%	55	6.3%	.038 (.846)
	I do not know	476	93.9	349	93.6%	825	93.8%	
Pollution	Yes	25	4.9%	14	3.8%	39	4.4%	.704 (.402)
	I do not know	482	95.1%	359	96.2%	841	95.6%	
Time of day	Yes	34	6.7%	32	8.6%	66	7.5%	1.087 (.297)
	I do not know	473	93.3%	341	91.4%	814	92.5%	
Latitude	Yes	15	3.0%	6	1.6%	21	2.4%	1.681 (.195)
	I do not know	492	97.0%	367	98.4%	859	97.6%	
Season	Yes	26	5.1%	21	5.6%	47	5.3%	.107 (.744)
	I do not know	481	94.9%	352	94.4%	833	94.7%	
Smoking	Yes	23	4.5%	16	4.3%	39	4.4%	.031 (.860)
	I do not know	484	95.5%	357	95.7%	841	95.6%	
Sunscreen use	Yes	42	8.3%	25	6.7%	67	7.6%	.764 (.382)
	I do not know	465	91.7%	348	93.3%	813	92.4%	
High-fat diet	Yes	28	5.5%	17	4.6%	45	5.1%	.412 (.521)
	I do not know	479	94.5%	356	95.4%	835	94.9%	
Health benefits/ don't know	Yes	81	16.0%	28	7.5%	109	12.4%	14.205 (.000)
	No	426	84.0%	345	92.5%	771	87.6%	
Bone health	Yes	351	69.2%	274	73.5%	625	71.0%	1.866 (.172)
	I do not know	156	30.8	99	26.5%	255	29.0%	
Prevention of rickets	Yes	186	36.7%	178	47.7%	364	41.4%	10.789 (.001)
	I do not know	321	63.3%	195	52.3%	516	58.6%	
Vision	Yes	99	19.5%	88	23.6%	187	21.3%	2.123 (.145)
	I do not know	408	80.5%	285	76.4%	693	78.8%	
Hair growth	Yes	185	36.5%	170	45.6%	355	40.3%	7.374 (.007)
	I do not know	322	63.5%	203	54.4%	525	59.7%	
Skin health	Yes	235	46.4%	168	45.0%	403	45.8%	.149 (.700)
	I do not know	272	53.6%	205	55.0%	477	54.2%	
Prevention of osteoporosis	Yes	282	55.6%	230	61.7%	512	58.2%	3.223 (.073)
	I do not know	225	44.4%	143	38.3%	368	41.8%	

Table 4: Distribution of the studied subjects by consumption of vitamin D supplements and awareness about Vit. D sources and importance.

Variable	Categories	Have Vit. D supplement				Total		X^2 (p-value)
		Yes		No		N	%	
		N	%	N	%			
Recommended daily amount of vitamin D	5µg/200IU	136	26.8%	117	31.4%	253	28.7%	19.800 (.001)
	10µg/400IU	180	35.5%	103	27.6%	283	32.2%	
	20µg/800IU	112	22.1%	62	16.6%	174	19.8%	
	50µg/2000IU	61	12.0%	61	16.4%	122	13.9%	
	100µg/4000IU	18	3.6%	30	8.0%	48	5.5%	
Individuals not often outdoors	Yes	244	48.1%	184	49.3%	428	48.6%	.125 (.724)
	I do not know	263	51.9%	189	50.7%	452	51.4%	
Institutionalized individuals	Yes	62	12.2%	45	12.1%	107	12.2%	.724 (.941)
	I do not know	445	87.8%	328	87.9%	773	87.8%	
Individuals who cover up the majority of their skin when outdoors	Yes	122	24.1%	97	26.0%	219	24.9%	.434 (.510)
	I do not know	385	75.9%	276	74.0%	661	75.1%	
Individuals with dark skin	Yes	50	9.9%	32	8.6%	82	9.3%	.419 (.518)
	I do not know	457	90.1%	341	91.4%	798	90.7%	
Individuals who don't eat fish	Yes	82	16.2%	75	20.1%	157	17.8%	2.269 (.132)
	I do not know	425	83.8%	298	79.9%	723	82.2%	
When do we get sufficient Vitamin D synthesis from sunlight exposure in the KSA?	All Year	239	47.4%	205	55.3%	444	50.7%	7.241 (.065)
	March or early April to September	54	10.7%	41	11.1%	95	10.9%	
	October to March	41	8.1%	19	5.1%	60	6.9%	
	Unsure	170	33.7%	106	28.6%	276	31.5%	
Those with darker skin pigmentation are more at-risk of Vitamin D insufficiency?	Agree	107	21.1%	88	23.6%	195	22.2%	.772 (.680)
	Unsure	305	60.2%	217	58.2%	522	59.3%	
	Not agree	95	18.7%	68	18.2%	163	18.5%	
Skin pigmentation affects vitamin D status	Agree	153	30.2%	104	27.9%	257	29.2%	.555 (.758)
	Unsure	297	58.6%	225	60.3%	522	59.3%	
	Not agree	57	11.2%	44	11.8%	101	11.5%	
If I regularly protect my skin from the sun, I may be in danger of not getting enough vitamin D	Agree	202	39.8%	171	45.8%	373	42.4%	4.634 (.099)
	Unsure	199	39.3%	121	32.4%	320	36.4%	
	Not agree	106	20.9%	81	21.7%	187	21.3%	
Seek direct sun	Yes	139	27.4%	127	34.0%	266	30.2%	4.482 (.034)
	No	368	72.6%	246	66.0%	614	69.8%	
Shade	Yes	231	45.6%	145	38.0%	376	42.7%	3.928 (.047)
	No	276	54.4%	228	61.1%	504	57.3%	
Cover-up or wear clothing	Yes	168	33.1%	121	32.4%	289	32.8%	.047 (.828)
	No	339	66.9%	252	67.6%	591	67.2%	

Table 4: Distribution of the studied subjects by consumption of vitamin D supplements and awareness about Vit. D sources and importance (continued)

Don't go outside	Yes	69 13.6%	51 13.7%	120 13.6%	.001 (.978)
	No	438 86.4%	322 86.3%	760 86.4%	
Minimal coverage (exposure of shoulders and above the knee)	Yes	114 22.5%	96 25.7%	210 23.9%	1.251 (.263)
	No	393 77.5%	277 74.3%	670 76.1%	
Moderate coverage (exposure of forearms, below knee and face)	Yes	278 54.8%	189 50.7%	467 53.1%	1.495 (.221)
	No	229 45.2%	184 49.3%	413 46.9%	
Maximal coverage (exposure of only hands and face)	Yes	144 28.4%	109 29.2%	253 28.7%	.071 (.791)

Table 5 Distribution of the studied subjects by consumption of vitamin D supplements and their practice to gain Vit. D.

Variable	categories	Have Vit. D supplement				Total		χ^2 (p-value)
		No		Yes				
		N	%	N	%	N	%	
When sunny from March to end of September, how often do you wear sunscreen/sun protection?	Never	162	32.0%	79	21.2%	241	27.4%	15.985 (.003)
	Rarely	107	21.1%	72	19.3%	179	20.3%	
	Usually	45	8.9%	43	11.5%	88	10.0%	
	Always	100	19.7%	94	25.2%	194	22.0%	
	Sometimes	93	18.3%	85	22.8%	178	20.2%	
Regarding typical daylight exposure from the March until end of September, how many days per week on average would you spend outdoors	2 day	89	17.6%	61	16.4%	150	17.1%	2.469 (.650)
	3 day	114	22.5%	100	26.8%	214	24.3%	
	5 day	94	18.6%	67	18.0%	161	18.3%	
	6 day	81	16.0%	52	13.9%	133	15.1%	
On these days of daylight exposure, how long on average would you spend outside each day?	1 hour	241	47.5%	203	54.4%	444	50.5%	4.370 (.224)
	2 hour	136	26.8%	83	22.3%	219	24.9%	
	3 hour	89	17.6%	58	15.5%	147	16.7%	
	5 hour	41	8.1%	29	7.8%	70	8.0%	
On these days of daylight exposure, what time of the day would you most often be out?	All day	71	14.0%	40	10.7%	111	12.6%	7.236 (.065)
	Evening hours	144	28.4%	85	22.8%	229	26.0%	
	Afternoon hours	91	17.9%	79	21.2%	170	19.3%	
	Morning hours	201	39.6%	169	45.3%	370	42.0%	
Are you concerned that your vitamin D levels may be too low?	Yes	298	58.8%	289	77.5%	587	66.7%	34.316 (.000)
	No	151	29.8%	57	15.3%	208	23.6%	
	Unsure	58	11.4%	27	7.2%	85	9.7%	
Have you ever had your vitamin D levels tested?	Yes	120	23.7%	227	60.9%	347	39.4%	126.586 (.000)
	No	375	74.0%	137	36.7%	512	58.2%	
	Unsure	12	2.4%	9	2.4%	21	2.4%	
Are you interested to know more about Vit D?	Yes	426	84.0%	341	91.4%	767	87.2%	10.507 (.001)
	No	81	16.0%	32	8.6%	113	12.8%	
Do you think there is any harm in taking fortified foods?	Yes	72	14.2%	64	17.2%	136	15.5%	5.599 (.061)
	No	255	50.3%	204	54.7%	459	52.2%	
	Unsure	180	35.5%	105	28.2%	285	32.4%	
Would you be willing to purchase/consume fortified foods?	Yes	205	40.4%	225	60.3%	430	48.9%	36.518 (.000)
	No	168	33.1%	70	18.8%	238	27.0%	
	Unsure	134	26.4%	78	20.9%	212	24.1%	

(continued next page)

If no, why not?	Unaware of the benefits of taking them	88	17.8%	10	15.2%	98	17.5%	36.854 (.000)
	Too expensive	50	10.1%	9	13.6%	59	10.5%	
	I don't know which one to take	137	27.7%	12	18.2%	149	26.6%	
	I don't know how I can get them	20	4.0%	0	0.0%	20	3.6%	
	I think I get enough	151	30.5%	12	18.2%	163	29.1%	
	Other	49	9.9%	23	34.8%	72	12.8%	

Discussion

In the present study, women tend more to consume vit D supplement. This is in line with findings from previous study (3). A majority of mothers with basic and vocational education were unable to indicate the proper functions of vitamin D, whereas in the group of mothers with secondary and higher education, this problem was much rarer. Knowledge about vitamin D functions and its nutritional sources rose with the level of mothers' education.(2) This is not in line with the findings from the present study. Greater proportion of those who consume vit – D supplement were those whose skin was Light or pale white- Always burns, never tans. This is consistent with findings from other studies (2, 5). Main sources of information were physicians , television and magazines . Physicians were cited more often by women, older participants and those with a lower educational level. The media were cited more often by men, and a distinction was observed between television (more cited by younger individuals and those with lower education or income) and newspapers and radio (more cited by older subjects and those with higher income). School/university was more frequently quoted by younger, better-educated subjects and those with higher income.(3) This is in line with findings from the present study.

Participants who learned about VitD from their physician were more likely to have a better knowledge of VitD sources and clearly established health effects. Participants who learned about VitD with another healthcare professional (e.g., pharmacist, dietitian, dentist, nurse, etc.) or at school/university also answered correctly for VitD sources and health effects but also tended to associate VitD with other health conditions with unclear consensus, as did participants who learned about VitD in the media. (3) This is consistent with findings from the present study.

Consumption of Vit D was significantly associated with increased knowledge about the function of Vit – D. This is in line with other study. (26)

Few foods naturally contain vitamin D. The flesh of fatty fish (such as trout, salmon, tuna, and mackerel) and fish liver oils are among the best sources . An animal's diet affects the amount of vitamin D in its tissues. Beef liver, egg yolks, and cheese have small amounts of vitamin D, primarily in the form of vitamin D3 and its metabolite 25(OH)D3. (6) . This is in line with findings from the resent study, where consumption of Vit D was associated with consumption of vegetables, Nuts, and diary products. There is consensus that daily intake of 400 IU of vitamin D can prevent nutritional rickets in infants and children Many observational studies suggest a link between low vitamin D status and T2DM. This is in line with findings from the present study. Clearly, daily intakes >400 IU/day are necessary to reduce the reported rates of deficiency in the UK. However, increased intake recommendations will be no more effective than current advice without programs that ensure adequate vitamin D intakes at the population level, best achieved by food fortification programs suited to local lifestyles. For example, from 2003 Finland has fortified milk and fatty spreads [voluntarily] while encouraging deficiency risk group supplementation; in 2010 Finland's food fortification was doubled which has successfully minimized deficiency apart from that in recent immigrant groups (14). This is in line with the present study

Conclusion

The majority of participants possessed good knowledge about vitamin D and they identified sun exposure as the main source of vitamin D. However, there is a lack of consistency between knowledge and attitude towards improving vitamin D levels in their sera. This indicates the

need to improve awareness among the Saudi population by providing specific guidelines about the frequency, duration, optimum season and amount of exposure to sunlight required, as well as the importance of fortification of food like milk.

Ethical consideration

This study was approved by IRRB of Ibn Sina national college for medical studies. Consent of the dean of the college of Ibn Sina as well as of the participants were obtained before the start of study.

The limitation of the study:

This study was convenient non-probability one, and used an online questionnaire so the representation of the data to the population can't be assured. However as this is an exploratory study and showed marked variation (no extreme outliers) in the characteristics of the studies' subjects and a validity study was conducted on the questionnaire and proved to be highly reliable and the results are similar to those obtained globally.

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